Nuna BURNSIDE

Monitoring Program and Quality Assurance/Quality Control Plan Hamlet of Kugluktuk

Prepared by

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1.0 Introduction

The Hamlet of Kugluktuk (formerly known as Coppermine), is situated on Coronation Gulf at the mouth of the Coppermine River. The Hamlet is situated on a rocky area on the west side of the Coppermine River, at latitude 67°49'N, longitude 115°06'W. The Hamlet is predominately residential with a few small commercial establishments including a hotel, several construction contracting businesses, a grocery store, and a variety of other small businesses. Hunting and fishing in the traditional manner is still a prime occupation for many of the inhabitants. Community buildings include a high school, elementary school, arena, swimming pool, Hamlet office, public works yard, GN offices, and police station. The community has a population of approximately 1,585, with an approximate projected growth rate of 1.5 percent.

The Hamlet provides trucked water and sewage services, along with regular solid waste collection for the residents, businesses and institutions. The water, wastewater, and solid waste systems include the following facilities and services:

- A water treatment plant, which draws water from the Coppermine River and treats it by membrane filtration and chlorination
- Trucked water to holding tanks in each building
- A sewage lagoon which receives trucked sewage collected from holding tanks in each building
- Sewage treatment via an exfiltration lagoon to a wetland discharging north to the ocean
- A solid waste disposal facility, which includes a bulky metals disposal area, a contaminated soil pile, a waste oil and liquid waste storage area, and a storage area for batteries and other hazardous materials.

1.1 Purpose

The Sewage Treatment Facility and Solid Waste Management Facility operate under Nunavut Water Board License NWB3KUG0308 (the license) issued on November 20, 2003 and expires November 30, 2008. An amendment application is in progress. The license requires the Hamlet to conduct a monitoring program, which includes regular water quality sampling and reporting. The license requires a Monitoring and Quality Assurance/Quality Control Plan (QA/QC Plan). The QA/QC Plan has been prepared to achieve the following objectives:

- To ensure that the collection of all samples taken in the field follows procedures and controls in order to maintain a high quality, so that the results obtained represent both the physical and chemical nature of the water at the sampling locations

- To ensure best management practices (BMP) are used throughout the sampling program

- To ensure all samples are delivered promptly to an accredited laboratory for analysis.

This document describes the procedures and controls to be used by Hamlet operations staff when conducting environmental sampling under the monitoring program.

Although the QA/QC Plan is submitted to the Nunavut Water Board (NWB) as a condition of the water license, it is primarily intended to be read, understood, and implemented by Hamlet operations personnel responsible for environmental quality monitoring. The water license requires Hamlet personnel to adhere to these procedures, which should be applied to all water quality samples taken by the Hamlet.

Quality Assurance (QA) and Quality Control (QC) are important components of environmental management for the Hamlet of Kugluktuk.

This Monitoring Program and QA/QC Control Plan is referenced by the following O&M Plans:

- Solid Waste Management Facility Operation and Maintenance (O&M) Plan
- Sewage Treatment Facility Operation and Maintenance (O&M) Plan.

1.2 Quality Assurance and Quality Control

Quality Assurance is a set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and defensible quality (Wilson, 1995). As such, the accuracy of the analytical results 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 required for sampling are suitable, well maintained, and always kept clean

- Standard procedures are developed and implemented for the collection, transportation and analysis of samples, based on recognized BMP

- Laboratory and field instruments are calibrated according to manufacturer's recommendations and good operating practices are implemented

- Supplies used for sampling and analysis are of consistent, high quality and are not expired

- Quality Control (QC) procedures are developed and implemented based on good operating practices to assess quality of analytical data and provide warning of unacceptable errors

- Remedial action is promptly implemented when deficiencies are identified

- Results of the monitoring program are reported in the Annual Report as required in the water license. The Annual Report must be submitted by March 31 of the following calendar year.

Quality Control (QC) is a set of specific procedures used to measure the quality of the data produced and correct deficiencies in the sampling or analyses, as they occur. Quality control is used by the analyst and sampler to achieve standards of measurement for the three principles components of quality: precision, accuracy and reliability.

1.3 Lab Accreditation

All analyses shall be conducted in laboratories that are accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL) or an equivalent alternative approved by the NWB.

The following is the contact information for the Laboratory retained by the Hamlet of Kugluktuk to complete analysis:

Name of Laboratory Envirotest Laboratories (or other to be determined)
Address _____
_____
_____
Phone No. _____
Fax No. _____

The Hamlet shall notify the NWB, in writing, of the laboratory to be used to perform the analysis prior to collecting any samples under the monitoring program.

Analytical methods and accreditation are usually dictated by the guideline criteria being followed. In most cases, the guideline criteria is the Canadian Environmental Quality Guidelines (CCME, 2006). These guidelines specify bottles, hold times, preservatives, sampling protocols, as well as lab accreditation, and analytical methodologies. Prior to any sampling, this information should be reviewed to ensure consistency with regulation and standards.

2.0 Field Sampling

2.1 Sample Collection

Effluent and surface water sampling is conducted to provide the Hamlet with effective environmental management information and to monitor regulatory compliance.

Sample collection must follow the specifics dictated by the CAEAL laboratory selected to do the analysis. These should conform to the protocols outlined in the Canadian Environmental Quality Guidelines (CCME, 2006). Exact sampling protocols need to be confirmed for each sampling event. Staff training is a necessary component to ensure quality monitoring.

2.1.1 Sampling Location and Frequency

The monitoring program created by the water license includes specific requirements regarding sampling locations, sampling frequency, parameters to be analyzed, and effluent quality. At the time that the water license was issued in 2003, the sewage lagoon was intended to be the sole method of sewage treatment, and effluent samples collected at the point of discharge from the lagoon were required to meet prescribed water quality criteria. The new detailed design for the Sewage Treatment Facility and Solid Waste Management facility, as described in the Detailed Design Report. The sampling locations specified by the license have been modified to reflect the new design, as described below.

The new design includes a larger, lined sewage lagoon that will provide improved retention of solids by increasing sewage retention time. However, the sewage lagoon is no longer the final step in the treatment process. Sewage discharged from the lagoon will flow into Wetland Treatment Area where treatment will be completed. The wetland will consist of a network of small berms, ditches, and shallow ponds designed to maximize retention time and promote attenuation by natural processes. The monitoring program dictated by the water license includes four sampling locations labeled KUG-1 to KUG-4. As shown on Figure 1, the monitoring program for the new facilities includes:

- KUG-2A – Discharge from the Solid Water Management Facility water retention pond
- KUG-3A – New effluent drop off point from the sewage tanks
- KUG-4A – New effluent discharge point from the sewage lagoon
- WS-1 through WS-4 – Wetland Treatment Area monitoring points.

Because WS-4 is the final discharge point of the sewage treatment facilities, samples collected at this location will be required to meet the effluent quality standards prescribed by the water license. Samples collected at KUG-4, which is located at the discharge point of the lagoon, will no longer be required to meet the standard. However, water quality monitoring will continue at KUG-4A to assess the effectiveness of the primary treatment provided by the lagoon. The locations of KUG-2 to KUG-4 are shown on

Figure 1. Note that KUG-1 is located at the raw water supply intake at the Coppermine River.

The sampling schedule and list of monitoring parameters specified by the water license will remain unchanged. Samples collected at WS-1 through WS-4 will be sampled according to the same schedule and list of parameters as KUG-3A and KUG-4A. The Monitoring Program is summarized in Table 1. Sample locations are displayed in Figure 1.

Table 1: Surveillance Network Program for Water License NWB3KUG0308

Station	Description	Frequency	Analysis Requirements
KUG-1	Raw Water Supply Intake at the Coppermine River	As per the water license	This document applies to the Sewage Lagoon and Solid Waste Management Facility only. Monitoring requirements for the raw water supply system are provided elsewhere. Station KUG-1 is included here for completeness
KUG-2 (KUG-2A)	Effluent Discharge from Final Discharge Point of The Solid Waste Disposal facility	Monthly during discharge	• BOD • Faecal Coliforms • pH • Conductivity • Total Suspended Solids • Ammonia as Nitrogen • Nitrate and Nitrite • Oil and Grease (visual) • Total Phenols • Sulphate • Sodium • Potassium Magnesium • Calcium • Total Arsenic • Total Cadmium • Total Copper • Total Chromium • Total Iron • Total Lead • Total Mercury • Total Nickel • Total Zinc • Chloride • Total Hardness • Additional parameters, if there is a specific concern identified (i.e. VOC's, Petroleum Hydrocarbons, etc.)
KUG-3	Raw Sewage from Pump Out Truck	Ongoing	• The Hamlet will measure and record the volume of all raw sewage offloaded at the facility. Monthly and annual totals will be reported in Annual Report • Sampling as per KUG-2 • Flow and discharge details recorded weekly
KUG-4 (KUG-4A)	Discharge from the Sewage Lagoon	Monthly from June to October	Same as KUG-2.
WS-1	Upper Part of Wetland Treatment Area	Monthly from June to October	Same as KUG-2

Station	Description	Frequency	Analysis Requirements
WS-2	Mid-Part of Wetland Treatment Area	Monthly from June to October	Same as KUG-2
WS-3	Lower Part of Wetland Treatment Area	Monthly from June to October	Same as KUG-2
WS-4	Final Discharge Point from Wetland Treatment Area to Coronation Gulf	Monthly from June to October	Same as KUG-2

The sampling stations will be clearly identified in the field by posted signs. All signs shall be in the Official Languages of Nunavut, and shall be located and maintained to the satisfaction of an Inspector. Each sampling location must have its Global Positioning System (GPS) coordinates determined. This task should be completed prior to the first sampling to be completed under this QA/QC Plan. Samples shall be taken at the same location on each sampling occasion, unless the Inspector has approved a new location.

Additional sampling and analysis may be requested by an Inspector.

2.1.2 Sample Planning

To understand what sample containers, sampling techniques, and preservation methods are required, Hamlet personnel first need to understand what parameters will be analyzed in the laboratory. A selected CAEL laboratory will be contacted and provided with the list of sampling parameters and comparative guidelines to be used. The lab will then supply the appropriate bottles with preservatives, chain of custody documents, and handling procedures. Table 2 is a summary of parameters required in the License, which are grouped according to their specific sampling requirements:

Table 2: Parameters Examined in NWB Water Licenses

Group	Description	Parameter
I	Microbiological	Biological Oxygen Demand (BOD) Fecal Coliform (FC)
II	General Water Chemistry	pH Conductivity Total Alkalinity Total Suspended Solids (TSS) Ammonia as Nitrogen (NH_3-N) Nitrate-Nitrite (NO_3-NO_2) Oil and Grease (OGG) (Visual) Sulphate (SO_4) Sodium (Na) Total Organic Carbon (TOC) Potassium (K) Magnesium (Mg) Calcium (Ca) *Total Hardness*

Group	Description	Parameter
		Chloride (Cl)
	Total Metals (except Mercury):	*Total Nickel (Ni)* *Total Aluminium (Al)* Total Arsenic (As) Total Cadmium (Cd) Total Copper (Cu) *Total Cobalt (Co)* Total Chromium (Cr) Total Iron (Fe) Total Lead (Pb) Total Manganese (Mg) Total Phosphorus (Total-P) Total Zinc (Zn)
III		Total Mercury (Hg)
IV		Total Phenols

Note: parameters in italics are not included in license, but should be sampled for completeness.

Specific sampling procedures for each parameter will be dictated by the CAEAL accredited laboratory, which should follow the protocols outlined in the Canadian Environmental Quality Guidelines (CCME, 2006) (Appendix B). It is recommended, that the laboratory pre-fill the sample collection bottles with the proper preservative to minimize error in the field.

All of the samples taken will be grab samples. Samples will normally be taken from natural lakes, streams, treatment ponds, or process streams. Where possible, samples shall be taken from just below the surface to avoid floating debris, which may contaminate the sample.

Freshwater Streams, Surface Drainage, and Wetlands

The samples shall be collected as close to the middle of the stream where water flows freely and is free of debris. Once in position, the sampler shall wait to allow any stirred sediment that occurred from entering the stream to settle or wash away. **The bottles shall not be rinsed. Prior to sampling for oil/grease, bacteria, and for any bottles containing preservative.** Sample bottles without preservatives shall be partially filled with the water to be sampled and rinsed with the lid in place at least three times. Rinse water shall be emptied downstream of the sampling point, so that stream sediments remain undisturbed.

If possible, bottles shall be submerged into the stream to a depth of approximately half the total stream depth, and allowed to fill with the mouth of the bottle facing upstream. Where the stream is too shallow for sample bottle to be filled completely, without disturbing bottom sediment of the streambed, the sampler may use a smaller container

that has been properly rinsed to transfer sample to the larger bottle. Do not use a smaller sample bottle containing preservatives.

When taking the sample, sufficient room shall be left to allow for the addition of preservatives, if required.

Lakes or Ponds

Surface sampling shall be collected using the same procedures as streams. Sample bottles shall be submerged to approximately 150 mm (6 inches) below the water surface.

Although not currently required under the Monitoring Program, information on water quality at various depths in lakes or ponds may be required. If an Inspector requests that this sampling be carried out, specific procedures shall be implemented in accordance with accepted sampling and good engineering practice.

Process Streams

When sampling a process stream (i.e. valve or pipe discharge) the sampler shall collect a grab sample or a set of composite samples over an extended period of time. In the case of sampling from a valve, valves shall be open and running for a least one-minute before taking the sample to ensure that a representative sample of the process stream is taken.

2.1.3 Sample Container Selection

Sample containers vary in size and material of construction depending on the specific type of analysis to be conducted. Sample containers to be used shall be obtained directly from the laboratory, which shall provide new containers to the Hamlet specific for the sampling program requested by the Hamlet. The laboratory will provide the correct sizes and types of bottles based on the parameters required. The Hamlet shall **contact the laboratory at least one month prior to the sampling event** in order to ensure that containers are available for sampling. Refer to Section 1.3 for laboratory contact information.

2.1.4 Field Sampling Log

The individual collecting the water sample shall record the following at the time of sampling:

- Date of sampling
- Time of sampling
- Weather conditions
- Monitoring Station Number (i.e. KUG-2, KUG-3, KUG-4, etc.)
- Results of any Field measurements
- Sampler shall also indicate if sample contained preservatives
- Any unusual conditions

- Any deviation from standard procedures.

Field sampling forms are included in Appendix C.

Laboratory supplied sample submission sheets should be filled out completely and Laboratory instructions followed carefully. Laboratory forms are included in Appendix D.

2.1.5 Field Measurements

No field measurements are required as part of the Hamlet sampling program, however, it is strongly recommended that the following parameters be sampled immediately on site using appropriate portable field equipment:

- pH
- Temperature
- Dissolved oxygen
- Total alkalinity
- Turbidity
- Chlorine residuals.

It is important that separate equipment be used to sample between potable water and non-potable water (i.e. surface water). Furthermore, all instruments, glassware, etc. should be cleaned between each sample following manufacturer's recommended guidelines and/or BMPs.

2.1.6 Sampling Procedures

The sampling procedures described in Table 3 shall be used to collect water samples appropriate to the sampling location.

General Procedures for Sample Collection

1. Protocols

General procedures for sample collection are outlined below. Different laboratories have slightly different bottle requirements and sample handling protocols. Sampling technicians must receive site specific training and laboratory procedures must take precedence over other protocols.

2. Sample Locations and Sampling Frequency

The sampling location and frequency has been carefully selected, and is part of site design and layout, as well as the Water Board License. Sampling will follow these

requirements. Diversions must be recorded and submitted to the Water Board for approval.

3. Preparation

Approximately one month prior to the sampling event, the laboratory will be notified and the required bottles, blanks, and materials assembled. Plans for rapid return of the samples prepared. See laboratory forms in Appendix D.

4. Field Collection

At each sampling station the specified samples will be collected and field data recorded.

5. Handling Storage and Transportation

Appropriate personal protective equipment (gloves, safety glasses, etc.) will be used when handling samples. Samples will be stored a 4°C and protected from freezing until delivered to the laboratory. Chain of custody for sampling, storage, and delivery must be maintained. Laboratory sample sheets will be completed in accordance with laboratory protocols. See example in Appendix D.

6. Delivery to Laboratory

Samples will be delivered to the laboratory in the laboratory dictated method and within the hold times specified. Preplanning for rapid transport and delivery will usually be required.

2.1.7 Sample Identification

All samples collected are to be labeled according to standard identification procedures (Name of sampler, time and date of sampling, sample identifier, sampling method and type of sample). **Sample labels shall be water-resistant, and prepared prior to going into the field.**

The individual samples will be labelled with the following information:

- Sample ID #
- Sample name
- Date and time of collection
- Parameter to be analyzed
- Preservatives
- Project number identifier
- Bottle number 1 of ___.

See example Chain of Custody sheet in Appendix D.

2.1.8 Sample Preservation

In order to obtain good results from a sampling program, time is critical. All samples are to be shipped to the Laboratory that has been contracted to carry out the analysis the same day as they are collected. Samples must be protected from breakage, and shall be shipped in an insulated cooler that can be provided by the Laboratory. **If samples cannot be shipped until the next day, due to unavoidable events such as weather or mechanical problems with transport aircraft, all samples must be stored in a refrigerator at 4°C**. Samples must not be frozen.

In all cases where samples cannot be delivered to the lab on the same day, specific preservatives must be added to the samples to prevent chemical changes that may alter the concentration of the parameters of interest. The samples must be preserved within two hours of sampling. Usually, samples can be preserved away from the field at the end of the site visit. In most cases, the laboratory can fill the bottles with preservative, and then ship them to the Hamlet to be filled and sent back for analysis. See examples of Laboratory Forms in Appendix D.

For the Hamlet of Kugluktuk, Table 3 provides the appropriate preservation methods for the parameters to be assessed.

Table 3: Sample Preservation

Type of Sample	Preservation Required
Group I Microbiological	Store in refrigerator at 4°C. Ship to Lab the same day as collected
Group II General Water Chemistry	Store in refrigerator at 4°C. Ship to Lab the same day as collected
Group II Total Metals (except mercury)	Acidify with 5 mL of <20 percent nitric acid. Store in refrigerator at 4°C. Ship to Lab the same day as collected
Group III Total Mercury	Acidify with 2 mL of 1:1 sulfuric acid and 5 percent potassium dichromate Store in refrigerator at 4°C. Ship to Lab the same day as collected
Group IV Total Phenols	Acidify with 4 mL of 1:1 sulfuric acid. Store in refrigerator at 4°C. Ship to Lab the same day as collected

Note: 1000 mL = 1 Liter

2.1.9 Sample Transportation

The main objective is to minimize any chemical changes to the sample between the time it is collected and delivery to the laboratory. Heat, light and agitation can all impact the water chemistry and the samples shall be protected from these effects.

Effluent and surface water samples shall be stored and transported at a temperature of 4°C. Coolers and ice packs need to be available and are usually provided by the laboratory. Upon arrival at the laboratory, samples shall be refrigerated as soon as possible.

3.0 Sample QA/QC

3.1 Laboratory QA/QC

Most commercial laboratories undertake QA/QC procedures with the volume of sample sent for analysis. QA/QC Reports are usually provided with the Certificates of Analysis. The QA/QC protocols dictated by the lab accreditation and by the comparative criteria document (i.e. Canadian Environmental Quality Guidelines). Lab QA/QC procedures should include replicate analysis and spiked samples tested to confirm recovery is within acceptable levels.

3.2 Field QA/QC

To ensure that the monitoring program maintains acceptable quality control, field blanks and duplicate samples will be collected as per the Canadian Environmental Quality Guidelines. The following QA/QC samples will be collected:

- One field bank per sampling season
- One duplicate per sampling month (which should coincide with one per sampling event).

These samples are collected and analyzed for the same parameters as the monitoring program in the license as part of a quality control check on monitoring activities.

The field blanks shall accompany the sampler into the field, labeled as field blanks, preserved in the field and submitted to the laboratory with the field samples.

Replicate or duplicate samples involves collecting more than one sample at a given sampling station subject to specific analysis. Standard procedures used for the routine sampling shall be applied. The replicate or duplicate samples are useful in identifying problems with accuracy and sampling methods.

Once per operating season, for each active monitoring station, a set of duplicate samples will be taken, representing as many of the routine analysis as possible. Where possible this shall be carried out in conjunction with the sampling undertaken by an INAC Inspector.

4.0 Monitoring Program Reporting

The laboratory will perform the analysis of all samples as outlined in the license. The results shall be received by the Hamlet within the time frame agreed to with the laboratory. The results shall contain the limits of detection used for analysis of each parameter as supplied by the laboratory.

The Hamlet may request clarification of the analysis by contacting the NWB Technical Advisor and a review of the analysis will be provided upon request.

The laboratory results are compared to the limits of the Water License for each parameter, and/or to other comparative criteria such as the Canadian Environment Quantity Guidelines. The results are reported to the NWB in the Annual Report. The content of the Annual Report and Guideline Criteria is outlined in the following documents:

- Solid Waste Management Facility O&M Plan
- Sewage Treatment Facility Operations and Maintenance (O&M) Plan.

All staff involved in sampling and reporting must have sufficient training to ensure the sampling program operates effectively.

5.0 Summary

An application for an amendment to the NWB license is currently in progress. The requirements of the license must be complied with, and this document should be updated to reflect additional requirements.

The monitoring program and the QA/QC plan is dependent on proper sampling protocols and laboratory analysis, followed by the appropriate assessment of the results. The exact protocols must be confirmed with the laboratory each sampling event. Training of sampling staff is mandatory to ensure that they can effectively liaise with the laboratory and conduct the sampling as per the laboratory specific protocols. The Canadian Environmental Quality Guidelines (CCME, 2006) should be followed, unless specific NWB license or Nunavut regulations specify otherwise.

This document should be updated annually and whenever there is a change to the NWB water license or new regulations are issued. Staff training must accompany the use of this document.

6.0 Glossary

Quality Assurance (QA): is the definitive program for laboratory operation that specifies the measures required to produce defensible data of known precision and accuracy. QA includes quality control and quality assessment activities.

Quality Control (QC): is a set of measures within a sample analysis methodology to assure that the process is in control.

Quality Assessment: is a process to determine the quality of the laboratory measurements through internal and external QC evaluations. It includes performance evaluation samples, laboratory inter-comparisons samples and performance audits.

7.0 References

Canadian Council of Ministers of the Environment (CCME), Canadian Environmental Quality Guidelines, Update 6.0, July 2006.

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