Quality Assurance (QA) & Quality Control (QC) Plan

Doris North Project, Nunavut

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1.0 INTRODUCTION

1.1 Preamble

This Quality Assurance/Quality Control Plan (QA/QC) was prepared for the proposed Doris North Project. The Doris North Project is located about 125 km southwest of Cambridge Bay on the Hope Bay Belt. This plan is intended to ensure sound QA/QC practices are followed where applicable for all environmental sampling and monitoring.

This QA/QC Plan was developed prior to the start of project construction and is intended to provide a framework and general guidance for quality assurance/quality control practices at the Doris North Project site both during the construction and operational phases of the project. This Plan is intended to be an integral component of the overall Environmental Protection Plan (EPP) for the proposed Doris North Project and will be periodically reviewed and updated as the Doris North mine moves through construction, operations, and final closure and reclamation. This will be updated after the water license has been issued to incorporate any new commitments made by Miramar Hope Bay Ltd. (MHBL) during the license process and to incorporate any conditions contained within the water license relating to QA/QC. This Plan is a “living document” and will be reviewed and updated periodically during the mine life to ensure that site experience with QA/QC procedures are captured and shared amongst all operating staff (adaptive management).

At a minimum, this QA/QC Plan is to be reviewed annually during the first quarter of each calendar year by the mine’s environmental staff and updated as needed to reflect changes in operating procedures. The revised Plan will be made available to the appropriate mine operating staff with appropriate refresher training and sent to the Nunavut Water Board (NWB) and to the Nunavut Impact Review Board (NIRB) Monitoring Officer for inclusion in the public registry.

Quality assurance (QA) and Quality Control (QC) are important components of the environmental management program for this project. This QA/QC Plan has been prepared in accordance with “QA/QC Guidelines for use by Class “A” Licensees in Meeting Surveillance Network Program Requirements and for Submission of a QA/QC Plan” published in July 1996 by the Water Resources Division of the Department of Indian and Northern Affairs and the Northwest Territories Water Board.

Through implementation of the Quality Assurance and Quality Control Plan, MHBL will ensure that sampling methods and analytical data are of the highest calibre. Proven scientific management practices are to be employed throughout the sampling program. All samples are currently being delivered to an accredited external environmental laboratory for analysis. This will continue until the on-site environmental lab is functional and generating results that have been checked against the outside lab. Analysis of compliance samples will continue to be sent to an accredited external lab.

This document describes the procedures to be used by MHBL personnel when conducting environmental water samples. Minimum criteria for sample collection, preservation, documentation, transportation, and data management are established and applied to samples from the Doris North Project. These procedures have been developed from literature and guidelines intended to promote good practices in field sampling and sample handling, which will provide assurance of the quality of the resulting data. This document will be reviewed on a regular basis with the intent to continually improve environmental performances.

The QA/QC Plan is primarily intended to be read, understood, and implemented by company personnel involved in water quality monitoring. The procedures are applied to all environmental water samples, whether analyzed for the purpose of regulatory compliance monitoring, or for the purpose of due diligence.

1.2 Quality Assurance and Quality Control (QAQC)

Quality assurance (QA) is a set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and defensible quality. As such, the accuracy of the analytical result can be stated with a high level of confidence. A high level of quality assurance can be achieved by applying the following principles:

- Personnel involved in water sampling and analysis are well trained;
- Facilities and equipment are suitable, well maintained, and always kept clean;
- Standard procedures are implemented for the collection and transportation of samples, based on recognized good operating practice;
- Standard analytical procedures are developed and implemented, based on recognized methods suited to the samples being analyzed and required data quality;
- Laboratory instruments are calibrated using procedures, and at a frequency, recommended by the manufacturer, or recognized as good operating practice;
- Laboratory water, reagents and other supplies are of consistent high quality;
- Quality Control (QC) programs are developed and implemented, based on recognized good operating practice, to assess the quality of the analytical data and provide warning of unacceptable analytical errors;
- Prompt remedial action is taken when deficiencies are identified; and
- Analytical results and QC program results are reported internally and externally using standard procedures.

Quality control is a set of specific procedures used to measure the quality of the data produced and correct deficiencies in sampling or analysis, as they occur. Quality control is used by the analyst and sampler to achieve standards of measurement for the three principal components of quality: precision, accuracy and reliability. The components are defined as follows:

- ***Precision -*** a measure of the closeness with which multiple analyses of a given sample agree with each other;
- ***Accuracy -*** a measure of the closeness of the analytical result to the true value; and

- ***Reliability -*** a measure of the frequency at which the standards of precision and accuracy are achieved.

Although each component of quality can be achieved without the other, true quality can only be achieved with a combination of all three components. Different quality control methods can be used to measure each of the components of quality and can isolate the probable source of errors detected. For this reason, a good QC program is made up of a number of recognized methods.

2.0 FIELD SAMPLING

2.1 Sampling Collection

Environmental water sampling at the Doris North Project will be conducted to provide information required by the company for effective environmental management of the site and to monitor regulatory compliance. Although the majority of sampling and analytical work is related to compliance monitoring, it is necessary to ensure sample integrity is maintained for all samples collected. Therefore, proven scientific management practices are employed during collection of all samples, whether they are for regulatory compliance or for internal use in assessing and managing the operating performance of the Doris North Project.

2.2 Sampling Locations and Frequency

Site water quality monitoring will be conducted for several purposes:

- Site Compliance Monitoring – sampling of sites expected to be included within the Surveillance Network Program (SNP) that is expected to be included in the water license for the Doris North Project. These sites are to be sampled to allow MHBL mine site personnel to determine whether water from the mine facilities meets standards for discharge, how much water can be discharged and to verify compliance with the discharge standards set under the water license and by the MMER. The SNP stations proposed by MHBL for inclusion in the water license are summarized in Table 5.1 in the Monitoring and Follow-Up Plan[1]. This table also includes the proposed sampling frequency and the parameters to be monitored at each SNP station. A list of the proposed water sampling points for all categories of sampling is provided as Table 7.1 in the Revised Water License Application Support Document. The table also presents the proposed frequency of sampling at each station;

- Site Environmental Management Sampling – these are samples expected to be collected by MHBL to facilitate day-to-day assessment and adaptive management of the site water management facilities and to provide data needed by mine operational staff to make operational decisions. This will not be scheduled sampling but represents sampling carried out on an as needed basis by site personnel to allow them to assess and manage environmental performance at the site. The sample locations will vary in response to events happening on site and to respond to internal data needs. These samples are not intended to be part of the SNP;

- Effluent Treatment Process Control – samples taken within the mill to provide data to MHBL operating personnel that will tell them how the mill effluent treatment circuit is performing and to adjust operational controls accordingly to optimize treatment performance; and

- Environmental Effects Monitoring of water quality in the downstream aquatic receiving environment to meet obligations under the MMER to monitor for

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[1] Monitoring and Follow-Up Plan, Supporting Document S10m to the Revised Water License Application Support Document, April 2007.

potential mine related effects and to facilitate adaptive management programs to mitigate when adverse effects are found[2]).

It is expected that a Surveillance Network Program (SNP) will be a component of the Doris North Water License and will prescribe a specific water-sampling program for the site, including sampling locations, sampling frequency, and parameters to be analyzed.

The SNP sampling stations will be clearly identified in the field by posted signs. The location of signs and the precise location of sampling will be approved by the designated Inspector for the site. Samples must always be taken at the same location on each sampling occasion, unless the Inspector has approved a new location.

The frequency of sampling at a given location can be quarterly, monthly, bi-weekly, weekly or four times weekly, as prescribed in the SNP. Charts will be included in the SNP that outline the sampling frequency and parameters analyzed for each of the sampling stations and these are to be followed implicitly3.

2.3 Sample Types

At any given location, either grab samples or composite samples may be taken, as prescribed in the SNP.

Samples are normally taken from natural lakes, streams, treatment ponds or process streams. Wherever possible, samples should be taken from just under the surface to avoid floating debris that may contaminate the sample.

2.4 Sample Containers

Sample containers vary in size and material of construction, depending on the analysis to be conducted. The method used to analyze for a particular parameter dictates the minimum size of the sample bottle. At the Doris North Project, MHBL will use clean one litre chemically resistant polyethylene bottles and closures with inert liners as the standard sample container, with the one exception being that for Oil & Grease. Samples to be analyzed for Oil & Grease must be collected in glass containers as hydrocarbons are attracted to the walls of plastic bottles and may not be released when sample aliquots are transferred from the bottle. Plastic bottles are suitable for all other analyses. Sample containers for each analysis are shown in Table 2-1 (also see Table 1 in Appendix A).

Sample containers may be new or previously used. The risk of cross contamination should be reduced with careful preparation and handling of the bottles. At present all sample containers utilized at the Doris North Project are new or clean bottles supplied by an external accredited laboratory. In the event that MHBL staff use sample bottles

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[2] Covered in Section 8 of the Monitoring and Follow-Up Plan, Supporting Document S10m to the Revised Water License Application Support Document, April 2007.

[3] For information on the proposed sampling locations the reader is referred to Section 5, Monitoring and Follow-Up Plan, Supporting Document S10m and to Section 9.6 of the Water Management Plan, Supporting Document S10j to the Revised Water License Application Support Document April 2007.

not previously cleaned, then the following cleaning procedure is to be followed before the bottles are put into service:

- Rinse well with hot tap water for 30 seconds;
- Empty the bottle and add 10% nitric acid (HNO_3) to about ⅓ capacity. Shake well for 60 seconds;
- Rinse vigorously with hot tap water for 60 seconds;
- Rinse three times with distilled water; and
- Empty bottle and rinse again three times with distilled water.

On occasion there will be a requirement for bacterial testing, usually in respect to the potable water systems. As bottles to be used for bacterial testing must be autoclaved (sterilized), they are obtained directly from the laboratory that is conducting the analysis.

Table 2.1: Sample Containers

Parameters	Samples Size	Container material - Type
Total Ammonia, Nitrate, Nitrite	1000 mL	Polyethylene
Alkalinity, Total Hardness, calcium, Chloride	1000 mL	Polyethylene
Conductivity, Dissolved Oxygen	1000 mL	Glass
Total Phosphorous	1000 mL	Polyethylene
Total Arsenic	1000 mL	Polyethylene
Total Aluminium, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium and Zinc	1000 mL	Polyethylene
Magnesium, Potassium, Sodium, Total Organic Carbon	1000 mL	Polyethylene
Total Organic Carbon, Dissolved Organic Carbon	1000 mL	Polyethylene
Total Cyanide	1000 mL	Polyethylene
Total Suspended Solids	1000 mL	Polyethylene
Oil and Grease	1000 mL	Polyethylene
Sulphate	1000 mL	Polyethylene
Radium 226	1000 mL	Polyethylene
pH	1000 mL	Polyethylene

2.5 Field Sampling Log Book

Details of all sampling exercises are to be recorded in a field logbook. The individual collecting the samples should record the date and time that sampling was conducted, the sampling stations visited, the samples taken at each station and the name of the person who performed the sampling or took the measurements. The results of any field measurements should be recorded. The sampler should indicate whether the sample was preserved and should initial each entry.

Additional information can be useful when inquiries are made into the meaning of sample data at a later date. The sampler should record any information that may have a bearing on water quality, such as weather conditions, stream flow rates and unusual conditions at the site. Any necessary deviations from standard procedures or sampling location must be recorded.

Condition 11 of the Doris North Project Certificate issued by the Nunavut Impact Review Board requires:

> *Monitoring information collected under this approval shall contain the following information:*
>
> *a. The name of the person(s) who performed the sampling or took measurements;*
>
> *b. Date, time, and place of sampling or measurement;*
>
> *c. Date of analysis;*
>
> *d. Name of the person who performed the analysis;*
>
> *e. Analytical methods or techniques used; and*
> *f. Results of any analysis*

MHBL will comply with this condition. Monitoring information to be collected for each sample taken and analysed will include:

- The name of the person(s) who performed the sampling or took measurements;
- Date, time, and place of sampling or measurement;
- Date of analysis;
- Name of the person who performed the analysis;
- Analytical methods or techniques used; and
- Results of any analysis.

This information will be incorporated into the monthly Water License SNP reports.

Condition 12 of the Doris North Project Certificate issued by the Nunavut Impact Review Board requires:

> *The results and records of any monitoring, data, or analyses shall be kept for a minimum of the life of the project including closure and post closure monitoring. This time period shall be extended if requested by NIRB, DFO, EC or the NWB.*

MHBL will comply with this condition. MHBL will set up and maintain a Laboratory Information Management System (LIMS) to record and manage all the water quality monitoring results. MHBL will consult with NIRB's Monitoring Officer for guidance on presentation of monitoring results and records.

2.6 Field Measurements

On most samples, pH and temperature of the water are measured and recorded in the field when the sample is taken. The field pH meter is to be calibrated prior to each sampling campaign, using two calibration standards of known pH. Measurements should be taken directly from the water body being sampled. Where this is impractical, perhaps due to the high velocity of a sample stream, the measurements can be taken from a sample bottle. pH and temperature should be recorded to one decimal place.

2.7 Sampling Methods

The following procedures should be used to collect water samples, as appropriate to the sampling location.

2.7.1 Streams

The sample should be collected as close as practical to the middle of the stream, where water flows freely and is free of debris. After getting into position, the sampler should wait to allow any sediment that may have been stirred up to settle or wash away.

The sample bottle should be partially filled with the water to be sampled and rinsed with the cap in place at least three times. Note that sampling for Oil and Grease and Bacteria are the exceptions to this procedure - Oil & Grease, and Bacteria sample bottles should NOT be field rinsed before taking the sample. Care should be taken to empty rinse water downstream from the sampling point, so that stream sediments are not disturbed.

If possible, the bottle should be plunged into the stream to a depth of approximately half the total stream depth and allow it to fill with the mouth facing upstream. In shallow streams, where plunging the sample bottle will not allow it to fill completely and may disturb sediment; a smaller bottle can be used to transfer water to the larger sample bottle. Bottles should be filled to near full capacity, allowing enough room for preservative addition and mixing (the neck of wide-mouthed bottles is sufficient space for this).

2.7.2 Lakes and Ponds

Surface samples from lakes and ponds should be collected using the same procedures as above. Subsequent samples should always be taken at the same location. Sample bottles should be plunged into the water to a depth of about six inches below the water surface.

Information on water quality at depth in lakes and ponds may be required at times. These samples will usually be collected with a Van Dorn type sampler, which is lowered to the required depth and triggered to trap a sample of water by releasing a "messenger" from the surface. Both the sampler and sample bottle are rinsed with the water to be sampled a total of three times and the sample is retrieved on the fourth submersion of the sampler to the given depth.

2.7.3 Process Streams (Pipes, Valves and Auto-Samplers)

Some sampling of process streams may be required by the Surveillance Network Program and for environmental management purposes. These may be grab samples, which are taken from a valve or a pipe discharge, or composite samples collected over an extended time period by an automated sampling system.

The same principles used in natural stream sampling should be applied when collecting grab samples. The sample bottle should be rinsed with the water to be sampled three times, with the exception of sampling for Oil and Grease analysis, as noted above. Valves should be open for at least one minute before taking the sample, to ensure that the water is representative of the process stream.

2.8 Sampling Handling

Best Management Practices are to be employed during collection of all samples, whether they are for regulatory compliance or site environmental management.

2.9 Sample Identification

Before starting a campaign of water sampling, the required number of sample bottles, of the correct size and material, should be selected. The sample location (SNP station number), the sampling date, and parameters to be analyzed should be marked on each bottle using previously prepared printed labels before heading into the field.

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

- Sample location (or SNP station number);
- Date of sampling;
- Parameters to be analyzed;
- Preservation method used;
- Name or initials of sampler; and
- Temperature and pH where applicable.

As the samples are to be sent to an external laboratory, the company and property name must also be included.

In some cases permanent markers can be used to identify sample bottles, however, these markings can be erased with wear and may not be clearly legible. Whenever possible, and always when sending samples to external laboratories, mark the bottles with pre-printed gummed labels. Labels should only be applied to dry surfaces.

2.10 Preservation

As typically samples cannot be delivered to the analytical laboratory within two hours of sampling, preservation is required. In all cases, specific preservatives must be added to the samples to prevent chemical changes that may alter the concentration of the parameter of interest. The samples must be preserved within two hours of sampling. In most cases samples can be preserved away from the field at the end of the campaign.

The appropriate preservation methods are provided in Appendix A, which is an excerpt from the EPA manual Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020. U.S.E.P.A. Table 2.2 lists some of these preservation techniques for some of the more common parameters to be sampled at the Doris North Project.

Under normal water sampling protocols samples being analyzed for total metals should not be filtered prior to being sent to the lab as this removes fine colloidal sediment and distorts the analytical results. Samples being analyzed for dissolved metals should be filtered on site (filtered at 0.45 microns) before being preserved and sent to the lab to ensure that only metals dissolved within the sample are measured in the analysis.

Table 2.2: Sample Preservation

Parameters	Preservation Method
Total Ammonia	Lower pH below 2 using sulphuric acid, refrigerate
Total Arsenic	Lower pH below 2 using nitric acid, refrigerate
Total Cyanide	Raise pH above 12 using sodium hydroxide, refrigerate, and store in the dark
Total Copper, Lead, Nickel, Zinc	Lower pH below 2 using nitric acid, refrigerate
Total Suspended Solids	Refrigerate
Oil and Grease	Lower pH below 2 using hydrochloric acid, refrigerate

2.11 Transportation

A major objective of the field sampler is to minimize any chemical changes to the sample between the time of sample collection and delivery to the laboratory, and which may alter the concentration of the parameter of interest. Heat, light, and agitation can all impact the water chemistry and the samples should be protected from these effects.

Samples should be delivered to the analytical laboratory as soon as possible after collection. All samples should be stored and transported at a temperature <10 C. Coolers and ice packs are to be used for field transportation and samples should be refrigerated as soon as possible following arrival at the laboratory.

A chain of custody form should be completed for each sampling site respectively. The original form should be sent to the external laboratory while a copy should be filed on-site accordingly. A follow-up call should be made to the external environmental laboratory ensuring that samples were received as scheduled.

The expected delivery time of samples from the field to the external lab, most likely in Edmonton will be in the order of 36 to 48 hours. Samples are to be collected taking into account transportation off site to either Yellowknife or Cambridge Bay where they can be transferred within 24 hours to a commercial flight to Edmonton. The recommended allowable holding times with appropriate preservation between sampling and analysis are included in Appendix A. In nearly all cases the expected delivery time is within this standard. The exceptions such as TSS and DO will be addressed by having capacity on site to complete analyses of these parameters.

3.0 QUALITY CONTROL

As outlined in section 1.2, accepted quality control practices are to be employed throughout the environmental sampling program. The following quality control samples are to be collected and analyzed for the same constituents being monitored in the Surveillance Network Program as part of the quality control check on monitoring activities:

3.1 Field Blanks

Field blanks are samples of pure water (deionized water from the lab still) that are subjected to exactly the same procedures as routine samples, following which they are analyzed for the same parameters as the field samples. Any measurement of the parameter of interest, above method detection limits, will indicate any analytical error, impurities in the laboratory distilled water supply, contaminated sample preservatives, or contamination of the sample during the handling process. Combined with the results of other quality control procedures, analysis of field blanks can help identification of sources of contamination.

A set of field blanks should be made up once each month and taken into the field when the active SNP stations are sampled. New sample bottles should be used and prepared using distilled water from the normal laboratory water supply. This set should represent all of the parameters routinely analyzed. They should be preserved in the field and submitted to the laboratory identified as field blanks.

3.2 Replicate Samples

Replicate sampling (or sometimes referred to as duplicate sampling) is the collection of more than one sample for a given analysis at a given location. The replicate samples are collected, handled, and analyzed using the standard procedures applied to routine samples. Replicate sampling, combined with the results of other quality control procedures, can help indicate sources of error and are particularly useful in identifying problems with accuracy and sampling methods.

Once per operating season, for each active SNP, a set of duplicate samples will be taken, representing as many of the routine analyses as possible. Where possible, this should be carried out in conjunction with MHBL's parallel sampling conducted at the same time as any audit sampling conducted by the designated water license inspector and during the independent third party verification sampling required under the NIRB Project Certificate4 Replicate sampling should alternate between the prescribed SNP stations.

3.3 Method "Spiked" Samples

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

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[4] See Section 9.6.7.3. of the Water Management Plan, Supporting Document S10j to the Revised Water License Application Support Document, April 2007.

3.4 Split Samples

Two or more representative sub-samples are removed from one collected sample and analyzed separately at the laboratory. This data is used as a check of the precision of the analytical procedure employed by the laboratory and normally forms part of the laboratory QA/QC program.

4.0 LABORATORY ANALYSIS

At current, MHBL does not maintain an analytical laboratory on site, all analyses are performed at an accredited external environmental laboratory. It is planned to construct and operate an environmental lab on site to allow real time management of the annual discharge of water from Tail Lake. This Plan will be updated to reflect the on-site laboratory sample handling and analytical procedures specific to the Doris North Project prior to the start of mining operations in early 2008. MHBL will register and seek accreditation of its on site laboratory under the Canadian Association of Environmental Analytical Laboratories (CAEAL) and will work to maintain certification for the key water license discharge parameters during the mine's life.

Condition 9 of the Doris North Project Certificate issued by the Nunavut Impact Review Board requires:

> *MHBL will fund and install an on-site laboratory for continuous and real-time monitoring of water quality contained within Tail Lake and Doris Creek after discharge. This will be done prior to the commencement of operations. The laboratory shall be certified, with standards to include the calibration of water quality monitoring instruments. MHBL shall file proof of application to become accredited, upon request of the NWB or NIRB's Monitoring Officer.*

MHBL will take the following actions to comply with this condition:

- A low level detection environmental laboratory will be established on site. For convenience the laboratory will be sited near the camp complex, but sufficiently removed from the mill site to prevent contamination. The laboratory will be established prior to commencement of any discharges from Tail Lake.
- Suitably qualified personnel familiar with the operation and maintenance of a low level environmental laboratory will be retained to operate the laboratory. Documented standard operating procedures (SOPs) will be used.
- The laboratory will be equipped with a low level inductively coupled plasma (ICP) mass spectrophotometer (MS) to enable low level detection analyses of metals[5].
- MHBL will seek laboratory accreditation with the Canadian Association for Environmental Analytical Laboratories (CAEAL). The requirements include a well-documented quality assurance/quality control (QA/QC) program, as well as demonstrated proficiency in analysis of performance evaluation (PE) samples. The assessment and accreditation will be updated every two years.
- A documented internal quality control program will be implemented (this document) which will include items such as calibration schedules, use of quality control samples, established control specifications with corrective actions if specifications are not met, data validation, equipment maintenance, and staff training and evaluation programs.

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[5] Technical information for the ICP-MS is provided in Appendix J, Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007.

- Quality control samples will include:
    - Blanks – analysis of de-ionized water to ensure that there is no contamination due to laboratory procedure;
    - Duplicates – a replicate analysis of a homogeneous sample to show method precision;
    - Spikes – a replicate sample spiked with a known amount of stock standard solution to show both method precision and accuracy and to check for any interferences; and
    - Reference materials – a National Institute of Standards and Technology (NIST) or other suitable certified reference material to show method accuracy.

All of the above laboratory QC samples will be run regularly. Results will be compared to Data Quality Objectives (DQOs) and be used to flag sample results where DQOs are not met. Control samples will be run at a minimum frequency of 10% of the samples for analysis. Quality records will be kept and will be available for inspection.

The analytical methods used by the external independent laboratory will be selected by the laboratory based on the detection levels required to measure down to levels consistent with the Canadian Council of Ministers Canadian Water Quality Guidelines for freshwater. MHBL will utilize this laboratory to help establish its on-site laboratory. Miramar currently has such an arrangement at the Con Mine with ALS Environmental where ALS actually operates the laboratory at the mine site for Miramar:

http://www.alsenviro.com/serv_lab/para.html#inor

For trace metals MHBL has committed to use the ICP-MS technique with typical ICP-MS detection limits as indicated in Table 4-1 following.

4.1 Calibration Schedules

Use of quality control samples, established control specifications with corrective actions if specifications are not met, data validation, equipment maintenance, and staff training and evaluation programs for the on-site laboratory will be established once the lab has been set up using the recommendations from the equipment and instrument suppliers and from the external lab. This QA/QC Plan will be updated once these schedules and procedures have been established.

Table 4.1: ICPMS Detection Limits

Element	Symbol	ICPMS DL (mg/L)
Aluminum	**Al**	0.001
Antimony	**Sb**	0.0001
Arsenic	**As**	0.0002
Barium	**Ba**	0.00005
Beryllium	**Be**	0.0002
Bismuth	**Bi**	0.0002
Boron	**B**	0.01
Cadmium	**Cd**	0.00002
Calcium	**Ca**	0.01
Chromium	**Cr**	0.0002
Cobalt	**Co**	0.0001
Copper	**Cu**	0.0001
Iron	**Fe**	0.01
Lead	**Pb**	0.00005
Lithium	**Li**	0.0002
Magnesium	**Mg**	0.01
Manganese	**Mn**	0.00005
Molybdenum	**Mo**	0.00005
Nickel	**Ni**	0.0002
Phosphorus	**P**	0.03
Potassium	**K**	0.02
Selenium	**Se**	0.0002
Silicon	**Si**	0.03
Silver	**Ag**	0.00003
Sodium	**Na**	0.01
Strontium	**Sr**	0.0001
Tellurium	**Te**	0.0002
Thallium	**Tl**	0.00002
Thorium	**Th**	0.0001
Tin	**Sn**	0.0001
Titanium	**Ti**	0.0002
Uranium	**U**	0.00001
Vanadium	**V**	0.0002
Zinc	**Zn**	0.001
Zirconium	**Zr**	0.002

5.0 REPORTING

In all cases analytical results are forwarded to the site Environmental Coordinator. The results are electronically imported into a database and are screened for anomalies. Electronic copies of the final results are placed into the appropriate environmental files.

Results that appear to be anomalous are flagged and either the analysis is repeated or, if possible, a new sample is taken to confirm the value. The electronic and paper copies of environmental files are maintained on site by the Environmental Coordinator as a management tool for environmental risk assessment and in preparation of summary reports for the regulatory agencies and company officials. In compliance with the Surveillance Network Program, reports of analytical results for SNP samples are to be typically submitted in hard copy and electronically to the Nunavut Water Board within 30 days following the month in which the samples were taken.

The reports are to present all required analytical results for SNP sampling stations that were sampled during the month. The Nunavut Water Board distributes the reports to other agencies and interested parties.

This report, “Quality Assurance (QA) & Quality Control (QC) Plan, Doris North Project, Nunavut, April 2007”, has been prepared by Miramar Hope Bay Ltd.

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APPENDIX A

Recommendation for Sampling and Preservation of Samples

Extract from manual:
U. S. Environmental Protection Agency. 1983.
Sample preservation. pp.xv-xx. In **Methods for Chemical Analysis of Water and Wastes**, EPA-600/4-79-020. U.S.E.P.A., Cincinnati, Ohio, USA.

TABLE 1:

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES, ARRANGED ACCORDING TO MEASUREMENT

(see note 1, below)

Complete and unequivocal preservation of samples, either domestic sewage, industrial wastes, or natural waters, is a practical impossibility. Regardless of the nature of the sample, complete stability for every constituent can never be achieved. At best, preservation techniques can only retard the chemical and biological changes that inevitably continue after the sample is removed from the parent source. The changes that take place in a sample are either chemical or biological. In the former case, certain changes occur in the chemical structure of the constituents that are a function of physical conditions. Metal cations may precipitate as hydroxides or form complexes with other constituents; cations or anions may change valence states under certain reducing or oxidizing conditions; other constituents may dissolve or volatilize with the passage of time. Metal cations may also adsorb onto surfaces (glass, plastic, quartz, etc.), such as, iron and lead. Biological changes taking place in a sample may change the valence of an element or a radical to a different valence. Soluble constituents may be converted to organically bound materials in cell structures, or cell lysis may result in release of cellular material into solution. The well known nitrogen and phosphorus cycles are examples of biological influence on sample composition. Therefore, as a general rule, it is best to analyze the samples as soon as possible after collection. This is especially true when the analyze concentration is expected to be in the low ug/1 range.

Methods of preservation are relatively limited and are intended generally to (1) retard biological action, (2) retard hydrolysis of chemical compounds and complexes, (3) reduce volatility of constituents, and (4) reduce absorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing.

The recommended preservative for various constituents is given in **Table 1**. These choices are based on the accompanying references and on information supplied by various E.P.A. Quality Assurance Coordinators. As more data become available, these recommended holding times will be adjusted to reflect new information. Other information provided in the table is an estimation of the volume of sample required for the analysis, the suggested type of container, and the maximum recommended holding times for samples properly preserved.

TABLE 1

Measurement	Vol. Req. (ml)	Container (note 2)	Preservative (notes 3,4)	Holding Time (note 5)
100. Physical				
Color	50	P,G	Cool, 4 deg. C	48 Hrs.
Conductance	100	P,G	Cool, 4 deg. C	28 Days
Hardness	100	P,G	HNO3 - pH below 2	6 Mos.
Odor	200	G only	Cool, 4 deg. C	24 Hrs.
pH	25	P,G	None Req.	Analyze Immediately
Residue				
Filterable	100	P,G	Cool, 4 deg. C	7 Days
Non-filterable	100	P,G	Cool, 4 deg. C	7 Days
Total	100	P,G	Cool, 4 deg. C	7 Days
Volatile	100	P,G	Cool, 4 deg. C	7 Days
Settleable Matter	1000	P,G	Cool, 4 deg. C	48 Hrs.
Temperature	1000	P,G	None Req.	Analyze Immediately
Turbidity	100	P,G	Cool, 4 deg. C	48 Hrs.
200. Metals				
Dissolved	200	P,G	Filter on site, HNO3 - pH below 2	6 Mos.
Suspended	200		Filter on site	6 Mos. (8)
Total	100	P,G	HNO3 - pH below 2	6 Mos.
Chromium (6)	200	P,G	Cool, 4 deg. C	24 Hrs.
Mercury				
Dissolved	100	P,G	Filter, HNO3 - pH below 2	28 Days
Total	100	P,G	HNO3 - pH below 2	28 Days
300. Inorganics, Non-Metallics				
Acidity	100	P,G	Cool, 4 deg. C	14 Days
Alkalinity	100	P,G	Cool, 4 deg. C	14 Days
Bromide	100	P,G	None Req.	28 Days
Chloride	50	P,G	None Req.	28 Days
Chlorine	200	P,G	None Req.	Analyze Immediately
Cyanides	500	P,G	Cool, 4 deg. C, NaOH - pH over 12 0.6g ascorbic acid (6)	14 Days (7)
Fluoride	300	P,G	None Req.	28 Days
Iodide	100	P,G	Cool, 4 deg. C	24 Hrs.
Nitrogen				
Ammonia	400	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Kjeldahl, Total	500	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Nitrate + Nitrite	100	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Nitrate (9)	100	P,G	Cool, 4 deg. C,	48 Hrs.
Nitrite	50	P,G	Cool, 4 deg. C,	48 Hrs.

Dissolved Oxygen				
Probe	300	G bottle + top	None Req.	Analyze Immediately
Winkler	300	G bottle + top	Fix on site and store	8 Hours
Phosphorus				
Ortho-P, dissolved	50	P,G	Filter on site, Cool, 4 deg. C	48 Hrs.
Hydrolyzable	50	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Total	50	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Total, dissolved	50	P,G	Filter on site, Cool, 4 deg. C, H2SO4 - pH below 2	24 Hrs.
Silica	50	P only	Cool, 4 deg. C	28 Days
Sulfate	50	P,G	Cool, 4 deg. C	28 Days
Sulfide	500	P,G	Cool, 4 deg. C, add 2 ml zinc acetate plus NaOH - pH over 9	7 Days
Sulfite	50	P,G	None Req.	Analyze Immediately

400. Organics

BOD	1000	P,G	Cool, 4 deg. C	48 Hrs.
COD	50	P,G	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Oil & Grease	1000	G only	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
Organic carbon	25	P,G	Cool, 4 deg. C, H2SO4 or HCI to pH below 2	28 Days
Phenolics	500	G only	Cool, 4 deg. C, H2SO4 - pH below 2	28 Days
MBAS	250	P,G	Cool, 4 deg. C	48 Hrs.
NTA	50	P,G	Cool, 4 deg. C	24 Hrs.

1. More specific instructions for preservation and sampling are found with each procedure. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.

2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

3. Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4 deg. C until compositing and sample splitting is completed.

4. When any sample is to be shipped by common carrier or sent through the mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table I the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

5. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

6. Should only be used in the presence of residual chlorine.

7. Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

8. Samples should be filtered immediately on-site before adding preservative for dissolved metals.

9. For samples from non-chlorinated drinking water supplies conc. H_2SO_4 should be added to lower sample pH to less than 2. The sample should be analyzed before 14 days.