DILLON CONSULTING

HAMLET OF PAULATUK

Sewage Disposal Facilities Operation and Maintenance Plan

October 2017 – 17-6028

October 18, 2017

Hamlet of Paulatuk
Box 98
Paulatuk, NT X0E 1N0

Attention: Mr. John Holland
Senior Administrative Officer

RE: Hamlet of Paulatuk Sewage Disposal Facilities Operation and Maintenance Plan

Dear Mr. Holland

Please find enclosed one (1) electronic copy of the *Hamlet of Paulatuk Sewage Disposal Facilities Operation and Maintenance Plan* for your review. Updates have been made to the existing draft report as per the Inuvialuit Water Board letter, dated November 3rd, 2015, and discussions with Hamlet staff.

We trust this meets your needs and expectations. Should you have any questions or immediate comments, please do not hesitate to contact the undersigned at 867.920.4555 ext. 4111 or at gstrong@dillon.ca.

Sincerely,

DILLON CONSULTING LIMITED

Gary Strong, P.Eng.
Partner

GS:cj
Attachment: *Hamlet of Paulatuk Sewage Disposal Facilities Operation and Maintenance Plan*

Our file: 17-6028

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1.0 Introduction

1.1 Purpose

The purpose of this plan is to assist the Hamlet of Paulatuk personnel with the operation and maintenance of their sewage disposal facilities. The plan has been developed according to the requirements of the Inuvialuit Water Board (IWB) and is based on the *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories* (Duong and Kent, 1996).

1.2 Site Setting

The Hamlet of Paulatuk is located at 69°21'N and 124°04'W, along the southern coast of Darnley Bay. The Hamlet is approximately 400 km by air east from Inuvik and 855 km by air northwest from Yellowknife. Located in an area of continuous permafrost, the Hamlet of Paulatuk is dominated by glacial till, and marine sands and silt. The daily mean temperature in July is 10.8°C while the daily mean temperature in January is -25.0°C, from the NWT Bureau of Statistics (2017) average monthly temperature data for 2006 – 2015. Average yearly rainfall is 92.9 mm and average yearly snowfall is 131.8 cm. The climate is characteristic subarctic.

The Hamlet has an airport, but no road access. Therefore, supplies are shipped in annually via barge or by plane. Figure 1 outlines the municipal boundaries for Paulatuk.

Figure 1: Hamlet of Paulatuk Municipal Boundaries
**Image from the Department of Municipal and Community Affairs, GNWT. Retrieved July 2015*

1.3 Contact Information

Table 1 details the individuals responsible for the operation and maintenance of the Paulatuk Sewage Disposal Facilities.

Table 1: Contact Information

Name	Role	Phone
John Holland	Senior Administrative Officer	867-580-3531
Keith Dodge	Hamlet Foreman	867-580-3039

2.0 Background

2.1 Site Location and General Operation

The community sewage lagoon, known as 'Dead Lake' or 'Lake A,' is located approximately 2 km from the Hamlet, in the southwest corner of the solid waste facility, as shown in Appendix A. It is a facultative lagoon providing primary treatment to municipal sewage, and is not connected to the drainage basin of New Water Lake, which supplies the Hamlet's water.

The community has used the lake as a municipal sewage lagoon since early 1990. It is approximately 250 m by 340 m, with an average depth of 2.04 m, and a maximum depth of 4.59 m. The natural lake shoreline has not been developed (no berms have been constructed to surround the lake); therefore the lagoon has no freeboard.

Sewage is collected from the community by vacuum truck six days a week. Sewage collection is not performed by contractors or sub-contractors, as the Hamlet itself performs these functions. The Hamlet currently has two sewage collection trucks in operation, with estimated capacities of 2,500 gallons each. The vacuum trucks discharge into the lagoon from a gravel pad, using a metal discharge chute located on the northeast side of the lagoon, as seen in Figure 2.

Figure 2: Paulatuk Discharge Chute (2015)

From the lagoon, sewage effluent continuously discharges at natural flow rates into a vegetated wetland, before migrating into Darnley Bay. The wetland is approximately 300 m by 50 m. Discharge is continuous throughout the year, though it does freeze over in winter months. Some overland flow can occur during spring thaw, or during major and prolonged precipitation events.

There is currently no data for the quality of raw sewage for the Hamlet.

2.2 Population Projections and Estimated Sewage Generation Rates

Population projections for the Hamlet of Paulatuk obtained from the Northwest Territories Bureau of Statistics (2017) indicate that the Hamlet will experience negative population growth after 2020. Population projection data is available to 2035. In accordance with MACA guidelines, a 0.5% increase in population projection is to be considered for all communities that are expected to experience negative population growth.

Table 2 presents the population and subsequent sewage generation rates, which were calculated to the year 2040. The estimated sewage generation rates are based on: (1) the Hamlet's available water withdrawal data from the 2010, 2011, 2012, 2015, and 2016 Annual Reports submitted to the IWB, and (2) on the MACA formula (1993) presented below for the calculation of water use. In both cases, it is assumed that all water withdrawals will yield sewage output. Average water withdrawal from New Water Lake is 108 L/c/d.

$$Production\left(\frac{L}{d}\right) = 90\frac{L}{c \cdot d} * \left(1 + (0.00023 * Population)\right) * Population$$

The estimated sewage generation based on water withdrawal data exceeds the results generated using the MACA formula. The more conservative values should be used for future planning related to the sewage lagoon. If the Hamlet experiences positive population growth in excess of the MACA guideline, and/or if the water use of the community increases significantly, it could be possible to exceed this amount. The current water licence (2015 renewal) permits a maximum annual withdrawal of 17,000 m^3 from New Water Lake.

Table 2: Estimated Sewage Generation Rates for the Hamlet of Paulatuk

Year	Population Projection (+0.5% Population Growth)	Estimated Sewage Generation Rates Based on Water Withdrawal Data (m^3/year)	Estimated Sewage Generation Rates Based on MACA Formula (m^3/year)
2016	327	12,846	11,550
2020	334	13,121	11,815
2025	342	13,435	12,118
2030	350	13,749	12,423
2035	359	14,103	12,767
2040	367	14,417	13,074

From the 2015 and 2016 Annual Reports prepared in accordance with the Hamlet's water licence, the Hamlet generates approximately 14,000 m^3 of sewage on an annual basis. This is likely an over-estimation of the true production, as the estimate of sewage produced is based on truckload counts, and trucks may not be full when discharging at the site. The water withdrawal data is metered, and is therefore a more accurate representation of the wastewater disposed of in the sewage lagoon.

3.0 Operational and Maintenance Procedures

3.1 Sewage Lagoon and Wetland System

Sewage collection will be carried out in the same manner as in previous years. Collected sewage will be discharged into the lagoon via the effluent discharge chute. Any effluent spilling onto the truck gravel pad must be cleaned up to prevent accumulation of ice during the winter.

To meet the required minimum quality standards established by the IWB, it is recommended that scheduled decanting should occur instead of current continual natural decanting. Based on natural TSS and pH cycles related to microorganism activity in the lagoon, to achieve SNP results within criteria, the lagoon should be manually decanted in the fall, mid-August to the first week of October, after the first frost occurs. This decant should lower the lagoon levels such that no natural decanting occurs during the year. This will allow for longer treatment over summer months, and will target decanting when effluent is most likely to fall within the IWB effluent criteria.

The Hamlet's water licence dictates that an ENR Inspector must be advised at least ten days in advance of initiating a decant of the sewage disposal facilities. Decanting may be initiated after receiving SNP results from stations 1619-2 and 1619-3 indicating that the effluent meets acceptable discharge standards.

During decanting operations, water should not be drawn from the surface of the lagoon, not the base. This can be accomplished by using a float on the hose, or by keeping the hose end just below the water level, and moving it down manually as the water level in the lagoon drops.

To reduce chance of lagoon overflow and natural decanting, the annual decant volume should be equal to the estimated sewage generation rates, plus a 10% contingency to account for potential runoff entering the lagoon and fluctuations in sewage generation. Table 3 details the approximate decant volume required. Initial manual decanting may require a greater decant volume to achieve 1 m of freeboard in relation to the recommended constructed berms. Decant volumes can be estimated by the flowrate of the pump and the duration of the pump's operation. It is recommended that a staff gauge be installed in the lagoon to obtain depth measurements and volume relationship. A trash pump may be used to perform decanting operations (Dillon, 2015).

Table 3: Decant Volumes for Sewage Lagoon

Year	Decant Volume (m^3)
2016	14,433
2020	14,778
2025	15,124
2030	15,513

Year	Decant Volume (m^3)
2035	15,859
2040	14,433

Final discharge will be into Darnley Bay after effluent migration through the wetland. It is imperative that the requirements of the Surveillance Network Program (SNP) are completed to ensure the lagoon and wetland is providing adequate treatment.

3.2 Yearly Operation and Maintenance

Operation of the lagoon has been broken down into two sections: operation during the winter months and operation during the summer months. These operation periods are estimates as operational changeovers are weather dependent and may occur earlier or later than the anticipated dates.

3.2.1 Operation from Freeze-up to Break-up

Operation of the lagoon during this time is for winter operations. Changeover to winter operations should occur when effluent in the lagoon begins to freeze. Sewage will be collected using the Hamlet's vacuum truck and will be discharged into the lagoon via the sewage discharge chute. Any sewage spilled onto the truck turn around pad must be cleaned up immediately to prevent the accumulation of ice. Also, any accumulation of ice on the discharge chute should be cleared away to keep the chute clean and free of blockages. Prior to freeze-up, the Hamlet must implement the SNP at Station Number 1619-2, 1619-3, and 1619-4. It is the Hamlet's responsibility to ensure that the SNP is carried out at this time to ensure compliance with the water licence.

3.2.2 Operation from Break-up to Freeze-up

Operation of the lagoon during this time is for summer operations. Changeover to summer operations should occur when stored effluent in the lagoon has thawed. Sewage will be collected and discharged into the lagoon as described for winter operations. Should the need arise (ie: severe risk of sewage overflow) the lagoon will also be decanted during this time using a pump and hose to decant effluent into the adjacent wetland. Prior to decanting any effluent into the wetland, the Hamlet must provide notice to an Environment and Natural Resources (ENR) Inspector at least 10 days before decanting occurs. Once the decantation period is over the pump and hose system will be disconnected and sewage will be stored in the lagoon during the winter months. Immediately after ice break-up, implementation of the SNP will begin at Station Number 1619-2, 1619-3, and 1619-4. It is the Hamlet's responsibility to ensure that this program is carried out each summer to remain in compliance with the Hamlet's water licence. Refer to Section 3.6 for further details.

3.2.3 Maintenance and Inspection of Sewage Disposal Facilities

Many aspects of the sewage disposal facilities need to be inspected and maintained on a regular basis. Table 4 shows which activities these are, and how often these inspections and maintenance activities are performed.

Table 4: Frequency of Inspection & Maintenance Activities at Sewage Disposal Facilities

Activity	Frequency
Inspection of inlet and truck discharge structures for damage, blockage, settlement and erosion and their maintenance	Monthly
Monitoring of water level to ensure minimum freeboard on constructed berms, dykes and dams is maintained	Weekly
Inspection of dam, dykes and berms for damage by animals or erosion and their maintenance	Weekly
Monitoring of the colour of the liquid in the lagoon as an indication of performance	Monthly
Measurement of sludge levels	Should be completed annually
Removal and disposal of accumulated sludge	Does not occur currently
Monitoring for damage to fencing/signage	Monthly
Inspection, grading and reshaping of access road and truck pad	Inspected monthly, graded and reshaped as needed

3.2.4 Sludge Depth Measurements

The measured sludge depth is to be reported annually, following a routine maintenance schedule. See Section 3.4 for details on how to perform these measurements.

3.3 Equipment Maintenance

Sewage trucks can be a source of pollution due to spills. Trucks should be inspected regularly and well-maintained to reduce this risk. Regular vehicle maintenance and inspections are to be performed on all Hamlet-owned equipment. These should include but are not limited to regular:

- Oil changes;
- Fluid changes;
- Checking of tire pressure;
- Greasing;
- Brake pad replacement;
- Cleaning; and
- Periodic maintenance requirements as set out by the equipment manufacturer.

3.4 Sewage Sludge Management Plan

3.4.1 Characterization of Sludge

Collected sewage will mostly come from residential buildings in the Hamlet as there are few industrial or commercial sources. The sludge will generally be a mixture of fecal matter, organic and inorganic material. However, contaminants such as heavy metals, solvents and petroleum products may enter the lagoon due to municipal activities.

Municipal activities which may lead to contaminants described above entering the Sewage Disposal Facilities include:

- Sump pumping from garages; and
- Washwater entering sewage holding tanks from sinks where items impacted by contaminants are washed.

It is recommended that a separate solvent bath be available for the washing of machinery items which may be impacted by oils, lubes and greases.

During the treatment process, heavier solids in the lagoon liquid will sink to the bottom of the lagoon and collect over time as a sludge blanket.

3.4.2 Methods for Performing Sludge Depth Measurements

According to the *National Guide to Sustainable Municipal Infrastructure* (2004), sludge depth measurements should be performed each year to determine the depth of sludge and rate of sludge accumulation within the lagoon. This will help Hamlet staff to plan and prepare for lagoon desludging operations. There are a number of methods available for measuring the depth of the sludge blanket; however one of the more economical tools is called a Sludge Judge® (see Figure 3). The Sludge Judge® is a clear plastic tube with a check valve on the bottom and measured increment markings on the tube. It comes in 5-foot sections that can be screwed together as necessary. The number of sections required for sampling will be dependent on the depth of the water level in the lagoon. The most recent sludge depth measurements (conducted July 26, 2017) included measurements which exceeded the length of three Sludge Judge® sections. It is recommended that a minimum of four sections be available for use for accurate measurements to be taken at the deepest points of the lagoon.

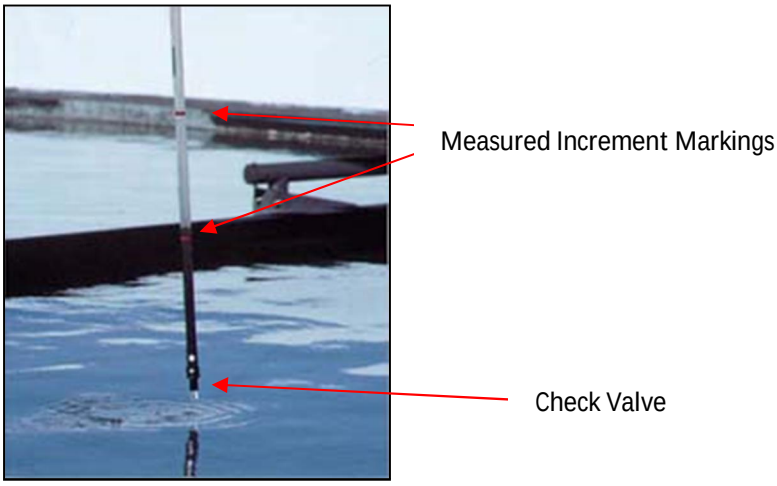

Figure 3: Photo of Sludge Judge®
Source: GENEQ Inc.(n.d)

Sludge depth measurements should be taken based on a grid format, and should be taken in the same locations each year. Based on the document *Sludge Survey Methods for Anaerobic Lagoons* (Westerman, Shaffer & Rice, 2008), six depths measurements per acre should be collected, to a maximum of 24 points in a grid formation. See Figure 4 as reference to sample location points.

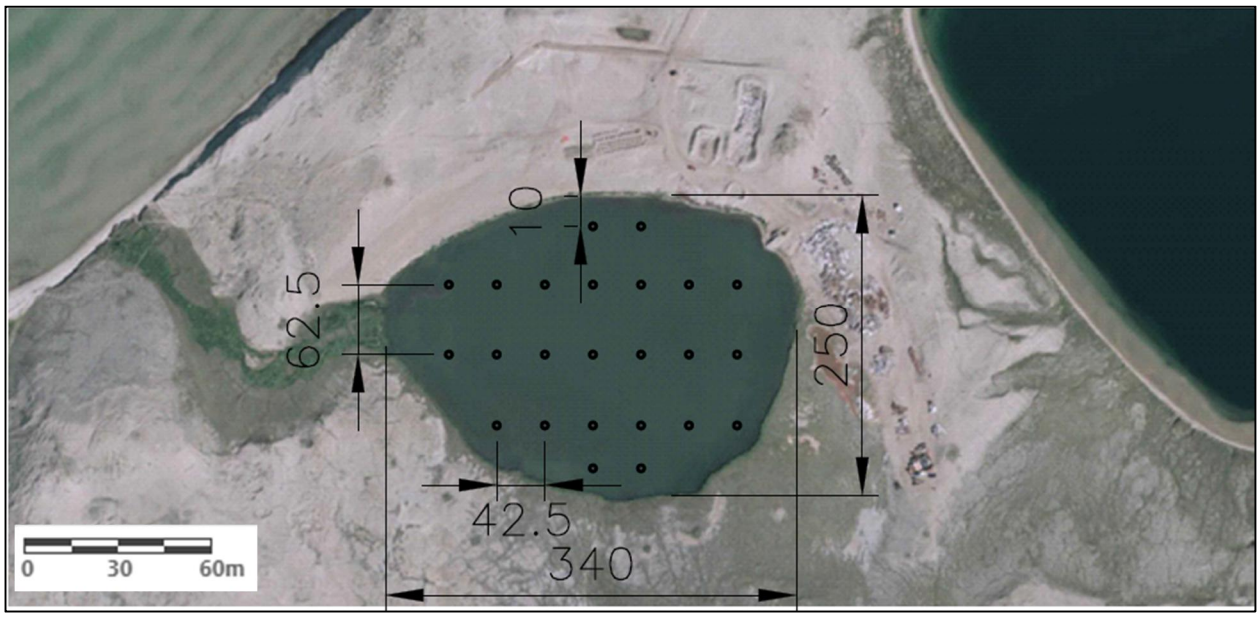

Figure 4: Paulatuk Sewage Lagoon 'Lake A' Sample Grid Reference
Source (Base Image): Land Administration, Department of Lands, Government of the Northwest Territories, NWT Centre for Geomatics (2013)

According to Westerman et al. (2008), sampling locations on-site should be marked by survey flags or landmarks (sewage truck discharge chute, boulders, outlet pipe, etc.). Hamlet staff can place markers on the side of the lagoon to indicate sampling point locations at intersecting junctures.

To prepare for sludge depth measuring, the follow items must first be obtained:

- A boat (a flat bottom boat should be used as they are more stable than a canoe or V-bottom boat, Westerman et al., 2008);
- Appropriate floatation devices for each sampling team member;
- Sludge Judge® or a similar measuring device (ensure that the check valve is operating properly);
    - If available, a measuring rod to measure total depth from top of water level to bottom of the lagoon to provide more accurate data, however the Sludge Judge® is capable of sampling effluent and sludge layer depths;
- Appropriate Personal Protective Equipment (PPE) such as latex or nitrile gloves, CSA certified rubber boots, coveralls, safety goggles, etc.; and
- Notebook and pen to record measurements.

Choose to take depth measurements during the summer, after the lagoon has completely thawed. Take measurements on a calm day when weather conditions (wind, rain, etc.) will not interfere with the process. According to Westerman et al. (2008), always have a team of three people to take measurements. One person will stay on shore to monitor and act as a rescuer should the need arise. The other two team members will be in the boat, one person will help to anchor the boat and record depth measurements while the second person uses the Sludge Judge® and measuring rod to obtain the measurements. All team members, including those on the shore, are to wear appropriate floatation devices (Westerman et al., 2008).

To take the depth measurements, follow these steps provided by Westerman et al. (2008):

1. Paddle to the first sampling location. Be sure to mark down which location it is (ie. depth sampling point #1).
2. Slowly lower the Sludge Judge® into the lagoon being careful not to move the tube up and down. To determine when the tube has reached the top of the sludge layer, watch the liquid level inside the tube as it is lowered into the lagoon. When the tube has reached the sludge layer, the water level inside the tube will drop slightly.
3. As soon as the tube has reached the sludge layer, tug on the rope to secure the check valve and pull the tube up slowly.
4. Using the increment markings on the tube, measure the depth of the liquid layer (this is the layer of water that sits above the sludge layer). There should be 1 to 2 inches of sludge at the bottom of the tube, indicating that the tube did reach the sludge layer. The depth of the liquid layer in the tube is measured from the top of the sludge to the top of the liquid (Refer to Figure 5 below). Record the measurement.

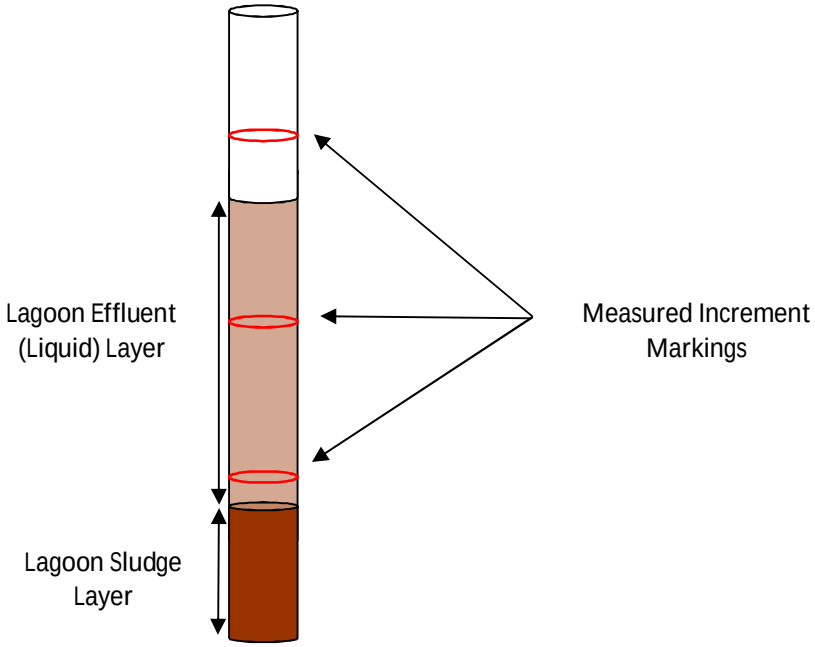

Figure 5: Sketch of Sludge Judge® After Retrieving Lagoon Effluent Depth Measurement (Not to Scale)

5. Take the measuring rod, place it in the lagoon with the zero end pointing downwards. Lower the rod all the way down until the bottom of the rod touches the lagoon floor. Read the water level measurement. This is the total depth of the effluent plus the sludge layer (Refer to Figure 6 below). Record the measurement.

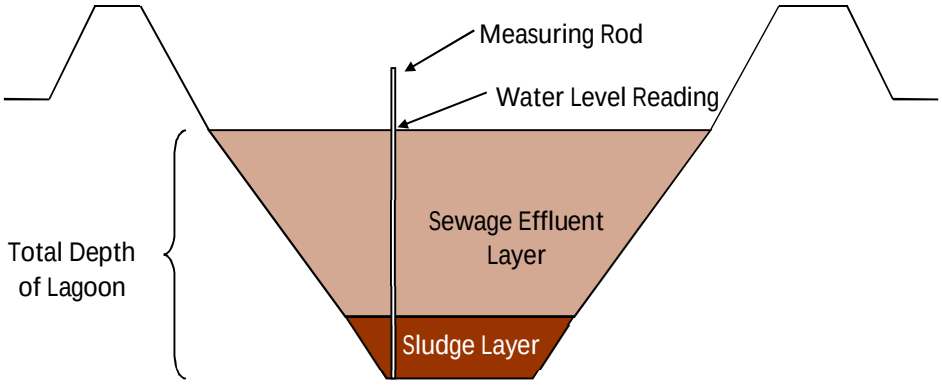

Figure 6: Sketch of Lagoon Cross-Section and Total Depth Measurement (Not to Scale)

6. To find the thickness of the sludge layer, subtract the depth of the liquid layer from the total depth.
7. Repeat steps 2 through 7 for the rest of the sampling locations. Be sure to record all measurements and the corresponding sample locations.

An alternative method to measure the depth of the sludge blanket if no measuring rod is available is to lower the Sludge Judge® all the way to the bottom of the lagoon. Sludge and effluent will enter the tube through the check valve. When the tube is lifted out of the water, a distinct layer of sludge will be visible at the bottom of the tube. The distance from the bottom of the tube to the top of the sludge layer in the tube is the estimated thickness of the sludge blanket. This method can provide inaccurate results as the sludge does not enter the tube as easily as the effluent. This may cause the sludge depth measurement to be less than the actual depth of the sludge blanket (Westerman et al., 2008).

3.4.2.1 Sludge Removal, Treatment, and Disposal

If the depth of the sludge blanket becomes thick enough to decrease the volume of the lagoon cell significantly or contaminant concentrations become too high, the sludge should be removed, treated, and disposed as directed by the Inuvialuit Water Board. As a guide, if the height of the sludge is thicker than 0.5 m from the bottom of the lagoon floor and has reached the bottom of the decant screen structure, the sludge should be removed from the lagoon. At this point, in consultation with the Government of the Northwest Territories, the Hamlet should retain the services of an Engineer for the design of appropriate sludge removal, treatment and disposal options. The design will need to be submitted and approved by the Inuvialuit Water Board prior to implementing the sludge removal process. Prior to any decant an ENR Inspector must be informed at least ten days in advance. A Sludge Removal Plan must be submitted to the IWB within 60 days prior to sludge removal activities. These notices must be made in accordance with Part D, Items 13 and 14 respectively.

3.4.2.2 Methods for Sampling Sludge

Although there are no specific guidelines with regards to the frequency of sludge sampling, sampling of sludge once per year should be sufficient to monitor the contaminant concentrations. Therefore sludge samples can be collected during the sludge depth measurements.

As well, parameters to be analyzed in the sludge have not been stated in the Hamlet's water licence. Therefore, prior to initiating the sludge sampling program, the Hamlet must contact the Inuvialuit Water Board to determine which parameters (ie. microbiological, nutrients, physical, metals, etc.) to test for during the program.

Sludge samples should be collected as a composite sample. This means that sludge samples are taken from various points in the lagoon and mixed together before bottling and sending to a laboratory for analysis (Westerman et al., 2008). To collect sludge samples, gather all items listed in Section 3.4.2 for sludge depth measurements as well as the following:

- Sample bottles;
- Preservatives (if required);
- Clean 5 gallon bucket;
- Cooler;
- Ice packs to keep samples cool;

- Chain of custody forms (also called COCs);
- Permanent marker to mark on bottles;
- Pen to fill out chain of custody forms;
- Packing tape;
- Shipping label to send samples back to the lab;
- Clean stir-stick to mix sludge samples in 5 gallon bucket (must be clean as an unclean mixer may contaminate the sample, leading to inaccurate results); and
- Sealable freezer bag.

Samples must be collected shortly before they are sent to the lab for analysis. For example, if the samples must be at the airport by 2:00pm, the samples should be collected that morning. Make sure that there is enough time to collect and package all samples for transport. This is important because the samples must be at the lab within 24 hours from the time they are collected, otherwise some of the samples will no longer be acceptable for analysis. Be sure to contact the airport and ask what time the samples must be there to make the flight. Contact the lab to let them know that samples will be arriving and ask if they are able to pick them up at the airport.

To collect a composite sludge sample, follow the procedure below (adapted from Westerman et al., 2008):

1. Prior to beginning sampling, label the sample bottles with the date, time of collection, your name and description of sample (ie. sludge from Paulatuk sewage lagoon).
2. After taking the sludge depth measurement using the Sludge Judge®, dip the Sludge Judge® into the lagoon to collect a sample of sludge in the tube. Pull the tube out and release the valve at the bottom to discharge sludge into the 5 gallon bucket. Be careful not to empty any of the effluent (liquid) into the bucket.
3. Continue this step until a sample of sludge has been collected from each sampling location.
4. Mix the sludge samples together in the 5 gallon bucket. Collect samples by dipping sample bottles carefully into the bucket. Do not allow any of the preservatives in the bottles to spill out of the bottle while filling it. Cap bottles and place in cooler.
5. Once all bottles have been filled, pack bottles in cooler with ice packs for shipping. Fill out chain of custody forms, place in a sealable freezer bag and place in the cooler with the samples. Close cooler and secure with packing tape and place shipping label on top of the cooler.
6. Take cooler to the airport and ship to the laboratory immediately. Some sample parameters must be analyzed within 24 hours of collection; otherwise they will not be acceptable for analysis. Call the lab and give them the shipping number of the cooler.

Samples should contain only sludge and include as little effluent as possible. This is because of the desludging procedure for the lagoon. When it is time to desludge the lagoon, the lagoon effluent will first be discharged to the wetland treatment area leaving mostly sludge (Westerman et al., 2008). Once the sludge is removed, it will most likely require further treatment prior to disposal. Sampling only the

sludge will give a more accurate analysis of the amount of contaminants within the sludge to be treated. Results are to be reported once analysis has been completed and are to be included in the Annual Report.

3.5 Lagoon and Wetland Monitoring Program (Surveillance Network Program)

As per the conditions set out in the Hamlet of Paulatuk's water licence, the effluent discharged from the lagoon into the wetlands must be sampled twice per year (once before freeze-up, and once after ice break-up). The following sections describe in detail how the program must be completed.

3.5.1 Program Description

The lagoon is the main storage and primary treatment facility for municipal sewage. Solids will settle to the bottom and the remaining effluent will be stored and continuously discharged, or decanted, into the adjacent wetland. The wetland area provides the final natural treatment step before discharge into the ocean, removing residual organic and inorganic contaminants.

There are three wastewater quality monitoring locations, as outlined in Table 5. The Hamlet of Paulatuk's water licence (N7L3-1619) has set the following effluent quality standards for effluent discharged from the sewage lagoon to the wetland as detailed in Table 6. Appendix A shows the locations for each SNP sampling station.

The following table is a sampling schedule for the lagoon and wetland treatment areas. Note that parameters may change, check the current water licence for updates.

Table 5: SNP Sampling Points at the Sewage Disposal Facilities

Sampling Station	Description	Sample Location Coordinates	Sampling Dates
1619-2	Outflow of Sewage Lagoon before entering adjacent wetland	69°20'19.45"N 124° 6'58.73"W	Twice annually; once before freeze-up and once after ice break-up
1619-3	Effluent discharge from adjacent wetland of existing sewage disposal facilities before entering Darnley Bay	69°20'22.32"N 124° 7'18.62"W	Twice annually; once before freeze-up and once after ice break-up
1619-4	Effluent discharge from abandoned sewage lagoon before entering Darnley Bay	69°21'4"N 124° 5'28"W	Twice annually; once before freeze-up and once after ice break-up

Table 6 presents the parameters that must be tested at the three sewage lagoon SNP stations, and their maximum allowable concentrations. The effluent water surface must be inspected for the presence of oil or grease sheens. If a surface sheen is identified, a sample must be taken at the sheen location, analyzed for the presence of oil and grease, and meet the Maximum Average Concentration parameter highlighted in Table 6. If no sheen is visible, the oil and grease sample is not required. Carbonaceous biochemical oxygen demand ($cBOD_5$) is also to be collected and tested at all stations.

Table 6: Quality Standards for Effluent Discharged from Sewage Treatment Facilities

Parameter	Maximum Average Concentration
Fecal Coliforms	1 x10^4 CFU/100 mL
Biological Oxygen Demand (BOD_5)	100 mg/L
Oil and Grease*	5 mg/L
Total Suspended Solids (TSS)	120 mg/L
pH	6-9

*Oil and Grease is not required at station 1619-4

All sampling, sample preservation and analysis is to be performed in accordance with methods approved by the Inuvialuit Water Board. All analysis must be completed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) Certified Laboratory. Note that an example of Taiga Environmental Laboratory's sampling instructions is provided in Appendix C.

3.5.2 Record of Sampling Events

It is the responsibility of the Hamlet to file an Annual Report to the Inuvialuit Water Board following the reported year. Appendix B contains the template for the Annual Report, on which sample forms and results must be attached when submitting. The amount of raw water pumped from SNP Station Number 1619-1 to the community, and the amount of sewage discharged to the lagoon must be documented monthly and annually. As well, the amount of solids removed from the sewage lagoon each year (if this has proven to be necessary due to excessive sludge accumulation) must be recorded. Laboratory results from the SNP must be included.

3.6 Quality Assurance/Quality Control Plan for Lagoon and Wetland Monitoring Program

The following sections describe the Quality Assurance/Quality Control (QA/QC) Plan for sampling of the Sewage Lagoon. This plan outlines general QA/QC procedures, however, the Hamlet should obtain more specific instructions on sample collection and handling from Taiga Environmental Laboratory. They must also obtain a certificate from the lab stating that the lab is certified as a CAEAL Laboratory. Information in developing this plan was taken from *Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "B" Licensees in Collecting Representative Water Samples in the Field and for Submission of a QA/QC Plan* (Department of Indian and Northern Affairs Canada, Water Resource Division & the Northwest Territories Water Board, 1996) and *Wastewater Sampling Instructions, Kitikmeot Region* (IEG Environmental, 2005).

3.6.1 Sample Collection

3.6.1.1 Preparing for Sample Collection

Samples are to be collected from the marked SNP locations. Please refer to Appendix A for a map of the SNP locations.

Before collecting samples, follow the list of instructions below:

- Contact the lab and ask where their lab is located. Tell them you need enough sampling bottles and equipment to test for the list of parameters in Table 6. As well, you will need travel blanks and field blanks. Travel blanks are jars of deionized water that are filled in the laboratory and travel in the coolers with the field samples to determine if there is any possible contamination from traveling and handling methods. Never open the Travel Blanks. Field blanks are also filled with deionized water, but must be filled in the field by the sampler during the sample collection process. Also ask the laboratory for an instruction sheet for collecting the samples. An example of an instruction sheet can be found in Appendix C.
- Contact the airport and find out what time the samples must be dropped off in order to make the flight to the city where you are sending them. The samples should be collected shortly before they are shipped.
- Go to the sampling locations and familiarize yourself with the area. Walk to each location so you know where each sample must be taken.

Once you have received the sampling bottles and equipment from the lab, make sure you have the following things with you before you begin collecting samples:

- Sample bottles;
- Preservatives;
- Coolers that the bottles and preservatives were sent in;
- Field blanks;
- Chain of custody forms (also called COCs);
- Permanent marker to mark on bottles;
- Pen to fill out chain of custody forms;
- Nitrile gloves;
- Packing tape;
- Ice packs; and
- Shipping label to send samples back to the lab.

3.6.1.2 Instructions for Sample Collection

Follow these instructions to collect samples from the sewage lagoon and wetland:

1. Place ice packs in freezer the night before sampling.
2. In the morning, place ice packs and other equipment into coolers and load into vehicle. Make sure that the Travel Blanks and Field Blanks are in the cooler as well.
3. Drive to site and park in a safe spot. Do not park on the truck turn around pad for the sewage lagoon.
4. Take coolers and equipment to the first sampling location (Station 1619-4). Samples should be collected in the order of least contaminated to most contaminated. Start at the end of the abandoned sewage facilities wetland, where effluent use to flow into Darnley Bay. Then sample at Station 1619-3 and finally Station 1619-2. Put cooler and bottles in a safe and accessible area.
5. Put on a pair of nitrile gloves.
6. Fill the field blanks with deionized water.
7. Take out bottles needed to sample at this location and place beside the cooler. Do not open the bottles.
8. Select the bottles not requiring or containing preservatives and put aside.
9. Take the bottles requiring or containing preservatives and sample these first.
10. Please note that some bottles must be rinsed and some bottles must not be rinsed. Please refer to the water sampling instructions provided by the laboratory that sent the sample bottles to determine if the bottle requires rinsing. If rinsing is required, discard rinse water downstream and away from the sampling location. Rinse the bottle three times. If the bottle must not be rinsed, carefully unscrew the cover and place bottle slowly into the water open end up and slightly tilted to allow water to slowly fill the bottle. The bottle should be fully submerged to avoid contamination at the water surface. If the bottle contains preservatives already, be sure not to tip or overfill the bottle as the preservatives will be washed out. Fill as directed by the water sampling instructions provided by the laboratory that sent the sample bottles (some bottles have fill lines, others must have no air bubbles). To add preservatives (if not already in the bottle) refer to the water sampling instructions provided by the laboratory that sent the sample bottles to determine which preservative to add to the sample. Carefully pour contents into the sample bottle. Screw the cover on tightly and mix by gently tipping the bottle back and forth.
11. Label the bottle with the Station Number, your name, date, time of collection, and preservative added. Make sure to use a waterproof/permanent marker to label the bottles. Place filled sample jar in cooler.
12. Continue until all preserved samples have been taken.
13. Now fill the bottles not requiring preservatives. Refer to the water sampling instructions provided by the laboratory that sent the sample bottles to determine which bottles need to be rinsed.
14. Fill bottle as directed in the water sampling instructions provided by the laboratory that sent the sample bottles and screw cover on tightly. Label and place in cooler.

15. Continue until the rest of the bottles have been filled.
16. Take off nitrile gloves and dispose in garbage bag.
17. Collect cooler and move to the next sampling location (Station 1619-3). Repeat steps 5 to 16.
18. Collect cooler and move to the next sampling location (Station 1619-2). Repeat steps 5 to 16.
19. Once all samples have been collected and labelled, put on a new pair of nitrile gloves and pack samples into coolers tightly with ice packs to limit movement during shipping. Remove gloves and wash hands thoroughly.
20. Fill out the chain of custody form.
21. Place form in a sealable freezer bag, seal and put in the cooler with samples. Tape up the cooler with packing tape. Tape shipping label to top of cooler and bring to the airport. Always wash hands thoroughly after handling the cooler.
22. Fill out the shipping forms for sending the cooler to the lab and check that the plane will be on time.
23. Call the lab and tell them that the samples are on the way and give them the flight information.

As part of QA/QC testing, a second set of samples should be taken from one of the sampling points. This means filling two sets of sampling bottles from the same location. This second set of samples is to verify that sample results are accurate and that sampling methods are consistent. The second set of samples should be taken from a different sampling point during each sampling period, if possible.

Lab Analysis

Once the lab has received the samples, they will begin processing them. A report stating all results as well as the detection limits will be produced and sent to the Hamlet Office. The report will also state any problems that may have occurred during analysis of the samples.

Laboratory Contact Information

Taiga Environmental Laboratory
Environment and Natural Resources
4601 52nd Avenue
Yellowknife NT, X1A 2L9
Phone: (867)-767-9235 ext. 53151
Facsimile: (867)-920-8740

3.7 Managing Insects and Weeds

3.7.1 Insect Management

In order to discourage attracting insects, the wetland surrounding the lagoon should be inspected regularly for areas of ponding water. Hamlet staff must cover up any puddles or potholes by filling them with soil (Department of Municipal and Community Affairs, n.d). Weeds growing in and around the lagoon surface may also attract insects.

3.7.2 Weed Management

Weeds growing in and around the lagoon may cause a number of problems such as attracting unwanted insects, causing excessive odours, and impeding photosynthesis. Surface weeds block sunlight from entering the lagoon that is required for photosynthesis to occur. Photosynthesis is the reaction that provides energy for algae and that in turn allows algae to provide oxygen to bacteria in the lagoon. Bacteria require oxygen in order to break down wastes within the lagoon (Department of Municipal and Community Affairs, n.d). Wastes that are not breaking down may result in excessive odour.

Weeds/plants on the surface and edges of the lagoon must be removed promptly. Hamlet staff should skim weeds off the top of the lagoon and trim them at them edges. Any weeds that have been removed must be buried in the landfill immediately to prevent odours and insects.

3.8 Measures to Prevent Short-Circuiting

The lagoon is a rough circular shape where sewage is dumped in at one end of the circle (the point furthest from the outfall) and discharged from the other end (at the outfall). Sewage effluent is therefore forced to pass through the longer length of the lagoon. As long as effluent is discharged in and out in these locations, short-circuiting should be minimized (Department of Municipal and Community Affairs, n.d). However, should a breach of the lagoon occur, effluent may discharge from the breach potentially causing a short-circuiting effect. The Hamlet should consider having an annual inspection of the lagoon conducted by a Geotechnical Engineer. This should help to identify problems with the lagoon structure and bring awareness to areas of the lagoon that need to be repaired prior to formation of a short-circuit.

3.9 Measures to Prevent Stagnation and Excessive Odour

Continuous flow provided by a lengthy discharge period should help to prevent stagnation of effluent in the lagoon. If stagnation does become a problem, the Hamlet may want to consider a mechanical option such as installation of an aeration pump to aerate the lagoon.

Excessive odour may result from one of the following (Department of Municipal and Community Affairs, n.d):

- Shortly after the spring melt;
- During periods of extensive cloud cover;
- Stagnation;
- Excessive presence of weeds in and around the lagoon; and
- Presence of sludge mats, floating scum, or algae mats on the surface of the lagoon.

Continuous discharge should help prevent stagnation of effluent in the lagoon and reduce excessive odour resulting from the spring melt. As well, natural wind on the surface of the lagoon should act to aerate the lagoon and prevent stagnation. Any mats and/or scum that accumulate on the surface of the lagoon must be promptly broken up and dispersed by Hamlet staff. For weed management methods please refer to Section 3.7.2.

4.0 Site Records

Copies of records pertaining to operation and maintenance of the sewage lagoon should be kept at both the Hamlet Office and the Hamlet's Maintenance Garage. Information that must be included in these records includes:

- Volumes of any effluent discharged to the environment through an accidental spill;
- Sewage volume collected (both monthly and annually);
- Details of any maintenance undertaken at site;
- Record sheets;
- Copies of annual reports submitted to the Inuvialuit Water Board;
- Copy of the Hamlet's water licence;
- Copies of all plans pertaining to the operation and maintenance of the Sewage Lagoon and Wetland Treatment Facility (i.e. Operation and Maintenance Plan, QA/QC Plan, Spill Contingency Plan, Abandonment and Restoration Plan, Sludge Management Plan); and
- Copies of spill reports and related regulations.

5.0 Safety Procedures

The following safety procedures should be obeyed in order to minimize health risks to personnel working in and around the wastewater and solid waste facilities:

- Equipment is to be kept clean;
- Wear protective clothing such as gloves and boots at all times;
- Work clothes must be kept in a designated change room and employees are to change into them when they arrive for work. Work clothes must not be worn home. The Hamlet's Public Works & Services Maintenance Garage should be equipped with laundry facilities to wash work coveralls onsite;
- Hands to be washed frequently; as a minimum before eating and after work; and
- Personnel should receive appropriate vaccinations and ensure they are kept up-to-date. Please contact the Department of Health for a list of the appropriate vaccinations.

6.0 Site Access Control

There are no measures in place to control access to the site. There is partial perimeter fencing at the north end of the facility, equipped with an entrance gate. The gate is not locked to control access hours, but is able to be locked if this is deemed necessary by the Hamlet. Signage indicating that the area is an active sewage lagoon should be considered.

7.0 Emergency Response

The Hamlet must be able to respond efficiently and effectively to all possible emergencies that may be encountered in the operation of the Hamlet's facilities. These include, but are not limited to fuel, chemical and wastewater spills as well as fires. Due to the nature of the Hamlet's facilities, burning or spillage of unknown or hazardous materials may occur. Only personnel who are properly trained to deal with these situations should respond to such emergencies.

Personnel must familiarize themselves with the emergency preparedness plans before an accident or emergency occurs. Copies of these plans must be kept in all sewage and solid waste disposal vehicles as well as in all common work areas.

7.1 Emergency Contact Numbers

The following is a list of contact numbers in the case of an emergency:

- Fire Department: (867) 580-2222
- RCMP Detachment: (867) 580-1111
- 24 Hour Spill Response Line: (867) 920-8130

7.2 Contingency Planning

In the case of a service disruption, caused by a breach in the sewage lagoon berm, the Hamlet should follow the emergency measures listed below:

- Notify the Municipal Supervisor and the SAO;
- Report the spill to the NT-NU Spill Line (867) 920-8130;
- Contain or divert the spill where possible (consult with the Hamlet of Paulatuk Spill Contingency Plan for appropriate containment measures); and
- Consult with regulatory personnel on next steps.

In the event that the lagoon is not accessible by road and the sewage trucks are not able to discharge sewage to the lagoon, the following procedures should be implemented:

- Notify the Municipal Supervisor and the SAO;
- Notify the public and implement water use restrictions on the community; and
- Consult with regulatory personnel on next steps.

7.3 Spill Contingency Plan

A spill contingency plan has been created for activities associated with Hamlet operations including the sewage lagoon, solid waste facility, and storage and handling of hazardous materials. A copy of the plan may be found in the Hamlet office and the Public Works and Services Maintenance Garage. Hamlet personnel must familiarize themselves with the plan in order to respond quickly and effectively in the event of a spill.

7.4 Fire Response Plan

The Hamlet Fire Department is responsible for creating a contingency plan to deal with fires in the Hamlet. As burning of waste may produce harmful gases, special precautions should be taken when responding to fires in and around the solid waste facility. In the event of an uncontrolled fire in the Hamlet, the following steps should be taken:

- Immediately evacuate the area and go to the Hamlet's meeting place;
- Keep everyone including Hamlet personnel up-wind from the source; and
- Contact the Hamlet Fire Department at (867) 580-2222.

Appendix A

SNP Monitoring Locations

PAULATUK
SEWAGE AND SOLID WASTE SITE ASSESSMENT

SOLID WASTE FACILITY
SURVEILLANCE NETWORK PROGRAM
LOCATIONS

- BUILDING FOOTPRINT
- ROADS
- SOLID WASTE FACILITY
- DRAINAGE PATHS
- SNP LOCATIONS

SCALE 1:12,000

0 0.1 0.2 0.4 km

N W E S

MAP DRAWING INFORMATION:
DATA PROVIDED BY GNWT AND DILLON CONSULTING

MAP CREATED BY: PH
MAP CHECKED BY: MH
MAP PROJECTION: NAD 1983 UTM Zone 10N

DILLON CONSULTING

PROJECT: 176028
STATUS: DRAFT
DATE: 2017-09-06

FILE LOCATION: G:\GIS\176028 Paulatuk Sewage and Solid Waste\mxd\Solid Waste Facility - SNP Monitoring Locations.mxd

Appendix B

Blank SWL – Annual Report Template

Hazardous Waste Site Record

Date	Description of Waste (type of waste, disposed in or removed from site?)	Volume of Waste	Generator (Name of Company Disposing Waste)	Method of Storage (ie. barrel, pallet, etc.)	Location of Waste	Name of Carrier Removing Waste	Copy of Form for Transporation of Dangerous Goods Attached to this Record? (Form should be from persons removing wastes from the site)

Appendix C

Taiga Environmental Lab – Sampling Instructions

Taiga Environmental Laboratory
4601 52nd Avenue – Yellowknife, NT X1A 2R3
Phone: (867) 669-2788 Fax: (867) 669-2718 Email: taiga@gov.nt.ca

Water Sampling Instructions — Collecting the Sample

Step One: Prior to sampling, ensure you have obtained all the sampling equipment you require, such as the proper bottles, filtration devices, *etc.* Refer to the Taiga's Water Sampling Instructions – Ordering Bottles. If there are any questions or concerns, do not hesitate to contact the laboratory. Please have your water license (if applicable) available before contacting the laboratory to ensure proper bottles are ordered. **Note: you may need more than one bottle per sampling site.**

Step Two: Check your local departure flight schedule to Yellowknife for the day you plan to take your samples. Samples should be shipped to the Laboratory **as soon as possible** after collection. Time your sampling so that the samples can be shipped out by plane as soon as possible.

Step Three: Follow the sampling instructions on the back of this sheet for each bottle type. Package bottles in a cooler and send to the laboratory. If your require microbiological tests, such as Total Coliforms, E. coli., Fecal Coliforms, BOD, *etc*., please contact the laboratory with the collection date and time, the Airline name, the waybill number and the expected time of arrival.

Safety Issues: Wear appropriate gloves when collecting any sample to avoid contamination and possible exposure to unhealthy substances. The sample preservatives provided by the Laboratory are corrosive and will cause a burning sensation on the skin. If you should spill any on your skin or clothes, rinse the area **immediately** with lots of cool water. Call a doctor should the burning sensation continue.

Taiga Environmental Laboratory

4601 52nd Avenue – Yellowknife, NT X1A 2R3
Phone: (867) 669-2788 Fax: (867) 669-2718 Email: taiga@gov.nt.ca

Parameter Group		Marking	Preservative	Instructions
	Routine	GREEN	Keep cool at 4°C	1. Rinse bottle three (3) times with sample 2. Fill to top and cap bottle.
	Nutrients	BLACK	Keep cool at 4°C	
	Biochemical Oxygen Demand (BOD)	PURPLE	Keep cool at 4°C	1. Rinse bottle three (3) times with sample 2. Fill to top and cap bottle. 3. Sample must be sent to laboratory within 24 hours
	Microbiological	STERILE	Sodium thiosulphate and Keep cool at 4°C	**1. DO NOT RINSE BOTTLE** 2. Fill to top and cap bottle. 3. Sample must be sent to laboratory within 24 hours
	Total Metals	RED	5mL of 1:3 nitric acid in RED-dot vials	1. Rinse bottle three (3) times with sample 2. Fill to near the top. 3. Add contents of preservative vial 4. Cap bottle and mix.
	Dissolved Metals	RED	5mL of 1:3 nitric acid in RED-dot vials	**1. Filter Sample with 0.45 µm Cellulose Acetate filter** 2. Rinse bottle three (3) times with **filtrate** 3. Fill to near the top. 4. Add contents of preservative vial 5. Cap bottle and mix.
	Hexane Extractable Material (HEM) (also known as Oil and Grease)	YELLOW	4mL 1:1 sulphuric acid in YELLOW-dot vial	**1. DO NOT RINSE BOTTLE** 2. Fill to shoulder of bottle. 3. Add contents of preservative vial 4. Cap bottle and mix
	BTEX, THM & Purgeable Hydrocarbons	40 mL CLEAR GLASS W/ WHITE LID	Keep cool at 4°C	**1. DO NOT RINSE BOTTLE** 2. Fill bottle completely leaving **NO** air bubbles
	Extractable Hydrocarbons	1 L AMBER GLASS W/ WHITE LID	Keep cool at 4°C	**1. DO NOT RINSE BOTTLE** 2. Fill to top and cap bottle.
	Cyanide	BLUE	1mL of 6N sodium hydroxide	1. Rinse bottle three (3) times with sample 2. Fill to near the top. 3. Add contents of preservative vial 4. Cap bottle and mix.
	Thiocyanate	ORANGE	2ml of 25% sulphuric acid	
P	Phenol	YELLOW with P	2mL of 20% sulphuric acid	
S	Sulphide	ORANGE with S	2mL of 25% zinc acetate	
R	Radionuclide	RED with R	25mL of 17.5% nitric acid	
	Chlorophyll A	1L BROWN PLASTIC BOTTLE	Keep cool at 4°C	1. Rinse bottle three (3) times with sample 2. Fill to top and cap bottle. 3. Sample must be sent to laboratory within 24 hours

TAIGA
Environmental Laboratory
Laboratoire Environnemental

Bottle Order Request Form

Date Ordered: 201__	Date Required: 201__	
Name:	Company:	**Project Name or Location**
Address:		
Phone:	Fax:	
Pick Up: ❒ Yes ❒ No	Ship by Air: ❒ Yes ❒ No	Pack as TDG : ❒ Yes ❒ No
Cooler Required: ❒ Yes ❒ No		
Date Filled: 200__	Filled By:	

NOTE: Bottles and preservatives are provided free of charge for analysis carried out at Taiga. Bottles, preservatives and laboratory supplies for other use, may be subject to additional charges. Unused bottles and preservative cannot be returned to the laboratory for reuse.

Parameter Type	**No. of Field Blanks**	**No. of Travel Blanks**	**No. of Bottles for Samples**	**QC Batch # of Bottles Sent**	**Number of Preservatives**	**QC Batch # of Pres. Sent**
Routine (Green)					Not Required	
Nutrients (Black)					Not Required	
Bacti (Sterile sealed)	Not Required	Not Required			Not Required	
BOD (Purple)	Not Required	Not Required			Not Required	
Total Metals (Red)						
Dissolved Metals (Red) *see note 1*						
Arsenic Speciation Bottle	Not Required	Not Required			Not Required	
Cyanide (Blue)						
Thiocyanate (Orange)						
Hexane Extractable Material (Oil & Grease) (Brown glass, wide or narrow-mouth)						
P Phenol (Brown glass, narrow-mouth)						
S Sulphide						
R Radionuclide						
Chlorophyll A	Not Required	Not Required			Not Required	
Extractable Hydrocarbons (Brown glass) *see note 2*					Not Required	
BTEX/Purgeable HC *see notes 2 and 3*					Not Required	
THM (Glass vial 40mL) *see note 3*					Not Required	
Metals or Hydrocarbons in sediment (500mL jar)	Not Required	Not Required			Not Required	
Metals or Hydrocarbons in sediment (250mL jar)	Not Required	Not Required			Not Required	
Metals or Hydrocarbons in sediment (125mL jar)	Not Required	Not Required			Not Required	
Metals or Hydrocarbons in sediment (60mL jar or Whirl Pak Bag)	Not Required	Not Required			Not Required	
Other:						

Other Field Supplies: (e.g. Type I UV^{+} water)

Notes:

1- Dissolved metals bottles will be preserved at the laboratory if the sample is not filtered in the field. The filtering and addition of preservative is $20.00/sample.
2- For TPH requests, both the extractable hydrocarbons (brown glass bottle) and the BTEX/Purgeable HC (40mL vial) have to be submitted.
3- For BTEX/Purgeable HC and THM, please submit two vials for each sample (in the event air bubbles occur in the vials, a back-up sample can be analyzed)

Shaded areas are for laboratory use only.

TAIGA ENVIRONMENTAL LABORATORY
LABORATOIRE ENVIRONNEMENTAL TAIGA
4601 – 52 Avenue, P.O. Box 1320, Yellowknife, NT, X1A 2L9
Tel: (867) 767-9235 • Fax: (867) 920-8740
www.enr.gov.nt.ca

FIELD SHEET

Batch No. : *Lab use only*

Send Results & Invoice to:
(Please notify if results or invoice are to be sent to different locations)

Company/Agency: _____

Address: _____

_____

City/Town: _____ Province/Territory: _____

Postal Code: _____

Phone: _____ Fax: _____

E-mail: _____

Signature : _____

Client Project No: _____

Date collected: _____

Time collected: _____

Sampler: _____

Location: _____

Rush Required: ❑Yes ❑No

Note: *Analysis may be subcontracted without prior notice.*
See reverse for how to complete form and sampling protocols.

Date Received: _____ Received By: _____
Comments:_____
(Laboratory use only)

-WATER SAMPLES –

Sample Type (freshwater, sewage, wastewater, potable , groundwater, salt water, *etc*)			
Client Sample ID (As it should appear on final report)			
Taiga Sample ID (Laboratory use only)			

Bottle Type and Parameter

[√] PLEASE CHECK PARAMETERS REQUESTED BELOW:

Routine	pH, Conductivity, Alkalinity	pH | Cond | Alk	pH | Cond | Alk	pH | Cond | Alk
	Individual Anions Suite ☐	Cl | SO_4 | F | NO_2-N | NO_3-N	Cl | SO_4 | F | NO_2-N | NO_3-N	Cl | SO_4 | F | NO_2-N | NO_3-N
	Total Nitrite (NO_2) + Nitrate (NO_3)	NO_2-N + NO_3-N	NO_2-N + NO_3-N	NO_2-N + NO_3-N
	Individual Cations Suite ☐	Ca | Mg | Na | K	Ca | Mg | Na | K	Ca | Mg | Na | K
	Hardness (Calculated)	Hardness	Hardness	Hardness
	Reactive Silica	SiO_2	SiO_2	SiO_2
	Color	Apparent | True	Apparent | True	Apparent | True
	Laboratory use only	Rec'd: Y N	Rec'd: Y N	Rec'd: Y N
Nutrients	Chlorine: Total, Residual	T. Cl | R. Cl	T. Cl | R. Cl	T. Cl | R. Cl
	Chemical Oxygen Demand	COD	COD	COD
	Turbidity	Turbidity	Turbidity	Turbidity
	Total Suspended Solids, Dissolved Solids	TSS | TDS	TSS | TDS	TSS | TDS
	Ammonia	NH_3-N	NH_3-N	NH_3-N
	Phosphorus: Total, Dissolved, Ortho	TP | DP | OP	TP | DP | OP	TP | DP | OP
	Carbon: Total, Dissolved	TOC | DOC	TOC | DOC	TOC | DOC
	Nitrogen: Total, Dissolved	TN | DN	TN | DN	TN | DN
	Visible Oil and Grease	Visible	Visible	Visible
	Laboratory use only	Received : Y N	Received : Y N	Received : Y N
Sterile	Fecal Coliforms (FC)	FC	FC	FC
	Total Coliforms (TC), E. Coli (EC)	TC | EC	TC | EC	TC | EC
	Fecal Streptococcus (FS)	FS	FS	FS
	Laboratory use only	Received: Y N T: _____°C Sterile container: Y N	Received: Y N T: _____°C Sterile container: Y N	Received: Y N T: _____°C Sterile container: Y N
	Biological Oxygen Demand	BOD	BOD	BOD
	Carbonaceous BOD	CBOD	CBOD	CBOD
	Laboratory use only	Received: Y N T: _____°C	Received: Y N T: _____°C	Received: Y N T: _____°C
Metals	Please indicate if sample is preserved and/or filtered	Pres ☐ | Filt☐ Pres☐	Pres ☐ | Filt☐ Pres☐	Pres ☐ | Filt☐ Pres☐
	ICP-MS(1): Cd, Cr, Cu, Co, Mn, Ni, Pb, Zn, Fe	Total | Dissolved	Total | Dissolved	Total | Dissolved
	ICP-MS(2): 25 element scan includes As (not included: B, Bi, Hg, Sn)	Total | Dissolved	Total | Dissolved	Total | Dissolved
	Individual Metals by ICP-MS (please circle each metal): Ag, Al, As, B, Ba, Be, Bi, Cd, Co, Cr, Cs, Cu, Fe, Hg, Li, Mn, Mo, Ni, Pb, Rb, Sb, Se, Sn, Sr, Ti, Tl, U, V, Zn	Total | Dissolved	Total | Dissolved	Total | Dissolved
	Laboratory use only	TM rec'd: Y N | DM rec'd: Y N	TM rec'd: Y N | DM rec'd: Y N	TM rec'd: Y N | DM rec'd: Y N
	Hexane Extractable Material (O&G)	HEM	HEM	HEM
	Laboratory use only	Rec'd: Y N Pres: Y N	Rec'd: Y N Pres: Y N	Rec'd: Y N Pres: Y N
	BTEX, Purgeable HC (40mL x 2 vials)	BTEX | Purg HC	BTEX | Purg HC	BTEX | Purg HC
	Extractable HC (1L amber glass bottle)	Ext HC	Ext HC	Ext HC
	Trihalomethanes (40 mL x 2 vials)	THM	THM	THM
	Laboratory use only	Vial rec'd: Y N | Ext rec'd: Y N	Vial rec'd: Y N | Ext rec'd: Y N	Vial rec'd: Y N | Ext rec'd: Y N
	Other: *see special request form*			

For safety purposes, please disclose any contaminants (e.g. heavy metals, cyanide, etc.) that may be present at high levels and pose a risk to human health:

References

Department of Indian and Northern Affairs Canada, Water Resources Division & The Northwest Territories Water Board. (1996). *Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "B" Licensees in Collecting Representative Water Samples in the Field and for Submission of a QA/QC Plan*.

Department of Municipal and Community Affairs, Government of the Northwest Territories. (n.d) *Small Wastewater Treatment Systems Operator – Student Manual*. Yellowknife: Municipal and Community Affairs, Government of the Northwest Territories.

Dillon Consulting Limited. (2015). *Hamlet of Fort Liard Sewage Lagoon Capacity Study Final Report.*

Duong, D. and Kent, R. (1996). *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solids Waste Disposal Facilities in the Northwest Territories*. Produced for MACA.

GENEQ Inc. Instruments Scientifiques. (n.d). Photograph. Retrieved August 25, 2017 from http://www.geneq.com/environnement/eau/%C3%A9chantillonnage-205/echantillonneur-de-solides-d%C3%A9cant%C3%A9s-dans-divers-milieux-liquides.html?search=sludge+judge.

IEG Environmental. (2005). *Wastewater Sampling Instructions, Kitikmeot Region*. Produced for Department of Community and Government Services, Government of Nunavut.

Lands Administration, Department of Lands, Government of the Northwest Territories, NWT Centre for Geomatics (2013). Retrieved August 25, 2017 from https://www.maps.geomatics.gov.nt.ca/HTML5Viewer_Prod/index.html?viewer=ATLAS.

National Guide to Sustainable Municipal Infrastructure. (2004). *Optimization of Lagoon Operation*. Issue No. 1.0. Federation of Canadian Municipalities and National Research Council. Retrieved August 25, 2017 from https://fcm.ca/Documents/reports/Infraguide/Optimization_of_Lagoon_Operations_EN.pdf.

NWT Bureau of Statistics (2017). *Paulatuk – Statistical Profile*. Retrieved August 10. 2017 from http://www.statsnwt.ca/community-data/infrastructure/Paulatuk.html.

Westerman, P. W., Shaffer, K. A., and Rice, J. M. (2008). *Sludge Survey Methods for Anaerobic Lagoons*. North Carolina State University, North Carolina Cooperative Extension Service. Retrieved July 19, 2017 from http://www.ncagr.gov/SWC/tech/documents/NCCESSludgeSurveyFormWorksheets.pdf.