QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

MARCH 2020

Quality Assurance and Quality Control Plan

Plain Language Overview:

This Plan describes the quality assurance and quality control procedures to be used at the TMAC Resources Inc. Hope Bay Project when conducting environmental sampling, analysis and reporting. This Plan outlines 1) the criteria for sample collection, preservation, documentation, transportation, and 2) data management and reporting practices associated with environmental sampling.

Hope Bay, Nunavut

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Revisions

Revision #	Date	Section	Changes Summary	Author	Approver
0	Feb 2002	Original	Original Document	MHBL	MHBL
1	Mar 2004	Throughout	Review	MHBL	MHBL
2	Oct 2007	Throughout	Review to include NWB specific concerns	MHBL	MHBL
3	Mar 2008	Throughout	Review to include changes	HBML	HBML
4	Feb 2009	Throughout	Annual Review	HBML	HBML
5	Jan 2011	Throughout	Annual Review	HBML	HBML
6	Jun 2011	Throughout	Added ST-6a and b, ST-11 to the required sampling stations; added ST-1, ST-2, ST-4, and ST-6a and b to the current sample stations; incorporated 2BE-HOP0712 and 2BB- BOS0712 within the document	HBML	HBML
7	Jun 2012	Throughout	Added ash characterization sampling, waste oil sampling, flow meter calibration and equipment blanks. Updated photos and samples lists to reflect camp status.	HBML	HBML
8	Nov 2012	Throughout	Minor edits, updated licence numbers. No technical content changes.	HBML	HBML
9	Jan 2017	Throughout	Updated to TMAC ownership and format; revision to section regarding soil sampling to expand beyond sampling hydrocarbon contaminated soils. Included subsequent Modules A, B and C to provide details for each site and the associated water licence.	TMAC	TMAC
10	Mar 2019	Section 1.3 Section 1.4 Section 5 Section 6 Appendix D through F Module A, C, D and E	Revised Table 1-2 reference to management plans. Updated Roles and Responsibilities. Included Maxxam and Nautilus Labs in Section 5. Update to Section 6 with change from EQWin to MonitorPro database management software. Update to Appendix D (ALS CALA Certificates and Scope). Addition of Appendix E and F (Maxxam and Nautilus Labs CALA Certificates and Scope). Updated SNP Stations and Conformity tables in Modules A and C for amended 2AM-DOH1335 and renewed 2BB-BOS1727 licences. Added Modules D and E for 2BB-MAE1727 and 2AM-BOS1835.	TMAC	TMAC

11	Mar 2020	Section 1.3 Section 1.4 Section 2.1 Section 5 Section 6 Appendix B Appendix C Appendix D Appendix E Appendix F Module A Module B	Revised Table 1-2 reference to management plans. Updated Roles and Responsibilities. Additional of sampling Final Discharge Point as outlined in the Metal & Diamond Mining Regulations. Addition of reporting required under the Metal & Diamond Mining Regulations. Addition of Bureau Veritas Canada Inc. (formally Maxxam Analytics) in Section 5. Updated bottle/preservative requirements in Appendix B. Updated ALS QC Protocols in Appendix C. Updated ALS CALA Certificate/Scope for Vancouver and Yellowknife laboratories in Appendix D. Updated Bureau Veritas CALA Certificate/Scope in Appendix E. Updated Nautilus Environmental CALA Certificate in Appendix F. Updated sample location figures in Module A and Module B.		

Contents

Tables

Figures

No table of figures entries found.

Glossary

Term	Definition
Accuracy	A measure of the closeness of the analytical result to the true value
ALS	ALS Environmental Laboratories
CCME	Canadian Council of Ministers of the Environment
Composite Sample	Obtained by combining portions of multiple grab samples or by using specially designed automatic sampling devices. Provide a more representative sampling of heterogeneous matrices in which the concentration of the analytes of interest may vary over short periods of time and/or space
Grab Sample	An undiluted quantity of material collected at a particular time and place that may be representative of the total substance being sampled at the time and place it was collected
INAC	Indigenous and Northern Affairs Canada
NWB	Nunavut Water Board
Precision	A measure of the closeness with which multiple analyses of a given sample agree with each other
Quality Assurance (QA)	The system of activities designed to better ensure that quality control is done effectively
Quality Control (QC)	The use of established procedures to achieve standards of measurement for the three principal components of quality: precision, accuracy and reliability
Reliability	A measure of the frequency at which the standards of precision and accuracy are achieved
TMAC	TMAC Resources Inc.

1 Introduction

This Hope Bay Quality Assurance and Quality Control Plan (the Plan) has been prepared by TMAC Resources Inc. (TMAC) in accordance with various water licences held by TMAC associated with developments throughout the Hope Bay region.

The Plan is intended primarily for use by TMAC and its contractors to ensure that best practices with respect to conducting environmental sampling, analysis and reporting are followed, and that the conditions of water licences and associated regulations are met.

This Plan is structured in a manner such that one document pertaining to quality assurance and quality control is approved and implemented across all TMAC Hope Bay project sites, while still addressing site- and licence-specific needs: the main document outlines TMAC's approach to conducting environmental sampling, analysis and reporting as it pertains to all TMAC Hope Bay developments; subsequent modules provide details for each site and the associated water licence. In the event of a new water licence, or an existing licence amendment, only the specific modules pertaining to that licence and site will need to be revised. This is intended for consistency and efficiency across operations and for compliance management.

1.1 Objectives

The main objective of this Plan is to outline a set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and legally defensible quality. Consistent with TMAC's intent to be a responsible operator, the following objectives will be applied to achieve a high level of quality assurance:

- Provide standard procedures for sample collection, preservation, documentation and transportation, to achieve precision, accuracy and reliability in data quality;
- Ensure personnel involved in sampling and analysis are trained and competent;
- Utilize high quality laboratory supplies and sampling equipment that are reliable and maintained in good working condition;
- Ensure that all chemical analyses are conducted at a certified external laboratory;
- Describe a standard process for managing analytical data results and completing internal and external reporting;
- Establish and review Data Quality Objectives (DQOs) to ensure that data required for environmental management is available;
- Implement quality control programs, based on recognized best operating practices, to assess the quality of analytical data, provide warning of unacceptable analytical or sample errors, and initiate prompt remedial action when deficiencies are identified;
- Apply these principals to all environmental samples, whether analyzed for the purpose of regulatory compliance monitoring, or for the purpose of internal environmental management.

1.2 Relevant Legislation and Guidance

Table 1-1 provides a summary of federal and territorial regulations governing this Plan and associated guidelines. Additional regulations and standards govern other TMAC plans which are implemented in conjunction with this Plan.

Table 1-1. List of federal and territorial regulations governing the Quality Assurance and Quality Control Plan

Regulation	Year	Governing Body	Relevance
Quality Assurance and Quality Control Guidelines For Use by Class "A" Licensees	1996	INAC Water Resources Division	Describes information to be included in the development of a QA/QC Plan
Standard Methods for the Examination of Water and Wastewater	1999		Provides procedures and methods of analysis for examination of water quality
Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites Volume I	1993	CCME	Technical support document which provides approach to sampling, analysis and data management.

1.3 Related Documents

The documents listed in Table 1-2 are expected to be referenced and utilized in conjunction with the QA/QC Plan.

Table 1-2. List of documents related to the Quality Assurance and Quality Control Plan

Document Title	Year	Relevance
Hope Bay Project Aquatic Effects Monitoring Plan	2018	Describes the monitoring schedule, sampling methods, analysis and determination of environmental effects, and the quality assurance and quality control procedures to be conducted in aquatic environments.
Hope Bay Project Doris-Madrid Water Management Plan	2020	Describes effluent discharge quality, monitoring programs and sampling locations associated with water management at Doris and Madrid.
Hope Bay Project Boston Water Management Plan	2018	Describes effluent discharge quality, monitoring programs and sampling locations associated with water management at Boston.
Hope Bay Project Groundwater Management Plan	2020	Describes monitoring schedule and analysis procedures associated with monitoring of mine groundwater.
Hope Bay Project Incinerator Management Plan	2017	Describes characterization sampling of incinerator bottom ash.
Hope Bay Project Hydrocarbon Contaminated Material Management Plan	2018	Describes sampling of soil and effluent placed in the Landfarm facility. Outlines remediation criteria for hydrocarbon contaminated soil.
Hope Bay Project Hazardous Waste Management Plan	2020	Describes waste oil and bottom ash characterization sampling.
Hope Bay Project Waste Rock, Ore and Backfill Management Plan	2019	Describes environmental monitoring required in pollution control ponds and seep sampling programs.
Hope Bay Project, Phase 2 Doris Tailings Impoundment Area – Operations, Maintenance and Surveillance Manual	2020	Describes sample schedule, documentation and reporting required for confirmatory monitoring of tailings geochemical characterization and thermal monitoring of infrastructure associated with the TIA.

Document Title	Year	Relevance
Hope Bay Project Boston Tailings Management Area – Operations, Maintenance and Surveillance Manual	2017	Describes sample schedule, documentation and reporting required for confirmatory monitoring of tailings geochemical characterization and thermal monitoring of infrastructure associated with the TMA.

1.4 Plan Management

In accordance with the requirements of the General Conditions (Part B) of the applicable water licences, this plan will be immediately implemented following its submission, subject to any modifications proposed by the NWB as a result of the review and approval process.

This plan will be reviewed annually and updated as necessary. Personnel responsible for implementing and updating the QA/QC Plan are identified in Table 3.

Table 1-3. Roles and Responsibilities

Role	Responsibility
VP Environmental Affairs	Overall responsibility for and implementation of this management plan; Provide the on-site resources to operate and maintain environmental sampling in accordance with this plan.
Environmental Manager	Review and update this plan as required; Ensure Environmental staff are trained in monitoring and quality assurance and quality control procedures; Support implementation of this management plan.
Environmental Superintendent	Provide training and support to environmental staff on the procedures contained in this plan; Ensure that required sampling is carried out in accordance with this plan and licence/permit requirements; Conduct regular inspections of the monitoring stations and audits of the maintenance records; Manage analytical data in accordance with this plan; Assess whether samples have met applicable regulatory standards and guidelines; Ensure sampling gear is in good working order and calibrated; Prepare and submit compliance reports to regulatory agencies.

2 Sample Collection in the Field

Environmental sampling is conducted to provide information required by TMAC for effective environmental management of the site, to provide information on follow-up monitoring of previous spill sites, and to monitor regulatory compliance. It is necessary to ensure sample integrity is maintained for all samples collected whether for regulatory compliance or internal management decisions.

2.1 Sample Locations

The Surveillance Network Program (SNP) is required by each water licence. The SNP defines a specific water-sampling program for the site, including sampling locations, sampling frequency and analytical parameters.

The SNP samples must always be taken at the same location and these sampling stations must be clearly identified in the field by posted signs. The location of signs and the precise location of sampling will be approved by the designated Inspector for the site. Sampling locations will be relocated as required by the water use permits or as recommended by the designated site Inspector. The appended modules provide information on the SNP stations to be monitored for each of the water licence areas.

Additional sampling sites will be added on an as needed basis in response to regulatory requirements or an identified internal monitoring need. These include samples at Final Discharge Points required under the Metal & Diamond Mining Effluent Regulations, samples taken under ice to compare water quality before and after a drilling effort, sites of new or previous petroleum product or chemical spills, and spring runoffs associated with construction activities. GPS coordinates of all sampling sites will be recorded using a handheld GPS and maintained on file.

2.2 Sample Types

Different sample types, such as composites or grabs, can be collected at various sampling locations. Water and liquid effluent samples (ie., natural lakes, streams, treatment ponds, process streams, sumps, effluent discharges) will generally be grab samples. Solid material samples (i.e., soil, ash, tailings solids) will usually be composite samples, although the purpose of the sampling program will dictate whether grab samples or composite samples will be used (i.e., characterization, delineation). For example, monitoring of the remediation levels in the land treatment area will usually require a composite sample within a homogenized area. Sampling hydrocarbon contaminated sites may require grab samples from various locations within the area to delineate a zone of contamination.

2.3 Sample Bottles

The laboratory analytical method and the parameter of interest will dictate the size and type of bottle (i.e., glass, plastic, amber glass) to be used for the sample. All sample bottles will be prepared and supplied by the contracted laboratory. Only clean unused bottles will be used to collect all samples to limit field generated contamination or preservation errors. If there is a need for bacterial testing, the bottles must be autoclaved (sterilized) by the contracted laboratory prior to use. New powder-free nitrile gloves will be worn at all times when handling sample bottles.

Some sampling bottle types require rinsing with the water to be sampled prior to collecting the sample. The contracted laboratory can provide instruction for the type of bottle and the rinsing requirements for each analytical parameter. If the sample bottle requires rinsing, the sample bottle should be partially filled with the water to be sampled and rinsed with the cap in place three times. Rinse water will be emptied away from the sampling point so that surface water is not contaminated and sediments are not disturbed. As a general rule:

- Plastic bottles require triple rinsing
- Glass bottles should not be triple rinsed because hydrocarbons can adsorb to the glass surface and increase sample concentrations during the rinsing process
- Sample bottles that are pre-charged with preservative must not be rinsed to prevent loss of the sample preservative

Bottles should be filled to near full capacity while allowing enough room for the preservative addition and mixing. Some bottles must be filled to the indicated fill-line on the bottle. Some analytical parameter samples must be collected without leaving head-space, which means that the bottle will be filled in such a way to prevent inclusion of air or bubbles. This is very important when sampling volatile parameters (e.g., volatile organic carbon or chlorine) which may evaporate out of solution if airspace is present. Typically, the easiest way to accomplish this is to place the cap on the bottle while the bottle is submerged. This can also be accomplished by filling the bottle to form a meniscus at the top and then carefully replacing the cap to ensure no water is lost. The contracted laboratory can provide instruction for the specific bottle filling requirements for each analytical parameter.

The sample bottles necessary for the different analyses required by the water licence SNPs are provided in the Appendix B.

2.4 Field Sampling Log Book

Details of all sampling activities are recorded in a field logbook. The sampler will record the sampling stations visited, the samples taken at each station, the date and time for each sample collected and the names of the individuals collecting the sample. The results of any field measurements (i.e., temperature, pH, etc.) will be recorded as well as information on sample preservation.

The sampler will also record any information that may influence the analytical results, such as weather conditions, stream flow rates, and unusual conditions at the site. Any necessary deviations from standard procedures or sampling location need to be documented and reasons for the change included in the field log book.

A scanned copy of the field log book pages should be made as soon as possible after sample collection and filed on the Environment server. This copy serves as backup in the event the log book were lost or destroyed, and as a reference for others who may need to review this data.

Field notes and the field log book are considered legal documents and should be kept legibly in permanent ink. In the event that an error is made it should be crossed out with a single line and

initialled by the one making the correction. Pages should never be removed and space or pages being left blank should be labelled with a single diagonal line and the phrase “intentionally left blank”. When filled, the field log book should be filed and retained in case of future need.

2.5 Sampling Methods

The following sections discuss methods that should be used to collect samples in different sampling locations. The bottle rinsing and filling techniques described in Section 2.3 will be incorporated into each of these methods.

2.5.1 Streams

The sample should be collected as close as practical to the middle of the stream, where water flows freely and is free of debris. If wading into the stream to collect the sample, the sampler should face upstream and wait to allow any sediment that may have been stirred up to settle or wash away. A sample pole may also be used to collect the sample from shoreline in situations where it is unsafe to enter the flowing stream. If a sample pole is used, the collection end of the pole will be cleaned prior to arriving at the sample location, transported to the sample site covered in a plastic bag and then rinsed in the water to be sampled prior to inserting the sample bottle into the collection end.

Ideally, the bottle will be submerged into the stream to a depth of approximately half the total stream depth to collect the sample. At minimum, the sample bottle will be submerged to approximately 10cm below the water surface. If the stream is too shallow to submerge the bottle to 10cm below the surface, care will be taken to prevent surface debris or sediments from contaminating the sample. If necessary, a smaller bottle or an individually-packaged sterile plastic syringe provided by the contract laboratory can be used to transfer water to the larger sample bottles, provided that these are rinsed as required.

2.5.2 Lakes and Ponds

Surface samples from lakes and ponds should be collected using the same procedures as above. Subsequent samples should always be taken at the same location. Sample bottles should be submerged to a depth of approximately 10cm below the water surface.

Water quality samples collected at depth in lakes or ponds will be collected with a clean discrete water sampler (e.g., Niskin sampler, Go-Flo sampler), which is lowered to the required depth and triggered to trap a sample of water by releasing a messenger weight from the surface down the rope used to lower the sampler. The sampler is lowered to depth three times and rinsed with the water to be sampled before collecting the sample the fourth time it is lowered to depth.

2.5.3 Process Streams (Pipes, Valves and Auto Samplers)

Some sampling of process streams may be required by the water licence SNP, MDMER and for environmental management purposes. These may be grab samples taken from a valve or pipe discharge, or composite samples collected by combining multiple grab samples or by an automated sampling system. The same principles used in natural stream sampling should be applied when collecting grab

samples. Valves should be open for at least one minute before taking the sample to help ensure that the water is representative of the process stream.

2.5.4 Soil Sampling

The location, number and depth of soil samples will depend on the purpose of the sampling program (i.e., characterization, delineation) and nature of the parameters of interest. All sampling equipment (e.g. trowel, scoop, augers) will be made of stainless steel or high density polyethylene, and will be cleaned prior to and between sample events. Powder-free nitrile gloves will be worn and gloves will be changed before each new sample is collected. Samples should be gathered from freshly exposed soil and preserved as soon as possible.

2.5.5 Ash Sampling

The monitoring, characterization and disposal of bottom ash generated through incinerating or open burning appropriate waste streams is a requirement of the water licences associated with the project. Ash is collected at intervals to be representative of all the ash and the analysis is used to determine suitability for landfill placement.

During each incinerator ash cleaning an ash sample is collected. These samples are combined together at month end into a composite which is then subsampled for analysis.

Each time ash is cleaned out of the burn pan an ash sample is collected. These samples are combined together at month end into a composite which is then subsampled and sent for analysis.

Bottom ash is analyzed for flash point, paint filter test, leachable metals, leachable mercury and leachable BTEX. Sub-samples are packed tightly into glass jars with no headspace and submitted to the contract laboratory for analysis.

2.5.6 Waste Oil Sampling

Feedstock oil to be burned in a waste oil burner must be analyzed to determine the content of metals and other substances known to exist in used oil from the lubrication of machinery components and internal combustion engines. This is a requirement of territorial guidelines, federal regulations and the water licences issued to TMAC by the NWB.

An annual supply of waste oil totes is identified and a representative sample is collected from each of the totes to create a composite which is then sent for analysis.

The samples are analyzed for glycol, PCBs, ash, flashpoint, metals, sulphur, total chlorine, heating value, viscosity, and water.

2.5.7 Environmental Surveillance Monitoring

Some of the monitoring required under the water licences does not involve collection of samples or laboratory analysis. This may include monitoring shoreline erosion or ground temperatures around

infrastructure facilities. The timely acquisition and preservation of this data provides documentation for aspects relating to how the camp is affecting the local environment. For example, if runoff from the site is not properly controlled permafrost degradation may be observed and documented. On the same note, a warming trend in a temperature monitoring station could be an early indicator of permafrost degradation. Field notes and measurements are collected for these programs and are an important part of the site environmental management.

2.5.8 Flow Measurements

Seametric TX-115 Flow meters are used to measure piped water movements and discharge within the water management facilities. The calibration procedure for the Seametric TX-115 Flow meters includes testing of the flow measurement reading against a known flow to determine accuracy, adjusting the K-factor to ensure the flowmeters are within 10% and recording the information in a flowmeter calibration log. This calibration is conducted prior to deployment in the field for water management related activities.

2.5.9 Field Measurements

Water temperature, electrical conductivity and pH are typically measured and recorded in the field when the sample is taken. The calibration of the meters must be verified against a known standard solution and recalibrated if necessary prior to each day's sampling activities. The calibration data is recorded in a calibration log. Additionally, the calibration of the meter should be checked against a known standard at the end of the days sampling. Any issues with the meter calibration, or discrepancies with the end of day calibration check should be noted in the field log book along with that days sampling data. Calibration check data will not be used to alter any reading taken during the day. Instead, these results may be used to help explain anomalous data.

Field measurements should be taken directly from the water body being sampled. Where this is impractical, perhaps due to high velocity of a sample stream, the measurements can be taken from a triple rinsed sample jug or pail. It is important that field meters are never introduced into sample bottles that are destined for laboratory analysis to prevent sample contamination.

3 Sample Handling

3.1 Sample Identification

Prior to beginning a sample event, the required sample bottles and preservatives should be gathered, prepared and organized into sample sets inside a plastic bag which should be supplied by the contract laboratory.

When sampling and sample preservation is completed, the bottles should be clearly marked with all information that the laboratory analyst will need to report the result. The following information should be included:

- Sample location (or SNP station number)
- Date of sampling
- Parameters to be analyzed
- Preservation method used
- Filtering method used
- Name or initials of sampler
- Temperature and pH (where applicable)
- Company name, and
- Property name

Prior to taking the bottles to the field, each bottle will be labelled with as many of the items above as possible using waterproof pre-printed labels. The sampling time, temperature and pH (where applicable) will be recorded on the label in the field using permanent waterproof ink

In some cases, permanent markers can be used to identify sample bottles, however these markings can be erased with wear and may not be clearly legible. Whenever possible pre-printed waterproof labels can be used to mark the sample bottles.

3.2 Chain of Custody Forms

A Chain-of-Custody (CoC) form must be completed for each sample collected. Template CoC forms are saved on the Environment server. The completed form is to be filed on the server in the Laboratory Data folder. A copy of this form must also be printed, signed and sent accompanying the samples.

3.3 Sample Preservation

As samples cannot be delivered to the analytical laboratory within two hours of sampling, preservation may be required for some parameters to prevent chemical reactions that may affect the concentration of the parameter of interest. The samples must be preserved within two hours of sampling. Preservative must be analytical grade and must not be used after the expiry date. Expired preservative is returned to the laboratory for proper disposal. The contracted laboratory can provide instruction for the preservative requirements for each analytical parameter and will provide appropriate preservatives for parameters to be analyzed.

Samples must be kept dark and cool (~4°C), but not frozen. Samples will be packed in a cooler with ice packs for transport and for shipment to the laboratory. Samples will be stored in a refrigerator if they will not be shipped to the laboratory immediately after sampling. Samples should be delivered to the analytical laboratory as soon as possible after collection.

The sample preservatives necessary for the different analyses required by the water licence SNPs are provided in Appendix B.

3.4 Transportation

Care should be taken when packing samples for shipment. To help prevent leakage and cross contamination, sample bottles should be packed standing upright in the cooler. Sample bottles laid on their side are much more likely to leak, especially if they have other samples on top of them. When possible, samples known or suspected to have elevated contaminate levels should not be shipped together with samples expected to be clean (i.e. sewage samples not shipped in same cooler as potable water samples).

The contracted laboratory can provide details on the storage or holding time for each parameter to be analyzed (i.e. can be as little as 24 hours). Where possible, sample dates will be scheduled so that a flight is available to transport the sample to the lab within the specified holding time. In all cases, samples will be shipped to the laboratory as quickly as possible and will be labelled as “Time Sensitive, Keep Cool” to ensure proper handling during shipment.

4 Quality Control Samples

There are six types of QC samples that can be collected and analyzed to verify the quality of the sample collection and analysis methods. These are described in the section below. These QC samples are analyzed for the same suite of analytical parameters as the SNP sampling station samples.

4.1 Travel Blanks

Travel blanks are used to check for contamination during the movement process of samples and are subjected to the same potential sources of contamination as the samples to be analyzed. The travel blanks are prepared by the analytical laboratory with de-ionized water and appropriate preservative. The travel blank bottles are shipped to site, transported to the field, carried through the sample collection and shipped back to the laboratory with the field samples. Travel blank bottles should not be opened at any time.

4.2 Equipment Blanks

Equipment blanks are collected after cleaning of field equipment and prior to sampling. De-ionized water provided by the contract laboratory is used to rinse the equipment. The field equipment is then filled with de-ionized water, and then collected and preserved in new sample bottles for the same analysis as the field samples (de-ionized water expires within six months of being produced by the laboratory; expired de-ionized water will not be used). The results from this blank sample assure adequate decontamination of the field equipment. The Niskin or other sampling equipment used to collect samples will be decontaminated prior to use.

4.3 Field Blanks

Field blanks are samples of laboratory-grade de-ionized water that are subjected to the same procedures as routine field samples. Any measurement of the parameter of interest, above method detection limits, will indicate an analytical error, impurities in the laboratory distilled water supply, contaminated sample preservatives or contamination of the sample during the handling process.

Combined with the results of other QC procedures, analysis of field blanks can help identify sources of contamination and error.

A set of field blanks should be made up once each month and taken into the field when the SNP stations are sampled. New sample bottles will be rinsed as directed by the contract laboratory and filled using de-ionized water provided by the contracted laboratory (de-ionized water expires within six months of being produced by the laboratory; expired de-ionized water will not be used). The samples will be poured directly from the bottles provided by the laboratory into the sample bottles to replicate grab sample methods. The field blank set should represent all the parameters routinely analyzed at that sample location. The bottles should be preserved using the same protocol as the regular samples and submitted to the laboratory identified as field blanks.

4.4 Replicate Samples

Replicate samples (sometimes referred to as duplicate samples) test precision and assure that sample results are reproducible. They are prepared by collecting two separate samples for each given analytical parameter at a given sample location. The replicate samples are collected, handled and analyzed using the same procedures applied to routine samples. The samples are also analyzed by the same analytical method in the laboratory. Replicate samples are usually used to identify sampling procedure errors.

Once per operating season, for each active SNP station, a set of duplicate samples will be taken representing as many of the routine analyses as possible. Where possible, this should be carried out in conjunction with audit sampling conducted by the designated Inspector. Replicate sampling should rotate between prescribed SNP stations.

4.5 Split Samples

Two or more representative sub-samples are removed from one collected sample and analyzed separately at the laboratory. This data is used as a check of the precision of the analytical procedure employed by the laboratory and is a normal part of the laboratory QA/QC program. These can also be collected in the field by dividing a composite sample into two sets of samples. If field split samples are collected, it is common to label each sample with a different station name, to provide a blind assessment of the laboratory's analytical program.

4.6 Method "Spiked" Samples and Certified Standards

The recovery of "known additions" from "spiked" samples is used as a check on the recovery of the parameter to be analyzed using a given analytical procedure. It is periodically carried out at the laboratories employed to analyze the samples and forms part of the laboratory's normal QA/QC program.

5 Laboratory Analysis

All environmental monitoring samples are submitted to an offsite analytical laboratory which is accredited by the Canadian Association for Laboratory Accreditation (CALA). Currently, TMAC uses ALS Environmental Laboratories (ALS), Bureau Veritas Canada Inc. (formally Maxxam Analytics) and Nautilus Environmental Inc. for analyses of all environmental samples. A cover letter from ALS confirming approval of the Plan for analyses to be performed under this Licence is provided in Appendix A of this plan. The quality control protocols used by ALS are provided in Appendix C of this plan. The CALA scope and Certificates for ALS can be found in Appendix D. The CALA scope and Certificates for Bureau Veritas Canada Inc. can be found in Appendix E. The CALA scope and Certificates for Nautilus Environmental Inc. can be found in Appendix F.

TMAC verifies with each laboratory that the analytical methods utilized for each parameter conform to industry best practices and those referenced in applicable guidance and regulatory documents.

6 Reporting

All analytical results are forwarded in electronic format to TMAC's Environmental Superintendent for filing. TMAC uses a MonitorPro electronic database to manage data and make data easily accessible. This database is maintained by the Environmental Superintendent.

After receipt, the results are screened for anomalies and/or trends, and are placed into the appropriate environmental files on the Environmental server. Results that appear to be anomalous are flagged and a review is conducted to identify potential sources of the anomaly. In some instances, the analysis is repeated. Analyses that indicate contamination or changes are subjected to further study and reported to the appropriate agencies. The environmental files are maintained on the server as a management tool for environmental risk assessment and in preparation of summary reports for the regulatory agencies and company officials. In compliance with the Surveillance Network Program, reports of analytical results for SNP samples are submitted electronically to the NWB and the Inspector within 30 days following the month in which the samples were taken. The NWB distributes the reports to other agencies and interested parties.

Results of samples collected under the Metal & Diamond Mining Effluent Regulations are reported to Environment and Climate Change Canada through the Single Window Information Manager online reporting system each calendar quarter not later than 45 days after the end of the quarter. An annual report of results of samples collected under the Metal & Diamond Mining effluent Regulations will be submitted by March 31 of each year.

7 References

Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites Volume I: Main Report. 1993, Canadian Council of Ministers of the Environment

Protocols Manual for Water Quality Sampling in Canada. 2011, Canadian Council of Ministers of the Environment

Standard Methods for the Examination of Water and Wastewater. 1999, American Public Health Association, American Water Works Association and Water Environment Federation

Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "A" Licensees. 1996, Indian and Northern Affairs Canada Water Resources Division and Northwest Territories Water Board.

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Appendix A – ALS QA/QC Plan Review Confirmation Letter

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January 4, 2017

TMAC Resources Inc.
Hope bay, Nunavut

RE: APPROVAL CONFIRMATION FROM ALS ENVIRONMENTAL FOR ANALYSES PERFORMED UNDER THE TMAC QA/QC PLAN

ALS Environmental has reviewed the Quality Assurance and Quality Control Plan – Appendix A – Analytical Parameters, Sample Bottles and Required Preservatives, provided to ALS by TMAC Resources.

ALS has the capability to conduct all analyses listed in Appendix A of the above referenced QA/QC plan. In addition, ALS is accredited by the Canadian Association of Laboratory Accreditation (CALA) for all analyses listed in Appendix A.

Please feel free to contact myself or Amber Springer if you require any additional information.

Sincerely,

Katherine B. Thomas, B.Sc.
Operations Manager
Vancouver, BC

Amber Springer, B.Sc.
Senior Account Manager,
Vancouver, BC

RIGHT SOLUTIONS | RIGHT PARTNER

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Appendix B – Analytical Parameters, Sample Bottles and Required Preservatives

Analytical Parameters, Sample Bottles and Required Preservatives

SNP Monitoring Group Reference	Analytical Parameters	Measurement Units	Sample Bottle	Preservative
General (G)	pH	pH units	500 mL plastic	None
	TSS	mg/L		
Nutrients (N1)	Orthophosphate-P	mg/L		
	Nitrate-N	mg-N/L		
	Nitrite-N	mg-N/L		
Nutrients (N2)	Total Ammonia-N	mg-N/L	120 or 250 mL amber glass	1 mL of 1:3 H2SO4 or 1 mL of 1:1 H2SO4
	Total Phosphate-P	mg/L		
Total Metals - Unfiltered (MT)	T-Aluminum	mg/L	60 mL plastic	None
	T-Arsenic	mg/L		
	T-Copper	mg/L		
	T-Iron	mg/L		
	T-Nickel	mg/L		
	T-Lead	mg/L		
	T-Zinc	mg/L		
Dissolved Metals - Filtered (MT)	D-Iron	mg/L	60 mL plastic; field filtered	None
	D-Copper	mg/L		
	D-Arsenic	mg/L		
	D-Zinc	mg/L		
	D-Cadmium	mg/L		
	D-Nickel	mg/L		
Biological (B)	Biochemical Oxygen Demand	mg/L	500 mL plastic	None
	Fecal Coliforms *	CFU/100 mL (colony forming units)	Sterile 250 mL plastic	Sodium Thiosulfate (precharged)
Hydrocarbons (HC)	Total Oil & Grease	mg/L	2 X 250 mL or 2 X 500 mL amber glass	0.5 mL of 1:1 HCl or 1 mL of 1:1 HCl
	Benzene	mg/L	2 X 40 mL glass	Sodium Bisulphate (precharged)
	Toluene	mg/L		
	Ethyl Benzene	mg/L		
Discharge (D)	Flow	m3/day	None, field measured	N/A
	Volume	m3		
	Duration	Day		

*ALS methodological change. Fecal coliforms now in MPN/100mL (Most Probable Number).

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Appendix C – ALS Quality Control Protocols

ALS Canada Limited

Quality Control Protocols

02 January 2018

Quality control (QC) samples are introduced into batches of client samples at critical points of sample handling, preparation and analysis to demonstrate the processes are performing as expected. In general, quality control samples are considered either Instrument QC or Method QC. The following identifies the standard requirements for Quality Control at ALS, which are applicable to most tests. Many test methods use additional QC elements to monitor control over specific steps in testing processes.

Instrument QC:

Instrument QC samples demonstrate control for the instrumental portion of a method. Instrument QC requirements must be successfully met before the analysis of Method QC or samples may proceed.

- Verification of initial calibration - criteria varies with each test.
- 2nd source Calibration Verification Standard (CVS) – at minimum, with each initial calibration.
- Continuing Calibration Verification (CCV) – frequency varies by test.
- Instrument Blanks – usage and frequency varies by test.

Method QC:

Method QC samples encompass the entire method and are initiated at the earliest point of the method where appropriate. Refer to the QC Definitions below. One set of Method QC is included for each batch of up to 20 client samples. Each set includes:

- 1 Method Blank.
- 1 Sample Duplicate. *
- 1 Lab Control Sample.
- 1 Reference Material or Matrix Spike. **
- Surrogate Compounds.

* Duplicate analyses are not performed where sub-sampling is not possible – e.g. most tests for organics in water.
** Spikes and Reference Materials are unavailable for Microbiology tests. Microbiology tests utilize positive and negative controls daily in each incubator. The controls are specific to the tests performed.

Method QC must be successfully analyzed before sample results are approved. Method QC results are normally reported to ALS clients with data reports.

Data Quality Objectives (DQOs):

DQOs are established for each QC sample, based on a combination of reference method objectives, customer requirements and historical test method performance. Where applicable, prescriptive elements of reference methods or regulatory requirements take precedence over internal DQOs. Current DQOs are available upon request.

Detailed descriptions of how DQOs are evaluated for different types of Quality Control are described on the following pages.

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Types of Quality Control – Definitions and Evaluation Protocols

Method Blank (MB) - A blank sample prepared to represent the sample matrix as closely as possible and analyzed exactly like the calibration standards, samples, and quality control (QC) samples. Results of Method Blanks provide an estimate of the within batch variability of the blank response and an indication of bias introduced by the analytical procedure.

Except in special cases (as outlined in ALS DQO summary documents) the ALS DQO for Method Blanks is for all results to lie below the Limit of Reporting (LOR).

Laboratory Sample Duplicate (DUP) - A second portion of sample taken from the same container as the sub-sample used for the primary analysis, that is analyzed independently through all steps of the laboratory's sampling and analytical procedures. Duplicate samples are used to assess variance of the total method including sampling and analysis.

Duplicate precision is normally measured as Relative Percent Difference (RPD), where RPD = |(Result2 - Result1) / Mean| * 100. Duplicate samples should normally agree to within the ALS Precision DQO for the test and parameter (expressed as RPD), or within ± 2 x the LOR (for low level results). Refer to the ALS DQOs for Precision for specific limits for any given test.

ALS does not establish DQOs for Field Sample Duplicates. However, it is generally understood and accepted that the variability of Field Sample Duplicates is significantly more than what is observed with Laboratory Sample Duplicates.[1]

Laboratory Control Sample (LCS) - A known matrix spiked with compound(s) representative of the target analytes. An LCS is used to verify the accuracy of the laboratory's performance of the test.

LCS accuracy is calculated as the measured amount divided by the target concentration, and is normally expressed as percent recovery. LCS recoveries should normally lie within the ALS Accuracy DQOs for the test and parameter. For a low level LCS, the result should normally lie within ± 1 x the LOR of the target concentration. Refer to the ALS Accuracy DQOs for specific limits for any given test.

Reference Material (RM) – A material or substance, one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. An RM is similar to an LCS, but encompasses a representative sample matrix. Similar to an LCS, an RM is used to verify the accuracy of the laboratory's performance of the test, but including the challenges of a complex sample matrix.

RM accuracy is calculated, expressed, and evaluated similarly to LCS accuracy. Refer to ALS Accuracy DQOs for specific limits for any given test.

Matrix Spike (MS) - A sample prepared by adding a known amount of a target analyte to a specified amount of a sample for which an independent estimate of the target analyte concentration is available. Spiked samples are used, for example, to determine the effect of the sample matrix on a method's recovery efficiency.

Matrix Spike results are calculated and expressed as percent recovery, by dividing the measured result (minus any analyte contribution from the unspiked sample) by the target analyte concentration. Matrix Spike results should normally lie within the ALS Accuracy DQOs for Matrix Spikes. Matrix Spike results cannot be accurately

[1] Depending on the type of Field Sample Duplicates being evaluated (e.g. Co-located versus Split Sample Duplicates), ALS recommends DQOs for Field Sample Duplicates that are between 1.5 – 2.0 times higher than our Laboratory Sample Duplicate DQOs. Co-located Sample Duplicates generally require higher DQOs than Split Sample Duplicates.

calculated or reported in cases where the background concentration of the test parameter in the sample is higher than the spike level.

Surrogate Compounds (SURR) – Surrogate Compounds are added to every sample where applicable (organics tests only). They are substances with properties that mimic the analyte of interest, and which are unlikely to be found in environmental samples. They are added at known concentrations to samples to establish that the analytical method has been properly performed.

Surrogate results are calculated and expressed as percent recovery, by dividing the measured result against the expected target concentration. Refer to ALS Accuracy DQOs for specific limits for any given test.

Automated Relational Checks

In addition to all our standard Quality Control checks, ALS also employs dozens of "Relational Checks", which are programmed into our Laboratory Information Systems (LIMS) to automatically highlight any situations where the expected relationships between different test parameters are violated, which can often point to errors. Such errors may originate with field sampling, or from laboratory processes, but should always be identified and pro-actively investigated.

Total versus Dissolved Metals ("D > T" Check) – One of the most important and common relational checks we do is a check for situations where Dissolved Metal concentrations significantly exceed Total Metal concentrations. By definition, this situation should not occur. However, there are a few reasons why this can occur:

i) Circumstances where Dissolved Metals slightly exceed Total Metals are expected in a small percentage of samples, simply due to normal random variability associated with sampling and testing protocols. In fact, when all metals in a test sample exist in the dissolved form, we expect that Dissolved Metals measurements will numerically exceed Total Metals measurements exactly half the time (by a small margin), simply due to random chance.

ii) Samples to be analyzed for Dissolved Metals must be filtered, which should be conducted in the field to ensure valid results. Unvalidated and uncontrolled filtration processes are a common source of low level metals contaminants. Contamination of a sample during field filtration is the most common source of significant D > T issues (ALS recommends syringe filtration in the field, using filters proven by ALS to be suitable for this task. If in-line filters are used, ALS recommends pre-rinsing with 1L of sample prior to use; smaller rinse volumes may be suitable but should be demonstrated in advance).

iii) ALS recommends the use of Field Filtration Blanks to monitor and control the filtration process, and to assist with the interpretation of any D > T issues.

iv) Field samples for Dissolved and Total Metals are normally collected independently, therefore field sampling variability is another common cause of D > T issues.

If none of the above causes can explain a situation where Dissolved Metals exceed Total Metals, then another type of error may be indicated, either with the collection of the sample in the field, or with sample containers or preservatives, or with the laboratory testing process.

ALS automatically highlights and investigates all circumstances where a Dissolved Metal result exceeds the Total Metal result by 30% RPD or more, but only if the absolute difference between the two results is greater than the sum of the Limits of Reporting (Detection Limits) of the two results.

In the case of field filtered samples where D > T, the following qualifier will be applied where no lab errors are identified upon review: *DTMF: Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants were likely introduced to dissolved sample during field filtration*. The mechanism of this relational

check is derived from the ALS Duplicate DQOs for Metals in Water (20% RPD), multiplied by 1.5 to account for variability attributed to field sampling, because the dissolved and total metals tests are conducted on independent samples.

All D > T relational checks that violate the rule above are flagged internally, and are investigated by ALS before sample results will be released to our clients. Anomalous results (except those consistent with low level contamination caused by field filtration) will be re-analyzed to confirm or correct the anomaly. If results are confirmed by re-analysis, the following data qualifier is applied: *DTC: Dissolved concentration exceeds total. Results were confirmed by re-analysis.*

Other Important Relational Checks Conducted by ALS

ALS employs dozens of other relational checks to highlight anomalous relationships between test parameters. Some of more common checks include the following:

- *Total Ammonia should not exceed Total Kjeldahl Nitrogen*
- *Weak Acid Dissociable Cyanide should not exceed Total Cyanide*
- *E. coli should not exceed Fecal Coliforms*
- *Nitrate + Nitrite should not exceed Total Nitrogen*
- *Hexavalent Chromium should not exceed Total Chromium*
- *True Colour should not exceed Apparent Colour*
- *Mineral Oil and Grease should not exceed Total Oil and Grease*
- *Reactive Phosphorus should not exceed Total Phosphorus*

ALS Canada Limited

Quality System Protocols

19 January 2018

ALS is a global diversified testing services organization with a presence on every continent, offering a broad range of services to leading global companies.

The following summarizes standard practices routinely employed by the ALS Environmental Division in Canada. Our practices exceed accreditation requirements and have been designed to meet or exceed the needs of our customers and to give them confidence in the reliability of our test data.

ALS Canada locations hold accreditations and certifications relevant to their work and area of operation. Participation in CALA, USA DOD, NELAP, various USA state and other regional and regulatory programs is location-specific. Refer to Accreditations in the Environmental Testing Downloads section at www.alsglobal.com for information relevant to each ALS location. Alternatively, current scopes and certificates are available from your Account Manager or by contacting our Quality Department.

Additional information is available on request. Customers are invited to audit or tour ALS facilities at their convenience.

Services to Customers:

ALS cooperates closely with our customers to ensure their testing needs are understood, and allows them reasonable access to relevant work areas of the laboratories to audit our management system or to witness test work undertaken on their behalf.

All client issues are logged into our tracking system to ensure each issue is addressed completely and appropriately. Local and national oversight and initiatives ensure that identified improvements are incorporated throughout our Canadian laboratory network so that customers receive the same level of service regardless of which location performs the testing.

Documentation and Document Control:

Test methods and support procedures are documented in detail to ensure consistency of application, repeatability of test results and traceability of analyses.

Test method requirements include but are not limited to sample handling, sample storage, minimizing interference, sample preparation, reagent and standard specifications, equipment, supplies, calibration requirements, instrumental measurement procedures, quality control requirements, data quality objectives and corrective actions, calculations, reporting requirements, reference information, and hazards and their preventive measures.

Administrative support procedures are also documented where needed to ensure quality system procedures and customer services are provided in a controlled, approved manner consistent with ALS policies and client needs.

All documents are authorized prior to use, ensuring adequate technical and quality oversight.

Distribution of documents is controlled to ensure only the most recent version is available for use. Authorized documents are reviewed periodically by the ALS signing authority to ensure they continue to meet both internal ALS requirements and our customers' needs.

Test methods and support procedures are available for client viewing on-site.

Internal Audits:

ALS Canada operates an extensive internal audit program. Audits are performed by qualified Quality Assurance and Technical staff for analytical procedures and Quality System elements. The ALS audit program ensures that

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procedures are implemented as intended, that test methods are scientifically defensible and technically sound, and that policies, procedures and records continue to meet the objectives of our Quality System.

Quality staff may periodically initiate unscheduled audits in response to proficiency testing program results, client feedback, requests from managers, or any other circumstance that warrants investigation.

Quality Control (QC):

ALS has established QC procedures for monitoring the validity of tests performed by our laboratories. Individual test methods specify quality control requirements, frequency of use, and Data Quality Objectives (DQOs).

The type of quality control elements used for process monitoring is dependent on the test performed, but typically includes (as appropriate): Calibration Verification Standards, Continuing Calibration Verifications, Instrument Blanks, Method Blanks, Laboratory Control Samples, Reference Materials, Matrix Spikes, Surrogate Spikes, and Internal Standards.

DQOs are established for each QC type, based on a combination of reference method objectives, customer requirements and historical test method performance. Where applicable, prescriptive elements of reference methods take precedence over internal DQOs.

Test results for selected QC samples are available on test reports. Please contact your Account Manager for more information.

Refer to the ALS Quality Control Protocol handout for details on ALS QC practices.

Control Charts:

Control charts are used to provide a graphical representation of QC results and test method performance over time. Control charts graphically display DQOs as well as the statistically derived mean and ± 2 and 3 standard deviations ("sigma") around the mean, calculated from recent historical QC results. ALS applies advanced trend monitoring algorithms to identify outliers and non-random data distributions (trends) that may indicate undesirable changes in test method performance, so the causes can be investigated and corrected.

Continuous Improvement:

ALS is committed to continuously improving our processes and services. The Quality System feeds into a continuous cycle of review, implementation, and monitoring so that improvements are actively sought and adopted where needed.

Test Data Validation and Record Retention:

ALS analytical data proceeds through several reviews prior to the release of final reports. The ALS data validation process includes test result validation, inter-parameter validation, and report validation. Test result validation involves a thorough analyst review followed by an independent peer review. Inter-parameter validation occurs when all department specific parameters for a sample are completed, and involves an overall review of test results within each sample for consistency among any related test parameters. Report validation occurs when all the requested test results for a work order are completed, and involves a review of the final report before it is sent to the customer.

ALS maintains laboratory records in a traceable manner for a minimum of five years.

Method Validation:

Customers rely on ALS to select test methods that are appropriate to meet their needs. Wherever possible, ALS references the latest versions of published standard methods developed by organizations such as American Public Health Association, United States Environmental Protection Agency, NIOSH, Environment Canada, and other international, regional or regulatory organizations or equipment manufacturers.

Method validations are conducted to confirm that our test methods are fit for their intended use. The validations are as extensive as necessary to meet the needs of the given application. The extent depends on the source of the method. Test methods are revalidated periodically to ensure continued suitability and fitness for purpose.

Method Detection Limits and Limits of Reporting:

ALS Limits of Reporting (LORs) are established using rigorous experimental and statistical procedures that begin with the determination of the Method Detection Limit (MDL) at 99% confidence. The MDL takes into account several factors, like long term Method Blanks, low level Sample Duplicates, and low level Spiked Samples. When detected at or above the MDL, ALS test results are considered to be qualitatively accurate, and a parameter can be reported with 99% confidence as being present in the sample.

$$MDL = (s_0 \times t_{n-1}) + |MBlk|$$

Where:
- s_0 = the standard deviation derived from the analysis of blank or low level samples, whichever gives a higher standard deviation,
- t_{n-1} = the Student's t-distribution with n-1 degrees of freedom for the one-sided 99% confidence interval.
- |MBlk|= the absolute value of the mean method blank.

ALS takes a conservative approach to detection limits. Our goal is to minimize false positives, because we recognize that any false positive results can be damaging for our clients. Where possible, we establish LORs at levels well-above the statistical MDL, and ideally at the LOQ_5. This improves the accuracy and precision of results near the detection limit, and reduces the chance of false positives due to sample-specific issues. At or above the LOQ_5, test results are considered to be quantitatively accurate. A reported parameter at the LOQ_5 is considered to be within 40% of the true value 95% of the time.

$$LOQ_5 = 5s_0 + |MBlk|$$

Where:
s_0 = the standard deviation used in the MDL calculation,
|MBlk | = the absolute value of the mean method blank.

The D.L. column on ALS analytical reports contains the LOR (also known as Detection Limit). The LOR may be the MDL as calculated above, or a higher value. ALS does not report LORs that are less than the calculated MDL.

Measurement Uncertainty (MU):

ALS procedures for calculating measurement uncertainty are based on accepted practices of identifying components contributing to uncertainty, compiling data that represents or includes these components, evaluating the data using appropriate statistical calculations, and reporting in a manner that prevents misunderstanding of the result. ALS follows the Type A method of calculating measurement uncertainty, however additional factors are considered to ensure the best and most complete information is derived from our evaluation of test method performance.

The ALS model describes the dependency of uncertainty on three factors. The first is a constant contribution to uncertainty attributable to s_0, the standard deviation of the method for concentrations that approach zero. The second is a constant relative uncertainty associated with higher parameter concentrations. The third is a constant

contribution to uncertainty attributable to the mean long-term method blank value where it is significant. The following is the ALS equation for measurement uncertainty, using an expansion factor of k=2:

Expanded 95% Uncertainty as a Function of Concentration

$$U(c) = 2 * [\sqrt{ \{ s_0^2 + (\theta c)^2 \} }] + |MBlk_{LT}|$$

Where:

U(c) =	The expanded uncertainty at concentration c. The range c ± U(c) represents approximately the 95% confidence interval (two standard deviations).
c =	Measured concentration of parameter in the sample.
s_0 =	A constant contribution to standard uncertainty represented by the standard deviation at zero concentration, which is related to the method detection limit.
θ =	Combined relative standard uncertainty, excluding MDL and Method Blank contributions. Theta has no units.
$\|MBlk_{LT}\|$ =	Absolute value of the mean long-term Method Blank value, where significant (i.e. if > 1/5 s_0). [Note that the Method Blank term is not expanded because it represents a constant bias, not a variance.]

Uncertainty values obtained from this procedure must be regarded as estimates. Primarily, this is because all environmental samples are different, especially with regard to matrix effects and heterogeneity. It is our intent with this procedure to arrive at an estimate of a 95% confidence level uncertainty value that can be assumed to apply to 95% (or more) of the samples that a laboratory receives for a given test. It follows that for samples where undetected matrix effects or interferences occur, or for samples that are atypically heterogeneous, uncertainty estimates may be low.

Another aspect of reporting MU is the reporting of test method bias. Bias occurs in a small number of test methods that cannot recover 100% of a parameter from a sample. In these cases ALS reports bias along with the MU to aid with the interpretation of the test result.

Participation in Interlaboratory Proficiency Testing (PT) Programs:

ALS locations participate in an extensive variety of proficiency testing programs. Where available, formal programs operated by outside agencies are used. When not available, ALS utilizes less formal proficiency testing studies.

Root cause analysis is initiated and corrective action plans are developed when PT program results indicate a decline in test method performance.

Staff Training:

Formal training procedures are in place to ensure all staff are trained in ALS polices and analytical procedures prior to performing analyses. A staff orientation program communicates ALS polices to newly hired staff. Task specific training is performed, and analyst proficiency is demonstrated and documented before staff are authorized to work independently. On-going analyst proficiency is monitored using proficiency testing programs. Records are maintained in training logs issued to staff upon hiring.

As well, ALS Canada promotes continuing education and learning by offering advanced courses covering technical and quality functions.

Employee Agreements:

ALS protects our customers' confidential information and proprietary rights. We require all employees to review and sign a Code of Conduct policy that communicates the ALS confidentiality policy. It is ALS practice to never disclose information about a client's analysis to a third party without prior consent of the client, or unless compelled to by law. If we are obligated by law to disclose such information, we will inform the client prior to doing so.

ALS employees avoid involvement in activities that would diminish confidence in their competence, impartiality, judgment, or integrity by complying with the ALS Code of Conduct and Data Integrity Policy.

Sample Tracking:

Procedures are in place to track samples from receipt at the lab through to final reporting. A data management system (LIMS – Laboratory Information Management System) is used to generate a work order number for each sample submission, and a unique identification number is generated for each sample within the work order. The system is then used to assign specific analyses for the samples, to identify methods to be used, and to assign due dates for the results. The system is used to manage analytical workloads and track the status of all samples in-house. LIMS is a secure system that can only be accessed using login passwords. Controlling the level of access according to the needs of individual staff members provides additional security.

When requested by the client, legal sample protocols are implemented to ensure chain of custody defensibility in a court of law. Contact the lab for legal sampling and transportation instructions if this service is needed.

Equipment Calibration:

Measuring and testing equipment used by ALS laboratories that can have a significant effect on the accuracy or validity of test results is calibrated using established procedures. These procedures ensure traceability through an unbroken chain of calibrations or comparisons to national measurement standards. Where traceability of measurements to SI units is not possible and/or not relevant, traceability is provided by the use of certified reference materials and/or consensus standards.

Management Reviews (MR):

ALS management conducts a review at least annually to ensure our management system is effective, and continues to be suitable for our operations, and to identify necessary changes or improvements. Senior management is included in the review process for all locations.

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Appendix D – ALS CALA Certificates and Scopes

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

ALS Environmental (Edmonton)
ALS Canada Ltd.
9450-17th Ave. NW
Edmonton, Alberta

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

CALA

Accreditation No.: A1352
Issued On: October 30, 2018
Accreditation Date: January 3, 2005
Expiry Date: April 29, 2021

Andrew M. Adams
President & CEO

CALA

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request; reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca.

CALA
Canadian Association for Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 1352
Laboratory Name: ALS Environmental (Edmonton)
Parent Institution: ALS Canada Ltd.
Address: 9450-17th Ave. NW Edmonton AB T6N 1M9
Contact: Ms. Sarah Stilson
Phone: (780) 413-5226
Fax: (780) 437-2311
Email: alsed.quality@alsglobal.com

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served: All Interested Parties
Revised On: October 30, 2018
Valid To: April 29, 2021

Scope of Accreditation

Air (Inorganic)
Dustfall - Air [Dustfall] (120)
ED-TM-1030; modified from ALBERTA ENVIRONMENT 32020
GRAVIMETRIC
Dustfall, Fixed
Dustfall, Total

Air (Inorganic)
Fluoride - Air (188)
ED-TM-1028; modified from SM 4500-F- C
SELECTIVE ION ELECTRODE
Fluoride

Air (Inorganic)
Fluoride - Air [Filter] (219)
ED-TM-1008, NA-TM-1001; modified from NIOSH 7906
ION CHROMATOGRAPHY
Hydrogen Fluoride (as F)

Air (Inorganic)
Mercury - Air [Filter] (190)
ED-TP-2001, NA-TM-1005; modified from EPA 245.1 and NIOSH 6009
COLD VAPOUR AA - DIGESTION
Mercury

Air (Inorganic)
Metals - Air [Filter] (016)
ED-TP-2001, NA-TM-1002; modified from EPA 6020A and NIOSH 7303
ICP/MS - DIGESTION
Aluminum

† "OSDWA" indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002).

The list of tests and measurement capabilities for which a laboratory is accredited can change at any time due to circumstances such as scope extensions, voluntary withdrawal of tests by the laboratory and suspension. Scopes are published by the CALA via the Internet at http://www.cala.ca/cala_directories.html

Antimony
Arsenic
Barium
Beryllium
Bismuth
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Sulfur
Thallium
Tin
Tungsten
Uranium
Vanadium
Zinc
Zirconium

Air (Inorganic)
Particulates - Air [Particulate] (223)
ED-TM-1140; modified from NIOSH 0500 and NIOSH 0600
GRAVIMETRIC
Particulates

Air (Inorganic)
Total Solids - Air [Impinger] (205)
ED-TM-1157; modified from EPA 5
GRAVIMETRIC
Total Solids

Air (Organic)
Formaldehyde - Air (221)
ED-TM-1151; modified from EPA TO-11A and NIOSH 2016
HPLC/UV - EXTRACTION
Formaldehyde

Air (Organic)
Gas - Air [Compressed Breathing Air] (218)
ED-TM-1144; modified from ASTM D1946 and CSA 180 and EPA 3C
GC/TCD
Nitrogen
Oxygen

† "OSDWA" indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002).

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Air (Organic)
Hydrocarbons - Air (217)
ED-TM-1142, ED-TM-1144; modified from CSA Z180 and EPA 18
GC/FID
Carbon dioxide
Carbon monoxide
Ethane
Methane
Total Volatile Hydrocarbons (TVH): C1-C16

Air (Organic)
Volatile Organic Compounds (VOC) - Air (216)
ED-TM-1142; modified from EPA 018 and EPA 25C
GC/FID
Benzene
Ethylbenzene
Non-methane organic carbons
Toluene
Xylenes

Oil (Organic)
Polychlorinated Biphenyls (PCB) - Oil (002)
ED-TM-1104, ED-TM-1116; modified from ASTM D4059 and EPA 8082
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Paint (Inorganic)
Lead - Paint (153)
ED-TM-1021, NA-TP-2004; modified from EPA 200.2 and EPA 200.7
ICP - DIGESTION
Lead

Soil (Inorganic)
Ammonia - Solids [Soil] (225)
ED-TM-1024, ED-TP-2019; modified from EPA 350.1 and SM 4500-NH3 and SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 15.2.1
COLORIMETRIC - SATURATED PASTE
Ammonia

Solids (Inorganic)
Anions - Solids [Soil] (176)
ED-TP-2019, NA-TM-1001; modified from EPA 300.1 and SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 15.2.1
ION CHROMATOGRAPHY (IC) - SATURATED PASTE
Chloride
Nitrate
Nitrate-N
Nitrite
Sulphate

† "OSDWA" indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002).

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Solids (Inorganic)
Asbestos - Solids [Bulk] (222)
ED-TM-1152; modified from EPA 600/R-93/116 and NIOSH 9002
POLARIZED LIGHT MICROSCOPY (PLM)
Bulk Asbestos

Solids (Inorganic)
Barium - Solids [Soil] (172)
ED-TM-1021, ED-TM-1055; modified from EPA 200.7 and SSSA PART 3, 1996, PG 202
ICP - FUSION
Barium

Solids (Inorganic)
Chloride - Solids [Saturated Paste, Soil] (168)
ED-TM-1032, ED-TP-2019; modified from SM 4500-CL- E and SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 15.2.1
COLORIMETRIC
Chloride

Solids (Inorganic)
Conductivity - Solids [Soil] (156)
ED-TM-1004, ED-TP-2019; modified from SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 15.2.1 and SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 15.3
SATURATED PASTE, METER
Conductivity

Solids (Inorganic)
Density - Solids [Soil] (170)
ED-TM-1025; modified from ASTM D5057
GRAVIMETRIC
Density

Solids (Inorganic)
Extractable Barium - Solids [Soil] (182)
ED-TM-1021, ED-TM-1051; modified from BARITE WASTE GUIDELINES
ICP - EXTRACTION
Barium

Solids (Inorganic)
Grain Size - Solids [Soil] (028)
ED-TM-1014; modified from ASTM D422-63
SIEVING
PSA% >75um

Solids (Inorganic)
Hexavalent Chromium - Solids [Soil] (148)
ED-TM-1023; modified from EPA 3060A
IC-ALKALINE DIGESTION
Chromium

Solids (Inorganic)
Hot Water Soluble Boron - Solids [Soil] (145)
ED-TM-1021, ED-TM-1040; modified from KEREN 1996 METHODS OF SOIL ANALYSIS
ICP - EXTRACTION
Boron

Solids (Inorganic)
Mercury - Solids [Soil] (164)
NA-TM-1005, NA-TP-2004; modified from EPA 200.2 and EPA 245.1
COLD VAPOUR AA - DIGESTION
Mercury

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Solids (Inorganic)
Metals - Solids [Soil] (023)
NA-TM-1002, NA-TP-2004; modified from EPA 200.2 and EPA 6020
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Sulfur
Thallium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Oil and Grease - Solids [Soil] (029)
ED-TM-1131; modified from SM 5520
GRAVIMETRIC - EXTRACTION
Oil and Grease

Solids (Inorganic)
Paint Filter - Solids [Paint, Soil] (231)
ED-TM-1042; EPA 9095A
FILTRATION
Paint Filter (Free Liquid)

Solids (Inorganic)
Particle Size Analysis (PSA) - Solids [Soil] (110)
ED-TM-1010; modified from SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 55.3
PARTICLE SIZE
% clay

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% Sand
Silt

Solids (Inorganic)
Percent Moisture - Solids [Soil] (179)
ED-TM-1200; modified from ASTM D2216-80
GRAVIMETRIC
Percent Moisture

Solids (Inorganic)
Percent Saturation - Solids [Soil] (169)
ED-TP-2019; modified from SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 15.2.1
GRAVIMETRIC
Percent Saturation

Solids (Inorganic)
pH - Solids [Soil] (099)
ED-TM-1003, ED-TP-2019; modified from SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 15.2.1 and SOIL SAMPLING & METHODS OF ANALYSIS, CARTER16.2
SATURATED PASTE, METER
pH

Solids (Inorganic)
pH - Solids [Soil] (100)
ED-TM-1003; modified from SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 16.2
EXTRACTION, METER
pH (1:1)
pH (1:2)

Solids (Inorganic)
pH - Solids [Soil] (163)
ED-TM-1015; modified from SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 16.3
1:2 CaCl2 EXTRACTION - METER
pH (1:2): CaCl2

Solids (Inorganic)
Salinity - Solids [Soil] (160)
ED-TM-1021, ED-TP-2019; modified from EPA 200.7 and SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 15.2.1
ICP (SATURATED PASTE)
Boron
Calcium
Magnesium
Potassium
Sodium
Sulfur
Sulphate

Solids (Inorganic)
Sulfate - Solids (173)
ED-TM-1046, NA-TM-1001; modified from CSA A23.2
IC - DIGESTION
Sulfate

Solids (Organic)
Alkanolamines - Solids [Soil] (210)
ED-TM-1155; modified from "QUANTITATIVE ANALYSIS OF AMINO ACIDS" T. NASHOLM, G. SANDLBERG, & A. ERICSSON. J. CHROMATOGRAM. 396:225-236 (1987)
HPLC - EXTRACTION
DEA (Diethanolamine)

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DIPA (Diisopropanolamine)
MEA (Monoethanolamine)
MIPA (Monoisopropanolamine)

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (154)
NA-TM-1102, NA-TP-2102; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 8260
GC/MS - HEADSPACE
Benzene
Ethylbenzene
m/p-xylene
o-xylene
Toluene

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (155)
NA-TM-1102, NA-TP-2102; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 5021 and EPA 8260
GC/FID - HEADSPACE
F1: C6-C10
VH: C6-C10

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (158)
NA-TM-1100, NA-TP-2100; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GC/FID - EXTRACTION TUMBLER
F2: C10-C16
F3: C16-C34
F4: C34-C50

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (171)
NA-TM-1100, NA-TP-2100; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GRAVIMETRIC - TUMBLER
F4: Gravimetric

Solids (Organic)
Phenols - Solids [Soil] (077)
ED-TM-1113; modified from EPA 3540 and EPA 8270
GC/MS - EXTRACTION
2-Chlorophenol
2-Methylphenol (o-Cresol)
2-Nitrophenol
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-Tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4 + 2,5-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,6-Dichlorophenol
3-Chlorophenol

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3-Methylphenol (m-Cresol)
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methyl phenol
4-Chlorophenol
4-Methylphenol (p-Cresol)
4-Nitrophenol
4,6-Dinitro-2-methylphenol
Pentachlorophenol
Phenol

Solids (Organic)
Polychlorinated Biphenyls (PCB) - Solids [Soil] (097)
ED-TM-1102, ED-TM-1116; modified from EPA 3550 and EPA 8082
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Solids (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Solids (227)
NA-TM-1105, NA-TP-2103; modified from EPA 3570 and EPA 8270
GC/MS - EXTRACTION
1-Methylnaphthalene
2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Benzo (a) anthracene
Benzo (a) pyrene
Benzo (b,j) fluoranthene
Benzo (g,h,i) perylene
Benzo (k) fluoranthene
Chrysene
Dibenzo (a,h) anthracene
Fluoranthene
Fluorene
Indeno (1,2,3 - cd) pyrene
Naphthalene
Perylene
Phenanthrene
Pyrene
Quinoline

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Solids (Organic)
Volatile Organic Compounds (VOC) - Solids [Soil] (167)
ED-TM-1111, NA-TM-1102, NA-TP-2102; modified from EPA 5021 and EPA 8260
GC/MS - HEADSPACE/EXTRACTION

- 1,1-Dichloroethane
- 1,1-dichloroethylene
- 1,1-Dichloropropene
- 1,1,1-Trichloroethane
- 1,1,1,2-Tetrachloroethane
- 1,1,2-Trichloroethane
- 1,1,2,2-Tetrachloroethane
- 1,2-Dibromo-3-chloropropane (DBCP)
- 1,2-dichlorobenzene
- 1,2-dichloroethane
- 1,2-Dichloropropane
- 1,2,3-Trichlorobenzene
- 1,2,3-Trichloropropane
- 1,2,4-Trichlorobenzene
- 1,2,4-Trimethylbenzene
- 1,3-Dichlorobenzene
- 1,3-Dichloropropane
- 1,3,5-Trimethylbenzene
- 1,4-dichlorobenzene
- 2-Chlorotoluene
- 2-Hexanone (MBK)
- 2,2-Dichloropropane
- 4-Chlorotoluene
- Acetone (2-Propanone)
- Acrylonitrile
- Benzene
- Bromobenzene
- Bromochloromethane
- Bromodichloromethane
- Bromoform
- Bromomethane
- Carbon disulfide
- Carbon Tetrachloride
- Chlorobenzene
- Chlorodibromomethane
- Chloroethane
- Chloroform
- Chloromethane
- cis-1,2-Dichloroethylene
- cis-1,3-Dichloropropene
- cis-1,4-Dichloro-2-butene
- Dibromomethane
- Dichlorodifluoromethane
- Dichloromethane
- Ethyl alcohol
- Ethyl methacrylate
- Ethylbenzene
- Ethylene Dibromide
- Hexachlorobutadiene

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Isopropylbenzene
m/p-xylene
Methyl Ethyl Ketone
Methyl iodide
Methyl isobutyl Ketone
Methyl t-butyl ether
n-Butylbenzene
n-Propylbenzene
o-xylene
p-Isopropyltoluene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
trans-1,4-Dichloro-2-butene
Trichloroethylene
Trichlorofluoromethane
Vinyl chloride

Swab (Inorganic)
Mercury - Solids [Swab] (211)
ED-TP-2004, NA-TM-1005; modified from EPA 245.1 and EPA 3050B
COLD VAPOUR AA - DIGESTION
Mercury

Swab (Inorganic)
Metals - Solids [Swab] (201)
ED-TP-2004, NA-TM-1002; modified from EPA 200.2 and EPA 6020
ICP/MS - EXTRACTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Strontium
Tin
Vanadium

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Zinc

Swab (Organic)
Polychlorinated Biphenyls (PCB) - Solids [Swab] (202)
ED-TM-1102, ED-TM-1116; modified from EPA 3550 and EPA 8082
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Waste (Inorganic)
Flashpoint - Waste (055)
ED-TM-1012; modified from ASTM 93-D
PENSKE-MARTEN CLOSED CUP
Flashpoint

Waste (Inorganic)
Mercury - Waste (162)
NA-TM-1005, NA-TM-1700; modified from EPA 1311 (PREPARATION) and EPA 245.1 (ANALYSIS) and EPA 245.7 (ANALYSIS)
COLD VAPOUR AA - DIGESTION - TCLP
Mercury

Waste (Inorganic)
Metals - Waste (141)
NA-TM-1002, NA-TM-1700, NA-TP-2001; modified from EPA 1311 (PREPARATION) and EPA 6020 (ANALYSIS)
ICP/MS - TCLP
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Chromium
Cobalt
Copper
Iron
Lead
Nickel
Selenium
Silver
Thallium
Uranium
Vanadium
Zinc
Zirconium

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Waste (Inorganic)
Specific Gravity - Waste (174)
ED-TM-1025; modified from ASTM D5057
GRAVIMETRIC
Specific Gravity

Waste (Organic)
BTEX - Waste (135)
ED-TP-2005, NA-TM-1102; modified from EPA 1311 (PREPARATION) and EPA 8260B (ANALYSIS)
GC/MS - TCLP
Benzene
Ethylbenzene
m,p-Xylene
o-Xylene
Toluene

Water (Inorganic)
Acidity - Water (206)
ED-TM-1049; modified from SM 2310
TITRATION
Acidity

Water (Inorganic)
Acidity - Water (212)
ED-TM-1049; modified from SM 2310
TITRATION - POTENTIOMETRIC
Acidity

Water (Inorganic)
Acidity - Water (229)
ED-TM-1026; modified from SM 2310
TITRIMETRIC
Acidity

Water (Inorganic)
Alkalinity - Water (004)
ED-TM-1026; modified from SM 2320 B
TITRIMETRIC
Alkalinity (pH 4.5)
Alkalinity (pH 8.3)

Water (Inorganic)
Ammonia - Water (178)
ED-TM-1016; modified from SM 4500-NH3
COLORIMETRIC
Ammonia

Water (Inorganic)
Ammonia - Water (213)
ED-TM-1024; modified from EPA 350.1
COLORIMETRIC
Ammonia

Water (Inorganic)
Anions - Water (005)
NA-TM-1001; modified from EPA 300.1
ION CHROMATOGRAPHY
Bromide
Chloride
Fluoride

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Nitrate
Nitrite
Sulfate

Water (Inorganic)
Biochemical Oxygen Demand (BOD) - Water (013)
ED-TM-1007, ED-TM-1037; modified from SM 5210 B
D.O. METER
BOD (5 day)
BODu (ultimate)
CBOD (5 day)

Water (Inorganic)
Carbon - Water (118)
ED-TM-1002; modified from SM 5310 B
IR - COMBUSTION
Inorganic Carbon
Organic Carbon
Total Carbon

Water (Inorganic)
Chemical Oxygen Demand (COD) - Water (051)
ED-TM-1009; modified from SM 5220 D
COLORIMETRIC - DIGESTION
COD

Water (Inorganic)
Chlorine - Water (123)
ED-TM-1036; modified from SM 4500-CL A and SM 4500-CL F and SM 4500-CL G
COLORIMETRIC
Free Chlorine
Total Chlorine

Water (Inorganic)
Colour - Water (152)
ED-TM-1038; modified from SM 2120 A and SM 2120 C
SPECTROPHOTOMETRIC
True Colour

Water (Inorganic)
Colour - Water (199)
ED-TM-1052; modified from SM 2120 A and SM 2120 C
COLORIMETRIC
True Colour

Water (Inorganic)
Conductivity - Water (006)
ED-TM-1026; modified from SM 2510 B
CONDUCTIVITY METER
Conductivity (25°C)

Water (Inorganic)
Dissolved Metals - Water (007)
NA-TM-1002, NA-TP-2002; modified from EPA 6020
ICP/MS
Aluminum
Antimony
Arsenic
Barium
Beryllium

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Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc
Zirconium

Water (Inorganic)
Dissolved Oxygen - Water (214)
ED-TM-1054; modified from SM 4500-O
TITRATION
Dissolved Oxygen

Water (Inorganic)
Hexavalent Chromium - Water (035)
ED-TM-1023; modified from SM 3500-CR C
ION CHROMATOGRAPHY
Hexavalent Chromium

Water (Inorganic)
Mercury - Water (149)
NA-TM-1005; modified from EPA 245.1 and EPA 245.7
COLD VAPOUR AA, COLD OXIDATION
Mercury

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Water (Inorganic)
Microtox - Water (161)
NA-TM-1400; modified from AER D50
BIOLUMINESCENCE
Microtox IC50 (15 min)

Water (Inorganic)
Oil and Grease - Water (038)
ED-TM-1132; modified from SM 5520 A and SM 5520 B and SM 5520 F
GRAVIMETRIC
Total Oil and Grease

Water (Inorganic)
Oil and Grease - Water (159)
ED-TM-1133; modified from SM 5520 C and SM 5520 F
INFRA-RED
Hydrocarbon Oil and Grease
Total Oil and Grease

Water (Inorganic)
pH - Water (015)
ED-TM-1026; modified from SM 4500-H+ A and SM 4500-H+ B
pH METER
pH

Water (Inorganic)
Phosphate - Water (084)
ED-TM-1031; modified from SM 4500-P
COLORIMETRIC
Phosphate

Water (Inorganic)
Phosphate - Water (183)
ED-TM-1018; modified from SM 4500-P
COLORIMETRIC - TECHNICON
Phosphate

Water (Inorganic)
Phosphorus - Water (011)
ED-TM-1031; modified from SM 4500-P B and SM 4500-P E
COLORIMETRIC - DIGESTION
Total Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Phosphorus - Water (119)
ED-TM-1031, ED-TP-2006; modified from SM 4500 A and SM 4500 B and SM 4500 E
COLORIMETRIC
Inorganic Phosphorus

Water (Inorganic)
Phosphorus - Water (184)
ED-TM-1018; modified from SM 4500-P B and SM 4500-P E
COLORIMETRIC - TECHNICON
Total Dissolved Phosphorus
Total Phosphorus

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Water (Inorganic)
Phosphorus - Water (224)
ED-TM-1018; SM 4500-P
COLORIMETRIC - TECHNICON
Inorganic Phosphorus

Water (Inorganic)
Reactive Silica - Water (200)
ED-TM-1053; modified from SM 4500-SIO2 A and SM 4500-SIO2 E
COLORIMETRIC
Reactive Silica

Water (Inorganic)
Solids - Water (012)
ED-TM-1005; modified from SM 2540 A and SM 2540 B and SM 2540 C and SM 2540 D and SM 2540 E
GRAVIMETRIC
Fixed Suspended Solids
Total Dissolved Solids
Total Suspended Solids
Volatile Suspended Solids

Water (Inorganic)
Sulphide - Water (033)
ED-TM-1001; modified from SM 4500-S2- A and SM 4500-S2- D and SM 4500-S2- E
COLORIMETRIC
Sulphide

Water (Inorganic)
Total Kjeldahl Nitrogen (TKN) - Water (010)
ED-TM-1017, NA-TM-1006; modified from EPA 351.2
COLORIMETRIC - DIGESTION
Dissolved Kjeldahl Nitrogen
Total Kjeldahl Nitrogen

Water (Inorganic)
Total Metals - Water (082)
NA-TM-1002, NA-TP-2001; modified from EPA 6020 and SM 3030 E
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel

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Phosphorus
Potassium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc
Zirconium

Water (Inorganic)
Turbidity - Water (078)
ED-TM-1011; modified from SM 2130 A and SM 2130 B
TURBIDIMETRIC
Turbidity

Water (Inorganic)
UV Absorbance and Transmittance - Water (230)
ED-TM-1058; modified from SM 5910 B
SPECTROPHOTOMETRIC
UV Absorbance
UV Transmittance

Water (Microbiology)
Coliforms - Water (196)
NA-TM-1300; modified from SM 9223 B
MOST PROBABLE NUMBER (QUANTI-TRAY)
Escherichia coli (E. coli)
Total Coliforms

Water (Microbiology)
Fecal (Thermotolerant) Coliforms - Water (197)
NA-TM-1300; modified from SM 9223 B
MOST PROBABLE NUMBER (QUANTI-TRAY)
Fecal (Thermotolerant) Coliforms

Water (Microbiology)
Heterotrophic Plate Count (HPC) - Water (198)
NA-TM-1300; modified from SM 9215 E
MOST PROBABLE NUMBER (QUANTI-TRAY)
Heterotrophic Plate Count (HPC)

Water (Organic)
Alkanolamines - Water (209)
ED-TM-1155; modified from "QUANTITATIVE ANALYSIS OF AMINO ACIDS" T. NASHOLM, G. SANDLBERG, & A. ERICSSON. J. CHROMATOGRAM. 396:225-236 (1987)
HPLC - EXTRACTION
DEA (Diethanolamine)
DIPA (Diisopropanolamine)

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MEA (Monoethanolamine)
MIPA (Monoisopropanolamine)

Water (Organic)
Base Neutral Extractables - Water (117)
ED-TM-1124; modified from EPA 3510 and EPA 8270
GC/MS - EXTRACTION
1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene
2-Chloronaphthalene
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Pentachlorobenzene

Water (Organic)
Petroleum Hydrocarbons (PHC) - Water (075)
NA-TM-1112; modified from EPA 3511
GC/FID - EXTRACTION
F2: C10-C16
F3: C16-C34
F4: C34-C50
Total Extractable Hydrocarbons (TEH): C11-C30

Water (Organic)
Petroleum Hydrocarbons (PHC) - Water (165)
NA-TM-1102; modified from EPA 5021 and EPA 8260
GC/FID - HEADSPACE
F1: C6-C10
Volatile Hyrocarbons (VH): C6-C10

Water (Organic)
Phenols - Water (076)
ED-TM-1114; modified from EPA 3510 and EPA 8270
GC/MS - EXTRACTION
2-Chlorophenol
2-Methylphenol (o-Cresol)
2-Nitrophenol
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4 + 2,5-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4,5-Trichlorophenol
2,4,6-trichlorophenol
2,6-Dichlorophenol
3-Chlorophenol
3-Methylphenol (m-Cresol)
3,4-Dichlorophenol

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3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methyl phenol
4-Chlorophenol
4-Methylphenol (p-Cresol)
4-Nitrophenol
4,6-Dinitro-2-methylphenol
Pentachlorophenol
Phenol

Water (Organic)
Phenols - Water (228)
ED-TM-1057; modified from EPA 9066
COLORIMETRIC
Total Phenolics

Water (Organic)
Polyaromatic Hydrocarbons (PAH) - Water (226)
NA-TM-1112, NA-TP-2019; modified from EPA 3511 and EPA 8270D
GC/MS - MICROEXTRACTION
1-Methylnaphthalene
2-Methylnaphthalene
Acridine
Benzo(e)pyrene
Perylene
Quinoline

Water (Organic)
Resin and Fatty Acids - Water (020)
ED-TM-1106; modified from ALBERTA ENVIRONMENT 129.0
GC/MS - EXTRACTION
12-Chlorodehydroabietic acid
12,14-Dichlorodehydroabietic Acid
14-Chlorodehydroabietic acid
9,10-Dichlorostearic acid
Abietic acid
Arachidic acid
Dehydroabietic acid
Isopimaric acid
Levopimaric acid
Linoleic acid
Linolenic acid
Myristic acid
Neoabietic acid
Oleic acid
Palmitic acid
Palustric acid
Pimaric acid
Sandaracopimaric acid
Stearic acid

Water (Organic)
Resin and Fatty Acids - Water (132)
ED-TM-1106; modified from ALBERTA ENVIRONMENT 129.0
GC/MS - EXTRACTION (RFA-Low ED)
12-Chlorodehydroabietic acid
12,14-Dichlorodehydroabietic Acid

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14-Chlorodehydroabietic acid
9,10-Dichlorostearic acid
Abietic acid
Arachidic acid
Dehydroabietic acid
Isopimaric acid
Levopimaric acid
Linoleic acid
Linolenic acid
Myristic acid
Neoabietic acid
Oleic acid
Palmitic acid
Palustric acid
Pimaric acid
Sandaracopimaric acid
Stearic acid

Water (Organic)
Volatile Organic Compounds (VOC) - Water (166)
NA-TM-1102; modified from EPA 5021 and EPA 8260
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-dichloroethylene
1,1-Dichloropropene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dibromo-3-chloropropane (DBCP)
1,2-dichlorobenzene
1,2-dichloroethane
1,2-Dichloropropane
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,3,5-Trimethylbenzene
1,4-dichlorobenzene
2-Chlorotoluene
2-Hexanone (MBK)
2,2-Dichloropropane
4-Chlorotoluene
Acetone (2-Propanone)
Acrylonitrile
Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide

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Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
cis-1,4-Dichloro-2-butene
Dibromomethane
Dichlorodifluoromethane
Dichloromethane
Ethyl alcohol
Ethyl methacrylate
Ethylbenzene
Ethylene Dibromide
Hexachlorobutadiene
Isopropylbenzene
m/p-xylene
Methyl Ethyl Ketone
Methyl iodide
Methyl isobutyl Ketone
n-Butylbenzene
n-Propylbenzene
Naphthalene
o-xylene
p-Isopropyltoluene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
trans-1,4-Dichloro-2-butene
Trichloroethylene
Trichlorofluoromethane
Vinyl Chloride

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Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

ALS Environmental (Vancouver)
ALS Canada Ltd.
8081 Lougheed Highway
Suite 100
Burnaby, British Columbia

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.: A1719
Issued On: December 12, 2018
Accreditation Date: January 3, 2005
Expiry Date: June 11, 2021

President & CEO

CALA

CALA
Canadian Association for Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 1719
Laboratory Name: ALS Environmental (Vancouver)
Parent Institution: ALS Canada Ltd.
Address: 8081 Lougheed Highway Suite 100 Burnaby BC V5A 1W9
Contact: Ms. Helenita Franco
Phone: (604) 253-4188
Fax: (604) 253-6700
Email: quality.vancouver@alsglobal.com

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served: All Interested Parties
Revised On: November 12, 2019
Valid To: June 11, 2021

Scope of Accreditation

Air (Inorganic)
Dustfall - Air [Dustfall] (227)
VA-TM-1039; ASTM D1739-98 and BC MOE LABORATORY MANUAL
GRAVIMETRIC
Fixed Dustfall
Total Dustfall
Total Insoluble Dustfall
Total Soluble Dustfall

Air (Inorganic)
Mercury - Air [Dustfall] (271)
NA-TM-1005, NA-TP-2012, VA-TP-2063; modified from BC MOE LABORATORY MANUAL and EPA 1631E
COLD VAPOUR AAS - DIGESTION
Mercury

Air (Inorganic)
Metals - Air [Dustfall] (224)
NA-TM-1002, NA-TP-2007, VA-TP-2063; modified from BC MOE LABORATORY MANUAL and EPA 6020B
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium

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1

Calcium
Chromium
Cobalt
Copper
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Strontium
Thallium
Tin
Uranium
Vanadium
Zinc

Air (Inorganic)
Total Particulates - Air [Filter, Particulate] (035)
VA-TM-1041; modified from ASTM D2009-65 and BC WORKERS COMPENSATION BOARD STANDARDS (BCWCB) 1150
GRAVIMETRIC
Respirable Dust
Total Particulate Matter

Air (Organic)
Volatile Organic Compounds (VOC) - Air (206)
VA-TM-1109; modified from EPA TO-17
GC/MS
1,1-Dichloroethane
1,1-Dichloroethylene
1,1-Dichloropropene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2-Trichlorotrifluoroethane
1,1,2,2-Tetrachloroethane
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (Ethylene dibromide)
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene

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2

1,2,4-Trimethylbenzene
1,3-Butadiene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
2-Butanone (Methyl ethyl ketone, MEK)
2-Chlorophenol
2-Chlorotoluene
2-Hexanone (Methyl butyl ketone, MBK)
2-Propanol (Isopropyl alcohol)
2,2-Dichloropropane
4-Chlorotoluene (p-Chlorotoluene)
4-isopropyltoluene (p-Cymene)
4-Methyl-2-pentanone (MIBK)
Acetone (2-Propanone)
Benzene
Biphenyl (1,1-Biphenyl)
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane (Ethyl Chloride)
Chloroethene (Vinyl chloride)
Chloroform
Chloromethane (Methyl chloride)
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Cyclohexane
Decane
Dibromochloromethane
Dibromomethane
Dichlorodifluoromethane
Dichloromethane (Methylene Chloride)
Ethyl acetate
Ethylbenzene
Hexachlorobutadiene
Isopropylbenzene (Cumene)
m,p-Xylene
Methyl tert-butyl ether (MTBE)
Methylcyclohexane
n-Butylbenzene

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3

n-Heptane
n-Hexane
n-Octane
n-Propylbenzene
Naphthalene
o-Xylene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane

Air (Organic)
Volatile Organic Compounds (VOC) - Air (207)
VA-TM-1109; modified from EPA TO-17
GC/FID
F1: C6-C10
F2: C10-C16
Total Volatile Organic Compounds (TVOC): >C10-C12
Total Volatile Organic Compounds (TVOC): >C12-C16
Total Volatile Organic Compounds (TVOC): >C6-C8
Total Volatile Organic Compounds (TVOC): >C8-C10
Volatile Hydrocarbons (VH): C6-C13

Dust (Inorganic)
Soluble Anions - Dustfall (255)
NA-TM-1001, VA-TM-1039; modified from BC MOE LABORATORY MANUAL and EPA 300.0 and SM 4110
ION CHROMATOGRAPHY
Chloride
Nitrate

Food
Arsenic Speciation - Food [Egg, Fresh Fruit, Meat, Processed Food, Vegetables] (236)
NA-TM-1002, NA-TP-2007, VA-TM-1082; modified from CFIA SOM-DAR-CHE-053-04 and EPA 6020A
HPLC - ICP/MS
Arsenate (As(V))
Arsenite (As(III))
Arsenobetaine (AsB)
Arsenocholine (AsC)
Dimethylarsinic acid (DMA)
Monomethyl arsenate (MMA)

Food (Inorganic)
Methyl mercury - Seafood (272)
NA-TM-1002, VA-TM-1088; modified from FDA METHOD 4.8
HPLC - ICP/MS
Methyl mercury

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4

Oil (Organic)
Total Polychlorinated Biphenyls (PCB) - Oil (080)
VA-TM-1118, VA-TP-2116; modified from EPA 3620C and EPA 3660B and EPA 3665A and EPA 600/4-81-045 and EPA 8082A
GC/ECD
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Paint (Inorganic)
Lead - Paint (261)
NA-TM-1002, NA-TP-2004; modified from EPA 200.2 and EPA 6020B
ICP/MS - DIGESTION
Lead

Soil (Inorganic)
Acidity - Solids [Soil] (257)
VA-TM-1053, VA-TM-1074; modified from MEND REPORT 1.20.1 and SM 2320 B
TITRIMETRIC - SHAKEFLASK EXTRACTION
Acidity

Soil (Inorganic)
Alkalinity - Solids [Soil] (258)
VA-TM-1053, VA-TM-1074; modified from MEND REPORT 1.20.1 and SM 2320 B
TITRIMETRIC - SHAKEFLASK EXTRACTION
Alkalinity

Soil (Inorganic)
Anions - Solids [Leachate] (256)
NA-TM-1001, VA-TM-1078; modified from BC MOE LABORATORY MANUAL and EPA 300.0 and SM 4110
ION CHROMATOGRAPHY (IC) - FIXED RATIO EXTRACTION
Chloride
Chloride
Sulphate
Sulphate (Sulfate)

Soil (Inorganic)
Leachable Anions - Solids [Soil] (244)
NA-TM-1001, VM-TM-1074; modified from EPA 300.1 and MEND REPORT 1.20.1
IC - SHAKEFLASK EXTRACTION
Bromide
Chloride
Fluoride
Nitrate as Nitrogen
Nitrite as Nitrogen
Sulphate (Sulfate)

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5

Soil (Inorganic)
Leachable Metals - Solids [Soil] (247)
NA-TM-1002, NA-TP-2007, VA-TM-1074; modified from EPA 6020B and MEND REPORT 1.20.1
ICP/MS - SHAKEFLASK EXTRACTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Uranium
Vanadium
Zinc

Soil (Inorganic)
pH - Solids [Soil] (250)
VA-TM-1074; modified from MEND REPORT 1.20.1 and SM 4500-H
pH METER-Shake flask Extraction
pH

Soil (Microbiology)
Fecal (Thermotolerant) Coliforms - Solids [Soil] (245)
VA-TM-1200; modified from EPA 1680
MOST PROBABLE NUMBER
Fecal (Thermotolerant) Coliforms

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6

Solids (Inorganic)
Acid Volatile Sulphide (AVS) - Solids [Soil] (230)
VA-TM-1021; modified from EPA 821-R-91-100
COLORIMETRIC - EXTRACTION
Acid Volatile Sulfides

Solids (Inorganic)
Anions - Solids [Soil] (148)
NA-TM-1001, VA-TP-2066; modified from EPA 300.1 and SM 4110 B and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
IC-SATURATED EXTRACTION
Bromide
Chloride
Fluoride
Nitrate-N
Nitrite
Sulphate

Solids (Inorganic)
Conductivity - Solids [Soil] (147)
VA-TM-1053, VA-TP-2066; modified from SM 2510 B and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
METER - SATURATION EXTRACTION
Conductivity

Solids (Inorganic)
Cyanide - Solids [Soil] (213)
NA-TM-1003, VA-WI-3019; modified from BC MOE LABORATORY MANUAL and ISO 14403 and ON MOECC E3015 and SM 4500-CN- I
AUTO COLOR - DISTILLATION-EXTRACTION
Cyanide (SAD)
Cyanide (WAD)

Solids (Inorganic)
Cyanide - Solids [Soil] (214)
NA-TM-1003, VA-WI-3019; modified from ASTM 7237 and BC MOE LABORATORY MANUAL and ON MOECC E3015
AUTO COLOR/GAS DIFFUSION-EXTRACTION
Cyanide, Free

Solids (Inorganic)
Flashpoint - Solids [Ash] (264)
VA-TM-1090; modified from ASTM D93-15
PENSKE-MARTEN CLOSED CUP
Flashpoint

Solids (Inorganic)
Leachable Mercury - Solids [Soil] (270)
NA-TM-1005, NA-TP-2012, VA-TM-1074; modified from MEND REPORT 1.20.1
COLD VAPOUR AA - SPECTROMETRIC SHAKE FLASK EXTRACTION
Mercury

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7

Solids (Inorganic)
Leachable Mercury - Solids [Waste] (267)
NA-TM-1005, NA-TP-2012, VA-TM-1071; modified from BC MOE ENVIRONMENTAL MANAGEMENT ACT HAZARDOUS WASTE REGULATION (EMA/HWR) and EPA 1631E
CVAAS-MELP EXTRACTION
Mercury

Solids (Inorganic)
Leachable Mercury - Solids [Waste] (268)
NA-TM-1005, NA-TM-1700, NA-TP-2012; modified from EPA 1311 (PREPARATION) and EPA 1631E (ANALYSIS)
COLD VAPOUR AA - TCLP EXTRACTION
Mercury

Solids (Inorganic)
Leachable Metals - Solids (121)
VA-TM-1066, VA-TM-1071, VA-TP-2072; modified from BC MOE ENVIRONMENTAL MANAGEMENT ACT HAZARDOUS WASTE REGULATION (EMA/HWR) and EPA 6010D
ICP/OES- MLEP EXTRACTION
Arsenic
Barium
Boron
Cadmium
Chromium
Copper
Lead
Selenium
Silver
Uranium
Zinc

Solids (Inorganic)
Leachable Metals - Solids (122)
NA-TM-1700, VA-TM-1066, VA-TP-2072; modified from EPA 1311 (PREPARATION) and EPA 6010D (ANALYSIS)
ICP/OES - EXTRACTION - TCLP
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Nickel
Selenium

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8

Thallium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Leachable Metals - Solids [Soil] (235)
NA-TM-1002, NA-TM-1700, NA-TP-2007; modified from BC PROTOCOL 13 (ANALYSIS) and EPA 1311 (PREPARATION) and EPA 6020B (ANALYSIS)
ICP/MS - Extraction - TCLP
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Nickel
Selenium
Silver
Thallium
Uranium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Mercury - Solids [Soil] (269)
NA-TM-1005, NA-TP-2004, NA-TP-2012; modified from BC MOE LABORATORY MANUAL, SALM (PREPARATION) and EPA 1631E (ANALYSIS) and EPA 200.2 (ANALYSIS)
COLD VAPOUR AAS - DIGESTION
Mercury

Solids (Inorganic)
Metals - Solids [Soil] (152)
NA-TM-1002, NA-TP-2004, NA-TP-2007; modified from BC MOE LABORATORY MANUAL, SALM (PREPARATION) and EPA 200.2 (ANALYSIS) and EPA 6020B (ANALYSIS)
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth

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9

Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Metals - Solids [Soil] (153)
VA-TM-1066, VA-TP-2066, VA-TP-2072; modified from EPA 6010D and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
ICP/OES - SATURATION EXTRACTION
Calcium
Magnesium
Potassium
Sodium

Solids (Inorganic)
Methyl Mercury - Solids [Soil] (173)
VA-TM-1062; modified from EPA 1630
P&T - GC - CVAFS - EXTRACTION
Methyl mercury

Solids (Inorganic)
Moisture - Solids [Soil] (089)
NA-TM-1200; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GRAVIMETRIC
Percent Moisture

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10

Solids (Inorganic)
Oil and Grease - Solids [Soil] (239)
VA-TM-1125; modified from BC MOE LABORATORY MANUAL
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease
Total Oil and Grease

Solids (Inorganic)
Paint Filter - Solids [Paint] (262)
VA-TM-1055; modified from EPA 9095B
FILTRATION
Paint Filter (Free Liquid)

Solids (Inorganic)
Percent Saturation - Solids [Saturated Paste] (149)
VA-TP-2066; modified from SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
GRAVIMETRIC - SATURATED PASTE
Percent Saturation

Solids (Inorganic)
pH - Solids [Soil] (120)
VA-TM-1078, VA-TP-2066; modified from SM 4500-H+ B and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
METER - SATURATION EXTRACTION
pH

Solids (Inorganic)
pH - Solids [Soil] (169)
VA-TM-1078; modified from BC MOE LABORATORY MANUAL and SM 4500-H+ B
METER - FIXED RATIO EXTRACTION
pH

Solids (Inorganic)
Simultaneously Extracted Metals (SEM) - Solids [Soil] (228)
NA-TM-1005, NA-TP-2011, NA-TP-2012, VA-TM-1021; modified from EPA 1631E and EPA 821-R-91-100
CVAFS - SEM EXTRACTION
Mercury

Solids (Inorganic)
Simultaneously Extracted Metals (SEM) - Solids [Soil] (229)
VA-TM-1021, VA-TM-1066, VA-TP-2072; modified from EPA 6010D and EPA 821-R-91-100
ICP/OES - SEM EXTRACTION
Arsenic
Cadmium
Copper
Lead
Nickel
Zinc

Solids (Inorganic)
Waste Oil - Solids (123)
VA-TM-1111; BC MOE LABORATORY MANUAL
GRAVIMETRIC - EXTRACTION
Waste Oil Content

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11

Solids (Organic)
Extractable Hydrocarbons - Solids [Soil] (184)
NA-TM-1106, NA-TP-2106; modified from BC MOE LABORATORY MANUAL and EPA 3570
GC/FID - EXTRACTION (COLD SHAKE)
EPH C10-C19 (sg)
EPH C19-C32 (sg)
Extractable Petroleum Hydrocarbons (EPH): C10-C19
Extractable Petroleum Hydrocarbons (EPH): C19-C32

Solids (Organic)
Glycols - Solids [Soil] (156)
VA-TM-1113; modified from EPA 8015B
GC/FID - EXTRACTION
Diethylene glycol
Ethylene glycol
Propylene glycol
Triethylene glycol

Solids (Organic)
Organochlorine (OC) Pesticides - Solids [Soil] (079)
VA-TM-1121, VA-TP-2117; modified from EPA 3540C and EPA 3630C and EPA 3660B and EPA 8081B
GC/ECD - EXTRACTION
2,4'-DDD (o,p'-DDD)
2,4'-DDE (o,p'-DDE)
2,4'-DDT (o,p'-DDT)
4,4'-DDD (p,p'-DDD)
4,4'-DDE (p,p'-DDE)
4,4'-DDT (p,p'-DDT)
Aldrin
alpha-BHC
alpha-Chlordane
beta-HCH (beta-Hexachlorocyclohexane (b-HCH, b-BHC, beta-BHC, beta-Hexachlorocyclohexane)
cis-Nonachlor
delta-HCH (d-HCH, d-BHC, delta-BHC, delta-Hexachlorocyclohexane)
Dieldrin
Endosulfan I (a-Endosulfan)
Endosulfan II (b-Endosulfan)
Endosulfan Sulfate
Endrin
gamma-Chlordane
Heptachlor
Heptachlor epoxide
Lindane (gamma-BHC)
Methoxychlor
Mirex
Oxychlordane
trans-Nonachlor

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12

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (189)
NA-TM-1100, NA-TP-2100; modified from ALBERTA ENVIRONMENT INTERPRETATION, SEPT 2003 and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD (DEC 2000 NO. 1310)
GC/FID - TUMBLER EXTRACTION
F2: C10-C16
F3: C16-C34
F4: C34-C50

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (190)
NA-TM-1100; modified from ALBERTA ENVIRONMENT INTERPRETATION, SEPT 2003 and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD (DEC 2000 NO. 1310)
GRAVIMETRIC - TUMBLER EXTRACTION
F4: Gravimetric
F4G-SG: Gravimetric Heavy Hydrocarbons - Silica

Solids (Organic)
Phenols - Solids [Soil] (071)
VA-TM-1122, VA-TP-2113; modified from EPA 3570 and EPA 8270D and KNAPP 1979
GC/MS - EXTRACTION
2-Chlorophenol
2-Methylphenol (o-Cresol)
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-Tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4-Dichlorophenol + 2,5-Dichlorophenol
2,4-Dimethylphenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,6-Dichlorophenol
3-Chlorophenol
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methylphenol
4-Chlorophenol
4-Methylphenol (p-Cresol)
m-Cresol
Pentachlorophenol
Phenol

Solids (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Solids [Soil] (185)
NA-TM-1106, NA-TP-2103; modified from EPA 3570 and EPA 8270D
GC/MS - EXTRACTION (COLD SHAKE)
2-Methylnaphthalene

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13

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b,j)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3 - cd)pyrene
Naphthalene
Phenanthrene
Pyrene
Quinoline

Solids (Organic)
Total Polychlorinated Biphenyls (PCB) - Solids [Soil] (112)
VA-TM-1119, VA-TP-2116; modified from EPA 3570 and EPA 3620C and EPA 3660B and EPA 3665A and EPA 8082A
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Solids (Organic)
Volatile Hydrocarbons (VH) - Solids [Soil] (202)
NA-TM-1102, NA-TP-2102; modified from BC MOE LABORATORY MANUAL and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 5021A
GC/FID - HEADSPACE
F1: C6-C10
VH: C6-C10

Solids (Organic)
Volatile Organic Compounds (VOC) - Solids (263)
NA-TM-1102, VA-TM-1126; modified from EPA 1311 (PREPARATION) and EPA 8260C (ANALYSIS)
GC/MS - HEADSPACE - TCLP
1,1-Dichloroethene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,4-Dichlorobenzene
Benzene

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14

Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethene (Vinyl chloride)
Chloroform
Dichloromethane (Methylene Chloride)
Ethylbenzene
m,p-Xylene
Methyl ethyl ketone
o-Xylene
Tetrachloroethylene
Toluene
Trichloroethylene

Solids (Organic)
Volatile Organic Compounds (VOC) - Solids [Soil] (201)
NA-TM-1102, NA-TP-2102; modified from EPA 5021A and EPA 8260C
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-Dichloroethylene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,4-Trimethylbenzene
1,3-Dichlorobenzene
1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
4-Isopropylbenzene
Benzene
Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane (Ethyl Chloride)
Chloroethene (Vinyl chloride)
Chloroform
Chloromethane (Methyl chloride)
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Dichloromethane

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15

Ethylbenzene
Ethylene Dibromide
Isopropylbenzene (Cumene)
m,p-Xylene
Methyl t-butyl ether
n-Propylbenzene
Naphthalene
o-Xylene
Styrene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane

Swab (Organic)
Total Polychlorinated Biphenyls (PCB) - Solids [Swab] (249)
VA-TM-1120, VA-TP-2116; modified from EPA 3620C and EPA 3660B and EPA 3665A and EPA 8082A
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268

Tissue (Inorganic)
Ashfree - Tissue (259)
VM-TM-1051; modified from SM 10300
GRAVIMETRIC
Ash-free weight

Tissue (Inorganic)
Lipid Content - Tissue (241)
VA-TM-1112; modified from EPA 3570 and EPA 8290A
GRAVIMETRIC
Lipid Content

Tissue (Inorganic)
Methyl Mercury - Tissue (172)
VA-TM-1062; modified from EPA 1630
P&T - GC - CVAFS - DIGESTION
Methyl mercury

Tissue (Inorganic)
Moisture - Tissue (090)
VA-TM-1087; modified from PUGET SOUND PROTOCOLS
GRAVIMETRIC
Percent Moisture

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16

Tissue (Inorganic)
Selenium Speciation - Tissue (253)
NA-TM-1002, NA-TP-2007, VA-TM-1085; CFIA METHOD SOM-DAR CHE-053-04
HPLC - ICP/MS
Selenium (IV)
Selenium (VI)
SelenoMethionine

Tissue (Inorganic)
Total Mercury - Tissue (266)
NA-TM-1005, NA-TP-2006, NA-TP-2012; modified from EPA 1631E and EPA 200.3
COLD VAPOUR AA - SPECTROMETRIC
Mercury

Tissue (Inorganic)
Total Metals - Tissue (100)
NA-TM-1002, NA-TP-2006, NA-TP-2007; modified from EPA 200.3 and EPA 6020A
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Rubidium
Selenium
Silver
Sodium
Strontium
Sulphur (Sulfur)
Tellurium
Thallium
Tin

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17

Titanium
Uranium
Vanadium
Zinc
Zirconium

Urine (Inorganic)
Creatinine - Biomaterials [Urine] (234)
VA-TM-1052; THERMO DRI CREATININE-DETECT SPECIMEN VALIDITY TEST
COLORIMETRIC
Creatinine

Urine (Organic)
Arsenic Speciation - Biomaterials [Urine] (233)
NA-TM-1002, NA-TP-2007, VA-TM-1081; modified from CDC METHOD ID ITU003B, 2004 and EPA 6020A
HPLC-ICPMS
Arsenate (As(V))
Arsenite (As(III))
Arsenobetaine (AsB)
Dimethylarsinic acid (DMA)
Monomethyl arsenate (MMA)
Total Arsenic Species
Total Inorganic Arsenic
Total Inorganic Arsenic and Methylated Metabolites

Water (Inorganic)
Acidity - Water (219)
VA-TM-1053; modified from SM 2310
TITRIMETRIC
Acidity

Water (Inorganic)
Alkalinity - Water (001)
VA-TM-1053; modified from SM 2320 B
TITRIMETRIC
Alkalinity (pH 4.5)
Alkalinity-Bicarbonate
Alkalinity-Carbonate
Alkalinity-Hydroxide
Phenolphthalein Alkalinity

Water (Inorganic)
Ammonia - Water (208)
VA-TM-1024; JOURNAL OF ENVIRONMENTAL MONITORING (2005) SECTION 7, P. 37-42
AUTO-FLUORESCENCE
Ammonia

Water (Inorganic)
Anions - Water (026)
NA-TM-1001; modified from EPA 300.1
IC
Bromide
Chloride
Fluoride

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18

Nitrate
Nitrate plus Nitrite
Nitrite
Sulfate

Water (Inorganic)
Arsenic - Water (232)
NA-TM-1002, NA-TP-2007, VA-TM-1086; modified from USGS Water Resources Investigation Report 02-4144
HPLC - ICPMS
Arsenate (AsV)
Arsenite (ASIII)
Arsenobetaine (AsB)
Dimethylarsinic acid (DMA)
Monomethyl arsenate (MMA)
Total Arsenic Species
Total Inorganic Arsenic
Total Inorganic Arsenic and Methylated Metabolites

Water (Inorganic)
Biochemical Oxygen Demand (BOD) - Water (027)
VA-TM-1032; modified from SM 5210 B
D.O. METER
BOD (5 day)
CBOD (5 day)
Soluble Biological Oxygen Demand (SBOD)

Water (Inorganic)
Carbon - Water (091)
VA-TM-1037; modified from SM 5310 B
IR - COMBUSTION
Inorganic Carbon
Organic Carbon
Total Carbon (TC)

Water (Inorganic)
Chemical Oxygen Demand (COD) - Water (028)
VA-TM-1033; modified from SM 5220 D
COLOR - DIGESTION
COD

Water (Inorganic)
Chlorophyll A - Water (220)
VA-TM-1038, VA-TP-2011; modified from EPA 445.0
FLUORIMETRY
Chlorophyll a

Water (Inorganic)
Colour - Water (015)
VA-TM-1004; modified from BC MOE Laboratory Manual and SM 2120 C
COLORIMETRIC
Apparent Colour
True Colour

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19

Water (Inorganic)
Conductivity - Water (004)
VA-TM-1053; modified from SM 2510 B
CONDUCTIVITY METER
Conductivity (25°C)

Water (Inorganic)
Cyanide - Water (209)
NA-TM-1003; modified from ISO 14403 and SM 4500-CN- I
AUTO COLOR - DISTILLATION
Cyanide (SAD)
Cyanide (WAD)

Water (Inorganic)
Cyanide - Water (210)
NA-TM-1003; modified from ASTM D7237
AUTO COLOR (GAS DIFFUSION)
Cyanide, Free

Water (Inorganic)
Dissolved Ferrous Iron - Water (242)
VA-TM-1046, VA-TP-2009; modified from SM 3500-FE
COLORIMETRIC - FILTRATION
Ferrous Iron

Water (Inorganic)
Dissolved Metals - Water (032)
NA-TM-1002, NA-TP-2002, NA-TP-2007; modified from EPA 6020B and SM 3030 B
ICP/MS - FILTRATION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Gallium
Gold
Indium
Iron
Lanthanum
Lead
Lithium
Magnesium
Manganese
Molybdenum

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20

Nickel
Niobium
Phosphorus
Potassium
Rhenium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur (Sulfur)
Tantalum
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Yttrium
Zinc
Zirconium

Water (Inorganic)
Dissolved Metals - Water (036)
NA-TP-2002, VA-TM-1066, VA-TP-2072; modified from EPA 6010D and SM 3030 B
ICP/OES
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum

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21

Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Vanadium
Zinc

Water (Inorganic)
Mercury - Water (136)
NA-TM-1005, NA-TP-2002, VA-TP-2068; modified from EPA 1631E
CVAFS - BrCl DIGESTION
Mercury

Water (Inorganic)
Mercury - Water (265)
NA-TM-1005, NA-TP-2002, NA-TP-2012; modified from EPA 1631E
COLD VAPOUR AA - SPECTROMETRIC
Mercury

Water (Inorganic)
Methyl Mercury - Water (192)
VA-TM-1062; modified from EPA 1630
P&T GC-CVAFS-DISTILLATION
Methyl mercury

Water (Inorganic)
Nitrogen - Water (217)
VA-TM-1047, VA-WI-3046; modified from SM 4500-P J
AUTO COLOR - DIGESTION
Total Dissolved Nitrogen
Total Nitrogen

Water (Inorganic)
Oil and Grease - Water (061)
NA-TM-1107; modified from EPA 1664
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease
Total Oil and Grease

Water (Inorganic)
pH - Water (018)
VA-TM-1053; modified from SM 4500-H+ B
pH METER
pH

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22

Water (Inorganic)
Phosphorus - Water (179)
VA-TM-1025, VA-TP-2009, VA-WI-3046; modified from SM 4500-P B and SM 4500-P E
COLOR - DIGESTION (AUTOCLAVE)
Phosphate
Total Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Reactive Silica - Water (008)
VA-TM-1018; modified from SM 4500-SIO2 D
COLORIMETRIC
Reactive Silica

Water (Inorganic)
Selenium Speciation - Water (252)
NA-TM-1002, NA-TP-2007, VA-TM-1084; Spectrochimica Acta Part B60 (2005) 633-641
HPLC - ICP/MS
Selenium (IV)
Selenium (VI)
SelenoMethionine

Water (Inorganic)
Solids - Water (016)
NA-TM-1004, VA-TM-1009, VA-TM-1050; modified from SM 2540 B and SM 2540 C and SM 2540 D and SM 2540 E
GRAVIMETRIC
Fixed Suspended Solids
Total Dissolved Solids
Total Solids (TS)
Total Suspended Solids
Volatile Suspended Solids

Water (Inorganic)
Sulphide - Water (010)
VA-TM-1020; modified from SM 4500-S2- D
COLOR
Sulphide

Water (Inorganic)
Thiocyanate - Water (014)
VA-TM-1029; modified from SM 4500-CN- M
COLOR
Thiocyanate

Water (Inorganic)
Total Kjeldahl Nitrogen (TKN) - Water (211)
VA-TM-1044; modified from SM 4500-NORG D
AUTO FLUORESCENCE - DIGESTION
Dissolved Kjeldahl Nitrogen
Total Kjeldahl Nitrogen

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23

Water (Inorganic)
Total Metals - Water (031)
NA-TM-1002, NA-TP-2001, NA-TP-2007; modified from EPA 200.2 and EPA 6020B
ICP/MS - DIGESTION

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Bismuth
- Boron
- Cadmium
- Calcium
- Cesium
- Chromium
- Cobalt
- Copper
- Gallium
- Gold
- Indium
- Iron
- Lanthanum
- Lead
- Lithium
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Niobium
- Phosphorus
- Potassium
- Rhenium
- Rubidium
- Selenium
- Silicon
- Silver
- Sodium
- Strontium
- Sulphur (Sulfur)
- Tantalum
- Tellurium
- Thallium
- Thorium
- Tin
- Titanium
- Tungsten

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24

Uranium
Vanadium
Yttrium
Zinc
Zirconium

Water (Inorganic)
Total Metals - Water (041)
NA-TP-2001, VA-TM-1066, VA-TP-2072; modified from EPA 6010D and SM 3030 E
ICP/OES - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Vanadium
Zinc

Water (Inorganic)
Turbidity - Water (020)
VA-TM-1011; modified from SM 2130 B
TURBIDIMETRIC
Turbidity

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25

Water (Inorganic)
UV Absorbance and Transmittance - Water (254)
VA-TM-1042, VA-TP-2011; modified from SM 5910 B
SPECTROPHOTOMETRIC
UV Absorbance
UV Transmittance

Water (Microbiology)
Coliforms - Water (145)
NA-TM-1300; modified from SM 9223 B
MOST PROBABLE NUMBER (ENZYME SUBSTRATE)
Escherichia coli
Fecal (Thermotolerant) Coliforms
Total Coliforms

Water (Microbiology)
Enterococci - Water (186)
VA-TM-1203; modified from SM 9230 C
MEMBRANE FILTRATION (mENTEROCOCCUS)
Enterococci

Water (Microbiology)
Escherichia coli (E. coli) - Water (240)
VA-TM-1201; modified from SM 9222 G
MEMBRANE FILTRATION (mFC/NA-MUG)
Escherichia coli

Water (Microbiology)
Fecal (Thermotolerant) Coliforms - Water (029)
VA-TM-1200; modified from SM 9221 E
MOST PROBABLE NUMBER
Fecal (Thermotolerant) Coliforms

Water (Microbiology)
Fecal (Thermotolerant) Coliforms - Water (030)
VA-TM-1201; modified from SM 9222 D
MEMBRANE FILTRATION (mFC)
Fecal (Thermotolerant) Coliforms

Water (Microbiology)
Heterotrophic Plate Count (HPC) - Water (126)
NA-TM-1301; modified from SM 9215 B
POUR PLATE (PLATE COUNT AGAR)
Heterotrophic Plate Count (HPC)

Water (Microbiology)
Pseudomonas aeruginosa - Water (187)
VA-TM-1204; modified from SM 9213 E
MEMBRANE FILTRATION (mPAC)
Pseudomonas aeruginosa

Water (Microbiology)
Total Coliforms - Water (142)
VA-TM-1200; modified from SM 9221 B
MOST PROBABLE NUMBER
Total Coliforms

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26

Water (Microbiology)
Total Coliforms - Water (143)
VA-TM-1201; modified from SM 9222 B
MEMBRANE FILTRATION (mENDO)
Total Coliforms

Water (Organic)
Extractable Petroleum Hydrocarbons (EPH) - Water (251)
NA-TM-1112, VA-TP-2127, VA-TP-2129; BC MOE LABORATORY MANUAL
GC/FID - EXTRACTION
EPH C10-C19 (sg)
EPH C19-C32 (sg)
Extractable Petroleum Hydrocarbons (EPH): C10-C19
Extractable Petroleum Hydrocarbons (EPH): C19-C32
Total Extractable Hydrocarbons (TEH): C10-C30

Water (Organic)
Glycols - Water (155)
VA-TM-1113; modified from EPA 8015C
GC/FID - EXTRACTION
Diethylene glycol
Ethylene glycol
Propylene glycol
Triethylene glycol

Water (Organic)
Petroleum Hydrocarbons (PHC) - Water (238)
NA-TM-1112, NA-TP-2100; modified from CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 3511
GC/FID - EXTRACTION
F2: C10-C16
F3: C16-C34
F4: C34-C50

Water (Organic)
Phenols - Water (059)
VA-TM-1101, VA-TP-2113; modified from BC MOE LABORATORY MANUAL and EPA 3510C and EPA 8270D
GC/MS - EXTRACTION
2-Chlorophenol
2-Methylphenol (o-Cresol)
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4,5-Trichlorophenol
2,4,6-trichlorophenol
2,6-Dichlorophenol

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27

3-Chlorophenol
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methylphenol
4-Chlorophenol
4-Methylphenol (p-Cresol)
m-Cresol
Pentachlorophenol
Phenol

Water (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Water (237)
NA-TM-1112, VA-TP-2128; modified from EPA 3511 and EPA 8270D
GC/MS - EXTRACTION
1-Methylnaphthalene
2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Acridine
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b,j)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3 - cd)pyrene
Naphthalene
Phenanthrene
Pyrene
Quinoline

Water (Organic)
Resin and Fatty Acids - Water (212)
VA-TM-1105, VA-TP-2114; modified from EPA 3510C and EPA 8270D
GC/MS/LIQUID-LIQUID EXTRACTION
12-Chlorodehydroabietic acid
14-Chlorodehydroabietic acid
Abietic acid
Arachidic acid
Behenic acid
Dehydroabietic acid
Dichlorodehydroabietic acid
Dodecanoic acid (Lauric acid)
Hexadecanoic acid (Palmitic acid)

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28

Isopimaric acid + Palustric acid
Levopimaric acid
Lignoceric acid
Linoleic acid
Linolenic acid (Octadecadienoic acid)
Myristic acid (Tetradecanoic Acid)
Neoabietic acid
Oleic acid
Pimaric acid
Sandaracopimaric acid
Stearic acid (Octadecanoic acid)

Water (Organic)
Total Polychlorinated Biphenyls (PCB) - Water (115)
VA-TM-1115, VA-TP-2116; modified from EPA 3510C and EPA 3620C and EPA 3660B and EPA 3665A and EPA 8082A
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Water (Organic)
Volatile Hydrocarbons (VH) - Water (197)
NA-TM-1102; modified from BC MOE LABORATORY MANUAL and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 5021A
GC/FID - HEADSPACE
F1: C6-C10
Volatile Hydrocarbons (VH): C6-C10

Water (Organic)
Volatile Organic Compounds (VOC) - Water (196)
NA-TM-1102, NA-TP-2102; modified from EPA 5021A and EPA 8260C
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-Dichloroethylene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,4-Trimethylbenzene
1,3-Dichlorobenzene

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29

1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
4-isopropyltoluene (p-Cymene)
Acetone (2-Propanone)
Benzene
Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane (Ethyl Chloride)
Chloroform
Chloromethane (Methyl chloride)
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Dichloromethane
Ethylbenzene
Ethylene Dibromide
Isopropylbenzene (Cumene)
m,p-Xylene
Methyl ethyl ketone
Methyl isobutyl ketone (MIBK)
Methyl t-butyl ether
n-Propylbenzene
Naphthalene
o-Xylene
Styrene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane
Vinyl chloride

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30

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

ALS Environmental (Yellowknife)
ALS Canada Ltd.
116 314 Old Airport Road
Yellowknife, Northwest Territories

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

CALA

Accreditation No.: A3590
Issued On: November 5, 2018
Accreditation Date: February 4, 2008
Expiry Date: May 5, 2021

Andrew M. Adams
President & CEO

CALA

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request; reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca.

CALA
Canadian Association for Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 3590
Laboratory Name: ALS Environmental (Yellowknife)
Parent Institution: ALS Canada Ltd.
Address: 116 314 Old Airport Road Yellowknife NT X1A 3T3
Contact: Ms. Sarah Stilson
Phone: (867) 873-5593
Fax: (780) 437-2311
Email: alsed.quality@alsglobal.com

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served:
Revised On: November 5, 2018
Valid To: May 5, 2021

Scope of Accreditation

Water (Inorganic)
pH - Water (005)
YL-TM-1004; modified from SM 4500-H+ B
pH METER
pH

Water (Microbiology)
Coliforms and Escherichia coli (E. coli) - Water (006)
NA-TM-1300; modified from SM 9223 B
MOST PROBABLE NUMBER (COLILERT)
Escherichia coli
Total Coliforms

Water (Microbiology)
Fecal (Thermotolerant) Coliforms - Water (018)
NA-TM-1300; modified from SM 9223 B
MOST PROBABLE NUMBER (COLILERT)
Fecal (Thermotolerant) Coliforms

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1

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Appendix E – Bureau Veritas Canada CALA Certificate and Scope

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

Bureau Veritas Canada (2019) Inc.
Bureau Veritas
4606 Canada Way
Burnaby, British Columbia

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

CALA

Accreditation No.: A2168
Issued On: May 28, 2018
Accreditation Date: January 3, 2005
Expiry Date: November 25, 2020

Andrew M. Adams
President & CEO

ilac-MRA CALA

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CALA
Canadian Association for Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 2168
Laboratory Name: Bureau Veritas Canada (2019) Inc.
Parent Institution: Bureau Veritas
Address: 4606 Canada Way Burnaby BC V5G 1K5
Contact: Mr. Ray Chapman-Chen
Phone: (604) 639-2619
Fax: (604) 731-2386
Email: Ray.CHAPMAN-CHEN@bvlabs.com

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served: All Interested Parties
Revised On: September 12, 2019
Valid To: November 25, 2020

Scope of Accreditation

Air (Inorganic)
Metals - Air [Cassette] (015)
BBY7SOP-00016, BBY7SOP-00018; modified from NIOSH 7303
ICP - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Sodium
Strontium
Sulphur (Sulfur)

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Tin
Titanium
Vanadium
Zinc
Zirconium

Air (Inorganic)
Metals - Air [Filter] (183)
BBY7SOP-00002, BBY7SOP-00016; modified from EPA 6020A
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Chromium
Cobalt
Copper
Iron
Lead
Manganese
Molybdenum
Nickel
Phosphorus
Selenium
Strontium
Vanadium
Zinc

Air (Inorganic)
Total Particulates - Air [Particulate] (181)
BBY5SOP-00005; modified from BC MOE LABORATORY MANUAL SECTION G and EPA 600/R-94/038B
GRAVIMETRIC
Particulate>2.5 microns

Air (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Air (281)
BBY8SOP-00027; modified from BC MOE LABORATORY MANUAL (PREPARATION) and EPA 8270D (ANALYSIS)
GC/MS
Acenaphthene
Acenaphthylene
Anthracene
Benzo (a) anthracene
Benzo(a)pyrene
Benzo(b,j)fluoranthene
Benzo(e)pyrene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo (a,h) anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene

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Naphthalene
Perylene
Phenanthrene
Pyrene

Air (Organic)
Volatile Hydrocarbons (VH) - Air (184)
BBY5SOP-00031; BC MOE LABORATORY MANUAL SECTION H
GC/MS - THERMAL DESORPTION
Volatile Hydrocarbons (VH): C6-C13

Air (Organic)
Volatile Organic Compounds (VOC) - Air (180)
BBY8SOP-00058; modified from BC MOE LABORATORY MANUAL SECTION H
GC/MS - THERMAL DESORPTION
1,1-Dichloroethane
1,1-Dichloroethene
1,1-Dichloropropene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (Ethylene dibromide)
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3-Butadiene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
2-Butanone (Methyl ethyl ketone, MEK)
2-Chlorophenol
2-Chlorotoluene
2-Hexanone (Methyl butyl ketone, MBK)
2-Propanol (Isopropyl alcohol)
4-Chlorotoluene (p-Chlorotoluene)
4-isopropyltoluene (p-Cymene)
4-Methyl-2-pentanone (MIBK)
Benzene
Bromobenzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Chlorobenzene
Chloroethane (Ethyl Chloride)
Chloroethene (Vinyl chloride)
Chloroform
cis-1,2-Dichloroethylene

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cis-1,3-Dichloropropene
Dibromochloromethane
Dibromomethane
Dichlorodifluoromethane (Freon12)
Dichloromethane
Ethylbenzene
Hexachlorobutadiene
Isopropylbenzene (Cumene)
m,p-Xylene
Methyl tert-butyl ether (MTBE)
Methylcyclohexane
n-Butylbenzene
n-Decane
n-Dodecane
n-Hexane
n-Propylbenzene
n-Tridecane
Naphthalene
o-Xylene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene
Toluene
trans-1,3-Dichloropropene
Trichloroethene
Trichlorofluoromethane
Trichlorotrifluoroethane

Leachate (Inorganic)
Fluoride - Leachate (300)
BBY6SOP-00048, BBY7SOP-00009; modified from BC MOE ENVIRONMENTAL MANAGEMENT ACT HAZARDOUS WASTE REGULATION (EMA/HWR) SCHEDULE 4, PART 2 (PREPARATION) and SM 4500-F- C (ANALYSIS)
ION SELECTIVE ELECTRODE - (BC MLEP/MODIFIED WEP)
Fluoride

Leachate (Inorganic)
Metals - Leachate (308)
BBY7SOP-00001, BBY7SOP-00009; modified from BC MOE ENVIRONMENTAL MANAGEMENT ACT HAZARDOUS WASTE REGULATION (EMA/HWR) SCHEDULE 4, PART 2 (PREPARATION) and EPA 6020B (ANALYSIS)
ICP/MS
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Chromium
Copper
Lead
Manganese
Mercury
Molybdenum

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Nickel
Selenium
Silver
Thallium
Tin
Uranium
Zinc

Solids (Inorganic)
Chloride - Solids [Saturated Paste, Soil] (185)
BBY6SOP-00011, BBY6SOP-00030; modified from SM 4500-CL- E and SOIL SAMPLING & METHODS OF ANALYSIS, CHAPTER 15, SECTION 15.2.1
AUTO COLOR - KONELAB
Chloride

Solids (Inorganic)
Conductivity - Solids [Saturated Paste, Saturated Paste Extract] (279)
BBY6SOP-00029; modified from SM 2510 B
CONDUCTIVITY METER
Conductivity

Solids (Inorganic)
Extractable Metals - Solids [Saturated Paste, Soil] (303)
BBY6SOP-00030, BBY7SOP-00018; modified from EPA 6010C (ANALYSIS) and SOIL SAMPLING & METHODS OF ANALYSIS, CARTER 15.2.1, 2008 (PREPARATION)
ICP/OES
Soluble Calcium
Soluble Magnesium
Soluble Potassium
Soluble Sodium
Soluble Sulphur

Solids (Inorganic)
Flashpoint - Solids [Ash, Soil] (260)
BBY6SOP-00042; modified from ASTM D3828-12A
SETA FLASH CLOSED TESTER
Flashpoint

Solids (Inorganic)
Free Liquid - Solids [Soil] (261)
BBY6SOP-00043; modified from EPA 9095B
VISUAL EXAMINATION
Free Liquid

Solids (Inorganic)
Leachable Metals - Solids [Soil] (187)
BBY7SOP-00001, BBY7SOP-00005; modified from EPA 1311 (PREPARATION) and EPA 6020B (ANALYSIS)
ICP/MS - TCLP
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Copper
Lead
Mercury

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Molybdenum
Selenium
Silver
Thallium
Uranium
Zinc

Solids (Inorganic)
Lead - Solids [Paint] (254)
BBY7SOP-00004, BBY7SOP-00018; modified from BC MOE LABORATORY MANUAL SECTION C
ICP/OES - DIGESTION
Lead

Solids (Inorganic)
Mercury - Solids [Sediment, Soil] (038)
BBY7SOP-00004, BBY7SOP-00012; modified from BC MOE LABORATORY MANUAL SECTION C and EPA 245.7
COLD VAPOUR ATOMIC FLUORESCENCE - DIGESTION
Mercury

Solids (Inorganic)
Metals - Solids [Sediment, Soil] (037)
BBY7 SOP-00004, BBY7SOP-00018; modified from BC MOE LABORATORY MANUAL SECTION C and EPA 6010C
ICP - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Tin
Titanium
Vanadium
Zinc
Zirconium

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The list of tests and measurement capabilities for which a laboratory is accredited can change at any time due to circumstances such as scope extensions, voluntary withdrawal of tests by the laboratory and suspension. Scopes are published by the CALA via the Internet at http://www.cala.ca/cala_directories.html

Solids (Inorganic)
Mineral Oil and Grease - Solids [Soil] (188)
BBY8SOP-00007; modified from BC MOE LABORATORY MANUAL SECTION D
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease

Solids (Inorganic)
Moisture - Solids [Soil] (189)
BBY8SOP-00017; modified from ON MOECC E3139
GRAVIMETRIC
Percent Moisture
Percent Moisture

Solids (Inorganic)
Nitrate plus Nitrite and Nitrite - Solids [Soil] (190)
BBY6SOP-00010, BBY6WI-00009; modified from SM 4500-NO3- I
AUTO COLOR
Nitrate + Nitrite Nitrogen
Nitrate-N
Nitrite

Solids (Inorganic)
Oil and Grease - Solids [Soil] (191)
BBY8SOP-00006; modified from BC MOE LABORATORY MANUAL SECTION D
GRAVIMETRIC - EXTRACTION
Total Oil and Grease

Solids (Inorganic)
Percent Saturation - Solids [Saturated Paste] (193)
BBY6SOP-00030; modified from SOIL SAMPLING & METHOD OF ANALYSIS, CHAPTER 15, SECTION 15.2.1
GRAVIMETRIC
Percent Saturation
Saturated Paste

Solids (Inorganic)
pH - Solids [Saturated Paste] (278)
BBY6SOP-00025; modified from SM 4500-H+ B
pH METER
pH

Solids (Inorganic)
pH - Solids [Soil] (192)
BBY6SOP-00028; modified from BC MOE LABORATORY MANUAL SECTION B and SM 4500-H+ B
PH METER
pH

Solids (Inorganic)
Sulfate - Solids [Saturated Paste, Soil] (194)
BBY6SOP-00017, BBY6SOP-00030; modified from SOIL SAMPLING & METHOD OF ANALYSIS, CHAPTER 15, SECTION 15.2.1
AUTO COLOR - KONELAB
Sulphate

Solids (Inorganic)
Total Metals - Solids [Soil] (196)
BBY7SOP-00001, BBY7SOP-00004; modified from BC MOE LABORATORY MANUAL SECTION C and EPA 6020B
ICP/MS - DIGESTION
Aluminum
Antimony

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Arsenic
Barium
Bismuth
Boron
Cadmium
Calcium
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Mercury
Molybdenum
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Tellurium
Thallium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc
Zirconium

Solids (Organic)
BTEX and MTBE and Styrene - Solids [Soil] (198)
BBY8SOP-00010; modified from EPA 5021A and EPA 5035 and EPA 8260C
GC/MS - HEADSPACE
Benzene
Ethylbenzene
m,p-Xylene
Methyl t-butyl ether
o-Xylene
Styrene
Toluene

Solids (Organic)
Extractable Petroleum Hydrocarbons (EPH) - Solids [Soil] (202)
BBY8SOP-00029; modified from BC MOE LABORATORY MANUAL SECTION D
GC/FID - EXTRACTION
Extractable Petroleum Hydrocarbons (EPH): C10-C19
Extractable Petroleum Hydrocarbons (EPH): C19-C32

Solids (Organic)
Leachable Polycyclic Aromatic Hydrocarbons (PAH) - Solids [Soil] (307)
BBY7SOP-00005, BBY8SOP-00021; modified from EPA 8270D (PREPARATION) and EPA (ANALYSIS)
GC/MS
1,4-Dimethylnaphthalene
2-Methylnaphthalene
Acenaphthene

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Acenaphthylene
Acridine
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b,j)fluoranthene
Benzo(e)pyrene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
Naphthalene
Perylene
Phenanthrene
Pyrene
Quinoline

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (205)
BBY8SOP-00030; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GC/FID - EXTRACTION
F2: C10-C16
F3: C16-C34
F4: C34-C50

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (206)
BBY8SOP-00012; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GC/FID - HEADSPACE
F1: C6-C10

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (264)
BBY8SOP-00003; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GRAVIMETRIC - SOXHLET
F4: Gravimetric

Solids (Organic)
Phenols - Solids [Soil] (207)
BBY8SOP-00054; modified from BC MOE LABORATORY MANUAL
GC/MS - EXTRACTION
2-Chlorophenol
2-Hydroxyphenol (Catechol)
2-Methoxyethyl acetate
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol, DNOC)
2-Methylphenol (o-Cresol)
2-Nitrophenol
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-Tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol

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2,4 + 2,5-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,6-Dichlorophenol
2,6-Dimethylphenol
3 + 4-Methylphenol
3-Hydroxyphenol (Resorcinol)
3,4-Dichlorophenol
3,4-Dimethylphenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methylphenol
4-Nitrophenol
4,6-Dinitro-2-methylphenol
Pentachlorophenol
Phenol

Solids (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Solids [Soil] (208)
BBY8SOP-00022, BBY8SOP-00038; modified from EPA 3570 and EPA 8270D
GC/MS - SHAKE EXTRACTION
1-Methylphenanthrene
2-Chloronaphthalene
2-Methylnaphthalene
3-Methylcholanthrene
4-Nitropyrene
7,12-Dimethylbenz(a)anthracene
9,10-Anthraquinone
Acenaphthene
Acenaphthylene
Acridine
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(e)pyrene
Benzo(g,h,i)perylene
Benzo(j)fluoranthene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,e)pyrene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3 - cd)pyrene
N-Methylaniline
Naphthalene
Perylene
Phenanthrene
Pyrene
Quinoline

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Solids (Organic)
Tetraethyllead - Solids [Soil] (316)
BBY8SOP-00060; modified from BC MOE LABORATORY MANUAL SECTION D
GC/MS/MS
Tetraethyl lead

Solids (Organic)
Tributyltins - Solids [Soil] (276)
BBY8SOP-00050; modified from RESTEK CORP APPLICATION NOTE# 59550
GC/MS
Tributyltin

Solids (Organic)
Volatile Organic Compounds (VOC) - Solids [Soil] (213)
BBY8SOP-00009, BBY8SOP-00052; modified from EPA 5021 and EPA 8260C
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-dichloroethylene
1,1-Dichloropropene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2-Trichloropropane
1,1,2,2-Tetrachloroethane
1,2-Dibromo-3-chloropropane (DBCP)
1,2-dichlorobenzene
1,2-dichloroethane
1,2-Dichloropropane
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,3-Trichloropropene
1,2,3-Trimethylbenzene
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3-Butadiene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,3,5-Trichlorobenzene
1,3,5-Trimethylbenzene
1,4-dichlorobenzene
2-Chlorotoluene
4-Chlorotoluene (p-Chlorotoluene)
4-isopropyltoluene (p-Cymene)
Benzene
Bromobenzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane (Ethyl Chloride)
Chloroethene (Vinyl chloride)
Chloroform
Chloromethane (Methyl chloride)

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cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
cis-1,4-Dichloro-2-butene
Dibromomethane
Dichlorodifluoromethane
Dichloromethane
Ethylbenzene
Ethylene Dibromide
Hexachlorobutadiene
Hexane
Isopropylbenzene (Cumene)
m,p-Xylene
Methyl t-butyl ether
Methylcyclohexane
n-Butylbenzene
n-Decane
n-Propylbenzene
Naphthalene
o-Xylene
Pentachloroethane
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
trans-1,4-Dichloro-2-butene
Trichloroethylene
Trichlorofluoromethane

Solids (Organic)
Volatile Organic Compounds (VOC) - Solids [Soil] (313)
BBY8SOP-00040; BC MOE LABORATORY MANUAL SECTION D
GC/MS - HEADSPACE
1-Butanol (n-Butanol)
1-Chlorobutane
1,4-Dioxane (p-dioxane)
2-Butanone (Methyl ethyl ketone, MEK)
2-Hexanone (Methyl butyl ketone, MBK)
2-Propanol (Isopropyl alcohol)
4-Methyl-2-pentanone (MIBK)
Acetone (2-Propanone)
Acrylonitrile
Allyl chloride (3-chloropropene)
Alpha-Diisobutylene
Beta-Diisobutylene
Butylated hydroxytoluene (BHT)
Carbon disulfide
Chloroprene (2-Chloro-1,3-butadiene)
Cyclohexanone
Cyclohexene
Dicyclopentadiene
Ethyl acrylate

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Ethyl ether
Hexachloroethane
Isobutanol (2-Methyl-1-propanol)
Methyl methacrylate
Methylacrylonitrile
Tetrahydrofuran (THF)
trans-Crotonaldehyde
Vinyl acetate

Solids (Organic)
Volatile Petroleum Hydrocarbons (VPH) - Solids [Soil] (214)
BBY8SOP-00011; modified from BC MOE LABORATORY MANUAL SECTION D
GC/FID - HEADSPACE
F1: C6-C10

Solids (Organic)
Waste Oil - Solids (306)
BBY8SOP-00008; BC MOE LABORATORY MANUAL SECTION D
GRAVIMETRIC
Waste Oil Content

Solids (Toxicology)
Bivalve Larval Survival and Development - Solids [Sediment] (293)
BBY2SOP-00032; PUGET SOUND ESTUARY PROGRAM 1995 B
GROWTH AND SURVIVAL
Bivalves (48hr)

Solids (Toxicology)
Chironomids - Solids [Sediment] (150)
BBY2SOP-00010; EPS 1/RM/32
SURVIVAL AND GROWTH
Chironomids (10 days)

Solids (Toxicology)
Echinoid Larval Development - Solids [Sediment] (298)
BBY2SOP-00062; EPS 1/RM/58
GROWTH AND SURVIVAL
Echinoid Larval Development (48hr)

Solids (Toxicology)
Hyalella azteca - Solids [Sediment] (149)
BBY2SOP-00011; EPS 1/RM/33
SURVIVAL AND GROWTH
Hyalella azteca (14d)

Solids (Toxicology)
Marine Amphipods - Solids [Sediment] (151)
BBY2SOP-00012; EPS 1/RM/26 and EPS 1/RM/35
ACUTE LETHALITY (SURVIVAL)
Marine Amphipods (10 day)

Solids (Toxicology)
Microtox - Solids [Sediment, Soil] (152)
BBY2SOP-00014; EPS 1/RM/42
BIOLUMINESCENCE
Microtox IC50

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Solids (Toxicology)
Neanthes Survival and Growth - Solids [Sediment] (288)
BBY2SOP-00030; PUGET SOUND ESTUARY PROGRAM, 1995
GROWTH AND SURVIVAL
Neanthes (20d)

Tissue (Inorganic)
Mercury - Tissue (255)
BBY7SOP-00012, BBY7SOP-00021; modified from EPA 200.3 and EPA 245.7
COLD VAPOUR ATOMIC FLUORESCENCE - DIGESTION
Mercury

Tissue (Inorganic)
Total Metals - Tissue (215)
BBY7SOP-00002, BBY7SOP-00021; modified from BC MOE LABORATORY MANUAL SECTION C and EPA 6020B
ICP/MS
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Mercury
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur (Sulfur)
Tellurium
Thallium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc
Zirconium

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Water (Inorganic)
Acidity - Water (137)
BBY6SOP-00037; modified from SM 2310 B
TITRATION
Acidity

Water (Inorganic)
Alkalinity - Water (216)
BBY6SOP-00026; modified from SM 2320 B
TITRIMETRIC - AUTOMATED
Alkalinity (pH 4.5)

Water (Inorganic)
Ammonia Nitrogen - Water (217)
BBY6SOP-00009; modified from EPA 350.1 and SM 4500-NH3 G
AUTO COLOR - PHENATE
Ammonia

Water (Inorganic)
Biochemical Oxygen Demand (BOD) - Water (218)
BBY6SOP-00045; modified from SM 5210 B
D.O. METER
BOD (5 day)
CBOD (5 day)

Water (Inorganic)
Chemical Oxygen Demand (COD) - Water (220)
BBY6SOP-00024; modified from SM 5220 D
TITRIMETRIC - DIGESTION
COD

Water (Inorganic)
Chloride - Water (221)
BBY6SOP-00011; modified from SM 4500-CL- E
AUTO COLOR - KONELAB
Chloride

Water (Inorganic)
Colour - Water (023)
BBY6SOP-00021; modified from SM 2120 B
VISUAL COMPARISON
Apparent Colour

Water (Inorganic)
Colour - Water (295)
BBY6SOP-00057; modified from SM 2120 C
SPECTROPHOTOMETRIC
True Colour

Water (Inorganic)
Conductivity - Water (222)
BBY6SOP-00026; modified from SM 2510 B
CONDUCTIVITY METER
Conductivity (25°C)

Water (Inorganic)
Conductivity - Water [Wastewater] (156)
BBY0SOP-00006; modified from SM 2510 B
CONDUCTIVITY METER
Conductivity (25°C)

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Water (Inorganic)
Dissolved and Extractable Metals - Water (004)
BBY7SOP-00018, BBY7WI-00004; modified from EPA 6010C

- ICP
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Bismuth
- Boron
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Phosphorus
- Potassium
- Selenium
- Silicon
- Silver
- Sodium
- Strontium
- Sulphur (Sulfur)
- Tin
- Titanium
- Vanadium
- Zinc
- Zirconium

Water (Inorganic)
Dissolved Metals - Water (225)
BBY7WI-00004, BY7SOP-00002; modified from EPA 6020B

- ICP/MS
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Bismuth
- Boron
- Cadmium
- Calcium
- Cesium
- Chromium
- Cobalt
- Copper

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Gold
Iron
Lanthanum
Lead
Lithium
Magnesium
Manganese
Mercury
Molybdenum
Nickel
Palladium
Phosphorus
Platinum
Potassium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur (Sulfur)
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc
Zirconium

Water (Inorganic)
Fluoride - Water (226)
BBY6SOP-00048; modified from SM 4500-F- C
SELECTIVE ION ELECTRODE
Fluoride

Water (Inorganic)
Mercury - Water (095)
BBY7SOP-00015; modified from BC MOE LABORATORY MANUAL SECTION C
COLD VAPOUR ATOMIC FLUORESCENCE - DIGESTION
Mercury

Water (Inorganic)
Mercury - Water (299)
BBY7SOP-00022; EPA 1631
COLD VAPOUR ATOMIC FLUORESCENCE SPECTROPHOTOMETRY
Mercury

Water (Inorganic)
Metals - Water [Seawater] (228)
BBY7SOP-00002, BBY7SOP-00007; modified from EPA 200.10
ICP/MS - CHELATION EXTRACTION
Cadmium
Cobalt
Copper

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Iron
Lead
Manganese
Nickel
Titanium
Uranium
Zinc

Water (Inorganic)
Mineral Oil and Grease - Water (229)
BBY8SOP-00004; modified from BC MOE LABORATORY MANUAL SECTION D
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease

Water (Inorganic)
Nitrate plus Nitrite and Nitrite - Water (230)
BBY6SOP-00010; modified from SM 4500-NO3- I
AUTO COLOR
Nitrate plus Nitrite
Nitrite

Water (Inorganic)
Nitrogen - Water (231)
BBY6SOP-00016; modified from SM 4500-N C
AUTO COLOR - DIGESTION
Total Dissolved Nitrogen
Total Nitrogen

Water (Inorganic)
Oil and Grease - Water (232)
BBY8SOP-00004; modified from BC MOE LABORATORY MANUAL SECTION D
GRAVIMETRIC - EXTRACTION
Total Oil and Grease

Water (Inorganic)
pH - Water (155)
BBY0SOP-00003; modified from SM 4500-H+ B
pH METER
pH

Water (Inorganic)
pH - Water (234)
BBY6SOP-00026; modified from SM 4500-H+ B
pH METER - AUTOMATED
pH

Water (Inorganic)
Phosphorus - Water (236)
BBY6SOP-00013; modified from SM 4500-P E
AUTO COLOR - KONELAB
Phosphate
Total Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Solids - Water (238)
BBY6SOP-00033, BBY6SOP-00034; modified from SM 2540 C and SM 2540 D
GRAVIMETRIC
Total Dissolved Solids
Total Suspended Solids

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Water (Inorganic)
Solids - Water (280)
BBY6SOP-00035; modified from SM 2540 A
GRAVIMETRIC
Fixed Solids
Total Solids (TS)

Water (Inorganic)
Sulphate - Water (239)
BBY6SOP-00017; modified from SM 4500-SO42- E
AUTO COLOR - KONELAB
Sulfate

Water (Inorganic)
Total Metals - Water (066)
BBY7SOP-00003, BBY7SOP-00018; modified from BC MOE LABORATORY MANUAL SECTION C and EPA 6010C
ICP - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur (Sulfur)
Tin
Titanium
Vanadium
Zinc
Zirconium

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Water (Inorganic)
Total Metals - Water (242)
BBY7SOP-00002, BBY7SOP-00003; modified from BC MOE LABORATORY MANUAL SECTION C and EPA 6020B

ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Bromine
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Gold
Iron
Lanthanum
Lead
Lithium
Magnesium
Manganese
Mercury
Molybdenum
Nickel
Palladium
Phosphorus
Platinum
Potassium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur (Sulfur)
Tellurium
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc
Zirconium

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Water (Inorganic)
Total Metals - Water [Seawater] (241)
BBY7SOP-00002, BBY7SOP-00003; modified from EPA 6020B
ICP/MS
Aluminum
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Silicon
Silver
Sodium
Strontium
Sulphur (Sulfur)
Tellurium
Thallium
Titanium
Vanadium
Zinc
Zirconium

Water (Inorganic)
Turbidity - Water (244)
BBY6SOP-00027; modified from SM 2130 B
TURBIDIMETRIC
Turbidity

Water (Organic)
BTEX and MTBE and Styrene - Water (252)
BBY8SOP-00010; modified from EPA 5021A and EPA 5035 and EPA 8260C
GC/MS - HEADSPACE
Benzene
Ethylbenzene
m,p-Xylene
Methyl t-butyl ether
o-Xylene
Styrene
Toluene

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Water (Organic)
Organotins - Water (310)
BBY8SOP-00059; modified from RESTEK CORP LIT. CAT#59550
GC/MS
Dibutyltin
Monobutyltin
Tributyltin

Water (Organic)
Petroleum Hydrocarbons (PHC) - Water (263)
BBY8SOP-00030; modified from CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GC/FID - EXTRACTION
F2: C10-C16
F3: C16-C34
F4: C34-C50

Water (Organic)
Petroleum Hydrocarbons (PHC) - Water (305)
BBY8SOP-00012 (ANALYSIS), BBY8SOP-00018 (PREP); modified from CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD (DEC 2000)
GC/FID - HEADSPACE
F1: C6-C10

Water (Organic)
Phenols - Water (248)
BBY8SOP-00025; modified from BCMOE LABORATORY MANUAL
GC/MS - EXTRACTION
2-Chlorophenol
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4 + 2,5-Dichlorophenol
2,4,5-Trichlorophenol
2,4,6-trichlorophenol
2,6-Dichlorophenol
3 + 4-Chlorophenol
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
Pentachlorophenol

Water (Organic)
Phenols - Water (311)
BBY8SOP-00054; modified from BCMOE LABORATORY MANUAL
GC/MS
2-Chlorophenol
2-Hydroxyphenol (Catechol)
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol, DNOC)
2-Methylphenol (o-Cresol)
2-Nitrophenol
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol

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2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4 + 2,5-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4,5-Trichlorophenol
2,6-Dichlorophenol
2,6-Dimethylphenol
3 + 4-Chlorophenol
3 + 4-Methylphenol
3-Hydroxyphenol (Resorcinol)
3,4-Dichlorophenol
3,4-Dimethylphenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4 chloro-3-methylphenol
4-Hydroxyphenol (Hydroquinone)
4-Nitrophenol
Phenol

Water (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Water (249)
BBY8SOP-00021; modified from EPA 3510C and EPA 8270D
GC/MS - EXTRACTION
1-Methylnaphthalene
2-Chloronaphthalene
2-Methylnaphthalene
3-Methylcholanthrene
4-Nitropyrene
7,12-Dimethylbenz(a)anthracene
9,10-Anthraquinone
Acenaphthene
Acenaphthylene
Acridine
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b,j)fluoranthene
Benzo(e)pyrene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,e)pyrene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3 - cd)pyrene
N-Methylaniline
Naphthalene
Perylene
Phenanthrene
Pyrene
Quinoline

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Water (Organic)
Tetraethyllead - Water (315)
BBY8SOP-00060; modified from BC MOE LABORATORY MANUAL SECTION D and EPA 8000C and EPA 8270E
GC/MS/MS
Tetraethyl lead

Water (Organic)
Total Extractable Hydrocarbons (TEH) - Water (250)
BBY8SOP-00029; modified from BC MOE LABORATORY MANUAL SECTION D
GC/FID - EXTRACTION
Total Extractable Hydrocarbons (TEH)

Water (Organic)
Volatile Hydrocarbons (VH) - Water (251)
BBY8SOP-00011; modified from BC MOE LABORATORY MANUAL SECTION D
GC/FID - HEADSPACE
Volatile Hydrocarbons (VH): C6-C10

Water (Organic)
Volatile Organic Compounds (VOC) - Water (253)
BBY8SOP-00009; modified from EPA 5021A and EPA 5035 and EPA 8260C
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-dichloroethylene
1,1-Dichloropropene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloro-1,2,2-Trifluoroethane
1,1,2-Trichloroethane
1,1,2-Trichloropropane
1,1,2,2-Tetrachloroethane
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (Ethylene dibromide)
1,2-Dibromoethane (Ethylene dibromide)
1,2-dichlorobenzene
1,2-dichloroethane
1,2-Dichloropropane
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,3-Trichloropropene
1,2,3-Trimethylbenzene
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3-Butadiene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,3,5-Trichlorobenzene
1,3,5-Trimethylbenzene
1,4-dichlorobenzene
2-Chloropropane
2-Chlorotoluene
4-Chlorotoluene (p-Chlorotoluene)
4-isopropyltoluene (p-Cymene)
Benzene
Bromobenzene

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Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane (Ethyl Chloride)
Chloroform
Chloromethane (Methyl chloride)
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
cis-1,4-Dichloro-2-butene
Dibromomethane
Dichlorodifluoromethane
Dichloromethane
Ethylbenzene
Ethylene Dibromide
Hexachlorobutadiene
Hexane
Isopropylbenzene (Cumene)
m,p-Xylene
Methyl t-butyl ether
Methylcyclohexane
n-Butylbenzene
n-Decane
n-Propylbenzene
Naphthalene
o-Xylene
Pentachloroethane
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrabromomethane
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
trans-1,4-Dichloro-2-butene
Trichloroethylene
Trichlorofluoromethane
Vinyl chloride

Water (Organic)
Volatile Organic Compounds (VOC) - Water (314)
BBY8SOP-00040; BC MOE LABORATORY MANUAL SECTION D
GC/MS - HEADSPACE
1-Butanol (n-Butanol)
1-Chlorobutane
1,4-Dioxane (p-dioxane)
2-Butanone (Methyl ethyl ketone, MEK)
2-Chloroethanol
2-Hexanone (Methyl butyl ketone, MBK)
2-Propanol (Isopropyl alcohol)
4-Methyl-2-pentanone (MIBK)

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Acetone (2-Propanone)
Acrolein (Propenal)
Acrylonitrile
Allyl chloride (3-chloropropene)
Alpha-Diisobutylene
Beta-Diisobutylene
Butylated hydroxytoluene (BHT)
Carbon disulfide
Chloroprene (2-Chloro-1,3-butadiene)
Cyclohexanone
Cyclohexene
Dicyclopentadiene
Ethyl acrylate
Ethyl ether
Hexachloroethane
Isobutanol (2-Methyl-1-propanol)
Methyl methacrylate
Methylacrylonitrile
Tetrahydrofuran (THF)
trans-Crotonaldehyde
Vinyl acetate

Water (Toxicology)
Bivalve Larval Survival and Development - Water (309)
BBY2SOP-00029; EPA 600/R-95/136 (1995)
GROWTH AND SURVIVAL
Bivalves (48hr)

Water (Toxicology)
Ceriodaphnia dubia - Water (139)
BBY2SOP-00001; EPS 1/RM/21
SURVIVAL AND REPRODUCTION
Ceriodaphnia dubia (7d)

Water (Toxicology)
Daphnia magna - Water (141)
BBY2SOP-00007; EPS 1/RM/11 and EPS 1/RM/14
LETHALITY
Daphnia LC50 (48 h)
Daphnia Single Concentration (48h)

Water (Toxicology)
Echinoid Fertilization - Water (143)
BBY2SOP-00009; EPS 1/RM/27
FERTILIZATION SUCCESS
Echinoderm Fertilization (20 min)

Water (Toxicology)
Fathead Minnow - Water (147)
BBY2SOP-00002; EPS 1/RM/22
GROWTH AND SURVIVAL
Fathead Minnow (7d)

Water (Toxicology)
Lemna minor - Water (289)
BBY2SOP-00053; EPS 1/RM/37
GROWTH INHIBITION
Lemna minor (7d)

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Water (Toxicology)
Microtox - Water (144)
BBY2SOP-00013; EPS 1/RM/24
BIOLUMINESCENCE
Microtox IC50 (15 min)

Water (Toxicology)
Pseudokirchneriella subcapitata - Water (146)
BBY2SOP-00006; EPS 1/RM/25
GROWTH INHIBITION
Pseudokirchneriella subcapitata (72h)

Water (Toxicology)
Rainbow Trout - Water (140)
BBY2SOP-00004; EPS 1/RM/13 and EPS 1/RM/9
LETHALITY
Single Concentration (96h)
Trout LC50 (96 h)

Water (Toxicology)
Rainbow Trout [pH Stabilization] - Water (294)
BBY2SOP-00061; EPS 1/RM/50
ACUTE LETHALITY (SURVIVAL)
Single Concentration (96h) - pH Stabilization
Trout LC50 (96h) - pH Stabilization

Water (Toxicology)
Topsmelt - Water (291)
BBY2SOP-00050; EPA 821-02-012
ACUTE LETHALITY
Topsmelt (96h)

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QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Appendix F – Nautilus CALA Certificate and Scope

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

Nautilus Environmental Inc.
8664 Commerce Court
Burnaby, British Columbia

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

CALA

Accreditation No.: A3525
Issued On: September 10, 2019
Accreditation Date: March 6, 2007
Expiry Date: March 10, 2022

Andrew M. Adams
President & CEO

CALA

This certificate is the property of the Canadian Association for Laboratory Accreditation Inc. and must be returned on request; reproduction must follow policy in place at date of issue. For the specific tests to which this accreditation applies, please refer to the laboratory's scope of accreditation at www.cala.ca.

CALA
Canadian Association for Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 3525
Laboratory Name: Nautilus Environmental Inc.
Parent Institution:
Address: 8664 Commerce Court Burnaby BC V5A 4N7
Contact: Ms. Julianna Kalocai
Phone: (604) 420-8773; (778) 829-6359
Fax: (604) 357-1361
Email: julianna@nautilusenvironmental.ca

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served: All Interested Parties
Revised On: September 10, 2019
Valid To: March 10, 2022

Scope of Accreditation

Sediment (Toxicology)
Chironomous dilutus - Sediment (011)
401; EPS 1/RM/32
SURVIVAL AND GROWTH INHIBITION
Survival and Growth (10d)

Sediment (Toxicology)
Hyalella azteca - Sediment (012)
400; EPS 1/RM/33
SURVIVAL AND GROWTH INHIBITION
Survival and Growth (14d)

Water (Toxicology)
Ceriodaphnia dubia - Water (003)
209; EPS 1/RM/21
SURVIVAL AND REPRODUCTION
Cerodaphnia dubia (7d)

Water (Toxicology)
Daphnia magna - Water (002)
205; EPS 1/RM/11 and EPS 1/RM/14
ACUTE LETHALITY (SURVIVAL)
Daphnia LC50 (48 h)

Water (Toxicology)
Fathead minnow - Water (010)
220; EPS 1/RM/22
SURVIVAL AND GROWTH INHIBITION
Survival and Growth (7d)

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Water (Toxicology)
Hyalella azteca - Water (013)
400; EPS 1/RM/33
SURVIVAL AND GROWTH INHIBITION
Survival and Growth (14d)

Water (Toxicology)
Lemna minor - Water (005)
215; EPS 1/RM/37
GROWTH INHIBITION
Lemna minor (7d)

Water (Toxicology)
Pseudokirchneriella subcapitata - Water (008)
213; EPS 1/RM/25
GROWTH INHIBITION
Pseudokirchneriella subcapitata (72h)

Water (Toxicology)
Rainbow Trout - Water (001)
201; EPS 1/RM/13 and EPS 1/RM/9
ACUTE LETHALITY (SURVIVAL)
Trout LC50 (96 h)

Water (Toxicology)
Rainbow Trout [pH Stabilization] - Water (009)
204; EPS 1/RM/50
pH STABILIZATION
Survival

Water (Toxicology)
Salmonid - Water (004)
203; EPS 1/RM/28
EARLY LIFE STAGE
Salmonid Embryo (7d)

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QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Module A: 2AM-DOH1335

Conformity Table

Licence	Part	Item	Topic	Report Section
2AM-DOH1335	B	13	The Licensee shall, for all plans submitted under this Licence, implement the plan as approved by the Board in writing. Any changes to the plans deemed significant shall be considered as an amendment to the plan(s) or as a modification and must be submitted to the Board for approval in writing. The Board has approved under this Amended Water Licence 2AM-DOH1335, the following plans for implementation under the relevant sections in the Amended Licence: *q. Quality Assurance and Quality Control Plan (January 2017)*	This plan
	I	3	The Licensee shall undertake the Monitoring Program provided in the Tables 1, 2, and 3 of Schedule I. The Licensee shall, in consultation with an Inspector, establish the locations and GPS coordinates for all Monitoring Program Stations.	Table A1 and Figure A1
		15	The Licensee shall annually review the approved Quality Assurance and Quality Control Plan and modify the Plan as necessary. Proposed changes shall be submitted to an Accredited Laboratory for approval.	Section 1.4
		16	All analyses shall be conducted as described in the most recent edition of “Standard Methods for the Examination of Water and Wastewater” or by other such methods approved by an Analyst.	Sections 2 and 3
		17	All compliance analyses shall be performed in an accredited laboratory according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.	Section 5

A1 Introduction

The Type A Water Licence No. 2AM-DOH1335 issued to TMAC by the Nunavut Water Board (NWB) details the sampling and analysis requirements for the SNP program.

A2 SNP Sampling Stations

Table A1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the Surveillance Network Program for water licence 2AM-DOH1335. The location of each sampling point is illustrated in Figure A1 through Figure A3 below.

Table A1. 2AM-DOH1335 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TIA
ST-1	Doris Sedimentation Pond	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
ST-2	Doris Contact Water Pond	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
ST-3	Discharge from Non-hazardous Landfill Contact Water Control Sump	Construction, Care and Maintenance, Operation, Closure	G, MT and Total Ammonia-N, Total Sulphate, Total and Free CN, Total Oil and Grease	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-4	Discharge from Landfarm sump	Construction, Operation, Care and Maintenance, Closure	G, HC, total Ammonium, total Lead	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-5	Discharge from the Doris Plant Site Fuel Storage and Containment Area Sump	Construction, Operation, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-6a and ST-6b	Discharge from the Roberts Bay Fuel Storage and Containment Area Sumps	Construction, Operation, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-7	Freshwater pumped from Doris Lake	Construction, Operation, Care and Maintenance, and Closure	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, and Total Oil and Grease, Cl	Monthly during periods pumping
			D	Monthly during periods of pumping
			Cl-a	Annually

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TIA
ST-7a	Freshwater pumped from the Windy Lake freshwater intake	Construction, Operation, Care and Maintenance, Closure	G, N1, N2, MT, Cl and, T-Ag, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, T-Ca, and Total Oil and Grease, Free CN, Total CN	Monthly during periods of pumping
			B	
			D	
ST-8	Discharge from Doris Sewage Treatment Plant bio-membrane	Construction, Operation, Care and Maintenance, Closure	G, B, and Total Oil and Grease	Monthly when discharge to the Tundra, Annually when discharge to the TIA
			Location of discharge	Monthly during periods of discharge
			D	Daily during periods of discharge
ST-9	Runoff from Doris Sewage Treatment Plant discharge - downstream of wastewater treatment plant discharge point and just prior to flow entering Doris Lake	Construction, Operation, Care and Maintenance, Closure	G, B, and Total Oil and Grease	Monthly when ST-8 is discharged to the tundra
ST-10	Doris Site Runoff from Sediment Controls	Construction, Operations, Closure	TSS or Turbidity (following development and approval of a site-specific TSS-Turbidity)	Daily during periods of discharge
ST-11	Reagent and Cyanide Doris Storage Facility Sumps	Construction, Operation, Care and Maintenance, Closure	G, HC , MT, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, Total Ammonia, Total and Free Cyanide, and D	Annually
ST-12	Doris Lake	Operation, Closure	Water Level	Monthly
			Ice Thickness	Annually in April
ST-13	Doris Contact Water Pond associated with Pad U	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
			D	Daily during periods of discharge
TL-1	TIA at the Reclaim Pipeline	Operation, Care and Maintenance, Closure, Post-Closure	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, HC, FC	Monthly during Operations, Closure and Post Closure. Annually during Care and Maintenance.
			Dissolved Oxygen and Redox Potential, BOD	Annually
			Acute Lethality	Annually during Post-Closure
			D	Daily during periods of discharge

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TIA
TL-2	Doris Outflow Creek - upstream (at the flow monitoring station adjacent to the bridge)	Closure, Post-Closure	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, Oil and Grease	Annually during Care and Maintenance Annually for 2 years prior to Post-Closure, and during Post-Closure, Increase to three times per year (under ice, freshet, and pre-freeze up), two years prior to breach of the North Dam.
		Operation	D	Daily upon commencement of mining in or beneath the Doris Lake Talik.
TL-3	Doris Outflow Creek (~80m downstream of the base of the waterfall)	Care and Maintenance, prior to any deposit of tailings to the TIA	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, Total Oil and Grease	Inactive
			D	
TL-4	TIA Discharge End-of-Pipe	Care and Maintenance, prior to any deposit of tailings to the TIA	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, T-Radium 226	Inactive
			Acute Lethality	
			B	
			D	
TL-5	Effluent from Doris Process Plant (tailings slurry/ water)	Operations	G, N1, MT, and Free CN, Total CN, WAD CN, Sulphate, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, and Total Metals by ICP-MS	Monthly
			Cyanate and Thiocyanate	Quarterly
TL-6	Tailings Discharged into TIA (Solid Component) taken from a valve in the mill at the discharge end of the mill tailings pumps	Operations	Tonnage of dry tailings solids	Monthly during periods of discharge
			MT and T-Cd, T-Cr, T-Hg, T-Mo, T-Se, Total Inorganic Carbon and Total Metals by ICP-MS (must include Sulphur)	Sampled on a weekly basis with analyses carried out monthly on a composite sample of the TL-6 weekly samples
TL-7a	Detoxified tailings sent underground as backfill	Operations	Dry tonnage of detoxified tailings sent underground; Moisture content of backfill trucked underground	Monthly
TL7b	Filtrate from TL-7a (Detoxified tailings send underground as backfill)	Operations	Cyanate and Thiocyanate, WAD CN, Total Inorganic Carbon, Total Metals by ICP-MS (including Sulphur)	Monthly

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TIA
TL-8	Reclaim water pumped from TIA to Mill Process water tank taken from a valve at the discharge end of the reclaim water	Operations	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl	Inactive
			D	
TL-9	Detox tailings reactor tank (650-TK-565)	Operations	Continuous automated monitoring. Should the automatic monitor used to carry out this measurement be out of service manual samples from the detox filter feed pumps (650-PU-567/568) will be used to verify process operations.	
TL-10	Water Column in deepest portion of Tail Lake and at a location away from the TIA Reclaim water floating pump house, sampled at surface, mid- depth and near bottom.	Inactive		Inactive
TL-11	Seepage from Doris underground backfilled stopes	Operations	Visual inspection for seepage. If seepage present parameters to be monitored include N1 and pH, EC, Trace metals by ICP-MS, Alkalinity, Acidity, Sulphate, Total, Free and WAD CN	Survey Twice annually
TL-12	Doris Mine Water Discharge Point	Operations during continuous pumping	Chloride, TDS and nitrate	Weekly
			Total Ammonia, Nitrate, Nitrite, pH, EC, Total Metals by ICPMS, alkalinity, bromide, fluoride, sulphate, TSS, and Total and WAD Cyanide	Monthly
			D	Daily during periods of discharge
MMS-1	Madrid North Contact Water Pond	Construction, Operations, Care and Maintenance	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Sampled twice annually, Weekly water levels
MMS-2	Madrid South Primary Contact Water Pond	Construction, Operations, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Sampled twice annually, Weekly water levels
MMS-3	Madrid South Secondary Contact Water Pond	Construction, Operations, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Sampled twice annually, Weekly water levels
MMS-4a	Fresh Water Intake at Windy Lake North	Construction, Operations, Care and Maintenance, Closure	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, and Total Oil and Grease, Cl, D	Sampled monthly during active pumping periods

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TIA
MMS-4b	Fresh Water Intake at Windy Lake South (Windy Camp)	Construction, Operations, Care and Maintenance, Closure	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, and Total Oil and Grease, Cl, D	Sampled monthly during active pumping periods
MMS-5	Discharge from Madrid South Fuel Storage Facility	Construction, Operations, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
MMS-6	Brine Mixing Facility	Operations during continuous pumping	G, N1, Chloride, Fluoride, Bromide, Sulphate, TDS, EC, Total Metals ICPMS, Alkalinity and Total and WAD Cyanide	Sampled monthly during active pumping periods
MMS-7	Effluent from Madrid North Connector to TIA	Operations	G, N1, MT, and Free CN, Total CN, WAD CN, Sulphate, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, and Total Metals by ICP-MS	Sampled quarterly during active pumping periods
MMS-8	Discharge from Madrid North Fuel Storage Facility	Construction, Operations, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
MMS-9	Site runoff from sediment controls during construction	Construction	TSS or Turbidity	Sampled daily during period of discharge
MMS-10	Mine Water Discharge Point	Operations during continuous pumping	Chloride, TDS and nitrate	Weekly
			Total Ammonia, Nitrate, Nitrite, pH, EC, Total Metals ICPMS, alkalinity, Fluoride, Bromide, Sulphate, TSS, and Total and WAD Cyanide	Monthly

Figure A.1 2AM-DOH1335 Sample Station Locations

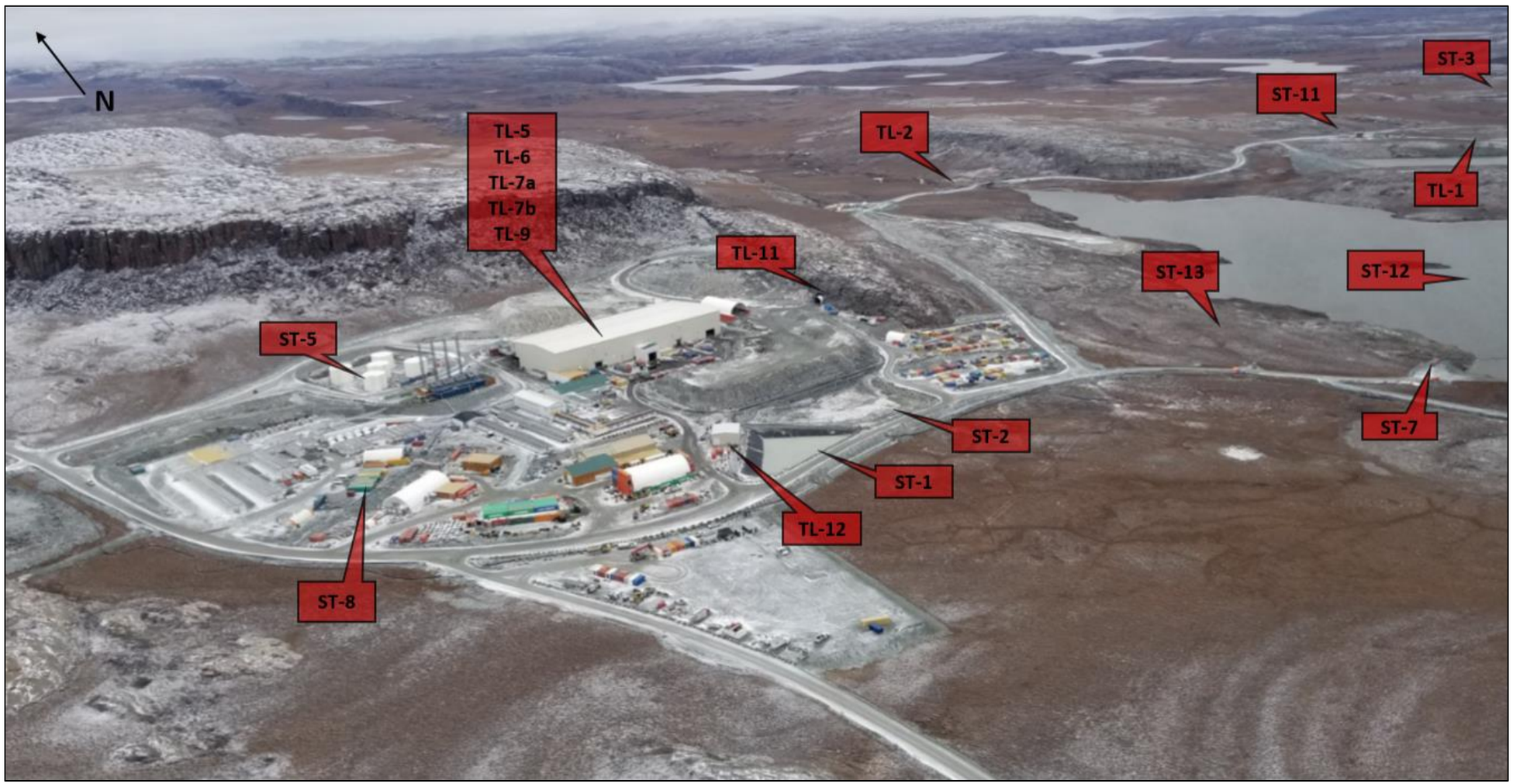


Figure A.2 2AM-DOH1335 Sample Station Locations

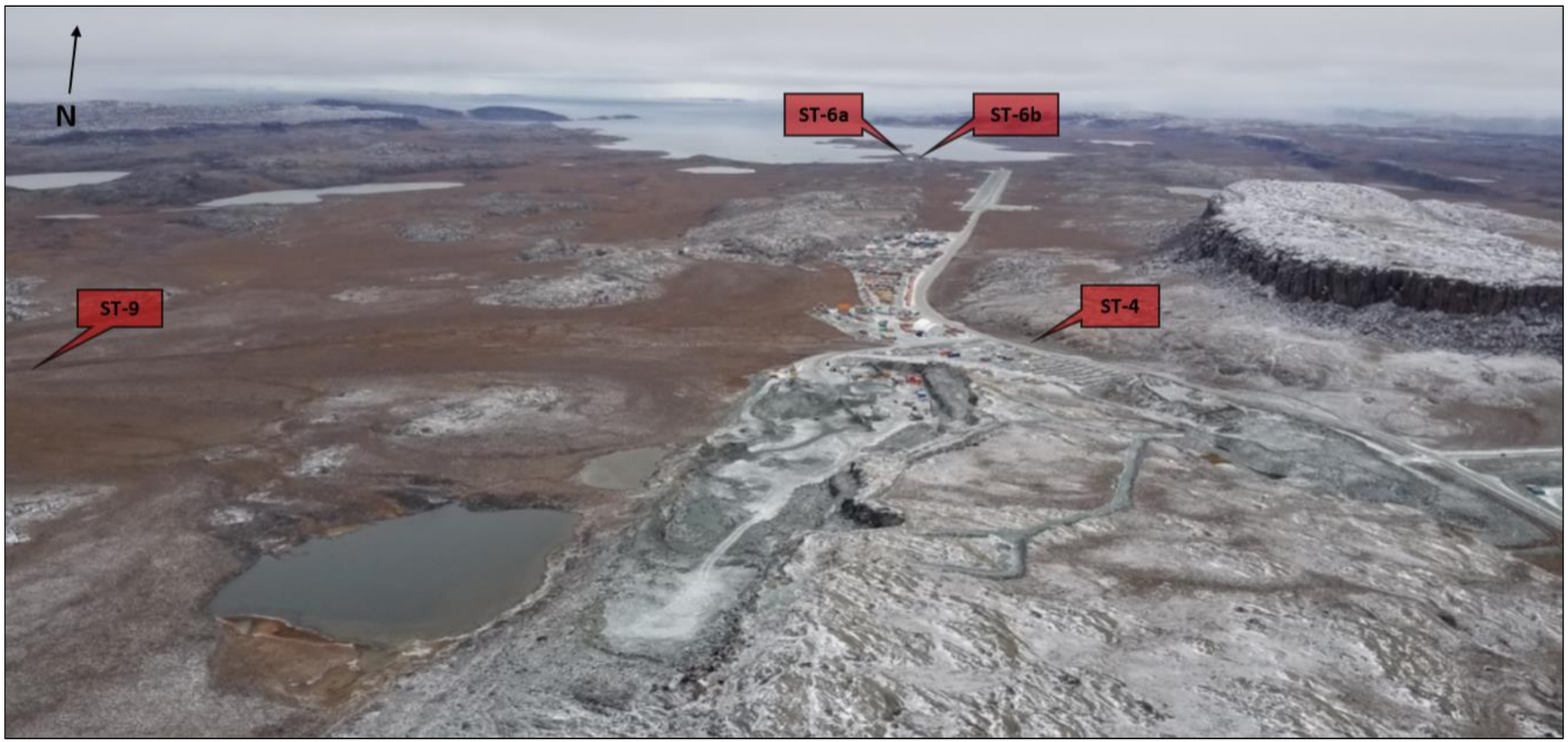


Figure A.3 2AM-DOH1335 Sample Station Locations

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Module B: 2BE-HOP1222

Conformity Table

Licence	Part	Item	Topic	Report Section
2BE-HOP1222	J	14	The Licensee shall implement the Hope Bay Mining Limited, Quality Assurance and Quality Control Plan R5, for the Windy Lake Camp and the Patch Lake Fuel Farm Area, dated December 31, 2010, prepared in accordance with the INAC document "Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "B" Licensees in Collecting Representative Water Samples in the Field, 1996" approved by an Analyst on July 4, 2011.	
		15	The Licensee shall annually review the approved Quality Assurance/Quality Control plan and modify it as necessary. Proposed modifications shall be submitted to an Analyst for approval.	Section 1.4
		16	The approved Quality Assurance/Quality Control Plan shall be submitted to the Board for review and implemented as approved by an Analyst.	This plan
		17	All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of Standard Methods for the Examination of Water and Wastewater, or by such other methods approved by the Board.	Sections 2 and 3
		18	All analyses shall be performed in a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.	Section 5

B1 Introduction

The Type B Water Licence No. 2BE-HOP1222 issued to TMAC by the Nunavut Water Board (NWB) details the sampling and analysis requirements for the SNP program. Windy Camp and the Patch Lake Laydown facility are no longer in use; therefore, sampling stations associated with camp operations and fuel storage facility are not being used or monitored. There are currently no active sampling stations at Windy Camp or Patch Lake. Water drawn from Windy Lake for domestic use at Doris Camp is monitored under the 2AM-DOH1323 Licence SNP Station ST-7A.

B2 SNP Sampling Stations

Table B1. 2BE-HOP1222 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
HOP-1	Raw water supply intake at Windy Lake	B, G, Oil and Grease	Monthly (when in use for Doris)
		D	Daily during periods of pumping
HOP-2*	WWTF effluent discharge at the surge tank prior to being pumped over the ridge east of the Windy Camp Facilities	G, B, MT, Oil and Grease	Monthly
		D	Daily during periods of discharge
HOP-3*	WWTF effluent at a point of entry into Windy lake	G, B, Oil and Grease	Monthly
		Acute Lethality	Annually
		D	Daily during periods of discharge
HOP-4*	Effluent from the Landfarm Treatment Facility pumped to the WWTF surge tank	B, G, Oil and Grease	Once before any discharge, daily when discharging onto the tundra
		D	Daily during periods of discharge
HOP-5*	Effluent from the Bulk Fuel Storage Facility located at the Windy Camp, prior to release	G, MT, HC, TPH, PAH, Nitrate, Nitrite, Total Phenols, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-6*	Effluent from the Bulk Fuel Storage Facility located at the Patch Lake location, prior to release to a location approved by an Inspector	G, MT, HC, Oil and Grease Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-7A, B and D	Discharge from Quarries A, B and D respectively	G, N1, MT, Total Sulphate, Alkalinity, Oil and Grease, Electrical Conductivity and Reduction potential (Eh)	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-8*	Effluent from the Bulk Fuel Storage Facility located at the new Windy Camp location, prior to release to a location approved by an Inspector	G, MT, HC, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
Drill Sites	Under-ice sampling before and after drilling	G, MT, Electrical Conductivity, Oil and Grease	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of discharge

* Monitoring station no longer active. Facility has been removed/dismantled.

Figure B1. 2BE-HOP1222 Sample Stations Locations

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Module C: 2BB-BOS1727

Conformity Table

Licence	Part	Item	Topic	Report Section
2BB-1727	J	16	The Board has accepted the Plan entitled "Quality Assurance and Quality Control Plan, Hope Bay, Nunavut, Module C: 2BB-BOS1217 Boston" dated January 2017, submitted as additional information with the Application. The Licensee shall submit with the Annual Report an addendum to the Plan; the addendum is to include an updated Table of Contents.	
		17	The Licensee shall annually review the Quality Assurance/Quality Control plan of Part J, Item 16 and modify it as necessary. Proposed modifications shall be submitted to an Analyst for approval.	Section 1.4
		18	All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of Standard Methods for the Examination of Water and Wastewater, or by such other methods approved by the Board.	Sections 2 and 3
		19	All analyses shall be performed in a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.	Section 5

C1 Introduction

The Type B Water Licence No. 2BB-BOS1727 issued to TMAC by the Nunavut Water Board (NWB) details the sampling and analysis requirements for the SNP program.

C2 SNP Sampling Stations

Table C1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the Surveillance Network Program for water licence 2BB-BOS1727. The location of each sampling point is illustrated in Figure C1 below.

Table C1. 2BB-BOS1727 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
BOS-1a	Raw water supply intake at Aimaokatalok (Spyder) Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
BOS-1b	Raw water supply intake at Stickleback Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
BOS-2	Containment Pond discharge	G, Electrical Conductivity, Total Hardness, Total Alkalinity, T-As, T-Cd, T-Cu, T-Cr, T-Fe, T-Pb, T-Hg, T- Ni, T-Se, T-Zinc, Oil and Grease, Nitrate, Nitrite, Total Phenols, Ca, Mg, K, Na, Sulphate and Chloride	Prior to discharge, then weekly during discharge
		D	Daily during periods of discharge
BOS-3	Sewage Treatment Facility treated effluent	B, G, Oil and Grease	Prior to discharge, then monthly during discharge
		D	Daily during periods of discharge
BOS-4	Treated sewage effluent at the point prior to entry into Aimaokatalok (Spyder) Lake	B, G, Oil and Grease	Monthly during discharge
BOS-5	Effluent from the Bulk Fuel Storage Facility prior to discharge onto the tundra	G, T-As, T-Ni, T, Cd, T-Cu, T-Cr, T-Fe, T-Hg, T-Se, T-Zn, HC, Total Phenols, Total Hardness, Total Alkalinity, Ca, Mg, K, Na, Sulphate and Chloride, Nitrate- Nitrite, Electrical Conductivity	Prior to discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
BOS-6	Effluent from the Landfarm Treatment Facility prior to discharge onto the tundra	G, HC, T-As, T-Cd, T-Cu, T-Cr, T-Fe, T-Hg, T-Ni, T-Se, Total Phenols, Total Hardness, Total Alkalinity, Ca, Mg, K, Na, Sulphate and Chloride, Nitrate-Nitrite, Electrical Conductivity	Prior to discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge

SNP Station	Description	Monitoring Parameters	Frequency
BOS-7	Runoff from the temporary storage area of hydrocarbon contaminated soils prior to discharge onto tundra	G, HC, T-As, T-Cd, T-Cu, T-Cr, T-Fe, T, Hg, T-Ni, T-Se, T-Zn, Total Phenols, Total Hardness, Total Alkalinity, Ca, Mg, K, Na, Sulphate and Chloride, Nitrate- Nitrite, Electrical Conductivity	Prior to discharge, monthly when discharging onto the tundra
BOS-8	Seepage/runoff from the ore stockpiles and camp pad	G, Sulphate and Chloride, Electrical Conductivity, Total Ammonia, Total Arsenic, Total Trace Metals Including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Initially during spring thaw and monthly when flow observed
BOS-9	Portal Decline, surface water runoff discharged onto tundra	G, Oil and Grease, Nitrate, Total Trace Metals Including T-As, T-Cu, T-Pb, T-Ni, T-Zn, T-Al, T, Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Fe, T-Li, T-Mn, T-Mo, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, Sulphate and Chloride, Electrical Conductivity, Total Ammonia	Once prior to discharge
		D	Daily during periods of discharge
BOS-10	Underground Mine Water Sumps	G, Sulphate and Chloride, Electrical Conductivity, Total Ammonia, Total Arsenic, Total Trace Metals Including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Three times a year during periods of water inflow
		D	Daily during periods of discharge
Drill Sites	Under-ice sampling before and after drilling	G, Electrical Conductivity, Total Trace Metals including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn, Trace Arsenic and Mercury	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of discharge

Figure C1. 2BB-BOS1727 Sample Stations Locations

QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Module D: 2BB-MAE1727

Conformity Table

Licence	Part	Item	Topic	Report Section
2BB-MAE1727	J	14	The Licensee shall submit to the Board for review within 60 (sixty) days prior any major monitoring takes place, a Quality Assurance and Quality Control Plan, prepared in consultation with the accredited laboratory conducting the analysis. The Plan shall include a cover letter from the accredited laboratory confirming approval of the Plan for analysis to be performed under this Licence. The Plan shall be developed in accordance with current Standard Methods and the 1996 Quality Assurance and Quality Control Guidelines for Use by Class "A" Licensees (INAC).	
		15	The Licensee shall annually review the approved Quality Assurance/Quality Control plan and modify it as necessary. Proposed modifications shall be submitted to an accredited laboratory for approval.	
		16	All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of Standard Methods for the Examination of Water and Wastewater, or by such other methods approved by the Board in writing.	
		17	All analyses shall be performed in a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.	

D1 Introduction

The Type B Water Licence No. 2BB-MAE1727 issued to TMAC by the Nunavut Water Board (NWB) details the sampling and analysis requirements for the SNP program.

D2 SNP Sampling Stations

Table D1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the Surveillance Network Program for water licence 2BB-MAE1727. The locations of these monitoring stations have not yet been established as work at Madrid under this licence. Work at the Madrid North site is monitored under water licence 2AM-DOH1335. Locations of these monitoring stations as approved by the Inspector will be provided with the next version of this plan. Proposed locations for monitoring stations MAE-14, MAE-15 and MAE-16 are illustrated in Figure D1 below.

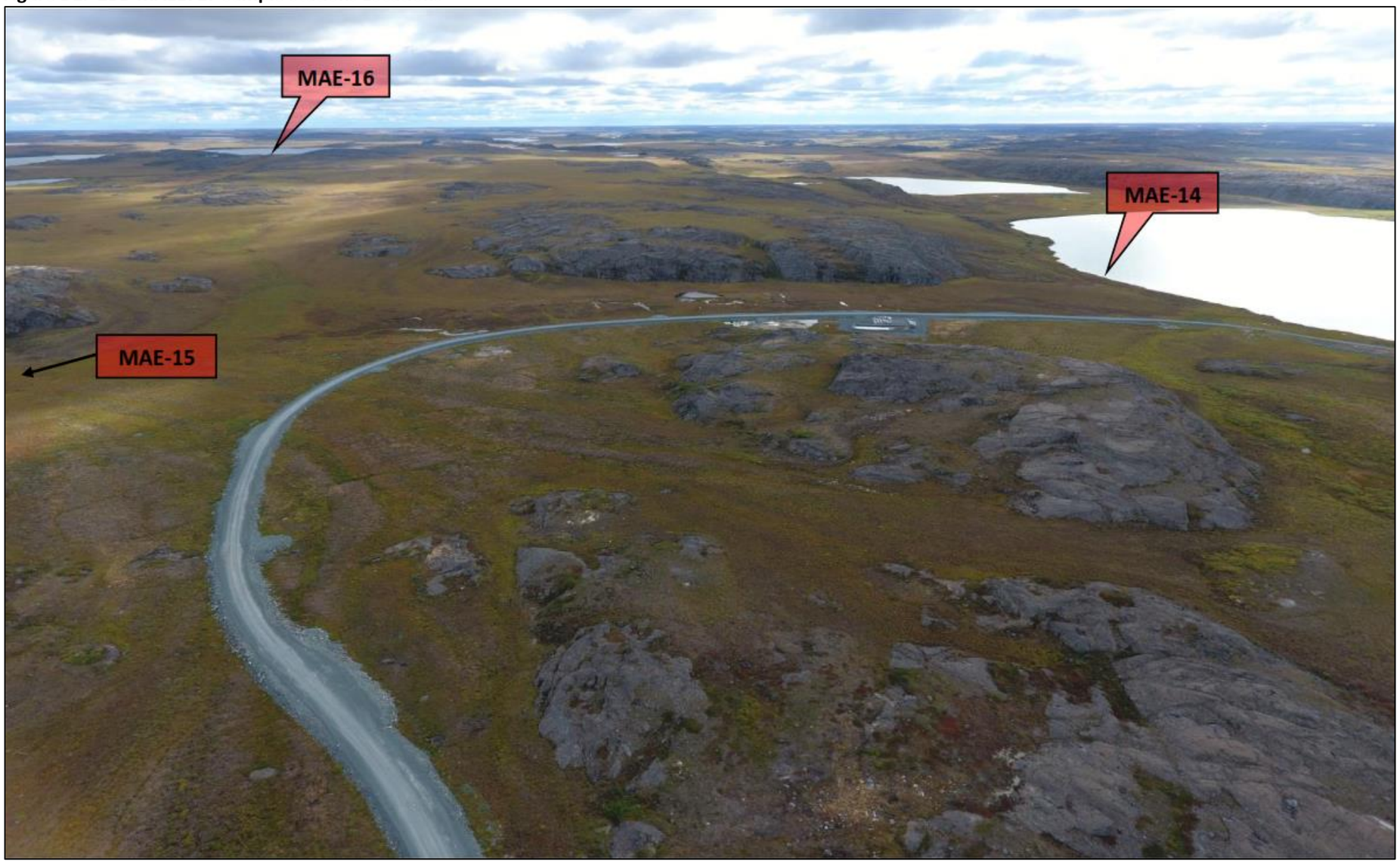
Table D1. 2BB-MAE1727 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
MAE-01	Madrid North Freshwater intake at Windy Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
MAE-02	Madrid South Freshwater intake at Patch Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
MAE-03	Freshwater intake at other Lakes	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
MAE-04	Madrid North Pollution Control Pond	G, Electrical Conductivity, Oil and Grease, Sulphate and Chloride, Total Ammonia, Nitrate-Nitrite, Total Phenols, Total Alkalinity, Total Hardness, Ca, Mg, K, Na, T-As, T, Cd, T-Cu, T-Cr, T-Fe, T-Pb, T-Hg, T-Ni	Prior to discharge to tundra
		D	Daily during periods of pumping
MAE-05	Madrid South Pollution Control Pond No. 1	G, Electrical Conductivity, Oil and Grease, Sulphate and Chloride, Total Ammonia, Nitrate-Nitrite, Total Phenols, Total Alkalinity, Total Hardness, Ca, Mg, K, Na, T-As, T, Cd, T-Cu, T-Cr, T-Fe, T-Pb, T-Hg, T-Ni	Prior to discharge to tundra
		D	Daily during periods of pumping
MAE-06	Madrid South Pollution Control Pond No. 2	G, Electrical Conductivity, Oil and Grease, Sulphate and Chloride, Total Ammonia, Nitrate-Nitrite, Total Phenols, Total Alkalinity, Total Hardness, Ca, Mg, K, Na, T-As, T, Cd, T-Cu, T-Cr, T-Fe, T-Pb, T-Hg, T-Ni	Prior to discharge to tundra
		D	Daily during periods of pumping

SNP Station	Description	Monitoring Parameters	Frequency
MAE-07	Madrid North Fuel Storage Area Water Sump	G, HC, Sulphate, Chloride, Electrical Conductivity, Total Ammonia, T-As and Trace Metals by ICP-Scan including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Prior to discharge to tundra
		D	Daily during periods of pumping
MAE-08	Madrid North Fuel Transfer Station Water Sump	G, HC, Sulphate, Chloride, Electrical Conductivity, Total Ammonia, T-As and Trace Metals by ICP-Scan including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Prior to discharge to tundra
		D	Daily during periods of pumping
MAE-09	Madrid South Fuel Storage Area Water Sump	G, HC, Sulphate, Chloride, Electrical Conductivity, Total Ammonia, T-As and Trace Metals by ICP-Scan including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Prior to discharge to tundra
		D	Daily during periods of pumping
MAE-10	Madrid South Fuel Transfer Station Water Sump	G, HC, Sulphate, Chloride, Electrical Conductivity, Total Ammonia, T-As and Trace Metals by ICP-Scan including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Prior to discharge to tundra
		D	Daily during periods of pumping
MAE-11	Quarry G Contact Water Sump	G, Sulphate, Chloride, Electrical Conductivity, Total Ammonia, T-As, and Trace Metals by ICP-Scan including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Prior to discharge to tundra
		D	Daily during periods of pumping
MAE-12	Quarry H Contact Water Sump	G, Sulphate, Chloride, Electrical Conductivity, Total Ammonia, T-As, and Trace Metals by ICP-Scan including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Prior to discharge to tundra
		D	Daily during periods of pumping
MAE-13	Quarry I Contact Water Sump	G, Sulphate, Chloride, Electrical Conductivity, Total Ammonia, T-As, and Trace Metals by ICP-Scan including T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co,	Prior to discharge to tundra

SNP Station	Description	Monitoring Parameters	Frequency
		T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	
		D	Daily during periods of pumping
MAE-14	Windy Lake immediately downgradient of the Pollution Control Pond Discharge	Chloride, Electrical Conductivity, Total Dissolved Solids	Monthly
MAE-15	Patch Lake immediately downgradient of the Pollution Control Pond Discharge	Chloride, Electrical Conductivity, Total Dissolved Solids	Monthly
MAE-16	Wolverine Lake immediately downgradient of the Pollution Control Pond Discharge	Chloride, Electrical Conductivity, Total Dissolved Solids	Monthly
Mine Water	Madrid South Underground Mine Water Sumps	Total Dissolved Solids, pH, Electrical Conductivity, Chloride, Total Ammonia and Nitrate, Alkalinity, Sulphate, Total Trace Metals by ICP Scan including T-As, T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Three times a year during periods of water inflow
Drill Sites	Under-ice sampling before and after drilling	G, Electrical Conductivity, Total Trace Metals by ICP Scan including T-As, T-Al, T-Sb, T-Ba, T-Be, T-Cd, T-Cr, T-Co, T-Cu, T-Fe, T-Hg, T-Pb, T-Li, T-Mn, T-Mo, T-Ni, T-Se, T-Sn, T-Sr, T-Tl, T-Ti, T-U, T-V, T-Zn	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of discharge

Figure D1. 2BB-MAE1727 Sample Stations Locations



QUALITY ASSURANCE AND QUALITY CONTROL PLAN

HOPE BAY, NUNAVUT

Module E: 2AM-BOS1835

Conformity Table

Licence	Part	Item	Topic	Report Section
2AM-BOS1835	B	13	The Licensee shall, for all plans submitted under this Licence, implement the plan as approved by the Board in writing. Any changes to the plans deemed significant shall be considered as an amendment to the plan(s) or as a modification and must be submitted to the Board for approval in writing. The Board has approved under this Water Licence 2AM-BOS1835, the following plans for implementation under the relevant sections in the Licence: *q. Quality Assurance and Quality Control Plan (January 2017)*	
	I	3	The Licensee shall undertake the Monitoring Program provided in the Tables 1 and 2 of Schedule I. The Licensee shall, in consultation with an Inspector, establish the locations and GPS coordinates for all Monitoring Program stations.	Table E1
		14	The Licensee shall annually review the approved Quality Assurance and Quality Control Plan and modify the Plan as necessary. Proposed changes shall be submitted to an Accredited Laboratory for approval.	Section 1.4
		15	All analyses shall be conducted as described in the most recent edition of “Standard Methods for the Examination of Water and Wastewater” or by other such methods approved by an Analyst.	Sections 2 and 3
		16	All compliance analyses shall be performed in an accredited laboratory according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.	Section 5

E1 Introduction

The Type A Water Licence No. 2AM-BOS1835 issued to TMAC by the Nunavut Water Board (NWB) details the sampling and analysis requirements for the SNP program.

E2 SNP Sampling Stations

Table E1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the Surveillance Network Program for water licence 2AM-BOS1835. The locations of these monitoring stations have not yet been established as work at Boston under this licence has not yet commenced. Locations of these monitoring stations as approved by the Inspector will be provided with the next version of this plan.

Table E1. 2AM-BOS1835 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TMA
BMS-1	Contact Water Pond #1 and #2	Construction, Operations, Care and Maintenance	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS, D	Sampled twice annually; Weekly water levels
BMS-2	Surge pond at intake to Contact Water Treatment Plant	Construction, Operations, Care and Maintenance, Closure	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, T-Radium 226, HC, D	Sampled monthly during discharge periods; Weekly water levels
BMS-3	Discharge from Contact Water Treatment Plant	Construction (upon Effluent release), Operations, Care and Maintenance, Closure	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, T-Radium 226, HC, D	Sampled weekly during discharge periods and prior to discharge
BMS-4	Reclaim line from TMA Contact Water Pond	Construction, Operations, Care and Maintenance, Closure	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, HC, D, Fecal Coliform	Sampled monthly during reclaim periods; Weekly water levels
BMS-5	Non-contact Water Pond	Construction, Operations, Care and Maintenance	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS, D	Sampled annually; Water levels after large inflow events
BMS-6	Fresh Water intake at Aimaokatalok Lake	Construction, Operations, Care and Maintenance, Closure	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl and Total Oil and Grease, Cl, D	Sampled monthly during active pumping periods

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and any time after initial deposit of Tailings to the TMA
BMS-7	Landfill Sump	Construction, Operations, Care and Maintenance, Closure	G, MT and Total Ammonia-N, Total Sulphate, Total and Free CN, Total Oil and Grease, D	Annually. Once prior to every discharge onto the tundra
BMS-8	Discharge of treated Sewage	Construction, Operations, Care and Maintenance, Closure	G, B, and Total Oil and Grease, D	Sampled monthly during active pumping periods
BMS-9	Landfarm Sump	Construction, Operations, Care and Maintenance, Closure	G, HC, Total Ammonium, Total Lead, D	Annually. Once prior to every discharge onto the tundra
BOS-10	Site runoff from sediment controls during construction	Construction	pH, TSS or Turbidity, Oil and Grease	Daily during periods of discharge
BMS-11	Discharge from the Boston Fuel storage and containment sumps	Construction, Operations, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of pumping