Figure 3.9 Recommended CREMP Sediment and Benthic Monitoring Stations following the 2015 Program

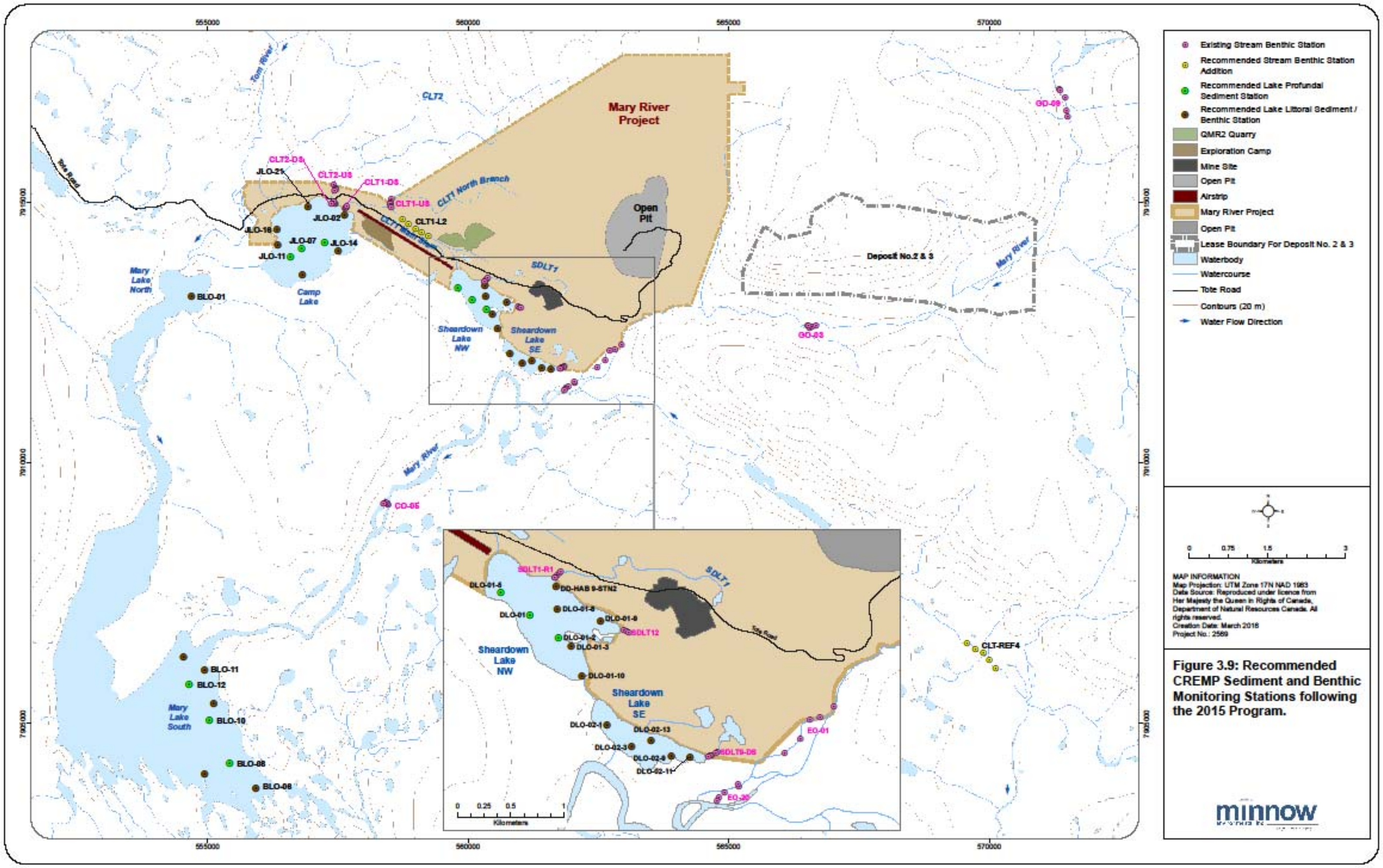

Figure 3.10 Recommended CREMP Reference Lake 3 Monitoring Stations following the 2015 Program

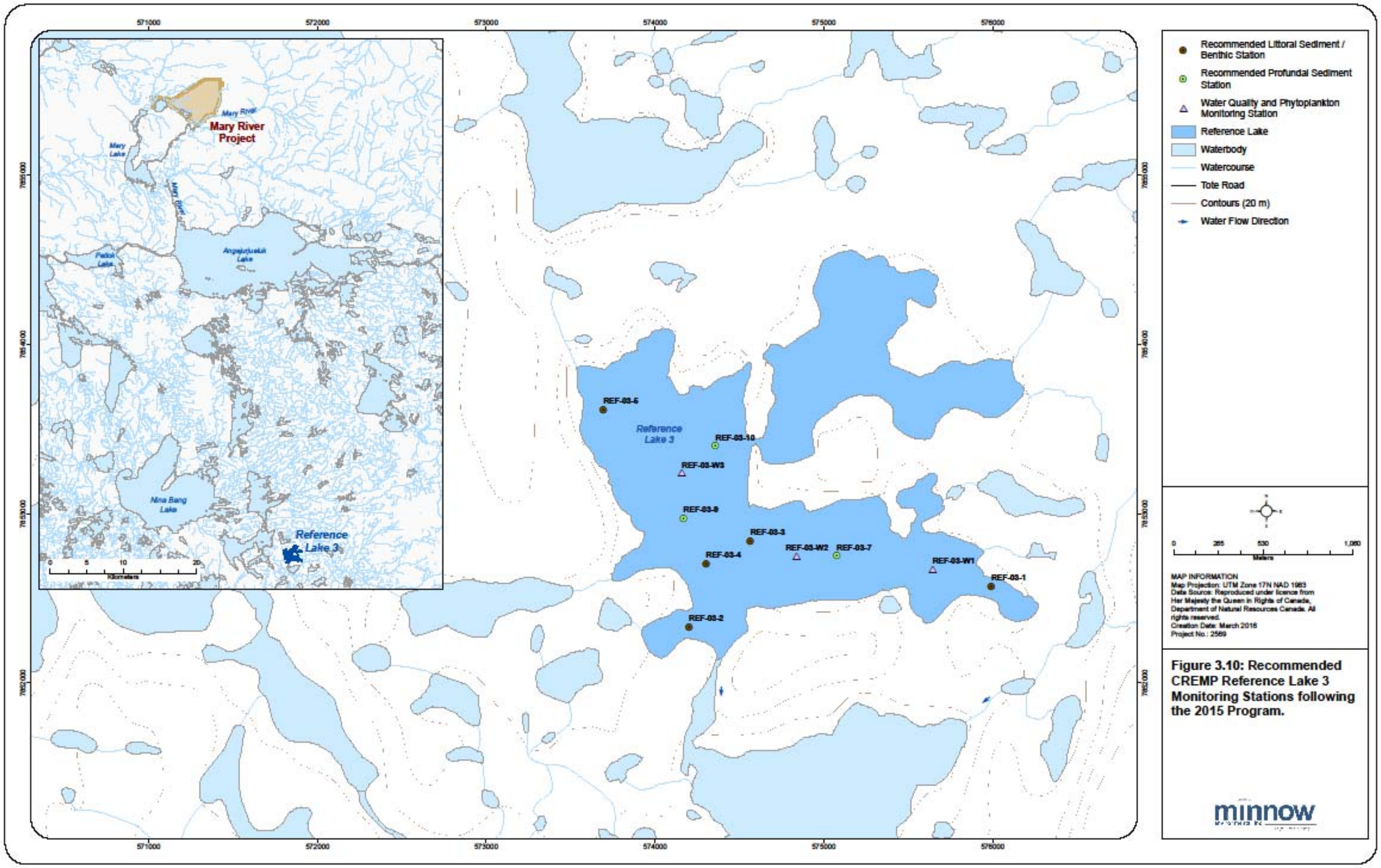

Table 3.7 Sediment Quality CREMP Stations Details

Station ID	Easting	Northing	Sediment	Benthic Macroinvertebrates	Description/Rationale
	NAD 83, Zone 17N				
Mary Lake (North Basin)					
BL0-01	554690	7913194	X	X	North basin receiving water from Camp La
Mary Lake (South Basin)					
BL0-06	555924	7903760	X	X	Main basin near outlet of Mary River
BL0-08	555420	7904237	X		Main basin between BL0-05 and BL0-06
BL0-10	555038	7905069	X		Main basin between BL0-05 and BL0-06
BL0-11	554987	7905976		X	Main basin near outlet of Mary River
BL0-12	554641	7905752	X		Main basin near outlet of Mary River
TBD	TBD	TBD	X	X	Main basin near outlet of Mary River
TBD	TBD	TBD	X	X	Main basin nearshore between BL0-12 an BL0-10
TBD	TBD	TBD	X	X	Main basin near south shore
Mary River (D/S of SDL)					
C0-05	558352	7909170		X	Mainstem - downstream of Mine Site
SDL-Tributaries					
SDLT-1-R1	560320	7913504		X	Tributary SDLT-1
SDLT-9-DS	561770	7911810		X	Tributary SDLT-9
SDLT-12	560776	7912867		X	Tributary SDLT-12
Sheardown Lake NW					
DD-Hab 9-Stn 2	560323	7913402	X	X	Nearshore station
DL0-01	560079	7913128	X		Mid-lake position
DL0-01-2	560353	7912924	X		Mid-lake position
DL0-01-3	560474	7912833	X	X	Southeastern region
DL0-01-5	559798	7913356	X		Near treated wastewater discharge locatio
DL0-01-8	560329	7913197	X	X	Mid-lake position
DL0-01-9	560750	7913077	X	X	Eastern region, near SDLT-9 inflow strea
DL0-01-10	560580	7912537	X	X	Near outlet channel to Southeast Basin
Sheardown Lake SE					
DL0-02-1	560813	7912116	X	X	Near inlet channel from Northwest Basin
DL0-02-3	561046	7911915	X	X	Mid-lake position
DL0-02-9	561414	7911804	X	X	Eastern region
DL0-02-11	561688	7911801	X	X	Eastern region near SDLT-9 stream inflow
DL0-02-13	561237	7911943	X	X	Mid-lake position
Mary River (US of SDL)					
E0-20	561688	7911272		X	Near EEM near field exposure area
E0-01	562942	7912274		X	Downstream of Deposit 1 near sewage outfall
G0-03	566516	7912618		X	Upstream of Deposit 1
G0-09	571341	7917169		X	Mary River Reference Area - Upstream of Deposit 1, 2 and 3
Camp Lake					
JL0-02	557614	7914750	X	X	On gradient transect between CLT-1 and lake outlet.
JL0-07	556800	7914094	X		
JL0-11	556598	7913935	X		
JL0-14	557235	7914222	X		Mid-lake position
JL0-16	556329	7914456	X	X	Near northwest shoreline
JL0-21	556935	7914913	X	X	Along the northwest shoreline
TBD	TBD	TBD	X	X	Near northwest shoreline

Station ID	Easting	Northing	Sediment	Benthic Macroinvertebrates	Description/Rationale
	NAD 83, Zone 17N				
Camp Lake cont'd					
TBD	TBD	TBD	X	X	Near southwest shoreline
TBD	TBD	TBD	X	X	Near southeast shoreline
Camp Lake Tributaries					
CLT-1 DS	557645	7914878		X	Lower reach of CLT-1 near lake outlet
CLT-1-US	558504	7915022		X	Upstream of CLT-1 near natural fish barrier
CLT-2 DS	557466	7914969		X	Lower reach of CLT-2 near lake outlet
CLT-2-US	TBD	TBD		X	Upper reach of CLT-2
CLT1-L2*	TBD	TBD		X	CLT1 Upper Main Stem, DS of QMR2
Reference Tributary					
CLT-REF4*	TBD	TBD		X	Camp Lake Tributary Reference Area 4
Reference Lake					
REF-03-1	575992	7852572	X	X	Nearshore southeast shoreline
REF-03-2	574200	7852330	X	X	Nearshore south shoreline
REF-03-3	574564	7852840	X	X	Nearshore north shoreline
REF-03-4	574301	7852705	X	X	Mid-lake position
REF-03-5	573694	7853613	X	X	Nearshore northwest shoreline
REF-03-7	575076	7852750	X		East Mid-lake position
REF-03-9	574168	7852975	X		Mid-lake position
REF-03-10	574358	7853400	X		Northwest shoreline
TOTAL			**38**	**41**	

NOTES:

1. STATION LOCATIONS PROPOSED BASED ON AVAILABLE SUBSTRATE AND WATER DEPTH DATA, SUBJECT TO CHANGE FOLLOWING IN-SITU FIELD CONFIRMATION OF CONDITIONS.

3.5.6 Study Design and Data Analysis

The purpose of sediment quality monitoring is to answer the same question posed in regard to water quality:

"What is the estimated mine-related change in contaminant concentrations in the exposed area?"

To answer this question, the study has been designed to test the following three hypotheses:

- Null hypothesis: Change over time is the same for exposure and reference stations. Alternate hypothesis: Data from exposure stations is statistically different from data measured at reference stations.
- Null hypothesis: Difference between exposure and reference stations is due to natural environmental variation. Alternate hypothesis: Difference in exposure and reference station is due to mine effects.
- Null hypothesis: Magnitude of concentrations at the exposure station does not exceed the benchmark. Alternate hypothesis: Magnitude of concentrations at the exposure station exceeds the benchmark.

The sediment quality CREMP monitoring program will focus solely on sediment in lakes, since the depositional characteristics found within the lakes is the final sink for natural and project-related contributions to sediment load.

Environment Canada (2012) recommends a Control-Impact (CI) or Gradient Sample design for detection of effects in the lake environment benthic invertebrate community (Figure 3.8).Stations are generally situated on a gradient type approach within each lake while the analysis is conducted using a CI approach. A gradient sample design has been defined for the CREMP lake sediment stations that is integrated with benthic invertebrate sampling and utilizes several historic sediment sampling locations that meet the cut-off criteria (Section 3.5.2). Within each mine exposed study lake and Reference Lake 3, stations are positioned to allow for the evaluation of any spatial differences in sediment chemistry in order to determine potential gradients in metal concentrations associated with mine sources (i.e. mine exposed tributaries).

As mentioned before, Reference 3 Lake was established as the reference lake for the CREMP in 2015. Being located outside of the mine area, Reference Lake 3 is expected to be unaffected by local mineralization to the extent that the mine site lakes are. Therefore, a control-impact approach to monitoring change in the mine site lakes may require use of various statistical approaches to assist with the detection of Project-related changes to sediment quality.

Additionally, a before-after comparison of monitoring data to baseline data will be conducted to detect Project-related changes to sediment quality.

In addition, the gradient design selected for lake sediment quality will allow for an assessment of the spatial extent of mine impacts. Since effluent discharges are fixed and dust deposition can be expected to occur in a gradient, it is expected that concentrations will decrease as the distance from the mine increases. In the absence of appropriate control data, it may be necessary to use the exposure data alone to assess mine effects. Mining effects could be observed in several ways:

- Before-After: concentrations increase over time at a given station
- Gradient effect: concentrations increase with increasing proximity to the mine
- Gradient effect changes over time: concentrations are stable across the gradient during baseline but increase with increasing proximity to the mine after mining commences. That is, concentrations increase over time at stations close to the mine but remain relatively stable at far field stations (i.e., the slope of the gradient effect increases over time).

In addition, because there is a relationship between sediment SOPCs, increases in multiple parameters can be used in a weight of evidence to identify project-related changes.

3.5.7 Assessment Framework

Monitoring data will be assessed during each year of monitoring and would follow the assessment framework as outlined in Figure 2.12 and described below. The assessment framework for sediment quality monitoring closely mirrors that described for water quality in Section 2.6.8, with minor differences.

3.5.7.1 Step 1: Initial Data Analysis

Initial data analysis will involve following specific data management and monitoring protocols in the handling and initial comparison of data.

Data Input and Storage

Following data collection, and upon receipt of the laboratory reports, data will be entered into the Project EQWin® database.

Initial Data Analysis including Outlier Assessment

The initial data analysis will include a number of possible steps, such as the following:

- Completion of summary statistics (average, median, maximum, minimum, quartiles)
- Flagging of sediment samples that do not meet the TOC and % sand cut-off values
- Flagging of values greater than the defined benchmark values
- Flagging of values at or exceeding the mid-point between the baseline mean and the benchmark
- Evaluating temporal changes in the data by season

The initial data analysis will include an outlier assessment after data entry and the completion of quality assurance and quality control steps. An outlier assessment is completed after each round of sampling to ensure data anomalies are identified early. If necessary, the laboratory can be contacted to re-analyze samples. Any identified outliers will be investigated to ensure no data integrity issue exists. For example, duplicate samples will be assessed along with any holding time exceedances. If no evidence exists to discard data, then the data will remain in the dataset but be flagged for future consideration.

3.5.7.2 Step 2: Determine if Change is Mine Related

Step 2 involves determining if the changes in sediment quality parameters of concern are due to the Project or due to natural variability or other causes. This question will be addressed using exploratory data analysis (EDA) and subsequently using statistical data analysis (SDA), as described below.

Prior to conducting EDA and SDA, Project activities with the potential to alter sediment quality will be reviewed to identify potential Project-related causes or sources. This could include evaluating effluent quality, discharge regime/rates, and loading, dust deposition, and other point/non-point sources as required. Also, any evidence of potential natural causes (i.e., a major erosional event such as a slumping riverbank) will be investigated. Sampling data sheets and site personnel will be a source of this information.

Exploratory Data Analysis

Exploratory data analysis (EDA) will be completed to visualize overall data trends. This could include evaluating spatial patterns in sediment quality results for mine area lakes to evaluate if changes are widespread or specific to certain waterbodies, or proximate to mine-related sources, and to identify the spatial extent and pattern of observed changes.

Data from Mine Area lakes will be compared to data from Reference Lake 3. This will further assist with determining whether the observed changes were due to natural variability or the Project.

These graphical analyses will also confirm assumptions required for statistical testing (normality, sample size, independence). Results of the EDA will be used in tandem with the SDA to confirm the observed statistical trends and can be used to evaluate the potential for biologically relevant change.

Statistical Data Analysis

Primary SDA will be completed using methodology consistent with the before-after design used for the power analysis. This will be used to assess the potential magnitude of change during post-mining.

This step in the analysis tests the primary hypothesis for the effects of mine-related change and can be applied to the parameters of interest.

If the Step 2 analysis concludes that the changes in sediment quality parameters of concern are, or are likely, due to the Project, the assessment will proceed to Step 3. If it is concluded the observed differences relative to baseline conditions are not due to the Project, no management response will be required.

3.5.7.3 Step 3: Determine Action Level

Once EDA and primary SDA has indicated with some certainly that the measured change is project-related, Step 3 involves determination of the action level associated with the observed monitoring results through comparisons to the benchmark.

If the benchmark is not exceeded, a **low action response** would be undertaken and would include:

- Evaluate temporal trends
- Identify likely source(s) and potential for continued contributions
- Confirm the site-specific relevance of benchmark and establish a site-specific benchmark, if necessary
- Based on evaluations, determine next steps

If the benchmark is exceeded and it is concluded to be due to, or likely due to, the Project, a **moderate action level response** would be undertaken and would include, in addition to analyses identified in for a low action response, the following:

- Consider a weight-of-evidence (WOE) evaluation and/or risk assessment, considering other monitoring results collectively with sediment quality to evaluate effects on the ecosystem
- Evaluate the need for and specifics of increased monitoring
- Evaluate the need for additional monitoring (e.g., confirmation monitoring) and/or modifications to the CREMP
- Consider results of the trend analysis (i.e., trend analysis indicates an upward trend) and evaluation of potential pathways of effect (i.e., causes of observed changes) to determine if management/mitigation is required
- Identify next steps based on the above analyses. Next steps may include those identified for the high action level response.

A quantitative trigger for the **high action level response** has not been identified as the need for additional study and/or mitigation will depend on the ultimate effects of the observed increases in sediment quality parameters of concern on the lakes as a whole, as well as the monitoring results from the freshwater biota CREMP. Also, the benchmark may need to be revised in consideration of ongoing monitoring results. The precise relationships between water quality, sediment quality and lower trophic level changes and the collective effects on fish is difficult to predict and therefore actions undertaken under Level 2 will attempt to explore these relationships to advise on overall effects to the ecosystem. Results would be discussed with regulatory agencies and the next steps would be identified. Additional actions that may be implemented in a subsequent phase (i.e., high action level response) include:

- Implementation of increased monitoring to confirm effects and/or define magnitude and spatial extent of effects if warranted

- Implementation of mitigation measures or other management actions that may be identified under the moderate action level response

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APPENDIX A

WATER AND SEDIMENT QUALITY SAMPLING PROTOCOL

(Pages A-1 to A-24)

APPENDIX B

DETAILED REVIEW OF BASELINE LAKE WATER QUALITY

(Pages B-1 to B-98)

APPENDIX C

DETAILED REVIEW OF BASELINE STREAM WATER QUALITY

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APPENDIX D

DETAILED REVIEW OF BASELINE SEDIMENT QUALITY

(Pages D-1 to D-37)

APPENDIX A
WATER AND SEDIMENT QUALITY SAMPLING PROTOCOL

REVISION 1

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DOCUMENT REVISION RECORD

Issue Date MM/DD/YY	Revision	Prepared By	Approved By	Issue Purpose
03/28/14	0	KP	KP	Issued in Final
03/31/16	1	AV	JM	Updated to reflect CREMP Study Design modifications proposed by Minnow in 2016

Index of Major Changes/Modifications in Revision 1

Item No.	Description of Change	Relevant Section
1	Included Baffinland's Sampling Program – Quality Assurance and Quality Control Plan (BAF-PH1-830-P16-0001) and discussed Minnow's recommendations for future CREMP monitoring.	1.0
2	Updated Table 2.1 to reflect the bottle types required in the 2015 CREMP field program.	2.2.2
3	Updated sampling handling and shipping protocols to reflect current operations.	2.2.5
4	Updated all lake sampling methodology sections to reflect recommendations proposed by Minnow.	2.3
5	Included modifications recommended by Minnow regarding water quality sampling methodology and protocols.	2.4
6	Discussed Minnow's recommendations to discontinue stream and sampling stations from future CREMP sediment sampling programs. Removed sections discussing stream and river sediment sampling methodology and protocols.	3.1, 3.3
7	Updated list of water and sediment quality analytes/parameters to reflect the parameters analyzed in the 2015 CREMP field program.	Appendix A
8	Replaced Exova COC with an ALS COC example.	Appendix C
9	Added Baffinland's Sampling Program – Quality Assurance and Quality Control Plan (BAF-PH1-830-P16-0001) as Appendix D.	Appendix D

April, 2016

PREFACE

This document was originally written by Knight Piésold Consulting in March 2014 for Baffinland Iron Mines Corporation (Baffinland). This document had been revised by Baffinland to reflect the recommendations proposed by Minnow Environmental Inc. in 2016 regarding modifications to the CREMP Study Design.

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Appendix B – Field Record Sheet
Appendix C – Example of Chain of Custody
Appendix D – Sampling Program – Quality Assurance and Quality Control Plan (BAF-PH1-830-P16-0001)

ABBREVIATIONS

AEMP	Aquatic Environment Monitoring Program
BIM	Baffinland Iron Mines Corporation
DO	Dissolved oxygen
EC	Environment Canada
FEIS	.Final Environmental Impact Statement
KP	Knight Piésold Ltd
Mary River Project	The Project
NSC	North South Consultants
UTM	Universal Transverse Mercator

1 – INTRODUCTION

This document is intended to provide a detailed description of the surface water and sediment quality field sampling methodologies that are applied to the CREMP sampling programs and should be used in conjunction with Baffinland's Sampling Program – Quality Assurance and Quality Control Plan (QA/QC Plan) (Appendix D). Where methodology protocols differ between this document and Baffinland's QA/QC Plan, methodology protocols outlined in this document will be followed.

CREMP water quality stations are monitored three (3) times per year. Stream water quality will be monitored during the spring, summer and fall, whereas, lake water quality will take place during the winter (late April), summer and fall. Lake sediment sampling is done concurrently with the surface water sampling program during the fall sampling event.

In 2015, Minnow Environmental Inc. (Minnow) was contracted to assist Baffinland in completing the fieldwork and reporting requirements of several of the AEMP component studies, including the CREMP. After completing the CREMP in 2015, Minnow proposed several modifications to the program (presented in Appendix I of the AEMP) to provide greater efficiencies and improve the program's ability to achieve its objectives (i.e. to evaluate short and long term effects of the Project on aquatic ecosystems).

The sampling methodologies within this protocol have been revised to reflect Minnow's recommendations.

This document includes details regarding:

- Equipment and sampling
- Field measurements and observations
- Quality assurance/quality control (QA/QC)
- Sample tracking (Chain of Custody) and shipping

2 – WATER QUALITY

2.1 GENERAL

Stream and lake water quality data has been collected for the Mary River Project (the Project) during every year since 2005, with the exception of 2009 and 2010. The analytical suite of parameters include nutrients, total and dissolved metals, and major ions. A detailed list of water quality parameters is provided in Appendix A.

2.2 STREAM SAMPLING METHODOLOGY

2.2.1 Sampling Strategy

Consistent sampling methods have been applied throughout the stream water sampling programs. Stream samples are collected from flowing sections of the streams (unless otherwise noted) and are obtained by either wading into the stream or by collecting the sample from the bank. Samples are collected in an upstream direction, with bottles being placed beneath the surface (when possible) to reduce the amount of surface residue collected. Bottles containing no acid preservative are rinsed three times before filling. For bottles already containing a preservative, the samples are transferred from a clean bottle/jug into the bottle containing preservative.

2.2.2 Equipment and Sampling

The width of the stream at the sampling location is measured using range finders. If the stream is less than 5 metres (minimum distance for range finders), the width is measured with a tape measure. Photos are taken upstream, downstream and across the sampling site.

The water quality monitoring program includes a suite of analytical parameters (Appendix A). The laboratory typically provides eight (8) sample bottles per bottle set for these analyses (Table 2.1)

Table 2.1 - Water Quality Sample Bottle Set Summary

Sample Bottle Description/Volume	Quantity	Preservative	Analytical Parameter
125 mL HDPE	1	Add HNO_3	Total Metals/Hardness
125 mL HDPE	1	Add HNO_3 after filtering	Dissolved Metals
120 mL Square Glass	1	Add HCl	Total Mercury
120 mL Square Glass	1	Add HCl after filtering	Dissolved Mercury
250 mL Round Glass	1	Add H_2SO_4	Nutrients
1 L Rectangular HDPE	1	None	General Chemistry
1 L Amber Glass	1	None	Chlorophyll-a/Pheophytin-a

The metals and mercury sample bottles require nitric and hydrochloric acid preservative, respectively. Preservatives are provided in single dose vials (one vial per bottle) by the accredited laboratory.

Prior to the addition of preservative, samples for dissolved metals are field filtered using Acrodisc® 32 mm Syringe Filters with 0.45 µm Supor® membrane filter. The syringes and filters are sealed in sterile packaging and should not be rinsed prior to use. The following steps outline the basic filtration technique that is utilized in the field:

- Attach the filter to the syringe prior to pulling the plunger out of the syringe (Note: pulling the plunger activates the filter media).
- Pull the plunger from the syringe, fill the syringe with sample water and then replace the plunger. Dispense the first 10 mL of water to the ground (not as sample).
- Filter the remaining sample directly into the appropriate container. Repeat the process until the sample bottle is full.
- Repeat the initial two steps if the water is particularly turbid and another filter is necessary prior to the sample bottle being full.

2.2.3 Field Measurements and Observations

In-situ water quality measurements will be taken during the sample collection process, provided the multi-parameter probe (e.g., YSI 6820, ProDSS or YSI 600Q sonde) can be positioned downstream of the sample collection area. The following *in-situ* parameters are recorded (when available from the multi-parameter sonde):

- Water temperature (°C)
- Dissolved oxygen (mg/L and %)
- pH (pH units)
- Conductivity (µS/cm) and/or specific conductance (µS/cm) (both when possible)

Field observations around the sample area include:

- Description of the landscape (e.g., hilly, mountains, marsh, etc.)
- Vegetation
- Stream substrate (e.g., sand, cobble, boulder, bedrock)
- Stream flow description (e.g., strong-turbulent, slow-calm)
- Weather conditions
- Air temperature

All measurements and observations are recorded on the field record sheets included within Appendix B.

2.2.4 QA/QC

The QA/QC protocol aims to ensure the collection of reliable and accurate data. Using standard methods as outlined in this document provides control of sample collection, handling and shipping. While collection of duplicate samples ensures the laboratory results meet defined standards of quality, in addition to the internal laboratory QA/QC protocols required for analytical accreditation. QA/QC samples will be taken for 10 percent of the total number of samples. At least, one field blank should be taken per sampling event.

2.2.5 Chain of Custody and Sample Shipment

An essential part of the QA/QC protocol is maintaining a record of the collected samples and the corresponding list of analytical parameters reported for those samples. A chain of custody (CoC) form will be completed digitally and saved on the main Environmental server for all samples collected. The completed COC will be sent electronically to the accredited lab conducting the analysis. A hard copy of the completed COC will also be sent with the cooler containing the samples. An example of a completed CoC form is included as Appendix C.

The current on-site laboratory is operated by ALS Canada Ltd. and is located at the Mine Site (Mine Site ALS Lab). Periodically, a select set of water quality parameters may be analyzed (i.e. turbidity, TSS, pH) or processed (i.e. filtering of chlorophyll a samples) onsite at the Mine Site ALS Lab to ensure parameters (analytes) are analyzed within the required holding times. The off-site laboratory, ALS Environmental, located in Waterloo, ON, run by ALS Canada Ltd. (Waterloo ALS Lab) performs the majority of analyses required.

Samples will be packaged in coolers with ice packs to ensure the temperature of the samples remain near 4 °C during transportation to the accredited laboratory.

Samples will be shipped from the Mine Site to the Mirabel airport and then expedited to the Waterloo ALS Lab by courier. All samples shipped from the Mine Site will be considered priority cargo to ensure samples are analyzed within the necessary parameter holding times.

2.3 LAKE SAMPLING METHODOLOGY

2.3.1 Sampling Strategy

Consistent sampling methods have been applied throughout the lake water sampling programs to date. Prior to 2016, water quality samples were collected from two isolated depths (approximately 1 meter below surface and approximately 1 meter above the bottom) at each of the lake water quality sites.

In the list of recommendations proposed by Minnow (cover letter of AEMP), Minnow noted that no consistent spatial differences in water quality/chemistry were evident in any of the study lakes in 2015, nor during any of the baseline studies, concluding that sampling at two isolated depths at each lake water quality site was redundant and unnecessary (Minnow, 2016). Similarity in surface and bottom water quality was also noted in sampled lakes (with the exception of aluminum in Sheardown Lake) in the 2014 AEMP Appendix C

Therefore, at each lake water quality site one sample will be taken at mid-depth unless *in-situ* water quality measurements (using a multi-parameter probe) suggests the sediment may be under anoxic conditions (<2 mg/L DO). If the sediment at the water quality site is suspected to be under anoxic conditions, water quality samples will be collected at approximately one meter below the surface and one meter above the bottom/sediment.

Small aluminum boats are used to access the lake water quality sites and are anchored at the sites for the duration of the sampling and *in-situ* data collection. Some boat drift is inevitable due to wind and wave influence. The general procedures to be undertaken at each lake water quality site are detailed below.

2.3.2 Equipment and Sampling

The total depth of the water at each lake station is determined either using a portable fish finder, a weighted meter tape or the pressure sensor on the multi-parameter probe. The depth is recorded on the field record sheets. Windy conditions during sampling may result in variable depth measurements. The depth range, the estimated wind speed, and the estimated wind direction are always recorded.

The water quality monitoring program includes a suite of analytes (Appendix A). As discussed above (Table 2.1), the analytical laboratory provides eight (8) sample bottles per bottle set for these analyses.

A 2.2 L acrylic Kemmerer bottle with a graduated line is utilized to obtain water samples at the target depths. The Kemmerer bottle is set in the open position for sampling with the bottom sample valve in the closed position. The sampler is lowered to the desired depth and the messenger weight is released down the line to trigger the closing spring of the sampler. The Kemmerer bottle is retrieved and the retained water is discarded over the side of the boat.

Following this initial rinse, the Kemmerer bottle is deployed to the sample depth to obtain the analytical sample. Upon retrieval of the Kemmerer bottle, a small amount of water is purged out of the bottom sample valve. The remaining sample is discharged into the pre-labelled, laboratory sample bottles (or into a field filter) via the sample valve. The remaining water is discarded over the side of the boat. This sampling process is then repeated for each water quality sample taken at any of the lake water quality sites.

Bottles with no acid preservative are rinsed three times before filling. For bottles where acid preservative is required, samples are transferred from the Kemmerer bottle into the sample bottle containing preservative. Some samples will also require field filtration before adding preservatives. The filtration process is discussed in Section 2.2.2.

2.3.3 Field Measurements and Observations

Prior to collecting water quality samples at each station, secchi depths should be recorded and *in-situ* monitoring near the water-sediment interface should be conducted to determine if sediment at the site is under anoxic conditions (<2 mg/L DO). Technicians should be extra vigilant in ensuring that sediment is not disturbed while determining the DO levels near the water-sediment interface.

As discussed in Section 2.3.1, if the sediment at the water quality site is suspected to be under anoxic conditions, water quality samples will be collected at approximately one meter below the surface and approximately one meter above the bottom/sediment. In addition to collecting two water samples at the site, *in-situ* profiling will also be conducted to further understand the degree and extent of the anoxic conditions.

In addition, *in-situ* profiling of the water column will be conducted at the main basin of each study lake, with the exception of Mary Lake where profiling with occur at both the north and south basin. These water quality sites, shown below, will have complete water column profiles completed during each sampling event regardless of the DO levels near the water-sediment interface.

Camp Lake Station - JL0-07
Sheardown Lake NW Station – DL0-01-2
Sheardown Lake SE Station – DL0-02-3
Mary Lake (North Basin) Station – BL0-1A
Mary Lake (South Basin) Station – BL0-9
Reference Lake 3 (NW Basin) Station – REF03-3

The *in-situ* profiling is undertaken using a measuring tape that is secured to a multi-parameter probe (e.g., YSI 6820, ProDSS or YSI 600Q sonde). The probe is lowered in 1 m increments and given time to stabilize prior to recording the *in-situ* parameters listed in Section 2.2.3

Secchi depths are determined by attaching the measuring tape to the secchi disk and lowering the disk over the shaded side of the boat. Two depths are recorded: the depth at which the disk disappears while lowering the disk and the depth at which it reappears while raising the disk. The secchi depth is calculated from the average of these two depths and recorded on the field record sheets.

2.3.4 QA/QC

As with stream samples, QA/QC samples are to be taken for 10 percent of the total number of samples. When possible, one field blank per sampling event will be taken.

2.3.5 Chain of Custody and Sample Shipment

Information regarding the COCs and sample shipping methods are discussed in Section 2.2.5.

2.4 METHODOLOGY ADJUSTMENTS OVER TIME

There have not been any changes to the sampling methods for streams and lakes between 2005 and 2015, unless specific circumstances required alternative methods. These exceptions would be very rare, and any changes to methodology would be recorded on field record sheets. Field record sheets used are included in Appendix B.

Equipment used for field measurements and lake sample collection have varied over time, based on the equipment available at the time. For lake sampling, the following samplers have been used:

- Beta bottle
- Van Dorn sampler
- Kemmerer bottle

To maintain consistency, all future sampling events after 2015 will use a Kemmerer bottle sampler to collect lake water quality samples.

As discussed in Section 2.3.1, prior to 2016, lake water quality sampling protocol involved taking water samples at two isolated depths (approximately 1 meter below surface and approximately 1 meter above the bottom) and conducting an *in-situ* water quality profile at each lake water quality site.

In 2015, Minnow Environmental Inc. (Minnow) was contracted to assist Baffinland in completing the fieldwork and reporting requirements of several of the AEMP component studies, including the CREMP. After completing the CREMP in 2015, Minnow proposed several modifications to the program (presented in Appendix I of the AEMP) to provide greater efficiencies and improve the program's ability to achieve its objectives (i.e. to evaluate short and long term effects of the Project on aquatic ecosystems).

In the list of recommendations proposed by Minnow (Appendix I of AEMP), Minnow noted that no consistent spatial differences in water quality/chemistry were evident in any of the study lakes in 2015, nor during any of the baseline studies, suggesting that study lakes are generally well mixed with relatively uniform water chemistry throughout the year. (Minnow, 2016) (Minnow, 2016). Because of this, Minnow proposed two adjustments to the water quality sampling methodology being applied to the CREMP water quality program:

1. Changing the number and depth at which water samples were taken (previously near surface and bottom) to a single sample taken at mid-depth (Item 9; Minnow, 2016)
2. Limiting water quality *in-situ* profiling to a few select stations located at the main basins of study lakes as well as any stations showing anoxic conditions (Item 8; Minnow 2016)

This document along with the CREMP study design has been modified to reflect both of these recommendations.

3 – SEDIMENT QUALITY

3.1 GENERAL

Stream sediment quality data was collected for the Project every year between 2005 to 2015, with the exception of 2009 and 2010. Lake sediment quality data was collected for the Project every year since 2006, with the exception of 2009 and 2010. Parameters analysed included nutrients, metals, major ions and particle size. A detailed list of current parameters is provided in Appendix A.

Sediment quality monitoring is typically conducted as part of the benthic invertebrate community surveys for mining projects. These sampling programs typically focus on total organic carbon content, metals and particle size distribution (EC, 2012). The purpose of sediment monitoring at these sites is to identify any changes in sediment quality from baseline data that may be attributed to mine operations and that may pose a risk to benthic macroinvertebrate communities. As such, sediment samples will be continued to be collected concurrently with benthic macroinvertebrate samples.

Following the 2015 CREMP field program, Minnow recommended that stream sediment sampling be discontinued in future CREMP studies due to the very limited amount of depositional habitat suitable for the collection of sediment in the streams and rivers located in the Mary River Project local study area. As observed during the 2015 CREMP and baseline studies, the general absence of any substantial accumulation of fine sediments within the studied watercourses preclude any meaningful assessment of potential mine-related influences on sediment quality within, along and/or between watercourses (Minnow, 2016). Because of this, historic sediment sampling sites within streams and rivers have been removed from the CREMP Study Design.

3.2 LAKE SEDIMENT SAMPLING METHODOLOGY

3.2.1 Sampling Strategy

Lake sediment samples have been collected using various methods as described in Section 3.4. The methods defined below describe the collection of the lake sediment samples.

3.2.2 Equipment and Sampling

A sediment gravity core sampler (Figure 3.1) will be utilized to obtain lake sediment samples. The top two centimeters of sediment from the core samples will be retained for laboratory analysis.

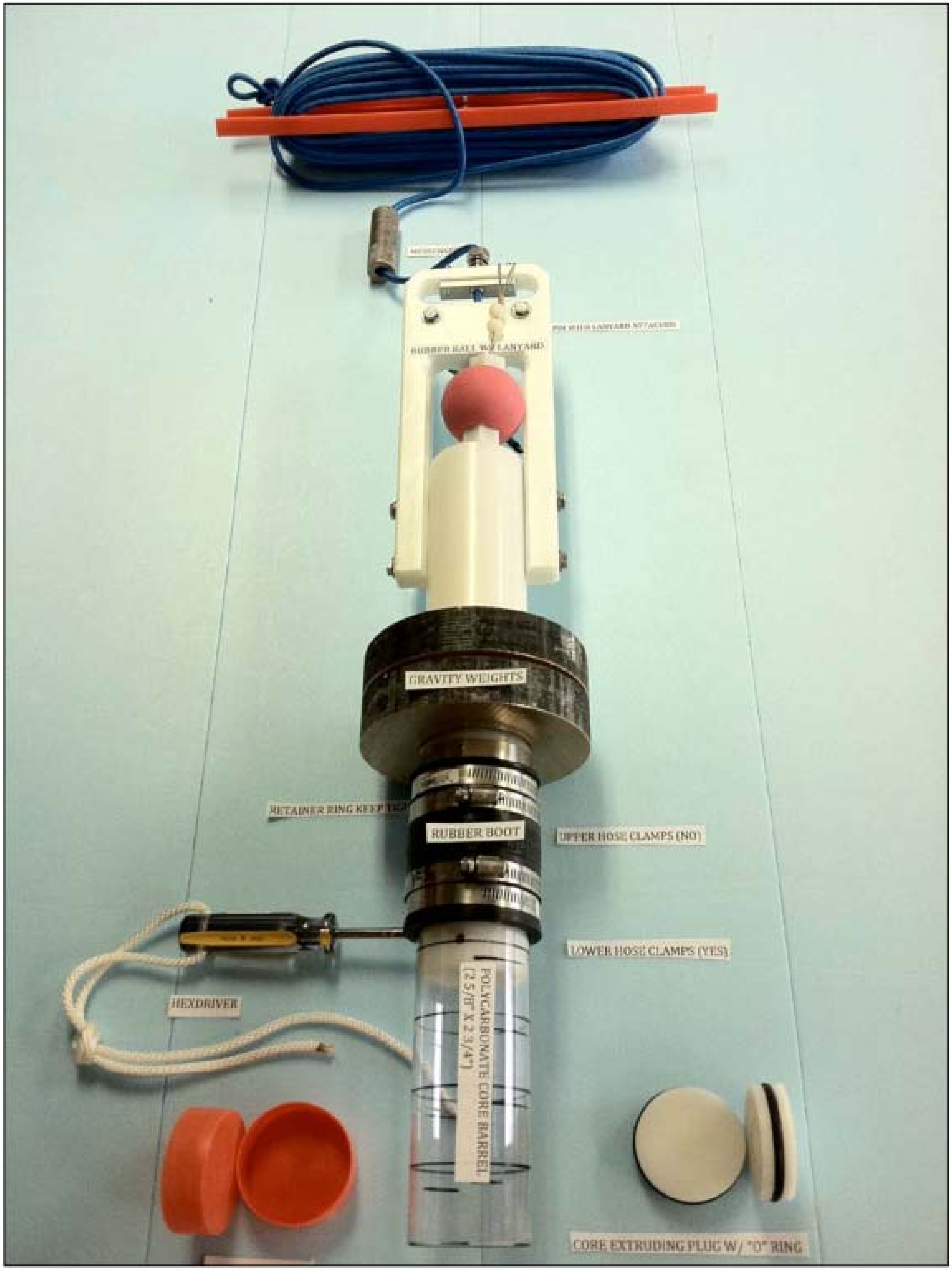


Figure 3.1 – Sediment Gravity Core Sampler

3.2.3 Field Measurements and Observations

At each sampling site, the following information will be recorded during the collection of sediment samples.

- Site ID and UTM coordinates and location of any duplicate samples collected
- Sampling date and time
- Ambient weather conditions (e.g., wind speed, direction, wave action, current, air temperature)
- Sediment collection device
- General site description and observations (e.g., depth of water or ice)
- Sample properties (e.g., colour, texture, consistency, odour, presence of biota, estimate of quantity of recovered sediment)
- Deviations from the standard operating procedures

Lake sediment samples will be collected using the sediment gravity corer and the following procedure.

- A clear polycarbonate core tube will be loaded into the corer and secured using a set of stainless steel hose clamps
- The corer (Figure 3.1) will be positioned perpendicular to the water surface prior to release. The penetration depth of the core tube is affected by the depth of water, angle of corer deployment and substrate type.
- Once the corer is embedded in the substrate, the stainless steel messenger will be sent down the corer rope to release the ball-type seal. This seal creates a vacuum in the core tube, retaining the sampled sediment.
- The corer will be retrieved vertically and at a constant speed to the surface.
- Upon retrieval, the bottom of the core tube will be plugged using an extruding plug prior to breaking the air-water interface. This procedure will prevent sample loss.
- Following placement of the core tube plugs, the hose clamps on the corer will be loosened to release the tube.
- The visual characteristics of the core sample will be recorded on the field record sheets (e.g., colour, apparent horizons, aquatic vegetation, etc.)
- Overlying water within the tube will be described on field notes (e.g., clarity) prior to decanting. The decanting process should be undertaken carefully to ensure that no sediment sample is lost.

The sample is extruded out of the core tube and processed as follows:

- A suitable extruding apparatus, such as a PVC tube cut longer than core tube and with a slightly suitable extruding apparatus, such as a PVC tube cut longer than core tube and with a slightly smaller outside diameter, will be used to force the extruding plug through the core tube. This process moves the sediment sample to the end. Care will be taken not to extrude the sediment, since the first two centimetres are the sample.

- The top two centimeters of sediment will be scooped out using a clean stainless steel spoon and placed in a clean stainless steel bowl
- A minimum of three core samples will be required per station. Limiting the amount of sampled sediment per tube (i.e., the top two centimeters) typically requires more sampling effort to obtain the required sample size.
- Samples within a station will be close to one another, but far enough apart to ensure that sampling disturbance from one grab does not affect another. Sampling from both sides of the boat and around the bow typically provides suitable spatial distribution within the station.
- After the top two centimeters are retained, the remaining, unused sediments within the core tube will be placed into a bucket and only released once sampling is complete at that particular station.
- The core tube will be rinsed at surface and reloaded into the sampler in preparation for the next sample.

3.2.4 Sediment Sample Homogenization

Once sufficient sediments have been collected within the stainless steel bowl, the sample will be homogenized. Prior to homogenization, excess water will be decanted once the water has settled (to prevent loss of fines) and any large inorganic material (e.g., cobble) or debris will be removed. Once this step is complete, the sample will be thoroughly mixed using a newly gloved hand or stainless steel spoon until the sample has a homogeneous appearance. The sample containers will be filled by alternating aliquots between each of the containers. Once the containers are full, each sample will be transferred to an ice-packed cooler. Samples will be kept cool and in the dark until they can be shipped to the analytical laboratory.

3.2.5 QA/QC

All sampling equipment will be thoroughly cleaned between sampling stations and rinsed with ambient water prior to sampling. Duplicate samples will be taken for ten percent of the total number of samples.

3.2.6 Chain of Custody and Sample Shipment

The COCs and sample shipping methods are discussed in Section 2.2.5.

3.3 METHODOLOGY ADJUSTMENTS OVER TIME

Sediment sampling conducted prior to 2012 utilized a Petite Ponar grab sampler (231 cm2) or an Ekman dredge sampler (523 cm2). The sediment fraction collected for analysis was limited to the top 5 cm.

During review of the FEIS, BIM agreed to a recommendation from Environment Canada to carry out sediment sampling utilizing core in order to collect only the uppermost one to two centimetres. The rationale for this approach is that most infaunal organisms and the most recently introduced sediment (including contaminants of concern) are found in the upper two centimetres of the lake sediment. Arctic lakes experience low sedimentation rates and, therefore, collection of a thinner sample using a sediment coring instrument provides better resolution of changes in sediment quality.

Collection of thinner (1 cm to 2 cm) sediment samples was implemented by Baffinland starting in 2012. The top 2 cm of sediment from the core samples as described above will be retained for laboratory analysis.

As discussed in Section 3.1, beginning in 2016, stream and river sediment sampling will no longer conducted as part of the CREMP sediment sampling program.

4 – REFERENCES

Environment Canada (EC). 2012. *Environmental Effects Monitoring Technical Guidance Document*. National Environmental Effects Monitoring Office.

Minnow Environmental Inc. (Minnow). 2016. *Mary River Project CREMP Recommendations for Future Monitoring*.

APPENDIX A

2015 SURFACE WATER AND SEDIMENT QUALITY PARAMETER LIST

Water Quality Parameters

Parameter	Lowest Detection Limit	Units
Physical Tests (Water)		
Conductivity	3.0	umhos/cm
Hardness (as CaCO3)	10	mg/L
pH	0.10	pH units
Total Suspended Solids	2.0	mg/L
Total Dissolved Solids	20	mg/L
Turbidity	0.10	NTU
Anions and Nutrients (Water)		
Alkalinity, Total (as CaCO3)	10	mg/L
Ammonia, Total (as N)	0.050	mg/L
Bromide (Br)	0.10	mg/L
Chloride (Cl)	0.50	mg/L
Nitrate and Nitrite as N	0.021	mg/L
Nitrate (as N)	0.020	mg/L
Nitrite (as N)	0.0050	mg/L
Total Kjeldahl Nitrogen	0.15	mg/L
Total Phosphorus	0.0030	mg/L
Sulfate (SO4)	0.30	mg/L
Organic / Inorganic Carbon (Water)		
Dissolved Organic Carbon	1.0	mg/L
Total Organic Carbon	1.0	mg/L
Total Metals (Water)		
Mercury (Hg)-Total	0.000010	mg/L
Total Metals (Undigested) (Water)		
Aluminum (Al)-Total	0.0030	mg/L
Antimony (Sb)-Total	0.00010	mg/L
Arsenic (As)-Total	0.00010	mg/L
Barium (Ba)-Total	0.000050	mg/L
Beryllium (Be)-Total	0.00050	mg/L
Bismuth (Bi)-Total	0.00050	mg/L
Boron (B)-Total	0.010	mg/L
Cadmium (Cd)-Total	0.000010	mg/L
Calcium (Ca)-Total	0.050	mg/L
Chromium (Cr)-Total	0.00050	mg/L
Cobalt (Co)-Total	0.00010	mg/L
Copper (Cu)-Total	0.00050	mg/L
Iron (Fe)-Total	0.030	mg/L
Lead (Pb)-Total	0.000050	mg/L
Lithium (Li)-Total	0.0010	mg/L
Magnesium (Mg)-Total	0.050	mg/L
Manganese (Mn)-Total	0.000070	mg/L
Molybdenum (Mo)-Total	0.000050	mg/L
Nickel (Ni)-Total	0.00050	mg/L
Potassium (K)-Total	0.20	mg/L
Selenium (Se)-Total	0.0010	mg/L
Silicon (Si)-Total	0.10	mg/L
Silver (Ag)-Total	0.000010	mg/L
Sodium (Na)-Total	0.050	mg/L

Strontium (Sr)-Total	0.00010	mg/L
Thallium (Tl)-Total	0.00010	mg/L
Tin (Sn)-Total	0.00010	mg/L
Titanium (Ti)-Total	0.010	mg/L
Uranium (U)-Total	0.000010	mg/L
Vanadium (V)-Total	0.0010	mg/L
Zinc (Zn)-Total	0.0030	mg/L

Dissolved Metals (Water)

Aluminum (Al)-Dissolved	0.00060	mg/L
Antimony (Sb)-Dissolved	0.000020	mg/L
Arsenic (As)-Dissolved	0.000020	mg/L
Barium (Ba)-Dissolved	0.000030	mg/L
Beryllium (Be)-Dissolved	0.000010	mg/L
Bismuth (Bi)-Dissolved	0.0000050	mg/L
Boron (B)-Dissolved	0.0050	mg/L
Cadmium (Cd)-Dissolved	0.0000050	mg/L
Calcium (Ca)-Dissolved	0.020	mg/L
Chromium (Cr)-Dissolved	0.00010	mg/L
Cobalt (Co)-Dissolved	0.0000050	mg/L
Copper (Cu)-Dissolved	0.00010	mg/L
Iron (Fe)-Dissolved	0.0010	mg/L
Lead (Pb)-Dissolved	0.0000090	mg/L
Lithium (Li)-Dissolved	0.00050	mg/L
Magnesium (Mg)-Dissolved	0.0050	mg/L
Manganese (Mn)-Dissolved	0.000070	mg/L
Mercury (Hg)-Dissolved	0.000010	mg/L
Molybdenum (Mo)-Dissolved	0.000050	mg/L
Nickel (Ni)-Dissolved	0.000090	mg/L
Phosphorus (P)-Dissolved	0.050	mg/L
Potassium (K)-Dissolved	0.050	mg/L
Selenium (Se)-Dissolved	0.000040	mg/L
Silicon (Si)-Dissolved	0.050	mg/L
Silver (Ag)-Dissolved	0.0000050	mg/L
Sodium (Na)-Dissolved	0.020	mg/L
Strontium (Sr)-Dissolved	0.000050	mg/L
Sulfur (S)-Dissolved	1.0	mg/L
Thallium (Tl)-Dissolved	0.0000020	mg/L
Tin (Sn)-Dissolved	0.000030	mg/L
Titanium (Ti)-Dissolved	0.00050	mg/L
Uranium (U)-Dissolved	0.0000070	mg/L
Vanadium (V)-Dissolved	0.000050	mg/L
Zinc (Zn)-Dissolved	0.00050	mg/L
Zirconium (Zr)-Dissolved	0.00010	mg/L

Aggregate Organics (Water)

Phenols (4AAP)	0.0010	mg/L

Plant Pigments (Water)

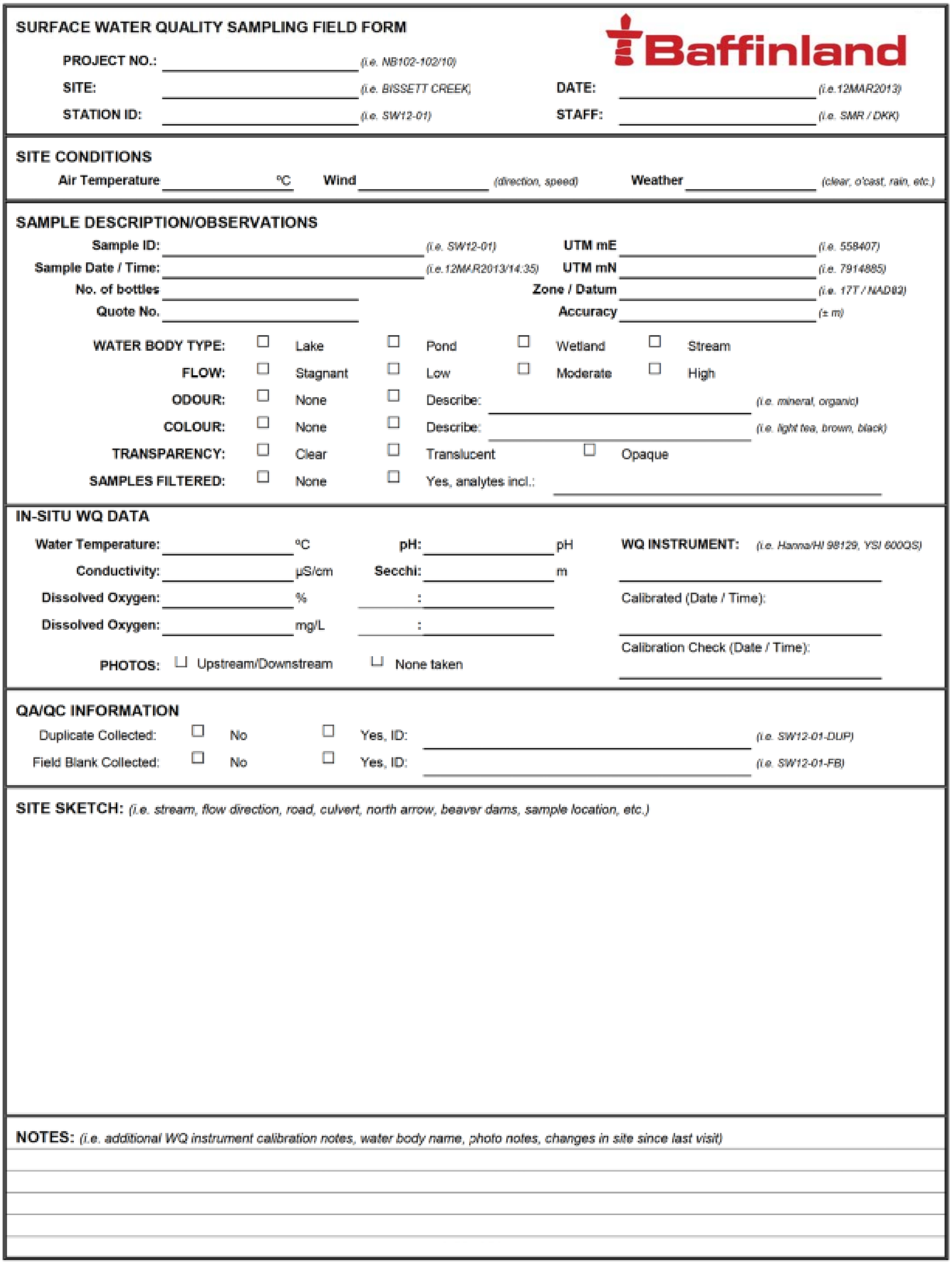
Chlorophyll a	0.10	ug/L
Phaeophytin a	0.10	ug/L

SEDIMENT QUALITY PARAMETERS

Parameter	Lowest Detection Limit	Units
Physical Tests (Sediment)		
% Moisture	0.10	%
Particle Size (Sediment)		
% Sand (2.0mm - 0.05mm)	0.10	%
% Silt (0.05mm - 2um)	0.10	%
% Clay (<2um)	0.10	%
Texture		-
Organic / Inorganic Carbon (Sediment)		
Fraction Organic Carbon	0.0010	g/g
Total Organic Carbon	0.10	%
Metals (Sediment)		
Aluminum (Al)	50	ug/g
Antimony (Sb)	0.10	ug/g
Arsenic (As)	0.10	ug/g
Barium (Ba)	0.50	ug/g
Beryllium (Be)	0.10	ug/g
Bismuth (Bi)	0.20	ug/g
Boron (B)	5.0	ug/g
Cadmium (Cd)	0.020	ug/g
Calcium (Ca)	50	ug/g
Chromium (Cr)	0.50	ug/g
Cobalt (Co)	0.10	ug/g
Copper (Cu)	0.50	ug/g
Iron (Fe)	50	ug/g
Lead (Pb)	0.50	ug/g
Lithium (Li)	2.0	ug/g
Magnesium (Mg)	20	ug/g
Manganese (Mn)	1.0	ug/g
Mercury (Hg)	0.0050	ug/g
Molybdenum (Mo)	0.10	ug/g
Nickel (Ni)	0.50	ug/g
Phosphorus (P)	50	ug/g
Potassium (K)	100	ug/g
Selenium (Se)	0.20	ug/g
Silver (Ag)	0.10	ug/g
Sodium (Na)	50	ug/g
Strontium (Sr)	0.50	ug/g
Sulfur (S)	5000	ug/g
Thallium (Tl)	0.050	ug/g
Tin (Sn)	2.0	ug/g
Titanium (Ti)	1.0	ug/g
Uranium (U)	0.050	ug/g
Vanadium (V)	0.20	ug/g
Zinc (Zn)	2.0	ug/g
Zirconium (Zr)	1.0	ug/g

APPENDIX B

FIELD RECORD SHEET



SURFACE WATER QUALITY SAMPLING FIELD FORM

PROJECT NO.: ______________ *(i.e. NB102-102/10)*
SITE: ______________ *(i.e. BISSETT CREEK)* DATE: ______________ *(i.e.12MAR2013)*
STATION ID: ______________ *(i.e. SW12-01)* STAFF: ______________ *(i.e. SMR / DKK)*

SITE CONDITIONS

Air Temperature ______________ °C Wind ______________ *(direction, speed)* Weather ______________ *(clear, o'cast, rain, etc.)*

SAMPLE DESCRIPTION/OBSERVATIONS

Sample ID: ______________ *(i.e. SW12-01)* UTM mE ______________ *(i.e. 558407)*
Sample Date / Time: ______________ *(i.e.12MAR2013/14:35)* UTM mN ______________ *(i.e. 7914885)*
No. of bottles ______________ Zone / Datum ______________ *(i.e. 17T / NAD83)*
Quote No. ______________ Accuracy ______________ *(± m)*

WATER BODY TYPE: ☐ Lake ☐ Pond ☐ Wetland ☐ Stream
FLOW: ☐ Stagnant ☐ Low ☐ Moderate ☐ High
ODOUR: ☐ None ☐ Describe: ______________ *(i.e. mineral, organic)*
COLOUR: ☐ None ☐ Describe: ______________ *(i.e. light tea, brown, black)*
TRANSPARENCY: ☐ Clear ☐ Translucent ☐ Opaque
SAMPLES FILTERED: ☐ None ☐ Yes, analytes incl.: ______________

IN-SITU WQ DATA

Water Temperature: ______________ °C pH: ______________ pH WQ INSTRUMENT: *(i.e. Hanna/HI 98129, YSI 600QS)*
Conductivity: ______________ µS/cm Secchi: ______________ m ______________
Dissolved Oxygen: ______________ % ______ : ______ Calibrated (Date / Time):
Dissolved Oxygen: ______________ mg/L ______ : ______ ______________
Calibration Check (Date / Time):
PHOTOS: ☐ Upstream/Downstream ☐ None taken ______________

QA/QC INFORMATION

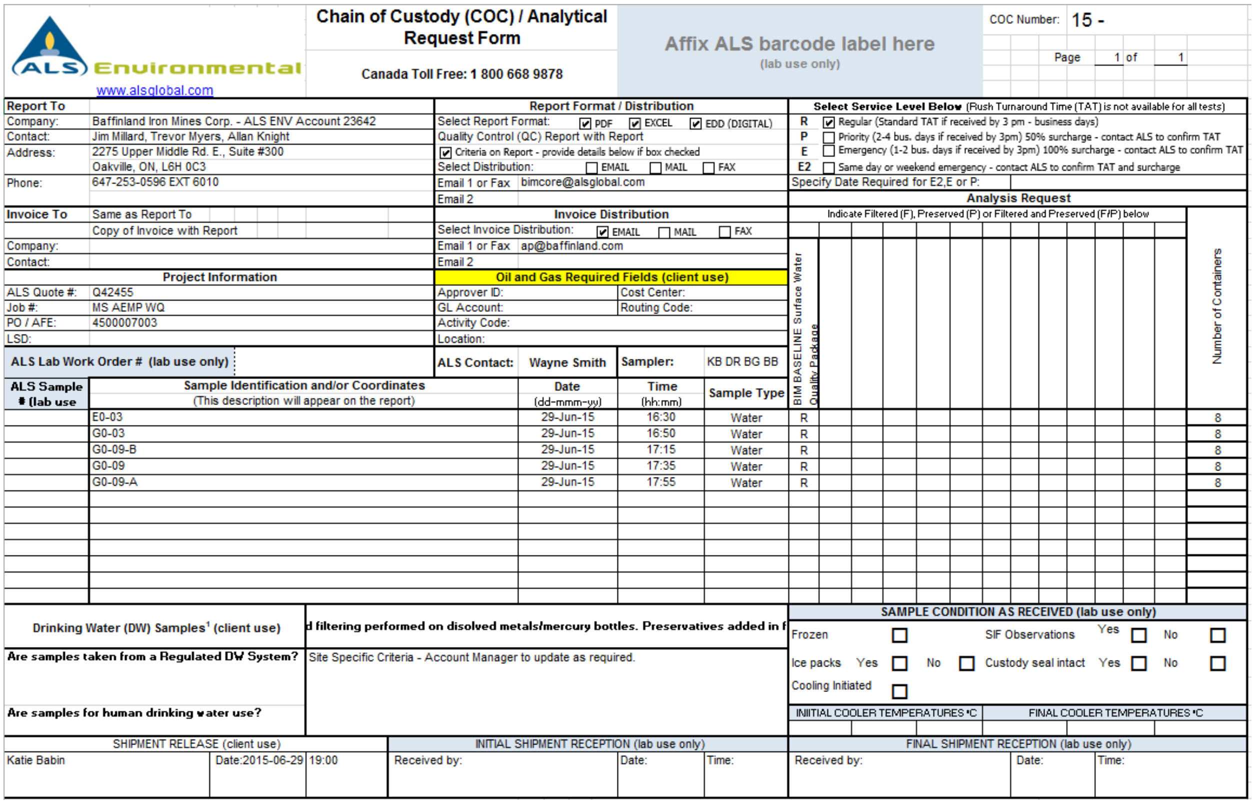
Duplicate Collected: ☐ No ☐ Yes, ID: ______________ *(i.e. SW12-01-DUP)*
Field Blank Collected: ☐ No ☐ Yes, ID: ______________ *(i.e. SW12-01-FB)*

SITE SKETCH: *(i.e. stream, flow direction, road, culvert, north arrow, beaver dams, sample location, etc.)*

NOTES: *(i.e. additional WQ instrument calibration notes, water body name, photo notes, changes in site since last visit)*

APPENDIX C

EXAMPLE OF CHAIN OF CUSTODY



ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number: 15 -

Page 1 of 1

Report To
Company: Baffinland Iron Mines Corp. - ALS ENV Account 23642
Contact: Jim Millard, Trevor Myers, Allan Knight
Address: 2275 Upper Middle Rd. E., Suite #300
Oakville, ON, L6H 0C3
Phone: 647-253-0596 EXT 6010

Report Format / Distribution
Select Report Format: ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report
☑ Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax bimcore@alsglobal.com
Email 2

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
R ☑ Regular (Standard TAT if received by 3 pm - business days)
P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Specify Date Required for E2,E or P:

Invoice To Same as Report To
Copy of Invoice with Report
Company:
Contact:

Invoice Distribution
Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax ap@baffinland.com
Email 2

Project Information
ALS Quote #: Q42455
Job #: MS AEMP WQ
PO / AFE: 4500007003
LSD:

Oil and Gas Required Fields (client use)
Approver ID:
Cost Center:
GL Account:
Routing Code:
Activity Code:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Wayne Smith
Sampler: KB DR BG BB

Analysis Request
Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	BIM BASELINE Surface Water Quality Package	Number of Containers
	E0-03	29-Jun-15	16:30	Water	R	8
	G0-03	29-Jun-15	16:50	Water	R	8
	G0-09-B	29-Jun-15	17:15	Water	R	8
	G0-09	29-Jun-15	17:35	Water	R	8
	G0-09-A	29-Jun-15	17:55	Water	R	8

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System?
Are samples for human drinking water use?

d filtering performed on disolved metals/mercury bottles. Preservatives added in f
Site Specific Criteria - Account Manager to update as required.

SAMPLE CONDITION AS RECEIVED (lab use only)
Frozen ☐ SIF Observations Yes ☐ No ☐
Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐
INIITIAL COOLER TEMPERATURES °C
FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Katie Babin	Date:2015-06-29	19:00	Received by:	Date:	Time:	Received by:	Date:	Time:

APPENDIX D

SAMPLING PROGRAM – QUALITY ASSURANCE AND QUALITY CONTROL PLAN
(BAF-PH1-830-P16-0001 r1)

Baffinland Iron Mines Corporation

Sampling Program – Quality Assurance and Quality Control Plan

BAF-PH1-830-P16-0001

Rev 1

Prepared By: **William Bowden**
Department: **Environment**
Title: **Environmental Coordinator**
Date: **March 14, 2016**
Signature:

Approved By: **Erik Madsen**
Department: **Health, Safety and Environment**
Title: **Vice President – SD, Environment, Health & Safety**
Date: **March 14, 2016**
Signature:

DOCUMENT REVISION RECORD

Issue Date MM/DD/YY	Revision	Prepared By	Approved By	Issue Purpose
01/15/2014	0	JM	EM	Approved for Use
03/14/16	1	WB	EM	Approved for Use

TRACK CHANGES TABLE

A review and update of the Surface Water Sampling Program – Quality Assurance and Quality Control Plan has been undertaken, with the following salient revisions to the January 15, 2014 version (BAF-PH1-830-P16-0001, Rev 0).

Index of Major Changes/Modifications in Revision 5

Item No.	Description of Change	Relevant Section
1	Major revision to whole document	
2		
3		
4		
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1 INTRODUCTION

As required by Baffinland Iron Mines Corporation's (Baffinland) Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 (Type A Water Licence) and Type B Water Licence No. 2BE-MRY1421 (Type B Water Licence) for the Mary River Project (Project), a review of Project Environmental Management and Monitoring Plans (EEMPs) was completed. This Quality Assurance and Quality Control (QA/QC) Plan was updated to meet the requirements of the Type A and B water licences. Further and continual modifications and revisions to this Plan shall be completed based on future work scope modifications, QA/QC procedures, and associated approvals. Updates to this Plan shall be completed in accordance to the terms and conditions of Baffinland's Water Licences, QIA Commercial Lease – Q13C301, issued September 6, 2013, the amended Project Certificate No. 005 issued by the Nunavut Impact Review Board (NIRB) and any subsequent requirements which may be issued.

This Quality Assurance and Quality Control (QA/QC) Plan has been reviewed to fulfill the requirement of Part I, Item 16 of License No. 2AM-MRY1325 Amendment No. 1 approved by the Nunavut Water Board to Baffinland Iron Mines Corporation (Baffinland) on July 31, 2014.

In accordance with the stipulations of the Type A Water Licence No. 2AM-MRY1325 Amendment No. 1, this Surface QA/QC Plan has been prepared following the general recommendations presented in *Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "A" Licensees in Meeting SNP Requirements and for Submission of a QA/QC Plan* (INAC, 1996). A copy of the guidelines is included in Appendix A.

1.1 PURPOSE AND SCOPE

The purpose of this Plan is to identify Baffinland's framework for accurate and effective QA/QC management by providing instruction for standardised field sample and laboratory analytical procedures.

For the purposes of this report, QA/QC is defined as:

- ***Quality Assurance*** - System of activities used to achieve quality control.
- ***Quality Control*** - Set of best practice methods and procedures used to ensure quality of data in terms of precision, accuracy and reliability.

The QA/QC best practices outlined in this management plan are designed to provide guidance to field staff and analytical laboratories in order to maintain a high level of confidence in the water quality, soil, and benthic data generated from Project Sites.

1.1.1 2016 WORK PLAN UPDATE

To support the activities identified in the 2016 Work Plan, Baffinland is committed to following the QA/QC procedures documented within this management plan.

1.2 REGULATORY REQUIRMENTS

Baffinland's QA/QC Plan is regulated by the Nunavut Water Board (NWB) and is subject to Baffinland's Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 which provides specific Terms and Conditions for the management of QA/QC procedures at the Project Sites.

Both federal and territorial legislation regulates Water and Soil Quality and Benthic communities in Nunavut. This legislation expects a professional standard and level of confidence when evaluating these Parameters and therefore apply to this QA/QC management plan

1.3 RELATIONSHIPS TO OTHER MANAGEMENT PLANS

This Plan is intended for use in conjunction with the following Plans:

- Air Quality and Noise Abatement Management Plan (BAF-PH1-830-P16-0002)
- Aquatic Effects and Monitoring Plan (BAF-PH1-830-P16-0039)
- Environmental Protection Plan (BAF-PH1-830-P16-0008)
- Fresh Water, Sewage and Wastewater Management Plan (BAF-PH1-830-P16-0010)
- Hazardous Materials and Hazardous Waste Management Plan (BHF-PH1-830-P16-0011)
- Interim Mine Closure and Reclamation Plan (BAF-PH1-830-P16-0012)
- Surface Water, Aquatic Ecosystems, Fish and Fish Habitat Management Plan (BAF-PH1-830-P16-0026)
- Terrestrial Environmental Management and Monitoring Plan (BAF-PH1-830-P16-0027)
- Waste Management Plan (BAF-PH1-830-P16-0028)

2 BAFFINLAND POLICIES

2.1 HEALTH, SAFETY AND ENVIRONMENT POLICY

This Baffinland Iron Mines Corporation Policy on Health, Safety and Environment is a statement of our commitment to achieving a safe, healthy and environmentally responsible workplace. We will not compromise this policy for the achievement of any other organizational goals.

We implement this Policy through the following commitments:

- Continual improvement of safety, occupational health and environmental performance
- Meeting or exceeding the requirements of regulations and company policies
- Integrating sustainable development principles into our decision-making processes
- Maintaining an effective Health, Safety and Environmental Management System
- Sharing and adopting improved technologies and best practices to prevent injuries, occupational illnesses and environmental impacts
- Engaging stakeholders through open and transparent communication.
- Efficiently using resources, and practicing responsible minimization, reuse, recycling and disposal of waste.
- Reclamation of lands to a condition acceptable to stakeholders.

Our commitment to provide the leadership and action necessary to accomplish this policy is exemplified by the following principles:

- As evidenced by our motto "Safety First, Always" and our actions Health and safety of personnel and protection of the environment are values not priorities.
- All injuries, occupational illnesses and environmental impacts can be prevented.
- Employee involvement and active contribution through courageous leadership is essential for preventing injuries, occupational illnesses and environmental impacts.
- Working in a manner that is healthy, safe and environmentally sound is a condition of employment.
- All operating exposures can be safeguarded.
- Training employees to work in a manner that is healthy, safe and environmentally sound is essential.
- Prevention of personal injuries, occupational illnesses and environmental impacts is good business.
- Respect for the communities in which we operate is the basis for productive relationships.

We have a responsibility to provide a safe workplace and utilize systems of work to meet this goal. All employees must be clear in understanding the personal responsibilities and accountabilities in relation to the tasks we undertake.

The health and safety of all people working at our operation and responsible management of the environment are core values to Baffinland. In ensuring our overall profitability and business success every Baffinland and business partner employee working at our work sites is required to adhere to this Policy.

Brian Penney
Chief Executive Officer
March 2016

2.2 SUSTAINABLE DEVELOPMENT POLICY

At Baffinland Iron Mines Corporation (Baffinland), we are committed to conducting all aspects of our business in accordance with the principles of sustainable development & corporate responsibility and always with the needs of future generations in mind. Baffinland conducts its business in accordance with the Universal Declaration of Human Rights and ArcelorMittal's Human Rights Policy which applies to all employees and affiliates globally.

Everything we do is underpinned by our responsibility to protect the environment, to operate safely and fiscally responsibly and with utmost respect for the cultural values and legal rights of Inuit. We expect each and every employee, contractor, and visitor to demonstrate courageous leadership in personally committing to this policy through their actions. The Sustainable Development and Human Rights Policy is communicated to the public, all employees and contractors and it will be reviewed and revised as necessary on a regular basis. These four pillars form the foundation of our corporate responsibility strategy:

1. Health and Safety
2. Environment
3. Upholding Human Rights of Stakeholders
4. Transparent Governance

1.0 HEALTH AND SAFETY

- We strive to achieve the safest workplace for our employees and contractors; free from occupational injury and illness, where everyone goes home safe everyday of their working life. Why? Because our people are our greatest asset. Nothing is as important as their health and safety. Our motto is “Safety First, Always”.
- We report, manage and learn from injuries, illnesses and high potential incidents to foster a workplace culture focused on safety and the prevention of incidents.
- We foster and maintain a positive culture of shared responsibility based on participation, behaviour, awareness and promoting active courageous leadership. We allow our employees and contractors the right to stop any work if and when they see something that is not safe.

2.0 ENVIRONMENT

- Baffinland employs a balance of the best scientific and traditional Inuit knowledge to safeguard the environment.
- Baffinland applies the principles of pollution prevention, waste reduction and continuous improvement to minimize ecosystem impacts, and facilitate biodiversity conservation.
- We continuously seek to use energy, raw materials and natural resources more efficiently and effectively. We strive to develop more sustainable practices.
- Baffinland ensures that an effective closure strategy is in place at all stages of project development to ensure reclamation objectives are met.

3.0 UPHOLDING HUMAN RIGHTS OF STAKEHOLDERS

- We respect human rights, the dignity of others and the diversity in our workforce. Baffinland honours and respects the unique cultural values and traditions of Inuit.
- Baffinland does not tolerate discrimination against individuals on the basis of race, colour, gender, religion, political opinion, nationality or social origin, or harassment of individuals freely employed.
- Baffinland contributes to the social, cultural and economic development of sustainable communities in the North Baffin Region.
- We honour our commitments by being sensitive to local needs and priorities through engagement with local communities, governments, employees and the public. We work in active partnership to create a shared understanding of relevant social, economic and environmental issues, and take their views into consideration when making decisions.
- We expect our employees and contractors, as well as community members, to bring human rights concerns to our attention through our external grievance mechanism and internal human resources channels. Baffinland is committed to engaging with our communities of interest on our human rights impacts and to reporting on our performance.

4.0 TRANSPARENT GOVERNANCE

- Baffinland will take steps to understand, evaluate and manage risks on a continuing basis, including those that may impact the environment, employees, contractors, local communities, customers and shareholders.
- Baffinland endeavours to ensure that adequate resources are available and that systems are in place to implement risk-based management systems, including defined standards and objectives for continuous improvement.
- We measure and review performance with respect to our safety, health, environmental, socio-economic commitments and set annual targets and objectives.
- Baffinland conducts all activities in compliance with the highest applicable legal & regulatory requirements and internal standards.
- We strive to employ our shareholder's capital effectively and efficiently and demonstrate honesty and integrity by applying the highest standards of ethical conduct.

4.1 FURTHER INFORMATION

Please refer to the following policies and documents for more information on Baffinland's commitment to operating in an environmentally and socially responsible manner:

Health, Safety and Environment Policy
Workplace Conduct Policy
Inuktitut in the Workplace Policy
Site Access Policy
Hunting and Fishing (Harvesting) Policy
Annual Report to Nunavut Impact Review Board
ArcelorMittal Canada Sustainability and Corporate Responsibility Report

If you have questions about Baffinland's commitment to upholding human rights, please direct them to contact@baffinland.com.

Brian Penney
Chief Executive Officer
March 2016

3 ENVIRONMENTAL RESPONSIBILITIES

3.1 ROLES AND RESPONSIBILITIES

Baffinland's Environment Department is structured into two components; on - site personnel and off–site personnel. The Project's organisational structure is provided in Figure 1.

Baffinland's Corporate Environment Department provides coordination and oversight on environmental and community works for both on and off-site programs and activities

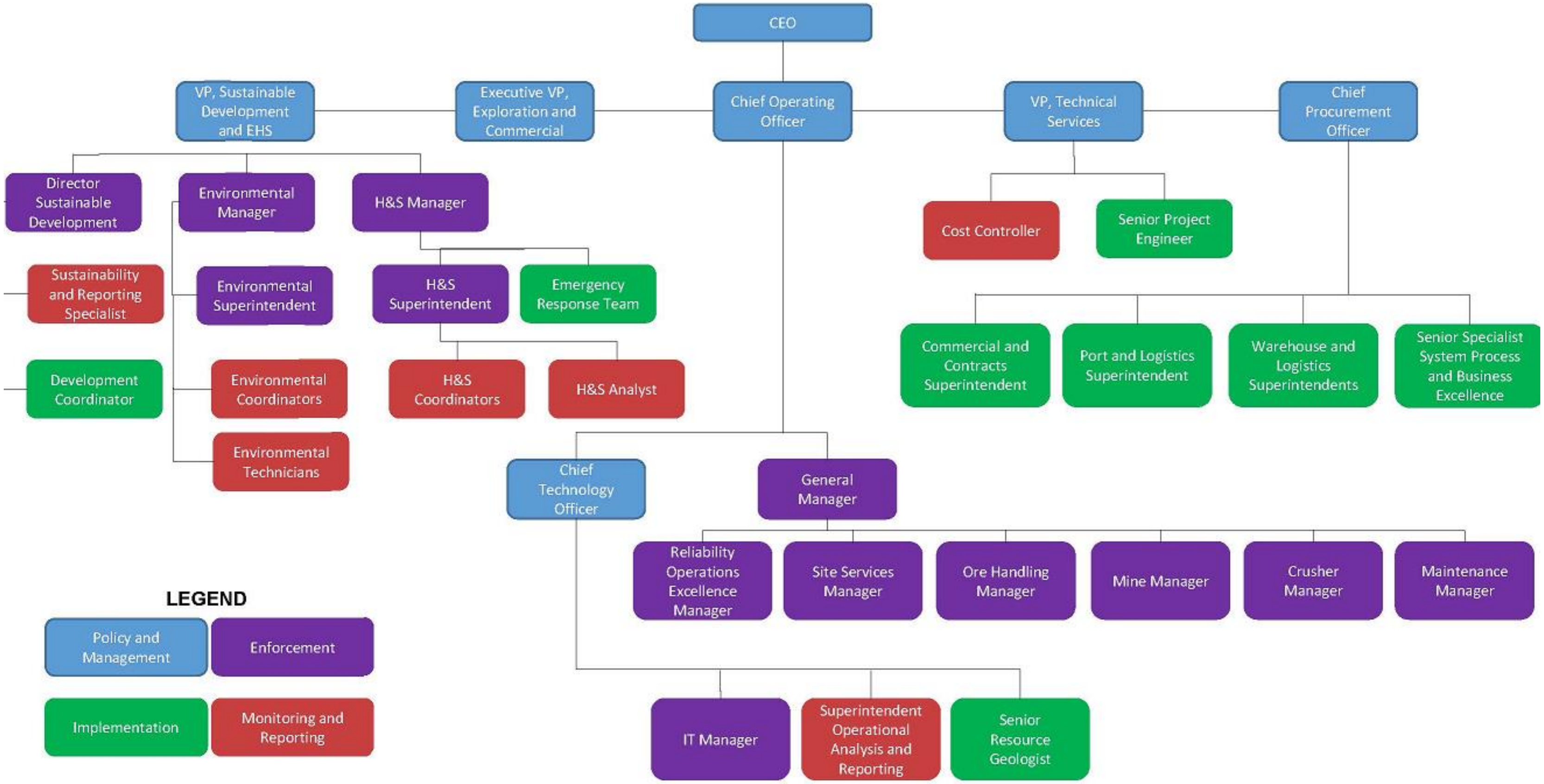
Baffinland's Project Environment Department provides direct coordination and oversight of Project environmental activities (refer to Table 1).

TABLE 1: BAFFINLAND IRON MINES CORPORATION ON-SITE ENVIRONMENTAL DEPARTMENT

Baffinland Iron Mines Corporation On-Site Environmental Team	
Position	**Responsibilities and Accountabilities**
Environmental Manager	• Reports directly to VP Sustainable Development, Health, Safety and Environment and Indirect reporting and coordination with Operations VP and Director Environment • Overall accountability for environmental staff and performance at site • Coordinates implementation and monitors the performance of the Environmental Management System at site • Liaises with the senior management, regulators and stakeholders • Ensures effective monitoring and auditing of environmental performance of departments and contractors on site and identifies opportunities for improvement • Monitors compliance with permits, licenses and authorizations • Ensures all regulatory environmental monitoring and reporting requirements (monthly, annual) are met • Leads and coordinates site permitting requirements. • Initiates and oversees environmental studies • Oversees investigations and reporting of environmental incidents to regulatory bodies, stakeholders and senior management • Reviews and updates environmental management plans
Environmental Superintendent	• Reports to Environmental Manager • Specific accountabilities for environmental monitoring and reporting • Leads investigations and reporting of environmental incidents onsite • Serves as the liaison for regulators during onsite inspections and visits • Provides ongoing environmental education and environmental awareness training to all employees and contract workers • Oversees environmental database management • Prepares updates for management plans
Environmental Coordinator	• Reports to the Environmental Superintendent and Manager • Specific accountabilities for environmental monitoring and reporting • Provides day to day direction to Environmental staff onsite • Serves as a liaison for regulators during onsite inspections and visits.

Baffinland Iron Mines Corporation On-Site Environmental Team	
Position	**Responsibilities and Accountabilities**
	• Provides ongoing environmental education and environmental awareness training to all employees and contract workers • Assists with environmental database management
Environmental Monitor and Technician	• Reports to the Environmental Superintendent or designate • Assists with environmental database management • Assists with monitoring and sampling activities as per the Project's management plans
QIA Monitor	• Works alongside the Baffinland Environment Department to ensure the proper implementation of all environmental management and monitoring plans • Acts as the QIA liaison for onsite environmental matters
Environmental Support Groups (Consultants, etc.)	• Assists with sampling, monitoring and reporting activities as required by permits, licenses and environmental management plans • Provides technical expertise to various environmental studies

Figure 1 - **MARY RIVER PROJECT ORGANIZATION CHART**



3.2 TRAINING AND AWARENESS

All site personnel (including contractors) are required to obtain a general level of environmental awareness and understanding of their obligations regarding compliance with regulatory requirements, commitments and best practices. Site personnel receive prescribed environmental training as part of Baffinland's Mary River Project Site Orientation.

Environment personnel performing environmental monitoring programs are required to understand and be proficient with the QA/QC procedures outlined in this management plan.

4 WATER SAMPLE COLLECTION

4.1 GENERAL

The samples will be collected following the general recommendations presented in *Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "A" Licensees in Meeting SNP Requirements and for Submission of a QA/QC Plan* (INAC, 1996). A copy of the guidelines is included in Appendix A.

A summary of recommended water sample containers, sample volumes, sample preservatives and maximum sample holding times is presented in Table 3. Laboratory parameters such as pH, turbidity, BOD, nitrite, nitrate, total phosphorus, faecal coliforms, chlorophyll-a and pheophytin typically have maximum sample storage times varying from four (4) to 72 hours. Due to the remoteness of the site, it may not always be possible to get laboratory analysis done within the sample holding time window. Every effort will be made to get samples analysed within the preferred holding time window.

Every effort will be made to prevent accidental freezing of water samples (due to on-site climatic conditions) which could affect analytical results for parameters.

For a complete list of the required sample analyses at each monitoring station, please refer to Baffinland's Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 (Nunavut Water Board, July 31 2014) and the Aquatic Effects Management Plan BAF-PH1-830-P16-0039 r1.

4.2 WATER QUALITY MONITORING LOCATIONS

The QA/QC Plan addresses the collection of freshwater surface water quality samples related to monitoring programs being carried out in support of Baffinland's Mary River Project, namely:

1. Collection of environmental surface water samples from area lakes, streams and rivers.
2. Collection of effluent samples from the current and future wastewater treatment facilities located at the Mine Site, Milne Port and Steensby Port.
3. Collection of drinking water samples from camp potable water sources.
4. Collection of surface water discharges from ore stockpiles and waste rock dumps.
5. Collection of surface water discharges from future bulk sample open pits.
6. Collection of water samples from fuel berms and dispensing facilities.
7. Collection of water samples from landfarm facilities and maintenance shops.
8. Collection of effluent samples from oily water treatment systems.
9. Collection of surface water discharges from landfill facilities at the Mine Site.
10. Collection of water samples representative of general site drainage before, during and after construction on Project Sites and the Tote Road.
11. Collection of water samples downstream of active Quarry locations
12. Measurement of water sample field parameters (e.g. pH, conductivity, temperature etc.).

Exact locations and sampling frequency for designated monitoring stations are presented in Baffinland's Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 (Nunavut Water Board, July 31 2014) and the Aquatic Effects Management Plan BAF-PH1-830-P16-0039 r1.

4.3 WATER SAMPLING METHODS AND EQUIPMENT

Water samples specified under Baffinland's Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 (Nunavut Water Board, July 31 2014) and Aquatic Effects Management Plan BAF-PH1-830-P16-0039 r1 are characterised by the following procedures.

4.3.1 GENERAL SAMPLING PROCEDURES

Generally, sampling procedures will consist of the following:

1. Sampler will wear a fresh pair of disposable nitrile gloves for each sampling event.
2. A fresh sample bottle(s) will be used at each monitoring station. Sample bottles will *not* be re-used.
3. Sampling will be carried out by either: i) rinsing the sample bottle with source water three times before immersing the sample bottle to fill it (after which preservative is added, as required), or ii) if the sample bottles are provided pre-charged with preservatives then it is generally convenient to transfer water samples from the source to the sample bottle using a 1-2L plastic jug. Plastic jugs will be rinsed in the source water three times before filling the sample bottle. A dedicated jug will be used for different sample types (e.g. sewage effluent, fuel contaminated drainage and receiving waters). Sample jugs will be replaced on a regular basis.
4. Prior to collecting the sample, the sampling jug will be rinsed in the source water three times. Rinse water will be disposed of so that it does not contaminate the source water where the sample will be collected.
5. Do not rinse bottles that are supplied certified sterile by the laboratory For samples *not requiring preservatives*, sample bottles not certified sterile will be rinsed three times with source water before filling the bottle to the top.
6. For samples *requiring preservatives*, the sample bottle will be filled to the top (or to the indicator line marked on the bottle) and securely sealed. Note that for some volatile contaminants (e.g. BTEX), the sample bottle must be filled with zero headspace.
7. Care will be taken to avoid disturbance of sediments and inclusion of disturbed suspended solids in the sample.
8. Sample details e.g. date, sample ID and analysis will be clearly marked on the bottle in indelible ink.
9. For *dissolved metals* analyses, if possible, the water sample will be filtered in the field immediately after sampling using a 0.45µm disposable filter and syringe. A fresh syringe and filters must be used at each monitoring station. Alternatively, sample filtration can be carried out by the analytical laboratory.
10. All samples will be sealed by ensuring their lids are tightly secured before placing the bottles into the coolers.
11. All samples will be placed in an iced cooler as soon as possible after collection.

4.3.1.1 SAMPLE PRESERVATION

Sample bottles and preservative will be stored under clean conditions on site. Sample bottles will have the appropriate volume of preservative added in the field immediately after sample collection to minimize chemical alterations. Alternatively, sample bottles will be supplied by the analytical laboratory with preservatives already added. Ensure that the preservative container does not come in contact with the sample or inside of the sample bottle/lid. If a water sample requires filtration (e.g., analysis of dissolved metals), preservative must be added following filtration.

4.3.2 LAKE SAMPLING

For monitoring of water quality arising from vertical stratification in lakes, a depth sampler will be used (e.g. a 'Van Dorn' or 'Kemmerer'). Generally, depth samplers consist of a clear polycarbonate sample tube with two spring mounted rubber bungs, one located at each end. The depth sampler is lowered to the correct depth attached to a cord, whereupon a metal weight is released. The weight slides down the cord and strikes a release mechanism button which releases the two bungs which then seal both ends of the tube. The water sample is then pulled back to the surface.

Regardless of the brand, water samplers that are used will be suitable for collection of water samples for ultra-low metals analyses i.e. will have acrylic or PVC construction and silicone seals.

For depth sampling, the following considerations will be taken into account to ensure sample QA/QC:

1. Sampling station locations will be dependent upon the monitoring program objectives and the lake dimensions. When sampling from a watercraft all efforts will be made to anchor the boat stationary. Map coordinates for all lake sampling station locations will be recorded using a GPS unit.
2. A vertical stratification profile (if required), profiling in-situ water quality measurements (e.g pH, temperature, dissolved oxygen, conductivity and turbidity), will be determined using a water quality multimeter (e.g. YSI Sonde) equipped with a long cord with metre intervals marked on it.
3. Depending upon the purpose of the monitoring program, water quality samples may be collected from the different stratified layers. The depth sampler must be slowly lowered in the 'open' position (i.e. to let water enter it) until it reaches the required depth.
4. The depth sampler will be held at this depth temporarily to allow flushing of water inside the apparatus.
5. The metal weight (messenger) will be released (to activate the closing mechanism) and the depth sampler will be pulled back to the surface. Field measurements can be taken at depth or by filling a bottle with the sampled water and taking measurements from that immediately after sampling.
6. When collecting samples close to the lake bed care must be taken to ensure that the depth sampler does not disturb lake bed sediments (which could contaminate the sample).
7. Depending upon the lake area and depth, multiple sampling stations will likely be required to adequately characterize lake water quality.

4.3.3 RIVER SAMPLING

Depending upon the size of the water body, river sampling methods are the same as those presented in Sections 4.3.1 and 4.3.2. To avoid inclusion of floating detritus in the sample, the sample bottle must be fully immersed in the river water. Care will be taken to ensure that disturbed sediments are not included in the sample.

For river sampling, the additional following considerations will be taken into account to ensure sample QA/QC:

1. Grasp the bottle well below the neck and remove the lid, taking care not to touch the inside of the lid.
2. Facing upstream, plunge the bottle beneath the surface of the water to a depth of 20 cm (if possible) with the opening facing downward, then tilt the bottle opening upward into the current to fill.
3. Once the bottle is full, remove the bottle from the water in one motion by forcing the opening upward and into the current and seal the bottle securely.

When selecting water quality monitoring station locations on rivers, care will be taken where a tributary joins a river, since complete mixing of the two waters may not be achieved within several hundred metres downstream of the confluence (or further). When in doubt, vertical profile monitoring across the river’s width using a field parameter such as pH, temperature or conductivity will be used to assess if complete mixing has occurred.

4.3.4 SAMPLING FOR TOXICITY TESTING

Sampling for lethal toxicity testing is a condition of Baffinland’s Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 (Nunavut Water Board, July 31 2014) for various monitoring programs. Sub-lethal toxicity testing is a condition of Environmental Effects Monitoring (EEM) and Metal Mining Effluent Regulations (MMER). Depending on the regulatory and analysis requirements, one or more 4L effluent samples are required. Depending upon the objectives of the toxicity testing, variables that will require confirmation prior to testing include:

- Type of effluent sample to be collected e.g. instantaneous grab sample, or composite sample collected over a period of time
- Type of dilution water to be used by the testing laboratory e.g. standard synthetic laboratory dilution water, receiving water collected upstream of the discharge etc.
- Preferred test organism e.g. *Daphnia magna* and/or rainbow trout

Details concerning laboratory methods are presented in Appendix D. For further details concerning acute lethality testing refer to Environment Canada (2002) and USEPA (2002). For further details concerning sub-lethal testing refer to Environment Canada (2012)

4.3.5 IN-SITU WATER QUALITY

Measurement of field parameters (e.g. temperature, pH, conductivity, redox potential, or dissolved oxygen, etc.), where warranted, will be carried out for each sample at the time of sampling. The required set of field parameters will vary according to sample type and monitoring objectives. For a complete list of required parameters please refer to the Baffinland's Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 (Nunavut Water Board, July 31 2014). The exact methods used for monitoring field parameters will depend upon the type of monitoring probes being used. Field staff will read and be familiar with the instruction manual for the equipment being used on site, and follow manufacturer's instructions for specifics on proper calibration, use, storage, and maintenance.

Field staff will rinse the monitoring probe three times with the water to be monitored before immersing the probe in the water. Generally, the user will ensure that the probe being used has had sufficient time to equilibrate in the water before the reading is taken. This is generally regarded as the point at which the reading has stabilized.

Field parameter data will be recorded in notebooks, or preferably in a custom form designed for this purpose. A copy of the data should be retained on site.

4.3.5.1 MONITORING PROBE CALIBRATION

Monitoring probes will be stored and calibrated in accordance with manufacturers' instructions. All probes will be calibrated regularly per sampling program requirements and a written record of the calibration results will be maintained on site. Field staff will ensure that calibration solutions are of the correct specification and that they have not passed their expiry date (if applicable). Monitoring probes will be stored as per manufacturers' recommendations.

5 SEDIMENT SAMPLE COLLECTION

For a complete list of the required sample analyses at pre-established monitoring station, please refer to Baffinland's Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 (Nunavut Water Board, July 31 2014) and the Aquatic Effects Management Plan BAF-PH1-830-P16-0039 r1. Every effort will be made to get samples analysed within the preferred holding time window conforming to the specified protocols for sediment sampling. A summary of recommended sediment sample containers, sample volumes, and maximum sample holding times is presented in Table 3. Field observations and parameters if warranted should be recorded during the collection of sediment samples.

5.1 SEDIMENT MONITORING LOCATIONS

The QA/QC Plan addresses the collection of sediment samples related to monitoring programs being carried out in support of Baffinland's Mary River Project, namely:

1. Collection of environmental sediment samples from area lakes, streams and rivers.
2. Collection of sediment samples from fuel berms and dispensing facilities.
3. Collection of sediment samples from landfarm facilities.
4. Collection of sediment samples from remediation and reclamation projects.
5. Collection of sediment samples evaluating spills and releases.

5.2 SEDIMENT SAMPLING METHODS AND EQUIPMENT

Sediment samples specified under Baffinland's Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 (Nunavut Water Board, July 31 2014) and Aquatic Effects Management Plan BAF-PH1-830-P16-0039 r1 are characterised by the following procedures.

5.2.1 GENERAL SAMPLING PROCEDURES

Generally, sampling procedures will consist of the following:

1. Sampler will wear a fresh pair of disposable nitrile gloves for each sampling event.
2. A fresh sample bottle(s) will be used at each monitoring station. Sample bottles will *not* be re-used.
3. Sample details e.g. date, sample ID and analysis will be clearly marked on the sample jar in indelible ink.
4. All samples will be sealed by ensuring their lids are tightly secured before placing the bottles into the coolers.
5. All samples will be placed in an iced cooler as soon as possible after collection.

5.2.2 RIVER AND GRAB SAMPLING

The collection of river and grab samples will follow the general procedures stated in 5.2.1 and will entail the following additional QA/QC considerations:

1. Sampling station locations will be dependent upon the monitoring program objectives and the sample location.
2. A sterile spatula or spoon will be utilized to obtain a representative sample of the sediment for analyse.
3. If composite samples are required by the monitoring program, a sterile container will be utilised to deposit and homogenize the subsamples, until the composite sample is fully mixed. The composite sample will then be transferred to the identified sample jars by alternating aliquots.
4. The quantity and holding time of samples obtained will depend on the prescribed analysis.

5.2.3 LAKE SAMPLING

For monitoring of sediment character and quality in lakes, a depth sampler will be used. The preferred sample apparatus for lake sediment samples are gravity percussion corers, since they allow for retrieval and analysis of sediment profiles. A petite Ponar can also be used but will not provide sediment profiles. Generally, forms of gravity percussion corers consist of a clear polycarbonate sample core tube attached to a weighted upper head assembly and a seal mechanism. The top two centimeters of sediment from the core samples will be retained for laboratory analysis unless sampling objectives state otherwise.

Sediment lake sampling procedures will follow the general procedures stated in 5.2.1 and the following additional QA/QC considerations for a gravity percussion corer:

1. Sampling station locations will be dependent upon the monitoring program objectives and the lake dimensions. When sampling from a watercraft all efforts will be made to anchor the boat stationary. Map coordinates for all lake sampling station locations will be recorded using a GPS unit.
2. The corer will be positioned perpendicular to the water surface prior to release. The penetration depth of the core tube is affected by the depth of water, angle of corer deployment and substrate type.
3. Once the corer is embedded in the substrate, the stainless steel messenger will be sent down the corer rope to release the ball-type seal. This seal creates a vacuum in the core tube, retaining the sampled sediment.
4. Upon retrieval, the bottom of the core tube will be plugged using an extruding plug prior to breaking the air-water interface. This procedure will prevent sample loss.
5. An extruding apparatus will be used to force the extruding plug through the core tube moving the sediment sample to the end of tube allowing the top two centimetres to be scooped out and placed in a clean stainless steel bowl for sample homogenisation.
6. Multiple core samples (generally three or more) are required per sample station to obtain the required sample volume. The multiple core samples are homogenized in the stainless steel bowl, removing any excess water or debris.
7. The sample containers will be filled by alternating aliquots between each of the containers.

8. After the top two centimeters are retained, the remaining, unused sediments within the core tube will be placed into a bucket and only released once all core sampling is complete at that particular station.
9. Depending upon the lake area and depth, multiple sampling stations will likely be required to adequately characterize lake water quality.

6 BENTHIC INVERTEBRATES SAMPLE COLLECTION

For a complete list of required analyses at pre-established monitoring stations, see Baffinland's Aquatic Effects Management Plan BAF-PH1-830-P16-0039 r1. Samples will be submitted to an analytical laboratory for processing and taxonomic identification. Laboratory methods for benthic invertebrate samples will be in accordance with guidance provided by EC, 2012. Field observations and parameters if warranted should be recorded during the collection of benthic invertebrate samples

6.1 BENTHIC INVERTEBRATE MONITORING LOCATIONS

This QA/QC Plan addresses the collection of benthic invertebrate samples related to monitoring programs being carried out in support of Baffinland's Mary River Project, namely:

- Collection of benthic invertebrate samples from area lakes, streams and rivers in remote reference areas
- Collection of benthic invertebrate samples from area lakes, streams and rivers in the Project Area to determine:
    1. Water quality changes related to discharge of ore or stockpile runoff to freshwater systems
    2. Water quality changes related to discharge of treated sewage effluent
    3. Water quality changes due to deposition of dust in lakes and streams.
    4. Changes in water levels and/or flows due to water withdrawals, diversions, and effluent discharges

6.2 BENTHIC INVERTEBRATE SAMPLING METHODS AND EQUIPMENT

Benthic Invertebrate samples follow the same general procedures outlined in 5.2.1. Benthic invertebrates can be collected from either depositional (lake) or erosional (stream) sample locations. A petite Ponar is utilised when sampling depositional environments while a Surber sampler is utilised when sampling erosional environments. For a complete list of depositional and erosional sample methods see Baffinland's Aquatic Effects Management Plan BAF-PH1-830-P16-0039 r1. Benthic invertebrate samples will be carefully sieved through 500 µm mesh. All materials, including invertebrates, retained by the mesh will be transferred to labelled plastic jars and fixed with 10% buffered formalin. Fixed and labelled samples will be shipped to an analytical laboratory for processing and archiving.

7 QA/QC

For monitoring of QA/QC during sample collection and shipping, a set of QA/QC samples will be routinely submitted for analysis. Descriptions of the QA/QC samples that will be used (e.g. field blank, travel blank, equipment blank and field duplicate) are presented on Table 2. Except equipment blanks, ten percent of all samples will comprise QA/QC samples.

In the interest of transparency, the analytical laboratories will also be instructed to report the results of their own in-house QA/QC testing (e.g. results of random replicate analyses of submitted samples).

The results of QA/QC analyses will be routinely reviewed by Baffinland or their designate, and any anomalous results will be promptly investigated with the assistance of the analytical laboratory. Once the reason for the anomalous results is identified, Baffinland will ensure that operating procedures of field staff and/or the analytical laboratory will be altered in order to rectify the problem. Compliance monitoring and data management for water license sampling will be conducted by Baffinland, with the assistance of a designate as required.

TABLE 2: PURPOSE, DESCRIPTION AND FREQUENCY OF QA/QC SAMPLES

QA/QC Plan	Purpose	Description	Frequency	Prepared By
Field blank	Identification of potential contaminants arising from sample collection. The field blank bottle is prefilled with laboratory deionized water and is handled in the same way as regular sample bottles (i.e., opened and closed during the sample collection). The bottle is submitted as a routine sample.	Bottle contains prefilled deionized water. Bottle is handled the same as one would handle the samples.	Ten percent of all samples collected will be QA/QC.	Field Staff
Travel blank	Identification of potential contaminants arising from sample storage, shipping and laboratory handling. The travel blank accompanies the samples to the laboratory but is not taken out into the field, or opened.	Sealed bottle containing deionized water provided by analytical laboratory.	Ten percent of all samples collected will be QA/QC.	Analytical laboratory
Equipment blank	Assesses cross contamination from field water sampling apparatus (e.g Kemmerer). Rinse deionized water through water sampling apparatus and transfer to sample bottles.	Bottle contains dionized water that has been rinsed through the sampling apparatus.	Collected prior and after completion of sampling program (if required).	Field Staff
Field duplicate	Assesses sample variability and precision of laboratory analytical methods. Collected from a randomly selected location, split from a homogenized	Duplicate sample selected at random. A large sterile bottle is used to collect the	Ten percent of all samples collected will be QA/QC.	Field Staff

	sample and analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory.	water. Water is then poured equally into two sets of pre-labelled bottles.		

8 SAMPLE MANAGEMENT

8.1 SAMPLE LABELING

Accurate sample labelling is essential for later interpretation of field data. Ensure that labels are legible and written with an indelible marker. For a complete list of the predetermined sample labels at monitoring station, please refer to Baffinland's Type A Water Licence No. 2AM-MRY1325 Amendment No. 1 (Nunavut Water Board, July 31 2014) and the Aquatic Effects Management Plan BAF-PH1-830-P16-0039 r1.

A consistent format for identifying samples must be followed if a predetermined sample label does not exist in order to facilitate accurate sample tracking and to ensure sample labels are interpreted in the same manner by all personnel involved in the program.

Samples must be uniquely identified with the following information:

- Sample ID
- Collection date and time
- Project identifier
- Company name

QA/QC samples will be labeled by the following conventions:

- Field Duplicate: 01 following the sample label
- Field Blank: 02 following the sample label
- Travel Blank: 03 following the sample label
- Equipment Blank: 04 following the sample label

8.2 SAMPLE STORAGE AND HANDLING

Physical, chemical and biochemical reactions may take place in the sample container between the time of sample collection and laboratory analysis Samples will be placed in iced coolers and shipped to the analytical laboratory as soon as possible after collection, consulting stipulated analytical holding times, to minimize these changes. Care will be taken to ensure that bottles are stored upright and are packed securely within the cooler. Preferably, leak-proof ice packs will be used for cooling the samples. If loose ice is used then this should be securely sealed in plastic bags to prevent leakage of melt water.

Biological samples (e.g. benthic invertebrates) preserved using formalin or Lugol's solution can be held at room temperature until submission to the analytical laboratory.

8.3 SAMPLE SUBMISSION AND CHAIN OF CUSTODY

A chain of custody (COC) form will accompany all samples being submitted to ensure that the required analyses are completed, and to confirm receipt of samples by the laboratory (see example form presented in Appendix B).Prior to shipment, samples should be carefully prepared for shipping and sample bottles listed on the COC must be reconciled with what has physically been placed in the shipping container. The collection of samples that are time sensitive needs to coincide with shipping schedules, travel time to the laboratory, and laboratory business hours. A record of all COCs submitted for analysis must be kept on site. Information on the COC form will include:

1. Project name and project assignment number.
2. Address of analytical laboratory, name of contact person and contact details.
3. Contact details and name of sampler.
4. Date and time of sampling.
5. Whether the sample has been filtered, or whether laboratory filtration is required.
6. List of sample I.D.'s, sample type (e.g. lake water, sewage effluent, etc.), number of sample bottles per sample and analysis requested.
7. Urgency of analysis (e.g. rush or normal). For rush samples the analytical laboratory should be notified ahead of time.
8. Whether sample contains preservative and if so, what preservative and when it was added.
9. Submission date and time.
10. Comments on any unusual conditions and other important information.

9 LABORATORY ANALYSIS

9.1 LABORATORY ACCREDITATION

Laboratory analysis of samples is performed by an on-site accredited analytical laboratory and an off-site accredited analytical laboratory. The on-site laboratory is operated by ALS Canada LTD. and is located at the Mine Site. A select set of basic analytical parameters (e.g. pH, TSS, Turbidity etc.), are performed by the on-site laboratory. The off-site laboratory, ALS Environmental, located in Waterloo, ON, run by ALS Canada Ltd. performs the majority of analyse required. Toxicity testing is performed by Aquatox Testing & Consulting Inc, located in Guelph, ON. Details of ALS analytical laboratory licencing and accreditation are presented in Appendices C.

9.2 ANALYTICAL DETECTION LIMITS

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. 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.

It should be noted that on occasion, a loss of analytical sensitivity can be encountered due to excessively high concentrations of parameters within a sample or lack of provided sample matrix. If this is encountered, Baffinland or their designate will work with the analytical laboratory to try and resolve the problem and new samples will be taken if taken if required. The detection limits on ALS analytical reports contains the LOR. The LOR may be the MDL as calculated, or a higher value. Required analytical laboratory detection limits are provided in Appendix D.

9.3 LABORATORY ANALYTICAL METHODS

Analytical methods used by the analytical laboratories for water analyses generally conform to the standard methods outlined in *Standard Methods for the Examination of Water and Wastewater* (APHA et al, 1989). Standard analytical methods for available analyses through ALS Environmental are provided in Appendix D.

9.4 ANALYTICAL LABORATORY QA/QC PROCEDURES

ALS Environmental adheres to a designated QA/QC Management System which includes documentation and document control, staff training and internal audits. The practices exceed accreditation requirements for high confidence in data reliability utilising but not limited to:

- Use of calibration verification standards and drift control standards.
- Use of surrogate standards and internal standards.
- Replicate analyses and blanks on submitted samples.
- Use of standard reference materials (SRM’s) and matrix spikes.
- Standards Data Quality objectives 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 take precedence over internal

  Further details on the analytical laboratories in-house QA/QC protocols are presented in Appendix E.

9.5 SUMMARY OF ANALYTICAL PROCEDURES

TABLE 3: SUMMARY OF ANALYTES, WATER AND SOIL SAMPLE VOLUMES, PRESERVATIVES AND SAMPLE STORAGE TIME FOR ALS ENVIRONMENTAL

Inorganics	Analysis [1]	Water Container	Water Preservation	Additional Notes	Soil Container	Water / Soil Hold Time
ROUTINE INORGANICS AND PHYSICALS	Acidity and Alkalinity	0.5-1 L Plastic			125-250 mL Jar or Bag	14 Days / NA
	Anions (Br, Cl, SO4, F) and Electrical Conductivity	0.5-1 L Plastic			125-250 mL Jar or Bag	28 Days [7]/ Unlimited
	Bromate[19], Chlorate and Chlorite	125 mL Plastic	EDA (Ethylenediamine)		NA	28 Days (Chlorite 14 Days) / NA
	BOD, Colour and Turbidity	0.5-1 L Plastic			NA	2-4 Days [8] / NA
	COD and Phenols (4AAP)	125-250 mL Glass	1:1 Sulfuric Acid (H_2SO_4)		NA	28 Days / NA
	Cyanide, Total ,Weak Acid Dissociable,Free	145 mL Plastic	6N NaOH		125-250 mL Jar or Bag	14 Days / 14 Days
	Dissolved Oxygen	300 mL BOD bottle	1 each; $MnSO_4$ & alkaline iodide azide pillows		NA	8 Hours[20] / NA
	Dissolved or Total Inorganic Carbon (DIC or TIC)	125-250 mL Glass	.	Field Filter for Dissolved	125-250 mL Jar or Bag	14 Days / 28 Days
	Dissolved or Total Organic Carbon (DOC or TOC)	125-250 mL Glass	1:1 Sulfuric Acid (H_2SO_4)	Field Filter for Dissolved	125-250 mL Jar or Bag	28 Days / 28 Days
	Flashpoint	2 x 100-250 mL Amber Glass		Zero Headspace	125-250 mL Jar	7 Days / 7 Days
	pH	0.5-1 L Plastic			125-250 mL Jar or Bag	0.25 Hours / 30 Days [9]
	Solids (TS, TSS, TDS)	0.5-1 L Plastic			NA	7 Days / NA
	Sulfide	125 - 150 mL Plastic	Zinc Acetate & 6N NaOH		125-250 mL Jar or Bag	7 Days / 7 Days
	Sulfite	125 mL Plastic			NA	0.25 Hours / NA
NUTRIENTS	Ammonia Nitrogen	250 mL Glass or Plastic	1:1 Sulfuric Acid (H_2SO_4)		125-250 mL Jar or Bag	28 Days / 72 Hours
	Nitrate or Nitrite Nitrogen (and Ammonia unpreserved)	0.5-1 L Plastic			NA	2-7 Days [10] / 72 Hours
	Nitrogen, Kjeldahl, Organic, Total or Dissolved	250 mL Glass or Plastic	1:1 Sulfuric Acid (H_2SO_4)	Field Filter for Dissolved	NA	28 Days / NA
	Nutrients, Available (N,P,K,S)	NA			125-250 mL Jar or Bag	NA / 3 Days [11]
	Phosphorus, Reactive (orthophosphate)	0.5-1 L Plastic			NA	2-7 Days [12] / NA
	Phosphorus, Total Dissolved	250 mL Glass or Plastic	1:1 Sulfuric Acid (H_2SO_4)	Field Filter for Dissolved	NA	28 Days / NA
	Phosphorus, Total	250 mL Glass or Plastic	1:1 Sulfuric Acid (H_2SO_4)		NA	28 Days / NA
METALS	Chromium VI (Hexavalent)	125 mL Plastic	50 % NaOH (BC MoE) or 6N NaOH + Ammonium Buffer (OMoE)		125-250 mL Jar or Bag	28 Days / 30 Days
	Mercury, Methyl	250 mL FLPE	1:1 Hydrochloric Acid (HCl)[21]	Field Filter for Dissolved	125-250 mL Jar or Bag	6 Months / 28 Days
	Mercury, Total or Dissolved	40 mL Glass Vial	1:1 Hydrochloric Acid (HCl)	Field Filter for Dissolved	125-250 mL Jar or Bag	28 Days / 28 Days
	Metals, Total or Dissolved	125-250 mL Plastic	1:3 Nitric Acid (HNO_3) to pH<2	Field Filter for Dissolved	125-250 mL Jar or Bag	6 Months / 6 Months
Organics						
HYDRO-CARBONS	F1, Volatile Organic Compounts (VOCs), THMs, 1,4-Dioxane, Volatile Petroleum Hydrocarbons (VPH)	2 or 3 x 40 mL Glass Vials [2]	Sodium Bisulfate [4]	Zero Headspace	Field Methanol Kit [6]	14 Days / 40 Days [13]
		2 or 3 x 40 mL Glass Vials [2]	Sodium Bisulfate [4]	Zero Headspace	Hermetic Sampler kit [6]	14 Days / 48 Hours
	CCME CWS F1, BTEX	2 or 3 x 40 mL Glass Vials [2]	Sodium Bisulfate [4]	Zero Headspace	125 - 500 mL Jar	14 Days / 7 Days
	CCME CWS F2-F4	2 x 60 mL Amber Glass Vials [3]	Sodium Bisulfate		125 - 500 mL Jar	14 Days [14]/ 14 Days
	EPH or LEPH/HEPH	2 x 250 mL Amber Glass with Septa Cap	Sodium Bisulfate		125 - 500 mL Jar	14 Days / 14 Days
	Polycyclic Aromatic Hydrocarbons (PAHs)	2 x 0.25 - 1 L Amber Glass [5]	Sodium Bisulfate		125 - 500 mL Jar	14 Days / 14 Days
	Oil & Grease or Mineral Oil & Grease	2 x 0.25 - 1 L Glass	1:1 HCl or H_2SO_4		125 - 500 mL Jar	28 Days / 28 Days
TRACE ORGANICS	Alcohols	2 x 40 mL Glass Vials		Zero Headspace	125 - 500 mL Jar	7 Days / 7 Days
	Alkanolamines (MEA, DEA, DIPA)	250 mL Amber Glass			125 - 500 mL Jar	7 Days / 14 Days
	AOX	40 - 250 mL Amber Glass	1:3 Nitric Acid (HNO_3) to pH<2		125 - 500 mL Jar	6 months [15] / 28 Days
	C1 - C5 Gases	3 x 40 mL Blue Septa Vials	Sodium Bisulfate [4]	Zero Headspace	NA	14 Days / NA
	Dioxins and Furans, PBDE and PBB	2 x 1 L Amber Glass			125 - 500 mL Jar	Unlimited / Unlimited
	Formaldehyde/Aldehydes	2 x 40 mL Amber Glass Vials [2]	Ammonium Chloride+Copper Sulfate	Zero Headspace	125 - 500 mL Jar	7 Days / 5 Days
	Glycols	2 x 40 mL Amber Glass Vials			125 - 500 mL Jar	7 Days / 14 Days
	Hormones and Steroids	1 L Plastic			NA	28 Days / NA
	Naphthenic Acids	2 x 250 mL Amber Glass			125 - 500 mL Jar	14 Days / 14 Days
	Nitroaromatics and Nitrosamines (Explosives)	1 L Amber Glass			125 - 500 mL Jar	7 Days / 14 Days
	Nonylphenol & Ethoxylates, Bisphenol A (BPA)	1 L Amber Glass			125 - 500 mL Jar	28 Days / 14 Days

	PCB	2 x 0.25 - 1 L Amber Glass			125 - 500 mL Jar	Unlimited / Unlimited [16]
	Perfluorinated Chemicals (PFCs), PFOS, PFOA	1 L Plastic (PTFE free)			125-250 mL Jar or Bag	14 Days / 14 Days
	Phenolics, Chlorinated and Non-Chlorinated	2 x 0.5 - 1 L Amber Glass	Ascorbic Acid & Sodium Bisulfate [4]		125 - 500 mL Jar	14 Days / 14 Days
	Priority Pollutants (EPA 625 list) or SVOCs	2 x 1 L Amber Glass			125 - 500 mL Jar	7 Days / 14 Days [17]
	Resin Acids & Fatty Acids	2 x 0.5 - 1 L Amber Glass	Ascorbic Acid & NaOH		125 mL Jar	14 Days / 14 Days
	Sulfolane	2 x 0.5 - 1 L Amber Glass	Sodium Bisulfate [4]		125 mL Jar	14 Days / 14 Days
PESTICIDE RESIDUES	Carbamate Pesticides	1 L Amber Glass	Use Sodium Thiosulfate if chlorinated		125 - 500 mL Jar	7 Days / 14 Days
	Glyphosate / AMPA	1 L Plastic	Use Sodium Thiosulfate if chlorinated		125 - 500 mL Jar	14 Days / 14 Days
	Herbicides, Acidic	2 x 1 L Amber Glass	Sodium Bisulfate [4]		125 - 500 mL Jar	14 Days / 14 Days
	Organochlorine or Organophosphate Pesticides	2 x 1 L Amber Glass			125 - 500 mL Jar	7 Days / 14 Days
	Soil Sterilant Scan	1 L Amber Glass			250 g Poly Bag	7 Days / 14 Days
Micro						
MICRO-BIOLOGICAL	Coliforms-Fecal, Total, E-coli & HPC	100 - 300 mL Sterilized Plastic	Sodium Thiosulfate		500 mL Sterilized Jar	24-48 Hours [18] (24 - HPC) / NA
	Microtox	1 L Amber Glass			125-250 mL Jar or Bag	3 Days / 3 Days

1. Additional analyses with the same container type and preservation may be possible - consult the lab for details.

2. The number of 40 mL glass vials required (2 or 3) for BTEX & VOC varies by lab based on instrumentation. Consult the lab for details.

3. Please fill to the top of the marked line on the 60 mL Amber Glass Vials.

4. Use Sodium Thiosulfate instead of Sodium Bisulfate if sample is chlorinated.

5. OMoE has no preservation requirement for PAHs. 2 X 250 mL Amber Glass required for BC MoE and OMoE. For AB and SK and for Alkylated PAHs, ALS requires 2 x 1 L Amber Glass.

6. Soil sampling options depend on soil location and condition of soil. Field Methanol Kit consists of one 5g TerraCore® sampler or similar sampling device, two pre-weighed 40 mL glass vials with methanol preservative and a 125mL soil jar for moisture. Hermetic sampler kit consists of a T-handle, two 5g hermetic samplers and a 125mL soil jar for moisture. One additional parameter, such as metals or hydrocarbons can also be obtained from the 125mL soil jar.

7. 4 Days hold time for Electrical Conductivity only as per Ontario MISA.

8. 3 Days hold time for British Columbia as per BC Ministry of Environment (BC MoE), 4 Days hold time as per OMoE.

9. pH in water should be taken in the field as per BC MoE, 4 Days hold time for Ontario MISA and 28 Days hold time for OMoE. 30 Days hold time as received for pH in soil as per OMoE. One year hold time once soil is dried.

10. 3 Days hold time as per BC MoE, 5 Days hold time as per Ontario MISA and 7 Days hold time as per OMoE.

11. 3 Days hold time until received. Unlimited hold time once soil is dried.

12. 3 Days hold time as per BC MoE and 7 Days hold time as per OMoE.

13. 40 Days hold time as per BC MoE and 14 Days hold time as per OMoE. Recovered methanol extract from laboratory has a 40 Days hold time as per OMoE.

14. 40 Days hold time as per OMoE.

15 14 Days hold time as per Ontario MISA.

16. 14 Days hold time as per OMoE. Consult lab for container size if limited sample volume is available.

17. 14 Days hold time for water and 60 Days hold time for soil as per OMoE. Ontario labs require 2 x 250 mL Amber Glass + 500 mL Amber Glass.

18. 30 Hours hold time as per BC Drinking Water Regulation and 48 Hours as per OMoE.

19. Bromate alone does not require preservative.

20. 15 Minutes hold time as per OMoE - Field measurement by meter is recommended.

21. Use 1:1 Sulfuric Acid (H_2SO_4) for preservation of marine or brackish samples.

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10 DATA MANAGEMENT AND REPORTING

10.1 DATA MANAGEMENT

All sample data collected by Baffinland or designate consultants from the various environmental programs required on Project sites will be stored electronically in a spreadsheet database (Microsoft Excel) or using alternative software designed specifically for environmental data management.

QA/QC measures relating to data validation will include the following:

1. Designation of a suitable person to act as Water Quality Database Manager (WQDM).
2. Upon receipt, laboratory analytical data will be reviewed by the WQDM to check for completeness, typos, outlying values, etc. The analytical laboratory will be immediately notified of any anomalous results.
3. At a suitable frequency (e.g. once per month) the spreadsheet database should be updated by the WQDM using: i) results provided in electronic format by the analytical laboratories, and ii) copies of the field parameter monitoring records forwarded from site
4. The WQDM will be responsible for ensuring that a third party (e.g. another staff member) carries out a QA/QC check on a minimum of ten percent of newly entered data.

10.2 REPORTING

All documents prepared by Baffinland or their designate for submission to the regulators will be reviewed by senior staff and Baffinland prior to issue, as per the company's standard practice and quality management system.

11 REFERENCES

1. APHA *et al*, 1989. Standard Methods for the Examination of Water and Wastewater; AHPA, AWWA and WPCF, 17th ed.

2. Environment Canada (EC). 2012. Metal mining technical guidance for Environmental Effects Monitoring. ISBN 978-1-100-20496-3.

3. Environment Canada, 2002. Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring. http://www.ec.gc.ca/eem/English/MetalMining/Guidance/default.cfm.

4. INAC, 1996. Quality Assurance (QA) and Quality Control (QC) Guidelines for Use by Class "A" Licenses in Meeting SNP Requirements and for Submission of a QA/QC Plan. Prepared by Department of Indian and Northern Affairs Canada Water Resources Division and the Northwest Territories Water Board, July 1996.

5. Nunavut Water Board, 2013. Baffinland Iron Mines Corp. – Class A Water License No: 2AM-MRY1325. Issued by the Nunavut Water Board, 2013.

6. USEPA, 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms; 5th Ed., USEPA, ref. No. EPA-821-R-02-012.

Appendix A-

Quality Assurance Assurance (QA) and Quality Control (QC) Guidelines for use by Class A Licensees in Meeting SNP Requirements and for Submission of a QA/QC Plan (INAC, 1996).

QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC)

GUIDELINES

FOR USE BY CLASS “A” LICENSEES
IN MEETING SNP REQUIREMENTS

AND FOR SUBMISSION OF A QA/QC PLAN

JULY 1996

DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS CANADA
WATER RESOURCES DIVISION
AND THE
NORTHWEST TERRITORIES WATER BOARD

Table of Contents

Appendixes

1.0 Introduction and Definitions

In order to assist Licensees in completing their Quality Assurance and Quality Control (QA/QC) Plan, the following guidelines are provided, which indicates the minimum information that should be included.

These Guidelines are divided into three sections:

1) Field Sampling
2) Lab Analysis
3) Reporting Requirements

It is recognized that there may be different interpretations as to what is covered by "Quality Assurance/Control" due to the fact that certain Licensees have their own laboratories, while others only use commercial laboratories. For licence purposes, "Quality Assurance" and "Quality Control" refer to the following:

Quality Assurance: is the system of activities designed to better ensure that quality control is done effectively; while

Quality Control: is the use of established procedures to achieve standards of measurement for the three principal components of quality: precision, accuracy and reliability.

2.0 Field Sampling

2.1 Sample Collection

2.1.1 <u>Location</u>

A QA/QC plan must identify the locations of all sampling stations and the markers used to identify the stations. If the Surveillance Network Program (SNP) of the Water Licence does not specify sampling locations, locations should be chosen with help from an Inspector.

Buoys and landmarks identify sampling stations in tailings ponds and lakes, while sign post positioning usually marks stream sample stations. Stations should be used repeatedly, with the same personnel and techniques to reduce operational error. The use of Global Positioning System (GPS) to identify Latitude and Longitude for sampling stations is recommended.

2.1.2 Sampling Equipment

The Plan must include a detailed section on the equipment used for sampling, the rationale behind the choices of equipment, and descriptions of how the equipment is maintained and calibrated. Equipment and bottles should be selected so that they do not contaminate or otherwise alter the concentrations of parameters of interest.

Sampling devices, sample bottles and filtration devices should be constructed of non-metallic material. Most samples are now collected in containers constructed of high density polyethylene plastic. However, there are some exceptions, when testing for oil and grease or phenols glass containers are to be used. When conducting a fish bioassay, plastic drums are used while hydrocarbon based containers are not to be used for the collection of organic samples.

This section should also identify whether new or used bottles are used for each sample analysis. New bottles are preferred, but sample containers may be used repeatedly with proper handling measures.

If old bottles are used, a detailed description should be included, noting how they are maintained, stored and cleaned. Usually, this will closely resemble the product manufacturer's instructions. An example of how bottles should be cleaned is outlined below:

- Rinse well with hot tap water for one minute or more.
- Empty bottle and add 30% HNO_3 to approximately 1/3 container capacity. Shake well for three to four minutes.
- Rinse vigorously with hot tap water for two minutes.
- Rinse thoroughly three times with tap water and three times with distilled water.
- Store with 0.2% HNO_3 for a minimum of one week.
- Rinse again with distilled water at least three times.

Bottles that are to be used for bacteria testing should be acid washed or autoclaved if possible.

Note: Additional information on bottle washing is also available from Water Resources Division.

2.1.3 Sampling Methods

This Section will include details on methods for sample collection and the equipment that is to be used for each station.

In lakes and ponds, regular sample bottles are used the majority of the time, but Van Dorn samples are often utilized. The sample or the sample bottle is usually lowered to mid depth and washed three times before collecting the sample on the fourth submersion. Approximately 2% of the sample container capacity should remain to provide for mixing, preservative addition and thermal expansion.

Stream water sampling is usually done by plunging a sample bottle toward the current and allowing it to fill. Once again, the bottle should be rinsed three times before filling and room should be left for preservative addition and mixing.

A glass bottle should be used when sampling for oil and grease with the sample being collected during the first submersion and not rinsed three times first.

This section should also describe how often field blanks and replicate samples will be collected. Field blanks are samples of distilled/deionized water that are to be treated in exactly the same manner as the other samples. Blanks should therefore be taken to the field and handled and preserved as part of the sample program. They indicate when a sample may be contaminated and are indicative of general sample integrity. Replicate samples (duplicates and triplicates) are two or three samples collected from the same station at the same time. They help to ensure sample precision at the laboratory.

2.2 Sample Handling

2.2.1 Preservation

After collection, most samples must be preserved in order to prevent chemical or biochemical changes to the sample. The QA/QC plan must describe how samples from each station are to be preserved.

Preservation is generally done by the addition of certain chemicals into the bottle immediately after the sample is collected. **Table 1** is a general guide to preservatives and their appropriate concentrations. The QA/QC plan should contain more detailed information on the concentrations and amount of preservatives that will be used.

2.2.2 Sample Identification

The plan should include a description of the system used to identify samples. The system must provide positive sample identification and ensure that the identification is maintained. It is advisable to keep a logbook of samples that have already been delivered.

The identification can be maintained by marking the bottle itself or a label, with a water resistant, non-smear felt pen. The information should be clear to persons uninvolved in the sampling and may include such details as company name, sample area, SNP number, time and date.

2.2.3 Transportation

The section on transportation will describe how sample integrity will be ensured from the time of collection to completion of delivery. Delivery to the lab should be done as soon as possible after the samples have been collected.

Usually, samples are sealed and stored upright in a box with other samples to provide a snug, immobile storage space during transfer. Any samples that require refrigeration for preservation should be kept cool during transport.

3.0 Lab Analysis

Because certain Class "A" Licensees have their own analytical laboratory and others rely on commercial laboratories, this section of the Guidelines is divided accordingly.

3.1 Outside Laboratories

3.1.1 Lab Accreditation

The Licensee will identify in the plan the name of the commercial laboratory that will be conducting the analyses. A letter must be provided from the commercial lab indicating that they are accredited to conduct analyses on each of the required sampling parameters. Ideally, the lab should be accredited by the Canadian Associated for Environmental Analytical Laboratories (C.A.E.A.L.) and should provide a certificate stating parameters for which they are accredited.

3.1.2 Detection Limits

Detection limits for the commercial lab should be identified for all parameters and should be reported when any SNP data is submitted.

3.1.3 Methodology

Descriptions should be included for any methods of analysis used that are not outlined in "Standard Methods for the Examination of Water and Wastewater".

3.2 In House Laboratories

3.2.1 Identification of Analytical Laboratory/Detection Limits

Licensees using in-house labs shall identify their detection limits for all parameters and report them when any SNP data is submitted. The Licensee shall also identify the commercial lab they use to check for quality control.

3.2.2 For Overall Analytical Methods, Precision and Accuracy

The plan must describe how the Licensee will ensure precision and accuracy in their analytical methods. This includes what action will be taken if any sample results are found to be outside the appropriate ranges.

All analyses should be conducted in accordance with methods prescribed in the current edition of “Standard Methods for the Examination of Water and Wastewater” or by other approved methods. In addition, the lab should analyze standard reference material for each parameter measured. For each parameter (group) to be measured, a complete description of the sampling procedure must be documented and adhered to.

If any sample results are outside the appropriate QA/QC ranges, attempts should be made to correct the problem and the sample shall be immediately re-analyzed. If any analysis indicates a violation of a licence condition, an Inspector shall be notified of the violation, any corrective action taken, and the results of retests.

3.2.3 Accuracy Requirements

The plan should document how the Licensee will go about ensuring accuracy in the laboratory. Accuracy is the measurement of how closely a value approximates a standard, or true value. The Licensee should identify the frequency at which certified or reference standards will be analyzed during each sampling period.

3.2.4 Precision Requirements

Precision is a measure of the closeness or repeatability of a set of values. This section will describe how and when replicate samples are taken to ensure lab precision. It is recommended that the Licensee take triplicates at one SNP station during each sampling period. If daily sampling is required at only one station, a duplicate sample should be taken each time, with a triplicate sample taken one a week.

3.2.5 Methodology

Descriptions should be included of any methods of analysis that are not taken from "Standard Methods for the Examination of Waste and Wastewater." Standard methods should be referenced.

4.0 Reporting Requirements

4.1 General Submission

The QA/QC plan will contain a section outlining what information will be reported in the monthly SNP reports. Any control charts or graphs which display the precision and accuracy of the methods used to analyze the samples should be submitted with the report. This includes warning and control limits used to determine acceptability of the data.

4.2 Outside Laboratories

The Licensee shall outline the number of replicate samples that will be collected and submitted with each SNP report. It is recommended that one set of duplicates or triplicates from an assigned SNP site, as well as the results from field blanks, be submitted with each required SNP report. This would serve as an internal/external check for the Licensee and the commercial lab.

4.3 In-House Laboratories

The Licensee shall outline the number of results from replicate samples that will be included with each required SNP report. It is recommended that two duplicate sets be collected per month at an assigned SNP site, with one set being sent to a commercial lab while the other is to be analyzed by the Licensee's lab. Analytical results from both labs should be submitted with each required SNP report. This would serve as an external check for the lab. Any results from a commercial lab should be presented on the lab's letterhead.

FOR FURTHER INFORMATION, CONTACT THE WATER RESOURCES DIVISION AT:

Box 1500
Yellowknife, NWT
X1A 2R3
(867) 669-2654 Phone
(867) 669-2716 Fax

Appendix 1
Table 1: General Summary of Special Sampling or Handling Techniques

Determination	Container	Minimum Sample Size (ml)	Preservation	Maximum Storage Recommended
BOD	Sterile polyethylene	1000	Refrigerate 4°C	24 hours
Conductivity	Polyethylene	500	Refrigerate 4°C	28 days
Total Cyanide	Polyethylene	500	Add NaOH to raise pH>12 refrigerate in dark	24 hours
Hardness	Polyethylene	100	Add Conc. HNO_3 to lower pH<2 OR (*) unpreserved	6 months
Metals, General	Polyethylene	250	For dissolved metals filter immediately, add Conc. $HN0_3$ to pH<2	6 months
Mercury	Glass (rinsed with 1 + 1 HNO_3)	500	Add Conc. HNO_3 or pH<2 or H_2SO_4 + 1 ml of 5% $K_2Cr_2O_7$, refrigerate 4°C	28 days
Nitrogen:				
Ammonia	Polyethylene	500	Analyze as soon as possible or add H_2S0_4 to pH<2, refrigerate OR (*) unpreserved	7 days
Nitrate	Polyethylene	100	Analyze as soon as possible or refrigerate	48 hours
Oil and Grease	Glass or wide-mouth calibrated	1000	Add H_2S0_4 to pH<2, refrigerate	28 days
pH	Polyethylene	--	Analyze immediately	2 hours
Suspended Solids	Polyethylene	--	Refrigerate	7 days
Temperature	Polyethylene	--	Analyze immediately	0
Turbidity	Polyethylene	--	Analyze same day; store in dark up to 24 hours, refrigerate	24 hours
Bacteria	Polyethylene (sterilized)	--	None: Keep cool	6 - 48 hours

(*) Unpreserved = check with lab that will be analyzing the samples

Appendix 2

References:

Gilbert, Andrew (1993). "Echo Bay Mines Ltd. Environmental Laboratory Quality Assurance Plan".

Soniassy, R. (1980). "A Guide for the Collection of Water and Effluent Samples"; pp 1-16; INAC

"Standard Methods for the Examination of Water and Wastewater" (1989); AHPA, AWWA and WPCF, 17th edition.

Water Resources Division, Indian and Northern Affairs Canada (1990). "Generic Quality Assurance (QA) Plan Guidelines for Use by the Licensees in Meeting SNP Requirements for Submission of a QA Plan"; INAC.

Appendix- B

Example Forms

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number: 15 -

Page of

Report To	Contact and company name below will appear on the final report	
Company:		
Contact:		
Phone:		
	Company address below will appear on the final report	
Street:		
City/Province:		
Postal Code:		
Invoice To	Same as Report To	☐ YES ☐ NO
	Copy of Invoice with Report	☐ YES ☐ NO
Company:		
Contact:		

Report Format / Distribution

Select Report Format: ☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☐ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☐ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)	**4 day [P4]**	☐	EMERGENCY	**1 Business day [E1]**	☐
	3 day [P3]	☐		**Same Day, Weekend or Statutory holiday [E0]**	☐
	2 day [P2]	☐			

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:

Job #:

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)		**ALS Contact:**	**Sampler:**

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	**Sample Identification and/or Coordinates** (This description will appear on the report)	**Date** (dd-mmm-yy)	**Time** (hh:mm)	**Sample Type**														Number of Containers

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human drinking water use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INIITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Appendix- C

Analytical Laboratory Accreditation and Licencing

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

ALS Environmental (Waterloo)
ALS Canada Ltd.
60 Northland Rd. Unit 1
Waterloo, Ontario

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 8 January 2009).

Accreditation No.: A3149
Issued On: July 24, 2014
Accreditation Date: January 3, 2005
Expiry Date: January 21, 2017

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.

Ministry of the Environment and Climate Change

Safe Drinking Water Branch
Laboratory Licensing and Compliance Program

125 Resources Rd.
Etobicoke ON M9P 3V6
Tel: (416) 235 - 6370
Fax: (416) 235 - 6519

Ministère de l'Environnement et de l'Action en matière de changement climatique

Direction du contrôle de la qualité de l'eau potable
Programme de délivrance des permis et de conformité des laboratoires

125, Chemin Resources
Etobicoke ON M9P 3V6
Tél: (416) 235 - 6370
Téléc: (416) 235 - 6519

Ontario

Drinking-Water Testing Licence

Under the Drinking-Water Testing Services Regulation, O. Reg. 248/03 and the Safe Drinking Water Act, 2002

Licence #: 2290
This supercedes licence issued: Sep 22, 2015
Licensee: ALS Canada Ltd.

Located at:
60 Northland Rd. Unit #1
Waterloo ON N2V 2B8
Canada

The licensee is authorized to conduct the following drinking-water tests at the laboratory:

Class: Inorganic	Lab Method Code:	Technique - Sub-Technique:	Appendix #:
4AAP-phenolics	WT-TM-1027	Colourimetry	C009
Alkalinity	WT-TM-1032	Colourimetry	C094
Alkalinity	WT-TM-1012	Titrimetry-Manual	C070
Aluminum	NA-TM-1002	ICP-MS(Total-digested)	C032
Aluminum	NA-TM-1002	ICP-MS (Total-non-digested)	C005
Ammonia	WT-TM-1013	Colourimetry	C095
Antimony	NA-TM-1002	ICP-MS (Total-non-digested)	C005
Antimony	NA-TM-1002	ICP-MS(Total-digested)	C032
Arsenic	NA-TM-1002	ICP-MS (Total-non-digested)	C005

Class: Inorganic	Technique - Sub-Technique:
Calcium **Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested) **Appendix #:** C005
Carbon; dissolved organic **Lab Method Code:** WT-TM-1024	Combustion **Appendix #:** C047
Carbon; total organic **Lab Method Code:** WT-TM-1024	Combustion **Appendix #:** C047
Chloride **Lab Method Code:** NA-TM-1001	IC **Appendix #:** C003
Chlorine; residual **Lab Method Code:** WT-TM-1021	Colourimetry **Appendix #:** C074
Chlorine; total **Lab Method Code:** WT-TM-1021	Colourimetry **Appendix #:** C074
Chromium **Lab Method Code:** NA-TM-1002	ICP-MS(Total-digested) **Appendix #:** C032
Chromium **Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested) **Appendix #:** C005
Chromium VI **Lab Method Code:** WT-TM-1035	IC-UV/VIS **Appendix #:** C157
Cobalt **Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested) **Appendix #:** C005
Cobalt **Lab Method Code:** NA-TM-1002	ICP-MS(Total-digested) **Appendix #:** C032
Copper **Lab Method Code:** NA-TM-1002	ICP-MS(Total-digested) **Appendix #:** C032
Copper **Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested) **Appendix #:** C005
Cyanate **Lab Method Code:** WT-TM-1036	ISE **Appendix #:** C161

Class: Inorganic

	Technique - Sub-Technique	Lab Method Code	Appendix #
Molybdenum	ICP-MS(Total-digested)	NA-TM-1002	C032
Molybdenum	ICP-MS (Total-non-digested)	NA-TM-1002	C005
Nickel	ICP-MS(Total-digested)	NA-TM-1002	C032
Nickel	ICP-MS (Total-non-digested)	NA-TM-1002	C005
Nitrate (as nitrogen)	IC	NA-TM-1001	C003
Nitrilotriacetic acid	Colourimetry	WT-TM-1007	C036
Nitrite (as nitrogen)	IC	NA-TM-1001	C003
Nitrogen; ammonia+ammonium	Colourimetry	WT-TM-1013	C095
Nitrogen; nitrate+nitrite	Calculation-IC	NA-TM-1001	N/A
Nitrogen; total Kjeldahl	Colourimetry-Digestion-Aquakem	WT-TM-1023	C099
o-Phosphate	Colourimetry	WT-TM-1025	C098
Organic nitrogen	Calculation-Colourimetry-Digestion-Aquakem	WT-TM-1023	N/A
Perchlorate	LC-MS-MS	WT-TM-1505	C168
Phosphorus	ICP-MS (Total-non-digested)	NA-TM-1002	C005

Class: Inorganic		Technique - Sub-Technique:	
Strontium	**Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested)	**Appendix #:** C005
Sulphate	**Lab Method Code:** NA-TM-1001	IC	**Appendix #:** C003
Sulphide	**Lab Method Code:** WT-TM-1003	Colourimetry	**Appendix #:** C012
Sulphur	**Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested)	**Appendix #:** C005
Sulphur	**Lab Method Code:** NA-TM-1002	ICP-MS(Total-digested)	**Appendix #:** C032
Thallium	**Lab Method Code:** NA-TM-1002	ICP-MS(Total-digested)	**Appendix #:** C032
Thallium	**Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested)	**Appendix #:** C005
Tin	**Lab Method Code:** NA-TM-1002	ICP-MS(Total-digested)	**Appendix #:** C032
Tin	**Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested)	**Appendix #:** C005
Titanium	**Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested)	**Appendix #:** C005
Titanium	**Lab Method Code:** NA-TM-1002	ICP-MS(Total-digested)	**Appendix #:** C032
Tungsten	**Lab Method Code:** NA-TM-1002	ICP-MS(Total-digested)	**Appendix #:** C032
Tungsten	**Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested)	**Appendix #:** C005
Uranium	**Lab Method Code:** NA-TM-1002	ICP-MS (Total-non-digested)	**Appendix #:** C005

Class: Microbiological	Technique - Sub-Technique		
Total coliform	MF-mEndo	**Lab Method Code:** WT-TM-1200	**Appendix #:** C002
Total coliform background	MF-mEndo	**Lab Method Code:** WT-TM-1200	**Appendix #:** C002

Class: Organic	Technique - Sub-Technique		
1,1,1,2-tetrachloroethane	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,1,1-trichloroethane	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,1,2,2-tetrachloroethane	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,1,2-trichloroethane	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,1-dichloroethane	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,1-dichloroethene	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,2,4-trichlorobenzene	GC-MS	**Lab Method Code:** WT-TM-1101/WT-TM-1300	**Appendix #:** C015
1,2-dibromoethane	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,2-dichlorobenzene	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,2-dichloroethane	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,2-dichloropropane	GC-MS/FID	**Lab Method Code:** NA-TM-1102	**Appendix #:** C113
1,2-propanediol	GC-FID	**Lab Method Code:** WT-TM-1601	**Appendix #:** C090

Class: Organic	Technique - Sub-Technique	Lab Method Code:	Appendix #:
2,4,6-trichlorophenol	GC-MS	WT-TM-1101/WT-TM-1300	C015
2,4-D	GC-MS	WT-TM-1107/WT-TM-1302	C023
2,4-dichlorophenol	GC-MS	WT-TM-1101/WT-TM-1300	C015
2,4-dimethylphenol	GC-MS	WT-TM-1101/WT-TM-1300	C015
2,4-dinitrophenol	GC-MS	WT-TM-1101/WT-TM-1300	C015
2,4-dinitrotoluene	GC-MS	WT-TM-1101/WT-TM-1300	C015
2,6-dichlorophenol	GC-MS	WT-TM-1101/WT-TM-1300	C015
2,6-dinitrotoluene	GC-MS	WT-TM-1101/WT-TM-1300	C015
2-chloronaphthalene	GC-MS	WT-TM-1101/WT-TM-1300	C015
2-chlorophenol	GC-MS	WT-TM-1101/WT-TM-1300	C015
2-hexanone	GC-MS/FID	NA-TM-1102	C113
2-methyl-4,6-dinitrophenol	GC-MS	WT-TM-1101/WT-TM-1300	C015
2-methylnaphthalene	GC-MS	WT-TM-1101/WT-TM-1300	C015
2-nitrophenol	GC-MS	WT-TM-1101/WT-TM-1300	C015

Class: Organic	Technique - Sub-Technique:
Aldrin+Dieldrin	Calculation-GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302	**Appendix #:** N/A
Anthracene	GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300	**Appendix #:** C015
Aroclor 1242	GC-MS
Lab Method Code: WT-TM-1105/WT-TM-1301	**Appendix #:** C017
Aroclor 1248	GC-MS
Lab Method Code: WT-TM-1105/WT-TM-1301	**Appendix #:** C017
Aroclor 1254	GC-MS
Lab Method Code: WT-TM-1105/WT-TM-1301	**Appendix #:** C017
Aroclor 1260	GC-MS
Lab Method Code: WT-TM-1105/WT-TM-1301	**Appendix #:** C017
Atrazine	GC-MS
Lab Method Code: WT-TM-1107/WT-TM-1302	**Appendix #:** C023
Atrazine + N-dealkylated metabolites	Calculation-GC-MS
Lab Method Code: WT-TM-1107/WT-TM-1302	**Appendix #:** N/A
Azinphos-methyl	GC-MS
Lab Method Code: WT-TM-1107/WT-TM-1302	**Appendix #:** C023
b-BHC	GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302	**Appendix #:** C019
Bendiocarb	GC-MS
Lab Method Code: WT-TM-1107/WT-TM-1302	**Appendix #:** C023
Benzene	GC-MS/FID
Lab Method Code: NA-TM-1102	**Appendix #:** C113
Benzo(a)anthracene	GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300	**Appendix #:** C015
Benzo(a)pyrene	GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300	**Appendix #:** C015

Class: Organic	Technique - Sub-Technique	Lab Method Code:	Appendix #:
Bromomethane	GC-MS/FID	NA-TM-1102	C113
Bromoxynil	GC-MS	WT-TM-1107/WT-TM-1302	C023
Camphene	GC-MS	WT-TM-1101/WT-TM-1300	C015
Carbaryl	GC-MS	WT-TM-1107/WT-TM-1302	C023
Carbofuran	GC-MS	WT-TM-1107/WT-TM-1302	C023
Carbon disulfide	GC-MS/FID	NA-TM-1102	C113
Carbon tetrachloride	GC-MS/FID	NA-TM-1102	C113
Chlordane; total	Calculation-GC-MS	WT-TM-1102/WT-TM-1302	N/A
Chlorodibromoacetic acid	GC-Derivitatization/ECD	WT-TM-1604	C163
Chloroethane	GC-MS/FID	NA-TM-1102	C113
Chloroform	GC-MS/FID	NA-TM-1102	C113
Chloromethane	GC-MS/FID	NA-TM-1102	C113
Chlorpyrifos	GC-MS	WT-TM-1107/WT-TM-1302	C023
Chrysene	GC-MS	WT-TM-1101/WT-TM-1300	C015

Class: Organic Technique - Sub-Technique:

Dichloromethane GC-MS/FID
Lab Method Code: NA-TM-1102 **Appendix #:** C113

Diclofop-methyl GC-MS
Lab Method Code: WT-TM-1107/WT-TM-1302 **Appendix #:** C023

Dieldrin GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302 **Appendix #:** C019

Diethyl phthalate GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 **Appendix #:** C015

Diethylene glycol GC-FID
Lab Method Code: WT-TM-1601 **Appendix #:** C090

Dimethoate GC-MS
Lab Method Code: WT-TM-1107/WT-TM-1302 **Appendix #:** C023

Dimethyl phthalate GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 **Appendix #:** C015

di-n-butyl phthalate GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 **Appendix #:** C015

di-n-octyl phthalate GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 **Appendix #:** C015

Dinoseb GC-MS
Lab Method Code: WT-TM-1107/WT-TM-1302 **Appendix #:** C023

Diphenyl ether GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 **Appendix #:** C015

Diphenylamine GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 **Appendix #:** C015

Diquat LC-MS-MS
Lab Method Code: WT-TM-1506 **Appendix #:** C134

Diuron LC-MS-MS
Lab Method Code: WT-TM-1502 **Appendix #:** C135

Class: Organic — **Technique - Sub-Technique:**

Formaldehyde — GC-Derivitatization/ECD
Lab Method Code: WT-TM-1603 — **Appendix #:** C162

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g-Chlordane — GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302 — **Appendix #:** C019

Glyphosate — LC-MS-MS
Lab Method Code: WT-TM-1504 — **Appendix #:** C133

Heavy hydrocarbon (F4 Gravimetric) — GC-FID
Lab Method Code: WT-TM-1307/WT-TM-1112 — **Appendix #:** C069

Heptachlor — GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302 — **Appendix #:** C019

Heptachlor epoxide — GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302 — **Appendix #:** C019

Heptachlor+Heptachlor Epoxide — Calculation-GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302 — **Appendix #:** N/A

Hexachlorobenzene — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

Hexachlorobutadiene — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

Hexachlorocyclopentadiene — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

Hexachloroethane — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

Hexane — GC-MS/FID
Lab Method Code: NA-TM-1102 — **Appendix #:** C113

Indeno(1,2,3-c,d)pyrene — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

Indole — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

Class: Organic — **Technique - Sub-Technique:**

Monochloroacetic acid — GC-Derivitization/ECD
Lab Method Code: WT-TM-1604 — **Appendix #:** C163

Monochlorobenzene — GC-MS/FID
Lab Method Code: NA-TM-1102 — **Appendix #:** C113

MTBE — GC-MS/FID
Lab Method Code: NA-TM-1102 — **Appendix #:** C113

Naphthalene — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

Nitrobenzene — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

n-Nitroso-di-n-propylamine — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

Nonylphenol — LC-MS-MS
Lab Method Code: WT-TM-1521 — **Appendix #:** C116

Nonylphenol Diethoxylate — LC-MS
Lab Method Code: WT-TM-1521 — **Appendix #:** C116

Nonylphenol Monoethoxylate — LC-MS
Lab Method Code: WT-TM-1521 — **Appendix #:** C116

o,p'-DDD — GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302 — **Appendix #:** C019

o,p'-DDE — GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302 — **Appendix #:** C019

o,p'-DDT — GC-MS
Lab Method Code: WT-TM-1102/WT-TM-1302 — **Appendix #:** C019

o-Cresol — GC-MS
Lab Method Code: WT-TM-1101/WT-TM-1300 — **Appendix #:** C015

Octylphenol — LC-MS
Lab Method Code: WT-TM-1521 — **Appendix #:** C116

Class: Organic — **Technique - Sub-Technique**

Parameter	Technique - Sub-Technique	Lab Method Code	Appendix #
Phenol	GC-MS	WT-TM-1101/WT-TM-1300	C015
Phorate	GC-MS	WT-TM-1107/WT-TM-1302	C023
Picloram	GC-MS	WT-TM-1107/WT-TM-1302	C023
p-nitrophenol	GC-MS	WT-TM-1101/WT-TM-1300	C015
Polychlorinated biphenyls	GC-MS	WT-TM-1105/WT-TM-1301	C017
Prometryn	GC-MS	WT-TM-1107/WT-TM-1302	C023
Pyrene	GC-MS	WT-TM-1101/WT-TM-1300	C015
Simazine	GC-MS	WT-TM-1107/WT-TM-1302	C023
Styrene	GC-MS/FID	NA-TM-1102	C113
Temephos	GC-MS	WT-TM-1107/WT-TM-1302	C023
Terbufos	GC-MS	WT-TM-1107/WT-TM-1302	C023
Tetrachloroethylene	GC-MS/FID	NA-TM-1102	C113
Tetraethyl Lead	GC-MS	WT-TM-1308	C159
Toluene	GC-MS/FID	NA-TM-1102	C113

Class: Physical/Others		**Technique - Sub-Technique:**	
CBOD (5 Day)	**Lab Method Code:** WT-TM-1002	Meter-D.O	**Appendix #:** C001
COD	**Lab Method Code:** WT-TM-1006	Colourimetry-Reflux	**Appendix #:** C035
Conductivity	**Lab Method Code:** WT-TM-1010	Potentiometry	**Appendix #:** C048
Conductivity	**Lab Method Code:** WT-TM-1028	Potentiometry	**Appendix #:** C108
Hardness (as CaCO3)	**Lab Method Code:** NA-TM-1002	Calculation-ICP-MS	**Appendix #:** NA
Oil and Grease; mineral	**Lab Method Code:** WT-TM-1100	Gravimetry-Extraction	**Appendix #:** C033
Oil and Grease; total	**Lab Method Code:** WT-TM-1100	Gravimetry-Extraction	**Appendix #:** C033
pH	**Lab Method Code:** WT-TM-1028	Potentiometry	**Appendix #:** C106
pH	**Lab Method Code:** WT-TM-1001	Potentiometry	**Appendix #:** C026
Solids; total	**Lab Method Code:** WT-TM-1011	Gravimetry	**Appendix #:** C056
Solids; total dissolved	**Lab Method Code:** NA-TM-1004	Gravimetry	**Appendix #:** C056
Solids; total suspended	**Lab Method Code:** WT-TM-1011	Gravimetry	**Appendix #:** C010
Solids; total volatile	**Lab Method Code:** WT-TM-1011	Gravimetry	**Appendix #:** C056
Tannins and Lignins	**Lab Method Code:** WT-TM-1015	Colourimetry-Spectrophotometry	**Appendix #:** C124

2.2 The licensee is only authorized to conduct drinking-water tests at the laboratory for the class and for the parameters set out in the licence.

2.3 Subject to conditions 2.4 and 2.5, the licensee shall only conduct drinking water tests at the laboratory for parameters using the methods that were listed in the application, and approved by this licence.

[Where applicable]

2.4 Despite condition 2.3, where the licensee listed a method for a parameter in the application for this licence, but the method is not designated as an acceptable testing method for that parameter in the protocol, the licensee is not authorized to use the method listed in the application for this licence, unless the method is specifically authorized under condition 2.5.

[Where applicable]

2.5 The licensee is specifically authorized to conduct drinking-water tests for the parameters listed below using the corresponding method listed below, despite the method not being designated as an acceptable testing method for that parameter in the protocol:

None

Accreditation

2.6 Except as authorized by condition 2.7, the licensee shall only conduct a drinking-water test if the laboratory is accredited by an accreditation body for the conduct of that test.

Non-accredited Tests [Where applicable]

2.7 In accordance with section 74 of the SDWA, the licensee is authorized to conduct the following tests for which the laboratory is not accredited by an accreditation body, using the method specified.

None

Part III: Operational Requirements

3.1. A copy of this licence shall be made readily available for reference by all persons responsible for all or part of the operation of the drinking-water testing laboratory.

3.2. A copy of this licence shall be made readily available to laboratory clients and for Ministry inspection.

3.3. The Certificate of Drinking Water Testing Licence shall be conspicuously displayed in a location at the laboratory which maximizes the likelihood of a client seeing it upon entry to the laboratory's sample receiving area.

(a) Owner of the Laboratory;
(b) Laboratory Administrator;
(c) Laboratory Operator;
(d) Laboratory Director, and
(e) Laboratory Director Designate

4.8 As per section 73(6) of the SDWA this licence is not transferable without the consent of the Director.

Information

4.9 Any information requested, by the Ministry, concerning the drinking-water testing laboratory and its operation under this licence, including but not limited to any records required to be kept by this licence shall be provided to the Ministry, upon request.

4.10 Records required by or created in accordance with the SDWA, any regulations under the SDWA, or this licence shall be retained for at least 5 years in a location where a provincial officer who is inspecting the laboratory can conveniently view them.

4. 11 The receipt of any information by the Ministry or the failure of the Ministry to prosecute any person or to require any person to take any action, under this licence or under any statute, regulation or other legal requirement, in relation to the information, shall not be construed as an approval, waiver, or justification by the Ministry of any act or omission of any person that contravenes any term or condition of this approval or any statute, regulation or other legal requirement.

Part V: Special Conditions

1 . Pursuant to subsection 10(1), clause (d) of O. Reg. 248/03, the chain of custody procedures submitted by the licensee as part of the application for this licence are approved.

2. When a sample is submitted to the licensee for a drinking-water test for a microbiological parameter, the licensee shall ensure that the test is conducted in a standardized timely manner and that microbiological plates are processed and read without extended overnight refrigerated incubation.

3. The licensee is authorized to report the results of more than one parameter (such as total THMs) as an aggregate result in order to comply with reporting requirements provided that that licensee conducts a separate test for each parameter using a method otherwise authorized by this licence, and the means by which the aggregate is calculated is documented and kept available for inspection by the Ministry.

4. The licensee shall not filter drinking water samples prior to analyses unless dictated by non-routine analytical contingencies.

4.1 The licensee shall collect and handle drinking water samples in accordance with the Ministry's Protocol.

5. Licensed laboratories shall report all adverse water quality results as per the drinking water legislation without any regard to calculated uncertainty estimations.

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

CALA

Canadian Association for
Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 3149
Laboratory Name: ALS Environmental (Waterloo)
Parent Institution: ALS Canada Ltd.
Address: 60 Northland Rd. Unit 1 Waterloo ON N2V 2B8
Contact: Mr. Jonathan Fisher
Phone: (519) 886-6910
Fax: (519) 886-9047
Email: ALSWT.Quality@alsglobal.com; linda.neimor@ALSGlobal.com

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Standard: Conforms with requirements of ISO/IEC 17025
Clients Served: All Interested Parties
Revised On: August 7, 2015
Valid To: January 21, 2017

Scope of Accreditation

Air (Inorganic)

Fixed Gases - Air (180)
WT-TM-1703; modified from EPA 3C and ASTM D1946-90

GC/FID & TCD
- Carbon Dioxide
- Carbon Monoxide
- Methane
- Nitrogen
- Oxygen

Biosolids (Microbiology)

Escherichia coli (E. coli) - Biosolids (087)
WT-TM-1200; modified from MOE/LSB-E3433

MEMBRANE FILTRATION (mFC-BCIG)
- Escherichia coli (E. coli)

Biosolids (Organic)

Nonylphenol and Nonylphenol Ethoxylates - Biosolids (165)
WT-TM-1554; modified from JOURNAL OF CHROMATOGRAPHY A.849 (1999) 467-482

LC/MS - EXTRACTION
- Bisphenol A
- Nonylphenol Diethoxylate
- Nonylphenol Monoethoxylates
- Nonylphenols
- Nonylphenols Ethoxylates
- Octylphenol
- Octylphenol Diethoxylate
- Octylphenol Monoethoxylate

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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

C1-Dibenzothiopenes
C1-Fluoranthenes/Pyrenes
C1-Fluorenes
C1-Naphthalenes
C1-Phenanthrenes/Anthracene
C2-Benzofluoroanthenes/Benzo(a)pyrenes
C2-Biphenyl
C2-Chrysenes
C2-Dibenzothiopenes
C2-Fluoranthenes/Pyrenes
C2-Fluorenes
C2-Naphthalenes
C2-Phenanthrenes/Anthracene
C3-Chrysenes
C3-Dibenzothiopenes
C3-Fluoranthenes/Pyrenes
C3-Fluorenes
C3-Naphthalenes
C3-Phenanthrenes/Anthracene
C4-Dibenzothiopenes
C4-Fluoranthenes/Pyrenes
C4-Naphthalenes
C4-Phenanthrenes/Anthracene
Chrysene
Dibenzo (a,h) anthracene
Dibenzothiopene
Fluoranthene
Fluorene
Indeno (1,2,3 - cd) pyrene
Naphthalene
Perylene
Phenanthrene
Pyrene
Quinoline
Retene

Solids (Inorganic)
Ammonia - Soil (096)
WT-TM-1013; modified from EPA 350.1
COLORIMETRIC
Ammonia

Solids (Inorganic)
Anions - Soil, Sludge (041)
NA-TM-1001, WT-TP-2013; modified from EPA 300
ION CHROMATOGRAPHY
Bromide
Chloride
Fluoride
Nitrate
Nitrite
Sulphate

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

Solids (Inorganic)
Metals - Solid Waste (138)
NA-TM-1700, NA-TM-1002; EPA 1311 (LEACH) and modified from EPA 6020A (ANALYSIS)
ICP/MS - TCLP
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Iron
Lead
Lithium
Magnesium
Manganese
Potassium
Selenium
Silver
Sodium
Strontium
Sulphur
Thallium
Tin
Uranium
Zinc
Zirconium

Solids (Inorganic)
Oil and Grease - Soil, Sludge (031)
WT-TM-1100; modified from SM 5520 B, D, E, F and EPA 8015
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease
Total Oil and Grease (Solvent Extractables)

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2-Nitrophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-Tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,6-Dichlorophenol
2,6-Dinitrotoluene
3,3'-Dichlorobenzidene
4-Bromophenyl Phenyl Ether
4-Chloro-3-Methylphenol
4-chloroaniline
4-Chlorophenyl Phenyl Ether
4-Nitrophenol
4,6-Dinitro-o-Cresol
5-Nitroacenaphthylene
Acenaphthene
Acenaphthylene
Acridine
Anthracene
Benzo (a) anthracene
Benzo (a) pyrene
Benzo (b) fluoranthene
Benzo (g,h,i) perylene
Benzo (k) fluoranthene
Benzyl Butyl Phthalate
Biphenyl
Bis (2-Chlorethoxy) Methane
Bis (2-Chloroethyl) Ether
Bis (2-Chloroisopropyl) Ether
Bis (2-ethylhexyl) Phthalate
Camphene
Chrysene
Di-n-Butylphthalate
Di-n-Octylphthalate
Dibenzo (a,h) anthracene
Diethyl Phthalate
Dimethyl Phthalate
Diphenyl Ether
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno (1,2,3 - cd) pyrene
Indole

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beta-BHC
Chlordane
delta-BHC
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin Aldehyde
gamma-Chlordane
Heptachlor
Heptachlor Epoxide
Lindane
Mirex
o,p'-DDD
o,p'-DDE
o,p'-DDT
Oxychlordane
p,p'-DDD
p,p'-DDE
p,p'-DDT
p,p'-Methoxychlor

Solids (Organic)
Pesticides - Soil (150)
WT-TM-1107, WT-TM-1302; modified from EPA SW-846 8270 and SW-846 3500 C
GC/MS - EXTRACTION
2,4-D
2,4,5-T
2,4,5-TP
Alachlor
Ametryn
Atrazine
Atrazine Desethyl
Azinphos-methyl
Bendiocarb
Bromoxynil
Carbaryl
Carbofuran
Chlorpyrifos
Cyanazine
Diazinon
Dicamba
Diclofop-methyl
Dimethoate
Dinoseb
Malathion
MCPA
Mecoprop
Metolachlor
Metribuzin
Parathion
Phorate
Picloram

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1,1,2,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
1,2-Dibromomethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Hexanone
Acetone (2-Propanone)
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon Disulfide
Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Dibromochloromethane
Dibromomethane
Dichlorodifluoromethane
Dichloromethane
Ethylbenzene
Ethylene Dibromide
Hexane
m/p-xylene
Methyl ethyl ketone
Methyl isobutyl ketone
Methyl t-butyl ether
Methylene Chloride
o-xylene
Styrene
Tetrachloroethane
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane
Vinyl chloride

Solids (Organic)
Volatile Organic Compounds (VOC) - Solid Waste (182)
WT-TM-1017, NA-TM-1002; EPA 1311 (LEACH) and modified from EPA SW-846 8260 (ANALYSIS)
GC/MS - HEADSPACE - TCLP
1,2-Dichlorobenzene
1,4-Dichlorobenzene
Benzene
Carbon tetrachloride

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Water (Inorganic) OSDWA †
Alkalinity - Water (070)
WT-TM-1012; modified from SM 2320 B
MANUAL TITRATION
Alkalinity (pH 4.5)

Water (Inorganic) OSDWA †
Alkalinity - Water (094)
WT-TM-1032; modified from EPA 310.2
COLORIMETRIC
Alkalinity (pH 4.5)

Water (Inorganic) OSDWA †
Ammonia - Water (095)
WT-TM-1013; modified from EPA 350.1
COLORIMETRIC
Ammonia
Ammonia + ammonium

Water (Inorganic) OSDWA †
Anions - Water, Wastewater (003)
NA-TM-1001; modified from EPA 300.0
ION CHROMATOGRAPHY
Bromide
Chloride
Fluoride
Nitrate
Nitrite
Sulfate

Water (Inorganic) OSDWA †
Biochemical Oxygen Demand (BOD) - Water (001)
WT-TM-1002; modified from SM 5210B
D.O. METER
BOD (5 day)
CBOD (5 day)

Water (Inorganic) OSDWA †
Bromate - Water (114)
WT-TM-1503, WT-TM-1505; modified from EPA 6850
LC-MS/MS - EXTRACTION
Bromate

Water (Inorganic) OSDWA †
Carbon - Water (047)
WT-TM-1024; modified from SM 5310 B
IR - COMBUSTION
Organic Carbon

Water (Inorganic) OSDWA †
Chemical Oxygen Demand (COD) - Water (035)
WT-TM-1006; modified from SM 5220 D
REFLUX - COLORIMETRIC
COD

Water (Inorganic) OSDWA †
Chlorine - Water (074)
WT-TM-1021; modified from SM 4500-CL G and EPA 330.5
COLORIMETRIC
Free Chlorine

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

Water (Inorganic) OSDWA †
Hexavalent Chromium - Water (157)
WT-TM-1035; modified from EPA 1636 and EPA 7199
ION CHROMATOGRAPHY
Chromium (Hexavalent)

Water (Inorganic) OSDWA †
Hydrogen Sulphide - Water (012)
WT-TM-1003; modified from SM 4500-S2, D, E, F
COLORIMETRIC
Hydrogen Sulfide

Water (Inorganic) OSDWA †
Mercury - Water, Wastewater (049)
WT-TM-1018; modified from EPA 7470A and EPA 245.2
COLD VAPOUR AA - SPECTROMETRIC
Mercury

Water (Inorganic) OSDWA †
Oil and Grease - Water (033)
WT-TM-1100; modified from SM 5520 B, D, E, F and EPA 1664
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease
Total Oil and Grease

Water (Inorganic) OSDWA †
Perchlorate - Water (168)
WT-TM-1505; modified from EPA 6850
LC-MS/MS - EXTRACTION
Perchlorate

Water (Inorganic) OSDWA †
pH - Water (026)
WT-TM-1001; modified from SM 4500-H B
pH - METER
pH

Water (Inorganic) OSDWA †
pH - Water (106)
WT-TM-1028; modified from SM 4500-H B
PC TITRATE
pH

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Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur
Thallium
Tin
Titanium
Tungsten
Uranium
Vanadium
Zinc
Zirconium

Water (Inorganic) OSDWA †
Total Phosphorus - Water (011)
WT-TM-1020; modified from SM 4500-P E, F
AUTO COLOR - DIGESTION
Total Phosphorus

Water (Inorganic) OSDWA †
Turbidity - Water (024)
WT-TM-1004; modified from SM 2130 B
TURBIDIMETRIC
Turbidity

Water (Microbiology) OSDWA †
Coliforms - Water (155)
WT-TM-1200; modified from MOE/LSB MICROMFDC-E3407
MEMBRANE FILTRATION (DC)
Escherichia coli (E. coli)
Total Coliforms

Water (Microbiology) OSDWA †
Escherichia coli (E. coli) - Water (052)
WT-TM-1200; modified from ONTARIO MOE COMPARISON EVALUATION and SM 9222D
MEMBRANE FILTRATION (mFC-BCIG)
Escherichia coli (E. coli)

Water (Microbiology) OSDWA †
Fecal (Thermotolerant) Coliforms - Water (051)
WT-TM-1200; modified from SM 9222 D
MEMBRANE FILTRATION (m FC)
Fecal (Thermotolerant) Coliforms

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C1-Chrysenes
C1-Dibenzothiopenes
C1-Fluoranthenes/Pyrenes
C1-Fluorenes
C1-Naphthalenes
C1-Phenanthrenes/Anthracene
C2-Benzofluoroanthenes/Benzo(a)pyrenes
C2-Biphenyl
C2-Chrysenes
C2-Dibenzothiopenes
C2-Fluoranthenes/Pyrenes
C2-Fluorenes
C2-Naphthalenes
C2-Phenanthrenes/Anthracene
C3-Chrysenes
C3-Dibenzothiopenes
C3-Fluoranthenes/Pyrenes
C3-Fluorenes
C3-Naphthalenes
C3-Phenanthrenes/Anthracene
C4-Dibenzothiopenes
C4-Fluoranthenes/Pyrenes
C4-Naphthalenes
C4-Phenanthrenes/Anthracene
Chrysene
Dibenzo (a,h) anthracene
Dibenzothiopene
Fluoranthene
Fluorene
Indeno (1,2,3 - cd) pyrene
Naphthalene
Perylene
Phenanthrene
Phenanthrene
Pyrene
Quinoline
Retene

Water (Organic) OSDWA †
Base Neutral Acid Extractables (BNA) - Water, Wastewater (015)
WT-TM-1101/WT-TM-1300; modified from EPA SW-846-8270 and EPA SW-846 3500C
GC/MS - EXTRACTION
1-Chloronaphthalene
1-Methylnaphthalene
1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene
1,3-Dichlorobenzene
2-Chloronaphthalene
2-Chlorophenol
2-Methylnaphthalene
2-Nitrophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-tetrachlorophenol

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Nitrobenzene
o-Cresol
p-chloroaniline
Pentachlorophenol
Perylene
Phenanthrene
Phenol
Pyrene
Quinoline
Total Diphenylamine

Water (Organic) OSDWA †
Diquat and Paraquat - Water (134)
WT-TM-1506; modified from MDS SCIEX APPLICATION NOTE DIQUAT and PARAQUAT
LC-MS/MS - EXTRACTION
Diquat
Paraquat

Water (Organic) OSDWA †
Formaldehyde - Water (162)
WT-TM-1603; modified from EPA 556.1
GC/ECD
Formaldehyde

Water (Organic) OSDWA †
Glycols - Water (090)
WT-TM-1601; modified from EPA 8015B - MODIFIED
GC/FID
1,2 - Propylene Glycol
1,3 - Propylene Glycol
Diethylene Glycol
Ethylene Glycol
Triethylene Glycol

Water (Organic) OSDWA †
Glyphosate - Water (133)
WT-TM-1504; modified from MOE-GLYMS-E3500
LC-MS/MS - EXTRACTION
Glyphosate

Water (Organic) OSDWA †
Haloacetic Acids - Water (163)
WT-TM-1604; modified from EPA 552.3
GC/ECD
Bromoacetic Acid (BAA)
Bromochloroacetic Acid
Bromodichloroacetic Acid
Chloroacetic Acid (CAA)
Chlorodibromoacetic Acid
Dalapon (2,2-Dichloropropionic Acid)
Dibromoacetic Acid (DBAA)
Dichloroacetic Acid (DCAA)
Tribromoacetic acid (TBAA)
Trichloroacetic Acid (TCAA)

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Water (Organic)
Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS) - Water (174)
WT-TM-1557; modified from JOURNAL OF CHROMATOGRAPHY A.1093 (2005), 89-97
LC-MS/MS
- Perfluorooctane Sulfonate (PFOS)
- Perfluorooctanoic Acid (PFOA)

Water (Organic) OSDWA †
Pesticides - Water (023)
WT-TM-1107/WT-TM-1109-/WT-TM-1302; modified from EPA SW-846 8270 and EPA SW-846 3500C
GC/MS - EXTRACTION
- 2,4-dichlorophenoxyacetic acid
- 2,4,5-trichlorophenoxyacetic acid
- Alachlor
- Atrazine
- Azinphos-methyl
- Bendiocarb
- Bromoxynil
- Carbaryl
- Carbofuran
- Chlorpyrifos (ethyl)
- Cyanazine
- De-ethylated atrazine
- Diazinon
- Dicamba
- Diclofop-methyl (as free acid)
- Dimethoate
- Dinoseb
- Malathion
- Metolachlor
- Metribuzin
- Parathion (ethyl)
- Phorate
- Picloram
- Prometryne
- Simazine
- Temephos
- Terbufos
- Triallate
- Trifluralin

Water (Organic) OSDWA †
Petroleum Hydrocarbons (PHC) - Water (068)
WT-TM-1307/WT-TM-1112; modified from MOE:DECPH E3421
GC/FID - EXTRACTION
- F2 (C10-C16)
- F3 (C16-C34)
- F4 (C34-C50)

Water (Organic) OSDWA †
Petroleum Hydrocarbons (PHC) - Water (069)
WT-TM-1307/WT-TM-1112; modified from MOE:DECPH E3421
GRAVIMETRIC
- F4G (C34-C50)

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Water (Organic) OSDWA †

Volatile Organic Compounds - Water (113)

NA-TM-1102; modified from EPA 8260C and EPA 5021A

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
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
2,2-Dichloropropane
4-Chlorotoluene
Acetone (2-Propanone)
Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide
Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Dichlorodifluoromethane
Dichloromethane
Ethylbenzene
Ethylene Dibromide
Hexachlorobutadiene
Hexane
Isopropylbenzene
Isopropyltoluene
Isopropyltoluene
m/p-xylene

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Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Road
Guelph, Ontario

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 8 January 2009).

Accreditation No.: A2803
Issued On: November 10, 2014
Accreditation Date: January 3, 2005
Expiry Date: May 10, 2017

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: 2803
Laboratory Name: AquaTox Testing & Consulting Inc.
Parent Institution:
Address: 11B Nicholas Beaver Road Guelph ON N1H 6H9
Contact: Ms. Stephanie Folz
Phone: (519) 763-4412
Fax: (519) 763-4419
Email: sfolz@aquatox.ca

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served:
Revised On: November 10, 2014
Valid To: May 10, 2017

Scope of Accreditation

Solids (Toxicology)
Chironomids - Sediment (011)
SOP 391, 271; EPS 1/RM/32
SURVIVAL AND GROWTH
Chironomus dilutus (formerly Chironomus tentans)
Chironomus riparius

Solids (Toxicology)
Hyalella azteca - Sediment (010)
SOP 390, 270; EPS 1/RM/33
SURVIVAL AND GROWTH
Hyalella azteca

Solids (Toxicology)
Marine Amphipods - Sediment (015)
SOP 387; EPS 1/RM/26, EPS 1/RM/35
ACUTE LETHALITY (SURVIVAL)
Amphipods

Solids (Toxicology)
Microtox - Solid Phase - Sediment (021)
SOP 375; EPS 1/RM/42
BIOLUMINESCENCE
Microtox Solid Phase IC-50

Solids (Toxicology)
Polydora cornuta - Sediment (030)
SOP 361; EPS 1/RM/41
SURVIVAL AND GROWTH
Polydora cornuta

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Water (Toxicology)
Rainbow Trout - Water (001)
SOP 330, 308, 240; EPS 1/RM/9, EPS 1/RM/13
ACUTE LETHALITY (SURVIVAL)
Trout LC50 (96 h)
Trout Single Concentration (96h)

Water (Toxicology)
Silverside - Water (009)
SOP 371; modified from EPA - 821-R-02-014, METHOD 1006.0
GROWTH AND SURVIVAL
Silverside

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Appendix- D

Laboratory Analytical Methods

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Misc.-Field Tests			
Air volume	HYGIENE METHOD	0	
Waste-Sample Preparation			
Final pH	EPA 1311	0.10	pH units
Initial pH	EPA 1311	0.10	pH units
Water-Physical Tests			
Color, Apparent	APHA 2120	1.0	C.U.
Conductivity	APHA 2510 B	3.0	umhos/cm
Hardness (as CaCO3)	APHA 2340 B	10	mg/L
pH	APHA 4500 H-Electrode	0.10	pH units
Total Dissolved Solids	APHA 2540C	20	mg/L
Total Suspended Solids	APHA 2540 D-Gravimetric	2.0	mg/L
Turbidity	APHA 2130 B	0.10	NTU
Soil-Physical Tests			
% Moisture	Gravimetric: Oven Dried	0.10	%
Soil-Particle Size			
% Clay (<2um)	Forestry Canada (1991) p. 46-53	0.10	%
% Sand (2.0mm - 0.05mm)	Forestry Canada (1991) p. 46-53	0.10	%
% Silt (0.05mm - 2um)	Forestry Canada (1991) p. 46-53	0.10	%
Texture	Forestry Canada (1991) p. 46-53		
Filter-Particulates			
Particulates Analysis	SEE SUBLET LAB'S REPORT		
Dustfall-Particulates			
Fixed Insoluble Dustfall	BCMOE DUSTFALLS	0.10	mg/dm2.day
Total Insoluble Dustfall	BCMOE DUSTFALLS	0.10	mg/dm2.day
Volatile Insoluble Dustfall	BCMOE DUSTFALLS	0.10	mg/dm2.day
Air-Asbestos/Quartz/Other Fibres			
Cristobalite	NIOSH 7500		
Soil-Leachable Anions & Nutrients			
Nitrate-N	EPA 300.0	1.0	ug/g
Nitrite-N	EPA 300.0	1.0	ug/g
Total Kjeldahl Nitrogen	APHA 4500-N	200	mg/kg
Water-Anions and Nutrients			
Alkalinity, Bicarbonate (as CaCO3)	EPA 310.2	10	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Alkalinity, Carbonate (as CaCO3)	EPA 310.2	10	mg/L
Alkalinity, Hydroxide (as CaCO3)	EPA 310.2	10	mg/L
Alkalinity, Total (as CaCO3)	EPA 310.2	10	mg/L
Ammonia, Total (as N)	EPA 350.1	0.050	mg/L
Bromide (Br)	EPA 300.0 (IC)	0.10	mg/L
Chloride	EPA 300.0 (IC)	2.0	mg/L
Chloride (Cl)	EPA 300.0 (IC)	2.0	mg/L
Fluoride	EPA 300.0 (IC)	0.10	mg/L
Nitrate and Nitrite as N	APHA 4110 B	0.10	mg/L
Nitrate-N (NO3-N)	EPA 300.0 (IC)	0.10	mg/L
Nitrite-N	EPA 300.1 (Modified)	0.0010	mg/L
Sulphate	EPA 300.0 (IC)	2.0	mg/L
Sulphate (SO4)	EPA 300.0 (IC)	2.0	mg/L
Total Kjeldahl Nitrogen	APHA 4500-N	0.15	mg/L
Total Phosphorus	APHA 4500-P B E	0.0030	mg/L
Soil-Anions and Nutrients			
Nitrate and Nitrite as N	APHA 4110 B	1.0	ug/g
Water-Cyanides			
Cyanide, Free	ASTM 7237	0.0050	mg/L
Water-Organic / Inorganic Carbon			
Dissolved Organic Carbon	APHA 5310 B-INSTRUMENTAL	1.0	mg/L
Total Organic Carbon	APHA 5310B	1.0	mg/L
Soil-Organic / Inorganic Carbon			
Fraction Organic Carbon	CARTER 21.2	0.0010	g/g
Total Organic Carbon	CARTER 21.2	0.10	%
Water-Bacteriological Tests			
E. Coli	SM 9222D	0	CFU/100 mL
Fecal Coliforms	SM 9222D	0	CFU/100 mL
Total Coliforms	SM 9222B	0	CFU/100 mL
Soil-Metals			
Aluminum (Al)	EPA 200.2/6020A	50	ug/g
Arsenic (As)	EPA 200.2/6020A	0.2	ug/g
Arsenic (As)	EPA 200.2/6020A	1	ug/g
Barium (Ba)	EPA 200.2/6020A	1	ug/g
Cadmium (Cd)	EPA 200.2/6020A	0.5	ug/g
Calcium (Ca)	EPA 200.2/6020A	100	ug/g

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Chromium (Cr)	EPA 200.2/6020A	1	ug/g
Copper (Cu)	EPA 200.2/6020A	1	ug/g
Iron (Fe)	EPA 200.2/6020A	50	ug/g
Lead (Pb)	EPA 200.2/6020A	1	ug/g
Magnesium (Mg)	EPA 200.2/6020A	20	ug/g
Manganese (Mn)	EPA 200.2/6020A	1	ug/g
Mercury (Hg)	SW846 3050B/7471	0.010	ug/g
Sodium (Na)	EPA 200.2/6020A	100	ug/g
Uranium (U)	EPA 200.2/6020A	1	ug/g
Zinc (Zn)	EPA 200.2/6020A	5	ug/g
Dustfall-Metals			
Aluminum (Al)-Total	EPA 6020A	0.0030	mg/dm2.day
Antimony (Sb)-Total	EPA 6020A	0.00010	mg/dm2.day
Arsenic (As)-Total	EPA 6020A	0.00010	mg/dm2.day
Barium (Ba)-Total	EPA 6020A	0.000050	mg/dm2.day
Beryllium (Be)-Total	EPA 6020A	0.00050	mg/dm2.day
Bismuth (Bi)-Total	EPA 6020A	0.00050	mg/dm2.day
Boron (B)-Total	EPA 6020A	0.010	mg/dm2.day
Cadmium (Cd)-Total	EPA 6020A	0.000050	mg/dm2.day
Calcium (Ca)-Total	EPA 6020A	0.020	mg/dm2.day
Chromium (Cr)-Total	EPA 6020A	0.00050	mg/dm2.day
Cobalt (Co)-Total	EPA 6020A	0.00010	mg/dm2.day
Copper (Cu)-Total	EPA 6020A	0.00050	mg/dm2.day
Interval	EPA 245.7	1	days
Interval	EPA 6020A	1	days
Lead (Pb)-Total	EPA 6020A	0.000050	mg/dm2.day
Lithium (Li)-Total	EPA 6020A	0.0050	mg/dm2.day
Magnesium (Mg)-Total	EPA 6020A	0.0050	mg/dm2.day
Manganese (Mn)-Total	EPA 6020A	0.000050	mg/dm2.day
Mercury (Hg)-Total	EPA 245.7	0.000050	mg/dm2.day

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Molybdenum (Mo)-Total	EPA 6020A	0.000050	mg/ dm2.day
Nickel (Ni)-Total	EPA 6020A	0.00050	mg/ dm2.day
Potassium (K)-Total	EPA 6020A	0.050	mg/ dm2.day
Selenium (Se)-Total	EPA 6020A	0.0010	mg/ dm2.day
Silver (Ag)-Total	EPA 6020A	0.000010	mg/ dm2.day
Sodium (Na)-Total	EPA 6020A	0.050	mg/ dm2.day
Strontium (Sr)-Total	EPA 6020A	0.00010	mg/ dm2.day
Thallium (Tl)-Total	EPA 6020A	0.00010	mg/ dm2.day
Tin (Sn)-Total	EPA 6020A	0.00010	mg/ dm2.day
Uranium (U)-Total	EPA 6020A	0.000010	mg/ dm2.day
Vanadium (V)-Total	EPA 6020A	0.0010	mg/ dm2.day
Zinc (Zn)-Total	EPA 6020A	0.0030	mg/ dm2.day
Water-Total Metals			
Aluminum (Al)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.003	mg/L
Aluminum (Al)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.01	mg/L
Aluminum (Al)-Total	EPA 200.8	0.01	mg/L
Antimony (Sb)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Arsenic (As)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Arsenic (As)-Total	EPA 200.8	0.001	mg/L
Barium (Ba)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.00005	mg/L
Barium (Ba)-Total	EPA 200.8	0.002	mg/L
Beryllium (Be)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Bismuth (Bi)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0005	mg/L
Boron (B)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.01	mg/L
Cadmium (Cd)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.00001	mg/L
Cadmium (Cd)-Total	EPA 200.8	0.00009	mg/L
Calcium (Ca)-Total	EPA 200.8	0.5	mg/L
Calcium (Ca)-Total	EPA SW-846 3005A/6010B	0.05	mg/L
Chromium (Cr)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Chromium (Cr)-Total	EPA 200.8	0.0005	mg/L
Cobalt (Co)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Copper (Cu)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0005	mg/L
Copper (Cu)-Total	EPA 200.8	0.001	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Iron (Fe)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.01	mg/L
Iron (Fe)-Total	EPA 200.8	0.05	mg/L
Lead (Pb)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.00005	mg/L
Lead (Pb)-Total	EPA 200.8	0.0005	mg/L
Lithium (Li)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0005	mg/L
Magnesium (Mg)-Total	EPA 200.8	0.5	mg/L
Magnesium (Mg)-Total	EPA SW-846 3005A/6010B	0.1	mg/L
Manganese (Mn)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.00005	mg/L
Manganese (Mn)-Total	EPA 200.8	0.001	mg/L
Mercury (Hg)-Total	EPA SW846 7470A	0.000010	mg/L
Molybdenum (Mo)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.00005	mg/L
Nickel (Ni)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0005	mg/L
Phosphorus (P)-Total	EPA SW-846 3005A/6010B	0.3	mg/L
Potassium (K)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.05	mg/L
Selenium (Se)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Silicon (Si)-Total	EPA SW-846 3005A/6010B	0.05	mg/L
Silver (Ag)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.00001	mg/L
Sodium (Na)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.05	mg/L
Sodium (Na)-Total	EPA 200.8	0.5	mg/L
Strontium (Sr)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0002	mg/L
Thallium (Tl)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.00001	mg/L
Tin (Sn)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Titanium (Ti)-Total	EPA SW-846 3005A/6010B	0.01	mg/L
Uranium (U)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.00001	mg/L
Uranium (U)-Total	EPA 200.8	0.001	mg/L
Vanadium (V)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.001	mg/L
Zinc (Zn)-Total	APHA 3030 B&E / EPA SW-846 6020A	0.003	mg/L
Zinc (Zn)-Total	EPA 200.8	0.003	mg/L

Water-Dissolved Metals

Aluminum (Al)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.001	mg/L
Antimony (Sb)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Arsenic (As)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Barium (Ba)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.00005	mg/L
Beryllium (Be)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Bismuth (Bi)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0005	mg/L
Boron (B)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.01	mg/L
Cadmium (Cd)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.00001	mg/L
Calcium (Ca)-Dissolved	EPA 200.8	0.5	mg/L
Chromium (Cr)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Cobalt (Co)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Copper (Cu)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0002	mg/L
Dissolved Metals Filtration Location	EPA 200.8		
Iron (Fe)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.01	mg/L
Lead (Pb)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.00005	mg/L
Lithium (Li)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0005	mg/L
Magnesium (Mg)-Dissolved	EPA 200.8	0.5	mg/L
Manganese (Mn)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.00005	mg/L
Molybdenum (Mo)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.00005	mg/L
Nickel (Ni)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0005	mg/L
Potassium (K)-Dissolved	EPA SW-846 3005A/6020A	0.05	mg/L
Selenium (Se)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Silver (Ag)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.00001	mg/L
Sodium (Na)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.05	mg/L
Strontium (Sr)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0002	mg/L
Thallium (Tl)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.00001	mg/L
Tin (Sn)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.0001	mg/L
Titanium (Ti)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.01	mg/L
Uranium (U)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.00001	mg/L
Vanadium (V)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.001	mg/L
Zinc (Zn)-Dissolved	APHA 3030 B&E / EPA SW-846 6020A	0.001	mg/L
Waste-TCLP Metals			
Arsenic (As)	EPA 200.8	0.001	mg/L
Barium (Ba)	EPA 200.8	0.01	mg/L
Cadmium (Cd)	EPA 200.8	0.0001	mg/L
Chromium (Cr)	EPA 200.8	0.001	mg/L
Lead (Pb)	EPA 200.8	0.001	mg/L
Mercury (Hg)	SW846 7470A	0.00010	mg/L
Water-Aggregate Organics			
BOD	APHA 5210 B	2.0	mg/L
COD	APHA 5220 D	10	mg/L
Oil and Grease, Total	APHA 5520 B	2.0	mg/L
Mineral Oil and Grease	APHA 5520 B	1.0	mg/L
Phenols (4AAP)	EPA 9066	0.0010	mg/L
Soil-Aggregate Organics			
Oil and Grease, Total	APHA 5520 B	500	mg/kg
Water-Volatile Organic Compounds			
1,4-Difluorobenzene	SW846 8260 (HEADSPACE)	1	

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
4-Bromofluorobenzene	SW846 8260 (HEADSPACE)	1	
Benzene	SW846 8260 (HEADSPACE)	0.5	ug/L
Ethyl Benzene	SW846 8260 (HEADSPACE)	0.5	ug/L
Toluene	SW846 8260 (HEADSPACE)	0.5	ug/L
Water-Hydrocarbons			
2-Bromobenzotrifluoride	MOE DECPH-E3421/CCME TIER 1	1	
3,4-Dichlorotoluene	E3421/CCME (HS)	1	
Chrom. to baseline at nC50	MOE DECPH-E3421/CCME TIER 1		
F2-Naphth	CCME CWS-PHC DEC-2000 - PUB# 1310-L	100	ug/L
F3-PAH	CCME CWS-PHC DEC-2000 - PUB# 1310-L	250	ug/L
F2 (C10-C16)	MOE DECPH-E3421/CCME TIER 1	100	ug/L
F3 (C16-C34)	MOE DECPH-E3421/CCME TIER 1	250	ug/L
F4 (C34-C50)	MOE DECPH-E3421/CCME TIER 1	250	ug/L
Total Hydrocarbons (C6-C50)	CCME CWS-PHC DEC-2000 - PUB# 1310-L	250	ug/L
F1 (C6-C10)	E3421/CCME (HS)	100	ug/L
F1-BTEX	CCME CWS-PHC DEC-2000 - PUB# 1310-L	100	ug/L
Soil-Hydrocarbons			
2-Bromobenzotrifluoride	MOE DECPH-E3398/CCME TIER 1	1	
3,4-Dichlorotoluene	E3398/CCME TIER 1-HS	1	
Chrom. to baseline at nC50	MOE DECPH-E3398/CCME TIER 1		
F2-Naphth	CCME CWS-PHC DEC-2000 - PUB# 1310-S	10	ug/g
F3-PAH	CCME CWS-PHC DEC-2000 - PUB# 1310-S	50	ug/g
F2 (C10-C16)	MOE DECPH-E3398/CCME TIER 1	10	ug/g
F3 (C16-C34)	MOE DECPH-E3398/CCME TIER 1	50	ug/g
F4 (C34-C50)	MOE DECPH-E3398/CCME TIER 1	50	ug/g
Total Hydrocarbons (C6-C50)	CCME CWS-PHC DEC-2000 - PUB# 1310-S	50	ug/g
F1 (C6-C10)	E3398/CCME TIER 1-HS	5.0	ug/g
F1-BTEX	CCME CWS-PHC DEC-2000 - PUB# 1310-S	10	ug/g
Water-Organic Parameters			
Chlorophyll a	EPA 445.0 ACET	0.10	ug/L
Phaeophytin a	EPA 445.0 ACET	0.10	ug/L
Misc.-Miscellaneous			
Special Request	SEE SUBLET LAB RESULTS		

Methodology

<table>
<tr><th>Product</th><th>Matrix</th><th>Product Description</th><th>Analytical Method Reference</th></tr>
<tr><td>AIR VOLUME-ED</td><td>Misc.</td><td>Air volume (L)</td><td>HYGIENE METHOD</td></tr>
<tr><td colspan="4">NOTE: When air concentrations of analytes are reported, they are based on air sampling information (air volume, sampling time, sampling flow rate) supplied by the client.</td></tr>
<tr><td>ALK-SPEC-WT</td><td>Water</td><td>Speciated Alkalinity</td><td>EPA 310.2</td></tr>
<tr><td>ALK-WT</td><td>Water</td><td>Alkalinity, Total (as CaCO3)</td><td>EPA 310.2</td></tr>
<tr><td>ANIONS3-WT</td><td>Water</td><td>Cl, F, SO4</td><td>EPA 300.0 (IC)</td></tr>
<tr><td>BOD-WT</td><td>Water</td><td>BOD</td><td>APHA 5210 B</td></tr>
<tr><td colspan="4">Diluted and seeded samples are filled in an airtight bottle and incubated at a specified temperature for 5 days.</td></tr>
<tr><td>BR-WT</td><td>Water</td><td>Bromide</td><td>EPA 300.0 (IC)</td></tr>
<tr><td>BTX-HS-WT</td><td>Soil</td><td>BTEX by Headspace</td><td>SW846 8260 (HEADSPACE)</td></tr>
<tr><td colspan="4">BTX is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/MS.</td></tr>
<tr><td>BTX-HS-WT</td><td>Water</td><td>BTEX by Headspace</td><td>SW846 8260 (HEADSPACE)</td></tr>
<tr><td colspan="4">BTX is determined by analyzing by headspace-GC/MS.</td></tr>
<tr><td>C-DIS-ORG-WT</td><td>Water</td><td>Dissolved Organic Carbon</td><td>APHA 5310 B-INSTRUMENTAL</td></tr>
<tr><td colspan="4">Sample is filtered through a 0.45um filter, sample is then injected into a heated reaction chamber which is packed with an oxidative catalyst. The water is vaporized and the organic cabon is oxidized to carbon dioxide. The carbon dioxide is transported in a carrier gas and is measured by a non-dispersive infrared detector.</td></tr>
<tr><td>CHL/A-ACET-FLUORO-WP</td><td>Water</td><td>Chlorophyll a by fluorometry</td><td>EPA 445.0 ACET</td></tr>
<tr><td colspan="4">This analysis is done using procedures modified from EPA method 445.0. Chlorophyll a is determined by a 90 % acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.</td></tr>
<tr><td>CL-WT</td><td>Water</td><td>Chloride</td><td>EPA 300.0 (IC)</td></tr>
<tr><td>CN-FREE-CFA-WT</td><td>Water</td><td>Free Cyanide in water by CFA</td><td>ASTM 7237</td></tr>
<tr><td colspan="4">This analysis is carried out using procedures adapted from ASTM Method 7237 "Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection". Free cyanide is determined by in-line gas diffusion at pH 6 with final determination by colourimetric analysis.</td></tr>
<tr><td>COD-BF</td><td>Water</td><td>Chemical Oxygen Demand</td><td>APHA 5220 D</td></tr>
<tr><td colspan="4">The dichromate ion oxidizes COD material when the sample is digested and after digestion the sample is then analyzed on a spectrophotometer.</td></tr>
<tr><td>COD-WT</td><td>Water</td><td>Chemical Oxygen Demand</td><td>APHA 5220 D</td></tr>
<tr><td colspan="4">The dichromate ion oxidizes COD material when the sample is digested and after digestion the sample is then analyzed on a spectrophotometer.</td></tr>
</table>

Methodology

<table>
<tr><th>Product</th><th>Matrix</th><th>Product Description</th><th>Analytical Method Reference</th></tr>
<tr><td>COLOUR-WT</td><td>Water</td><td>Colour</td><td>APHA 2120</td></tr>
<tr><td colspan="4">Apparent colour is determined by analysis of the decanted sample using the platinum-cobalt colourimetric method.</td></tr>
<tr><td>DUSTFALLS-INS.DM2-VA</td><td>Dustfall</td><td>Dustfalls Insoluble (mg/dm2.day)</td><td>BCMOE DUSTFALLS</td></tr>
<tr><td colspan="4">Dustfall analysis is carried out in accordance with procedures published by the B.C. Ministry of Environment Laboratory.</td></tr>
<tr><td>EC-BF</td><td>Water</td><td>Conductivity</td><td>APHA 2510 B</td></tr>
<tr><td colspan="4">Water samples can be measured directly by immersing the conductivity cell into the sample.</td></tr>
<tr><td>EC-MF-WT</td><td>Water</td><td>E. coli</td><td>SM 9222D</td></tr>
<tr><td colspan="4">A 100mL volume of sample is filtered through a membrane, the membrane is placed on mFC-BCIG agar and incubated at @44.5±0.2°C for 24±2h. Method ID: WT-TM-1200</td></tr>
<tr><td>EC-WT</td><td>Water</td><td>Conductivity</td><td>APHA 2510 B</td></tr>
<tr><td colspan="4">Water samples can be measured directly by immersing the conductivity cell into the sample.</td></tr>
<tr><td>ETL-HARDNESS-CALC-WT</td><td>Water</td><td>Hardness (as CaCO3)</td><td>APHA 2340 B</td></tr>
<tr><td>ETL-N2N3-WT</td><td>Water</td><td>Calculate from NO2 + NO3</td><td>APHA 4110 B</td></tr>
<tr><td>F-WT</td><td>Water</td><td>Fluoride</td><td>EPA 300.0 (IC)</td></tr>
<tr><td>F1-F4-CALC-WT</td><td>Soil</td><td>CCME Total Hydrocarbons</td><td>CCME CWS-PHC DEC-2000 - PUB# 1310-S</td></tr>
</table>

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k) fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

Methodology

Product	Matrix	Product Description	Analytical Method Reference
F1-F4-CALC-WT	Water	CCME Total Hydrocarbons	CCME CWS-PHC DEC-2000 - PUB# 1310-L

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k) fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F1-HS-WT	Soil	F1 (O.Reg.153/04)	E3398/CCME TIER 1-HS

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

F1-HS-WT	Water	F1 (O.Reg.153/04)	E3421/CCME (HS)

Fraction F1 is determined by analyzing by headspace-GC/FID.

F2-F4-WT	Soil	F2-F4 (O.Reg.153/04)	MOE DECPH-E3398/CCME TIER 1

A sub-sample of the solid sample is extracted with a solvent mixture. Following extraction, the sample extract is treated in situ with Silica Gel analyzed by GC/FID.

The F2 fraction is determined by integrating the area in the chromatogram from the apex of nC10 to the apex nC16 and quantitating using external calibration using a standard mix containing nC10, nC16 and nC34. Similarly, the F3 fraction extends from the apex of nC16 to the apex nC34 and the F4 fraction covers the area from the apex nC34 to the apex nC50. If the chromatogram does not return to the baseline by the time nC50 elutes, a gravimetric determination of the F4 is performed.

Methodology

Product	Matrix	Product Description	Analytical Method Reference
F2-F4-WT	Water	F2-F4 (O.Reg.153/04)	MOE DECPH-E3421/CCME TIER 1
The petroleum hydrocarbons are extracted from the aqueous samples using solvent partition. The extracts are treated with silica gel to remove polar contaminants. The final concentrated extract is analyzed by gas chromatography (GC) using flame ionization detection (FID) and a 100% polydimethylsiloxane column. The F2 fraction is determined by integrating the area in the chromatogram from the apex of nC10 to the apex nC16 and quantitating using external calibration using a standard mix containing nC10, nC16 and nC34. Similarly, the F3 fraction extends from the apex of nC16 to the apex nC34 and the F4 fraction covers the area from the apex nC34 to the apex nC50. If the chromatogram does not return to the baseline by the time nC50 elutes, a gravimetric determination of the F4 is performed.			
FILTER-NC-WT	Water	Lab Filtered and Preserved (as required)	
HG-DUST(DM2-CVAFS-VA	Dustfall	Total Mercury in Dustfalls by CVAFS	EPA 245.7
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
HG-R511-WT	Soil	Mercury-O.Reg 153/04 (July 2011)	SW846 3050B/7471
Solid sample is digested with a heated, strong, mixed acid solution to convert all forms of mercury to divalent mercury. The divalent mercury is then reduced to elemental mercury, sparged from solution and analyzed by CVAAS. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).			
HG-T-L-CVAA-WT	Water	Total Mercury in Water by CVAAS (Low)	EPA SW846 7470A
Liquid sample is digested with a heated, strong, mixed acid solution to convert all forms of mercury to divalent mercury. The divalent mercury is then reduced to elemental mercury, sparged from solution and analyzed by CVAAS.			
HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	SW846 7470A
LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).			
MET-D-MS-WT	Water	Dissolved Metals in Water by ICPMS	EPA 200.8
The metal constituents of a non-acidified sample that pass through a membrane filter prior to ICP/MS analysis. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).			
MET-DIS-MS-VA	Water	Dissolved Metals by ICPMS	EPA SW-846 3005A/6020A
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - mass spectrometry (EPA Method 6020A).			

Methodology

Product	Matrix	Product Description	Analytical Method Reference
MET-DUST(DM2)-MS-VA	Dustfall	Total Metals in Dustfalls by ICPMS	EPA 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-T-MS-WT	Water	Total Metals in Water by ICPMS	EPA 200.8

This analysis involves preliminary sample treatment by hotblock acid digestion (APHA 3030E). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 200.8
MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-UG/G-CCMS-WT	Soil	Metal Scan Collision Cell ICPMS	EPA 200.2/6020A

Sample is vigorously digested with nitric and hydrochloric acid. Analysis is conducted by ICP/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried
NH3-WT	Water	Ammonia, Total as N	EPA 350.1

Sample is measured colorimetrically. When sample is turbid a distillation step is required, sample is distilled into a solution of boric acid and measured colorimetrically.

NO2-L-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (Modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

NO2-WT	Soil		EPA 300.0
NO3-WT	Soil	Nitrate in Soil	EPA 300.0
NO3-WT	Water	Nitrate-N	EPA 300.0 (IC)

A filtered water sample (drinking waters-unfiltered) is analyzed by ion chromatography.

Methodology

<table>
<tr><th>Product</th><th>Matrix</th><th>Product Description</th><th>Analytical Method Reference</th></tr>
<tr><td>OGG-SPEC-CALC-WT</td><td>Water</td><td>Speciated Oil and Grease A/V Calculation</td><td>CALCULATION</td></tr>
<tr><td colspan="4">Sample is extracted with hexane, sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.</td></tr>
<tr><td>OGG-SPEC-WT</td><td>Water</td><td>Speciated Oil and Grease-Gravimetric</td><td>APHA 5520 B</td></tr>
<tr><td colspan="4">Sample is extracted with hexane, sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.</td></tr>
<tr><td>OGG-TOT-WT</td><td>Soil</td><td>Oil and Grease, Total</td><td>APHA 5520 B</td></tr>
<tr><td colspan="4">Sample is extracted with an acetone:hexane mixture followed, extract is then evaporated and residue is weighed to determine total oil and grease.</td></tr>
<tr><td>OGG-TOT-WT</td><td>Water</td><td>Oil and Grease, Total</td><td>APHA 5520 B</td></tr>
<tr><td colspan="4">Sample is extracted with hexane, extract is then evaporated and the residue is weighed to determine total oil and grease.</td></tr>
<tr><td>P-TOTAL-LOW-WT</td><td>Water</td><td>Phosphorus, Total, Low Level</td><td>APHA 4500-P B E</td></tr>
<tr><td colspan="4">This analysis is carried by out an discrete colorimetric auto-analyzer using procedures adapted from APHA Method 4500-P "Phosphorus".</td></tr>
<tr><td>PARTICULATE-0.10-SLT</td><td>Filter</td><td>Respirable Dust N0600</td><td>SEE SUBLET LAB'S REPORT</td></tr>
<tr><td>PH-BF</td><td>Water</td><td>pH</td><td>APHA 4500 H-Electrode</td></tr>
<tr><td colspan="4">Water samples are analyzed directly by a calibrated pH meter.
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</td></tr>
<tr><td>PH-WT</td><td>Water</td><td>pH</td><td>APHA 4500 H-Electrode</td></tr>
<tr><td colspan="4">Water samples are analyzed directly by a calibrated pH meter.
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</td></tr>
<tr><td>PHENOLS-4AAP-WT</td><td>Water</td><td>Phenol (4AAP)</td><td>EPA 9066</td></tr>
<tr><td colspan="4">An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.</td></tr>
<tr><td>PHEOA-ACET-FLUORO-WP</td><td>Water</td><td>Pheophytin a by fluorometry</td><td>EPA 445.0 ACET</td></tr>
<tr><td colspan="4">This analysis is done using procedures modified from EPA method 445.0. Pheopigments present in the sample are determined collectively as Pheophytin a by a 90% (v/v) acetone extraction followed with analysis by fluorometry using the acidification procedure.</td></tr>
<tr><td>PREP-DUSTFALL-VA</td><td>Dustfall</td><td>Dustfall Sample Preparation</td><td></td></tr>
</table>

Methodology

<table>
<tr><th>Product</th><th>Matrix</th><th>Product Description</th><th>Analytical Method Reference</th></tr>
<tr><td>PSA-3-SK</td><td>Soil</td><td>Particle size - Pipette removal OM & CO3</td><td>Forestry Canada (1991) p. 46-53</td></tr>
<tr><td colspan="4">Dry, < 2 mm soil is treated hydrochloric acid top remove carbonates, then hydrogen peroxide to remove organic matter. The remaining soil is treated with sodium hexametaphosphate to ensure complete dispersion of primary soil particles. The homogenized suspension is allowed to settle in accordance with Stoke's Law so that only clay particles remain in suspension.To determine the clay fraction, an aliquot of the clay suspension is removed, then dried and weighed. The sand fraction is determined by wet sieving the remaining suspension, then drying and weighing the sand retained on the sieve. The silt fraction is determined by calculation where % Silt = 100 - (%Sand+%Clay)

Reference:
Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.</td></tr>
<tr><td>SAMPLE-DISPOSAL-WT</td><td>Misc.</td><td>Sample Handling and Disposal Fee</td><td></td></tr>
<tr><td>SHIPPING-WT</td><td>Misc.</td><td>Shipping Charge</td><td></td></tr>
<tr><td>SO4-WT</td><td>Water</td><td>Sulphate</td><td>EPA 300.0 (IC)</td></tr>
<tr><td>SOLIDS-TDS-BF</td><td>Water</td><td>Total Dissolved Solids</td><td>APHA 2540C</td></tr>
<tr><td colspan="4">A well-mixed sample is filtered though glass fibres filter. A known volume of the filtrate is evaporated and dried at 105±5°C overnight and then 180±10°C for 1hr.</td></tr>
<tr><td>SOLIDS-TDS-WT</td><td>Water</td><td>Total Dissolved Solids</td><td>APHA 2540C</td></tr>
<tr><td colspan="4">A well-mixed sample is filtered though glass fibres filter. A known volume of the filtrate is evaporated and dried at 105±5°C overnight and then 180±10°C for 1hr.</td></tr>
<tr><td>SOLIDS-TSS-BF</td><td>Water</td><td>Suspended solids</td><td>APHA 2540 D-Gravimetric</td></tr>
<tr><td colspan="4">A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 105±5°C for a minimum of four hours or until a constant weight is achieved.</td></tr>
<tr><td>SOLIDS-TSS-WT</td><td>Water</td><td>Suspended solids</td><td>APHA 2540 D-Gravimetric</td></tr>
<tr><td colspan="4">A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 105±5°C for a minimum of four hours or until a constant weight is achieved.</td></tr>
<tr><td>SPECIAL REQUEST-SLT</td><td>Misc.</td><td>Special Request Datachem Salt Lake</td><td>SEE SUBLET LAB RESULTS</td></tr>
<tr><td>TC-MF-WT</td><td>Water</td><td>Total Coliforms</td><td>SM 9222B</td></tr>
<tr><td colspan="4">A 100mL volume of sample is filtered through a membrane, the membrane is placed on mENDO LES agar and incubated at 35±0.5°C for 24±2h. Method ID: WT-TM-1200</td></tr>
<tr><td>TKN-WT</td><td>Soil</td><td>Total Kjeldahl Nitrogen</td><td>APHA 4500-N</td></tr>
<tr><td colspan="4">A homogenized soil sample is digested to convert the TKN to ammonium sulphate. The ammonia ions are heated to produce a colour complex. The absorbance measured by the instrument is proportional to the concentration of ammonium sulphate in the sample and is reported as TKN.</td></tr>
<tr><td>TKN-WT</td><td>Water</td><td>Total Kjeldahl Nitrogen</td><td>APHA 4500-N</td></tr>
<tr><td colspan="4">Sample is digested to convert the TKN to ammonium sulphate. The ammonia ions are heated to produce a colour complex. The absorbance measured by the instrument is proportional to the concentration of ammonium sulphate in the sample and is reported as TKN.</td></tr>
</table>

Methodology

<table>
<tr><th>Product</th><th>Matrix</th><th>Product Description</th><th>Analytical Method Reference</th></tr>
<tr><td>TOC-WT</td><td>Soil</td><td>TOC & FOC in Solids</td><td>CARTER 21.2</td></tr>
<tr><td>TOC-WT</td><td>Water</td><td>Total Organic Carbon</td><td>APHA 5310B</td></tr>
<tr><td colspan="4">Sample is injected into a heated reaction chamber which is packed with an oxidative catalyst. The water is vaporized and the organic cabon is oxidized to carbon dioxide. The carbon dioxide is transported in a carrier gas and is measured by a non-dispersive infrared detector.</td></tr>
<tr><td>TURBIDITY-BF</td><td>Water</td><td>Turbidity</td><td>APHA 2130 B</td></tr>
<tr><td colspan="4">Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.</td></tr>
<tr><td>TURBIDITY-WT</td><td>Water</td><td>Turbidity</td><td>APHA 2130 B</td></tr>
<tr><td colspan="4">Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.</td></tr>
<tr><td>XYLENES-SUM-CALC-WT</td><td>Soil</td><td>Sum of Xylene Isomer Concentrations</td><td>CALCULATION</td></tr>
<tr><td colspan="4">Total xylenes represents the sum of o-xylene and m&p-xylene.</td></tr>
<tr><td>XYLENES-SUM-CALC-WT</td><td>Water</td><td>Sum of Xylene Isomer Concentrations</td><td>CALCULATION</td></tr>
<tr><td colspan="4">Total xylenes represents the sum of o-xylene and m&p-xylene.</td></tr>
</table>

Appendix- E

Analytical Laboratory QA/QC Procedures

ALS Quality Management System Summary

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

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

Services to Customers

ALS cooperates closely with its customers to ensure their testing needs are understood, and allows them reasonable access to relevant work areas of the laboratories to audit the 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 in the Canadian laboratories 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, 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 procedures are authorized prior to use by the signing authority, 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 signing authority to ensure they continue to meet ALS requirements and customer needs.

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

Internal Audits

Internal audits are scheduled and performed by qualified Quality and Technical staff for all routine analytical procedures and Quality System elements. Such audits ensure that procedures are implemented as intended, that test methods are scientifically defensible and technically sound, and that policies, procedures and records continue to meet the Quality System objectives.

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 its 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 sample, 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.

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. The trend monitoring process has been automated within our LIMS. Upon data entry, each QC result is checked against programmed limits and trends. If a trend is identified, a notification is e-mailed to the analyst and their supervisor, so that it can be investigated and corrected.

Continuous Improvement

ALS is committed to continuously improving its 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.

Data Validation

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 an independent peer review of raw and calculated test results. 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 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.

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

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.

$$\mathbf{LOQ_5 = 5s_0 + |MBlk|}$$

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. 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. The Type A method of calculating measurement uncertainty is followed, 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 its 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.

Our 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 staff needs 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. The 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)

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

ALS Quality Control Protocols

08 May, 2012

Quality control samples are introduced into batches of 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.

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.

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 take precedence over internal DQOs. Current DQOs are available upon request.

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

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 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

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[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.

Spikes. Matrix Spike results cannot be calculated or reported in cases where the background concentration of the test parameter in the sample is too high relative to 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 concentration 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. 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 is normally done in the field. Filtration processes are a common source of low level metals contaminants. Contamination of a sample during filtration is the most common source of significant D > T issues.

iii) Field samples for Dissolved and Total Metals are normally collected independently, so variability of the sampling process 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 20% 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.

The mechanism of this relational check is derived from the ALS Duplicate DQOs for Metals in Water.

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. In most cases, results will be re-analyzed to confirm or correct the anomalous relationship. 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*

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Matrix is the substance type of the QC sample.

Common matrices are water, soil, and tissue.

The **Reference** column contains:

a) Lab sample number (L#) or work group number (WG#) of samples that were used for duplicates or matrix spikes - this information is for internal tracking purposes.

b) Test results for actual samples that were duplicated for QC purposes.

Result from analyzing the QC sample.

% Recovery is calculated for QC samples with known target values (e.g. Spikes or CRMs).

Actual (absolute) test results are reported for the second aliquot of a duplicate pair and method blanks.

A **Qualifier** is used to communicate important information about the QC sample test results.

Sample parameter qualifiers used in the report are defined near the end of the Quality Control Report.

Also refer to the *Sample Parameter Qualifier Definitions* on the next page.

Units of the QC sample test results.

Test results are reported in % recovery for samples with known target values.

Actual (absolute) concentration units are used for reporting duplicate sample and Method Blank test results.

The calculated **Relative % Difference** between duplicate pairs.

RPD is calculated as follows:
|{(Sample Result - Duplicate Result) / [Mean]}| x 100

Duplicate pairs with test results that are < 5 x LOR are reported in sample concentration units (absolute units) and are accompanied by a J qualifier.

The Control **Limit** for the QC sample (ALS Data Quality Objective (DQO)).

QC samples must fall within Control Limits or appropriate action is taken, such as reanalysis where possible, or the data is qualified.

QC samples with known target values have a range for % recovery (eg) 85-115%.

Duplicates have a ± RPD range (e.g. ± 20 RPD). The RPD is reported as an absolute value (e.g. 20 RPD).

Method Blank control limit is the parameter Detection Limit (DL), also known as the Limit of Reporting (LOR).

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-IC-WP	Water							
Batch R2179887								
WG1269694-3 DUP		L997018-4						
Sulfate		60.1	62.0		mg/L	3.1	20	21-APR-11
WG1269674-2 LCS								
Sulfate			100		%		85-115	21-APR-11
WG1269674-1 MB								
Sulfate			<0.50		mg/L		0.5	21-APR-11
WG1269674-4 MS		L997018-4						
ulfate			N/A	MS-B	%		-	21-APR-11
G1269674-5 CVS								
ulfate			103		%		85-115	21-APR-11
G1269674-6 CRM								
lfate			95		%		80-120	21-APR-11

Test Code:
Sulfate (SO4), analyzed by Ion Chromatography (IC), in ALS Winnipeg (WP).

DUP: Laboratory Sample Duplicate - a second portion of sample taken from the same container as the sub-sample used for the primary analysis. Assesses variance of the total method including lab sub-sampling and analysis.

The results for this duplicate pair are 60.1 and 62.0 mg/L. The RPD is 3.1 and the control limits are ± 20 RPD.

LCS: Laboratory Control Sample – a known matrix spiked with target analytes. Verifies the accuracy of the performance of the test.

The recovery for this LCS is 100%, with control limits of 85 to 115% recovery.

MB: Method Blank – a blank matrix taken through the entire test method. Monitors variability of the blank response and bias of the test method.

The result for this MB is less than 0.50 mg/L. The control limit for the MB is equal to the LOR.

MS: Matrix Spike – a known amount of target analytes are added to a client sample. Measures the effect of the sample matrix on a method's recovery efficiency.

In this example, the recovery of the MS could not be calculated. The qualifier explains why – refer to the *Sample Parameter Qualifier Definitions*.

CVS: Calibration Verification Standard - a second source reference standard containing known concentrations of target analytes. Confirms the accuracy and stability of the calibration standards.

This CVS has a recovery of 103% and control limits of 85 to 115% recovery.

CRM/IRM: Certified or Internal Reference Material – a homogeneous sample whose analyte values have been well characterized.

This CRM has a 95% recovery and control limits of 80 to 120% recovery.

Quality Control Report Guide

Legend:

Limit ALS Control Limit (Data Quality Objectives)
DUP Duplicate RPD Relative Percent Difference
N/A Not Available
LCS Laboratory Control Sample
SRM Standard Reference Material
MS Matrix Spike
MSD Matrix Spike Duplicate
ADE Average Desorption Efficiency
MB Method Blank
IRM Internal Reference Material
CRM Certified Reference Material
CCV Continuing Calibration Verification
CVS Calibration Verification Standard
LCSD Laboratory Control Sample Duplicate

Legend: explains acronyms that may be used in the QC Report.

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Qualifiers: QC sample qualifiers are listed and explained here.

The three examples are common qualifiers. They explain unusual or special circumstances that pertain to the QC sample results.

Quality Control Report Guide

Parameters and sample numbers that had Hold Time exceedances are listed in this table.

Hold Times are tracked from sampling date and time to the date and time when the sample was processed in the lab.

The recommended Hold Times.

See the Notes* section for sources of recommendations.

Hold time exceedance Qualifiers are explained in the *Legend and Qualifiers Definitions* section below.

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Transmittance, UV (254 nm)	1	19-APR-11 14:00	25-APR-11 08:16	48	38	hours	EHTL
pH	1	19-APR-11 14:00	10-MAY-11 09:32	0.25	499	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Explanations for the Qualifiers listed above.

See also the additional Notes below.

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L997206 were received on 21-APR-11 07:30.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

APPENDIX B

DETAILED REVIEW OF BASELINE LAKE WATER QUALITY

(Pages B-1 to B-98)

ISO 9001 - FS 64925
ISO 14001 - EMS 550121
OHSAS 18001 - OHS 550122

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

DETAILED REVIEW OF BASELINE LAKE WATER QUALITY
NB102-181/33-1B

Rev	Description	Date
1	Issued in Final	May 30, 2014

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B.1 OVERVIEW

A detailed review of lake water quality within the mine site area was undertaken to facilitate the development of the Core Receiving Environment Monitoring Program (CREMP) for water and sediment quality. As stated in Section 1.2 of the main report, the objectives of the baseline review were as follows:

- Identify data quality issues
- Determine whether or not mineral exploration and bulk sampling activities conducted since 2004 have affected water quality in the mine site area
- Understand the seasonal, depth (for lakes) and inter-annual variability of water quality
- Understand natural enrichment of the mine site area waters
- Determine the potential to pool data from multiple sample stations to increase the statistical power of the baseline water quality dataset
- Develop study designs for monitoring water quality in mine site streams and lakes
- Determine if changes to the existing water quality monitoring program are required to meet monitoring objectives

The focus of this review of lake water quality is the mine site area lakes: Camp Lake, Sheardown Lake NW, Sheardown Lake SE and Mary Lake.

Parameters of interest in the baseline review included water quality stressors of potential concern (SOPCs) identified on the basis of the existence of an established water quality guideline, as well as other factors such as Exposure Toxicity Modifying Factors (ETMF): pH, water hardness, dissolved organic carbon, etc., and indicator parameters (alkalinity, chloride, nitrate). Baseline water quality data was compared to Canadian Council of Ministers of the Environment (CCME) – Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CWQG-PAL). The focus was on total concentrations (versus dissolved) since CWQG-PAL guidelines are developed for total concentrations. The parameters of interest are displayed graphically in box plots. The box plots are used to portray natural ranges of selected parameters. Concentration data measured for the parameters of interest has been log transformed and further analyzed to investigate the possibility of aggregating data, bearing in mind:

- Seasonal variability (between summer, fall and winter samples)
- Inter-annual variability (from 2006 through 2008 and 2011 through 2013)

To assist in the development of study designs, parameter and station-specific a priori power analyses were completed in order to determine the power of the proposed sampling program to detect statistical changes. As per the Assessment Approach and Response Framework in the CREMP (see Figure 2.12 in the main report), management action is triggered if the mean concentrations of any parameter at selected stations reach benchmark values. Benchmark values were developed for the identified SOPCs that consider aquatic toxicology, natural enrichment in the Project area, or low concentrations below MDLs (Intrinsik, 2014; see Section 2.7.3 of the main report). Draft benchmarks were applied in the power analysis of the baseline presented in this detailed review.

The resultant study design for the monitoring of Project-related effects to water quality is presented in Section 2.7 of the main report.

B.2 BASELINE SUMMARY

B.2.1 Camp Lake

A total of 51 lake samples were collected over the baseline sampling period. Most sampling was completed during July and August. Late winter sampling (May) was carried out in 2007, 2008 and 2013. Three stations were monitored (Figures B.1 and B.2):

- JL0-01-S and JL0-01-D - Shallow and deep; centre and deepest part of the lake
- JL0-02-S and JL0-02-D - Near two main tributaries likely to be influenced by the Project
- JL0-09-S and JL0-09-D - Near the outlet of Camp Lake

A summary of the data collected during each season are included in Table B.1. A graphical representation of the sampling events is provided in Figure B.3.

Table B.1 Camp Lake Sample Size

Year	Summer	Fall	Winter
2006	2	2	0
2007	6	6	6
2008	6	0	2
2011	4	0	0
2012	0	6	0
2013	5	6	2
Site	**Summer**	**Fall**	**Winter**
JL0-01-S	4	3	1
JL0-01-D	5	4	3
JL0-02-S	3	3	1
JL0-02-D	4	4	1
JL0-09-S	4	3	3
JL0-09-D	3	3	1

NOTES:

1. WINTER SAMPLING OCCURRED DURING APRIL AND MAY; SPRING SAMPLING OCCURRED DURING JUNE; SUMMER SAMPLING OCCURRED FROM JULY TO AUGUST 17; FALL SAMPLING OCCURRED FROM AUGUST 18 THROUGH SEPTEMBER 30.
2. LAKE SAMPLING DID NOT OCCUR DURING SPRING, DUE TO SAFETY CONCERNS OF SAMPLING OVER MELTING ICE.
3. NO SAMPLING OCCURRED DURING 2009 AND 2010.