Sewage Treatment Facility O&M manual, May 2014
Prepared by: Nuna Burnside Engineering and Environmental Ltd.

Item 1.2 Nunavut Water Board License

Current contents: License NWB3KUG0308
Replace with: License 3BM KUG 1520

Item 1.4 Sewage volumes

Item 3.1 Overview

Current contents: The lagoon will be fenced
Replace with: The lagoon berm is fully fenced with walkway inside the fence on the berm

Item 3.3.1 Existing lagoon

current: The old lagoon has yet to be commissioned
Replace: The old lagoon has been decommissioned

current: the former lagoon will be desludged with the sludge transferred
Replace: the former lagoon was desludged and level gradients towards the wetland

Current: A decommissioning plan has developed…. the topography of the area
Replace: the old sewage facility has been decommissioned. Metal spillway has been removed and berm materials were pushed to infill lagoon area and levelled.

Item 3.3.4 Gas under Synthetic Liner (1st paragraph)

Current: the remaining bubbles will not be removed……Operation of the lagoon
Replace with: remaining bubbles hopefully be removed through a maintenance work later

Item 3.7.2 Monitoring stations

Current: KUG-1 ….. KUG-4A …… WS-4
Replace with:

Station	Description	Comments
KUG-1	Raw Water intake location at Coppermine River	Volume of water intake annually
KUG-2	Solid waste run-off effluent sampling location	sampling June-Sep and as available
KUG-3	Raw sewage deposition from truck off-load	Volume of sewage deposition
KUG-3A	Decanting location from sewage lagoon inside	Sampling when decanting in plan
KUG-4	Effluent outfall from wetland to Coronation Gulf	sampling Jun-Sep as available
KUG-5	Landfill and soil storage run-off towards wetland	Sampling Jun-Sep and as available

Note: surface monitoring stations WS 1 – WS 4 were part of old sewage lagoon effluent quality control, which are no more active since the old sewage lagoon facility was decommissioned.

Item 3.7.3 (list# 4) Monitoring procedures

Current sentence starts:raw sewage samples will be collected…..several loads
Replace with: raw sewage sample collects from location at KUG-3A decanting inlet point

Sewage Treatment Facility
Operation and Maintenance (O&M) Plan
Hamlet of Kugluktuk, Nunavut

Prepared by

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Prepared for

The Department of Community and Government Services
Kitikmeot Region
Government of Nunavut

May 2014

File No: N-O 09755

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1.0 Introduction

1.1 Hamlet Description

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, as shown on Figure 1.

The community has a population of approximately 1,585 (2006), with an approximate 1.5 percent projected growth rate over the 20-year design period. Community infrastructure includes:

- A water treatment plant, which draws water from the Coppermine River and stores it for treatment
- Trucked water to holding tanks in each building
- A sewage lagoon which receives trucked sewage collected from holding tanks in each building
- Sewage treatment was historically via an exfiltration lagoon to a wetland discharging north to the ocean
- A new lagoon and wetland treatment area has been designed
- A Solid Waste Management Facility, which includes a bulky metals disposal area
- A contaminated soil pile, a waste oil and liquid waste storage area, and a battery and other materials storage area next to the lagoon
- Former honey bag pit next to the lagoon
- Several rock and sand quarries
- Diesel powered generators
- Two wind generators (one partially dismantled and the other currently off-line)
- Barge landing area.

The Hamlet of Kugluktuk is predominately residential with a few small commercial establishments including a hotel, several construction and contracting businesses, 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, an elementary school, arena, swimming pool, Hamlet office, public works yard, GN offices, and a police station. A layout of the entire community and infrastructure is displayed on Figure 2.

1.2 Nunavut Water Board License

The Hamlet of Kugluktuk operates their municipal water, sewage, and solid waste facilities under the Nunavut Water Board (NWB) License NWB3KUG0308, dated July 15, 2003 (Appendix B). Part G, Section 1 requires that an Operation and Maintenance

(O&M) Plan be submitted for the facilities in accordance with applicable regulations and guidelines. This document was created to provide staff with O&M procedures for the proposed Sewage Treatment Facility. An amendment to the NWB license is being requested.

The O&M Plan of the Sewage Treatment Facility will be used in conjunction with the normal operating procedures. This document provides a list of tasks and procedures that will assist the Hamlet's operations staff in the O&M of the facility.

This O&M Plan should be updated when the amended NWB license is issued.

1.3 Climate

Kugluktuk is affected by Arctic air masses, and experiences a maritime Arctic climate characterized by short cool summers, and long cold winters. The mean annual air temperature is -12°C. Monthly averages range from -31°C in February to 10°C in July. Kugluktuk receives about 249 mm of precipitation per year, of which 134 mm falls as rain between June and September. Prevailing winds are from the east in the summer and from the southwest in the winter. The mean wind speed is approximately 15 km/hr. Climate details are included in Appendix C. Tracking weather conditions will be important during lagoon discharge in the summer.

1.4 Sewage Volumes

The Detailed Design Report (Nuna Burnside, March 2007) for the Improvements to the Sewage Lagoon and Solid Waste Facilities determined the projected population, associated waste requirements and sewage generation rates using information from the Nunavut Bureau of Statistics. The tables with the detailed calculations are included in Appendix D.

1.5 Health and Safety

Health and safety of workers and the public is the first priority while operating the Sewage Treatment Facility. The requirements of the Nunavut Safety Act must be followed at all times. All actions and operations must be undertaken with safety as the first priority.

Template forms to assist staff in operating the facility, planning and costing the short term and long term use of the facility are included in Appendix E.

1.6 Training

Staff training is an important aspect of the operation of a Sewage Treatment Facility. Staff must be adequately trained to follow this O&M Plan and operate the facility. This O&M Plan is dependent on sufficient site specific training to allow staff to operate the facility.

2.0 Sewage Collection and Delivery

The Hamlet of Kugluktuk provides trucked water and sewage services, as well as regular solid waste pickup for the Community's residents, businesses, and institutions.

The Sewage Treatment Facility operated by the Hamlet of Kugluktuk is located approximately 5 km from the Hamlet (Figure 2). Sewage is collected daily by truck from all the houses and occupied buildings with holding tanks, and discharged to the sewage lagoon located to the west-southwest of the community.

The lagoon is designed to receive municipal sewage only. The discharge of other liquid wastes is prohibited, unless it can be demonstrated that the waste quality will have not deleterious impact on the Sewage Treatment Facility.

The Environmental Guidelines for Industrial Waste Discharge in Nunavut (Government of Nunavut, 2002), provides a Decision Flow Chart for Managing an Industrial Waste Discharge. It also includes schedules of comparative criteria for evaluating the liquid waste.

Liquid wastes meeting the criteria are acceptable for discharge into the sanitary sewer system (Sewage Treatment Facility). Liquid wastes that do not meet the criteria must be pre-treated until they do, or be stored in the Hazardous Waste Storage Area for future disposal at a licensed facility located outside of the community.

3.0 Operation and Maintenance of the Sewage Treatment Facility

3.1 Overview

The Hamlet of Kugluktuk Sewage Treatment Facility consists of two main components:

- Lagoon
- Wetland Treatment System.

The facility operates by holding sewage collected from the community and trucked to the lagoon for approximately one year prior to discharge to a wetland treatment area. The discharged effluent migrates along an approximate 1.5 km wetland pathway to the ocean at Coronation Gulf (Figure 4).

Monitoring points are located at the discharge point from the lagoon, and at selected locations down stream including the final discharge point prior to entering the ocean.

The lagoon is sized to contain the annual volume of sewage in year 20 of the design life. The wetland treatment system is designed to gradually become a more biologically rich area, to provide natural biological attenuation processes as the discharge volume increases year by year (Figure 4).

The lagoon will be fenced and the wetland treatment area identified with signs to alert overland travellers. The wetland treatment area is not commonly travelled.

3.2 Sewage Collection Procedures

The following sewage collection operational procedures shall be carried out by the staff of the Hamlet of Kugluktuk on a daily basis dependent upon weather conditions:

- Household and commercial sewage holding tanks will be pumped out using a vacuum truck and hauled to the Sewage Treatment Facility

- Sewage from the vacuum truck will be discharged to the Sewage Lagoon, via a pair of flumes designed to prevent erosion of the lagoon wall

- Daily waste volumes deposited to the Sewage Lagoon (and trip counts) shall be recorded on the recording form attached in Appendix D

- In the event of an accident, a spill of sewage or petroleum products or a fire during sewage collection operations, the *Environmental Emergency Contingency Plan, Hamlet of Kugluktuk* shall be implemented (separate document).

3.3 Sewage Treatment Facility Design

3.3.1 Existing Lagoon

The existing sewage lagoon (Figure 3) is no longer in operation, and has been replaced by the new Sewage Treatment Facility which was commissioned in 2008. The old lagoon has yet to be decommissioned.

The former lagoon will be desludged with the sludge transferred to the Solid Waste Disposal Facility for initial treatment in the landfarm followed by use as interim cover.

A decommissioning plan has been developed but is yet to be completed. The metal spillways (flumes) will be re-used or transferred to the Bulky Metals Area. Once this is completed the lagoon berm will be pushed over to infill the lagoon and maintain the topography of the area.

3.3.2 New Sewage Treatment Facility

The as-builts drawing of the new facility are found in Appendix A.

Trucks will discharge sewage onto discharge flumes. The lagoon will gradually fill throughout the year until mid-June of each year, when climatic conditions (Appendix C) are suitable for discharge. Liquid discharge is through a diesel-driven portable pump. The effluent intake hose shall be placed a minimum of 0.5 m above the bottom of the lagoon to avoid uptake of sludge into the discharge system.

Discharge should begin when the wetland is sufficiently recovered from winter and becomes biologically active (that is, when the vegetation has become green). The 300 mm diameter portable discharge line should be extended 300 m by the automatic reel, and connected to the effluent outfall pipe. The effluent outfall pipe is a perforated 300 mm diameter 90 m long high-density polyethylene pipe which allows gradual seepage of the effluent to the wetland area. The effluent outfall pipe sits on 300 mm of granular material See Figure CNN-3 and CNN-4 (Appendix A) for location of effluent outfall pipe and portable hose discharge line.

The wetland treatment area provides biological treatment of the effluent. A meandering hydraulic path is created by the wetland to slow the flow of effluent to the Ocean.

The lagoon is designed for an operational capacity of approximately 126,000 m^3 in year 20 of operation. Approximately 60 to 90 days (depending on pump discharge flow and operational time) are required to empty the lagoon when filled to capacity. See Appendix G for estimated time to empty lagoon volume based on sewage pump discharge flow.

This must be accomplished during the 120 day discharge window between mid-June and mid-October when conditions are optimum.

The lagoon will be desludged when the sludge level reaches approximately 0.3 m thick, which is estimated to occur in 5 to 10 years. Over the 20 year design life, desludging would be needed on two or three occasions.

The following procedures will be followed for decanting:

- Inform the NWB a minimum of 10 days prior to the planned discharge period
- Approximate mid-June – evaluate ice and wetland treatment area conditions
- Once favourable conditions have been achieved, the portable pump and intake and discharge lines should be set up and effluent pumping should begin
- Discharge will flow through the portable sewage pump and 300 mm discharge line into the effluent outlet diffuser pipe. It will then seep into the wetland treatment area through the perforations in the effluent outlet pipe. The wetland treatment area is designed to slow and spread the flow over a wide area and through multiple channels, to maximize flow paths and minimize flow depths
- Monitor the discharge and wetland treatment area for water quality parameters
- Keep pumping the effluent until water depths have reached approximately 600 mm. Discontinue pumping prior to freeze up and prior to the wetland treatment area becoming biologically inactive.

During the discharge period reduce the discharge rate or stop the discharge during high volume storm events that could cause flooding of the wetland treatment area and overland flow. Re-start discharge when water levels return to normal.

The lagoon has been sufficiently sized, so it is unlikely that there will be "flow through" of raw sewage from one end of the lagoon to the other during the discharge period. Monitoring of the Sewage Treatment Facility and reporting will meet NWB license requirements.

The facility is designed for a minimum of 20 years of operation based on population growth projections. Maintenance, including de-sludging is scheduled when sludge thickness reaches 0.3 m throughout the 20 year period. When de-sludging is required, effluent levels must be reduced to the sludge line in order to allow removal and treatment of sludge.

3.3.3 Monitoring of Interior Berm Temperatures

Thermistor strings were installed in four locations in the sewage lagoon dyke to measure the temperature of the interior of the dykes and to monitor the permafrost regime in the dyke structure. See Figure 1.0 in Appendix A. The thermistor string is able to sense the ground temperature at one meter intervals for the full depth of the dyke. The multi-meter provides measurements in ohms, which is then converted to a temperature value based on a conversion chart.

Monitoring of permafrost in the berms should be down in the middle of winter and the middle of summer. The expectation is that the permafrost will move up into the dykes over time, and there will be some thawing of the permafrost under the lagoon because of heat from the warm sewage. Based on records from the thermistors, the permafrost has moved into the dyke bottoms. Continued measurements of dyke temperatures are recommended. See Appendix G for the berm temperature recording form.

3.3.4 Gas Under Synthetic Liner

Gases bubbling under the liner from the melting of the permafrost have caused the liner to bubble up in several locations. The liner of the lagoon was torn prior to its full operation, causing water to seep under the liner. Along with the thawing out of the permafrost, the leaks have created wet conditions under the liner, which make piping off gases difficult. Through the installation of a suction line as an underliner drain, some air bubbles have been removed from the underside of the liner. The remaining bubbles will not be removed as they do not impede the proper operation of the lagoon.

The underliner drain that was installed consists of a 75 mm suction line placed inside a carrier pipe. Along the interior downslope of the dyke, the pipes were covered with a 60 mm HDPE liner which was welded to the existing lagoon liner, to protect the system from ice damage. The suction line was inserted under the liner by cutting a hole in the existing liner and providing stone bedding. The portable pump used for lagoon discharge should be attached to the suction line, and the liquid under the liner should be discharged to the lagoon. See Figure 2.0 and 3.0 for the suction drain line detail.

3.4 Sewage Lagoon Operational Procedures

The following operational procedures shall be carried out by the Hamlet of Kugluktuk, during lagoon decant operations:

- The Hamlet of Kugluktuk shall advise an Inspector and the Nunavut Water Board at least 10 days prior to starting the decant operations of the sewage lagoon
- Household and commercial sewage deposited to the Sewage Lagoon shall be pumped to the wetland treatment system via the portable discharge line and effluent outlet pipe
- Effluent discharging shall occur between mid June and mid October, dependant on weather conditions
- During effluent pumping, the portable pump and all discharge piping shall be inspected daily for defects or blockages, and repaired immediately as necessary
- During pumping operations, effluent quality monitoring shall be undertaken in accordance with the terms and conditions outlined in the NWB water license, or at the direction of an Inspector as defined in the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*
- Upon completion of pumping operations, the pump shall be shut off and the portable discharge lines shall be collected using the automatic reel. The lagoon berms shall be inspected, and any required maintenance performed
- Monitoring and inspections will occur as outlined in the NWB license and described in this O&M Plan.

3.5 Periodic and Seasonal Maintenance Procedures

The following procedures shall be undertaken by the staff of the Hamlet of Kugluktuk during periodic and seasonal maintenance operations at the Sewage Treatment Facility:

- The roadway and truck pad shall be maintained by snow clearing in the winter and surface grading in the summer, with any defects repaired as necessary
- Berms and fences shall be inspected monthly
- Ditches and drainage channels shall being inspected for erosion (once per month) during the summer, and repaired as necessary

- Site warning signage, which identifies the boundaries of the Sewage Treatment Facility (i.e. Sewage Lagoon and the Wetland Treatment Area) shall be inspected monthly, and repaired or replaced as necessary

- The discharge flume/spillways to the Sewage Lagoon shall be inspected for damage or displacement monthly, and repaired as necessary. The vehicle stop bollards located between the truck pad and the discharge spillway are particularly important

- Any airborne litter shall be removed from the Sewage Treatment Facility to the Hamlet landfill in the Spring and Autumn, or as required

- Any places where the liner is exposed will be examined after pumping operations

- The Sewage Lagoon shall be inspected following pumping operations, to determine the thickness of sludge which has accumulated in the lagoon since the previous inspection

- Desludging of the lagoons shall occur as required, based on the sludge thickness in the lagoon.

Forms to assist site staff in conducting the inspections and data recording are included in Appendix E.

The activities described above shall be completed by the staff of the Hamlet and details of any repairs shall be reported in the Annual Report submitted to the Nunavut Water Board, in compliance with the Hamlet's Water License.

3.6 Wetland Treatment Area

The wetland treatment area is an integral part of the Sewage Treatment Facility. It consist of a meandering stream and wetland pathway, that reaches across the raised beach tundra a distance of approximately 1.5 km between the lagoon and Coronation Gulf (Figure 3). Monitoring of the existing wetland down stream of the existing lagoon has demonstrated that, even with raw sewage discharge in 2005, the wetland was providing adequate treatment such that the NWB license requirements were being met before discharging into Coronation Gulf. The wetland treatment area for the new Sewage Treatment Facility is designed to increase in capacity for treatment slowly as the volume of discharge increases year to year. Continuous monitoring will allow ample warning if maintenance efforts such as diverting some of the flow into adjacent drainage systems is required.

As shown on Figure 4, there are several small drainage systems that could be used to expand the wetland treatment area if required.

The proposed system operates as follows:

- Discharge of clarified sewage from the lagoon (retained from October to June)
- Discharge from the lagoon when climate and vegetation conditions are optimized
- Controlled discharge with monitoring
- Additional areas are available to further expand the flow path (Figure 4), if required
- Monthly monitoring at four sampling stations in the wetland treatment area to closely monitor impacts (Figure 3)
- Monthly collection descriptive data and measurements during discharge (refer to the Monitoring Plan and QA/QC Plan)
- Signs to alert the public and identify sample locations

Wetland treatment area maintenance, if required, would consist of the following:

- Enhancement of ditches to alter or lengthen flow paths
- Construction of exfiltration berms to slow the flow and lengthen the flow path
- Diversion of a portion of the flow into adjacent small drainage systems to expand the wetland treatment area.

The operation of the wetland treatment area is based on continued close monitoring at the four stations along the length of the flow path. This will provide ample forewarning of a potential problem such that maintenance measures can be implemented.

3.7 Sewage Treatment Facility Monitoring Program

3.7.1 Water License Requirements

As outlined in the NWB water license, regular monitoring of the effluent from the Sewage Treatment Facility is required. The Monitoring Program is to include effluent samples collected at various places including the Final Discharge Point of the Wetland Treatment System, during the months of June to October, inclusive. Effluent samples collected shall be analyzed for the following parameters:

- Biological Oxygen Demand (BOD)
- Total Suspended Solids (TSS)
- Conductivity
- Oil and Grease (OGG) (Visual)
- Magnesium (Mg)
- Sodium (Na)
- Chloride (C1)
- Total Hardness
- Ammonia as Nitrogen (NH_3-N)
- Total Cadmium (Cd)
- Total Cobalt (Co)
- Total Chromium (Cr)
- Total Copper (Cu)
- Total Aluminium (Al)
- Total Mercury (Hg)
- Faecal Coliforms (FC)
- pH
- Nitrate and Nitrite as Nitrogen (NO_3-NO_2)
- Total Phenols (Total-P)
- Calcium (Ca)
- Potassium (K)
- Sulphate (SO_4)
- Total Alkalinity
- Total Zinc (Zn)
- Total Iron (Fe)
- Total Manganese (Mn)
- Total Nickel (Ni)
- Total Lead (Pb)
- Total Arsenic (As)
- Total Organic Carbon (TOC)

Additional analytical parameters, which could become a requirement of the NWB water license or be requested by an Inspector as defined in the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*. Other parameters can be added as needed.

Sampling completed by the Hamlet of Kugluktuk shall be in accordance with the Hamlet of Kugluktuk Monitoring Program and Quality Assurance/Quality Control (QA/QC) Plan, which has been prepared as a separate document.

A monitoring station will be established at the point where raw wastewater is off-loaded by the sewage trucks. Monthly and annual quantities of raw wastewater offloaded will be measured and recorded in the official operations logbook on a form similar to that presented in Appendix D.

3.7.2 Monitoring Locations

Monitoring stations are displayed on Figures 3 and 4. Monitoring stations from water quality parameters for the existing lagoon will continue to be used. The following is a description of each monitoring location as outlined in the requested amendment to the NWB license:

Kug-1	Raw water supply (not part of the Sewage Treatment Facility)
Kug-2	Existing downstream sampling point for the existing lagoon (will be replaced once new system is operational)
Kug-2A	Proposed discharge sampling point from the landfill retention period (not part of the Sewage Treatment Facility)
Kug-3	Previous raw sewage sampling point
Kug-3A	Raw sewage discharge sampling station for the new lagoon
Kug-4	Previous lagoon discharge sampling point
Kug-4A	Lagoon discharge sampling point for the new lagoon
WS-1	Surface water monitoring station in the wetland treatment area. Upper portion of wetland immediately downstream from lagoon
WS-2	Surface water monitoring station in wetland treatment area
WS-3	Surface water monitoring station in the downstream portion of the wetland treatment area
WS-4	Final Effluent Discharge Point from the Sewage Treatment Facility at the point of discharge from the wetland treatment area not Coronation Gulf. This is the point at which the facility must meet the establish effluent quality criteria for discharge.

Signs will be erected to mark each location and alert the public.

3.7.3 Monitoring Procedures

General monitoring procedures are as follows:

- Sludge measurement – sludge measurements will be taken with a "sludge judge", which is an approximate 2 cm clear tube, which is pushed into the sludge and withdrawn and measured. Sampling will take place at the discharge pipe concrete retaining wall

- Water levels – water levels will be measured from a fixed point on the concrete training wall

- Lagoon discharge samples will be collected from the small pond that will form downstream of the effluent outlet pipe

- Raw sewage samples will be collected from the base of the input flume, after several consecutive loads have been dumped to obtain a representative sample of several loads. Samples will collected using a pole with bottle clamp

- All other samples will be collected from designated surface water sampling stations. Refer to the Monitoring Plan and QA/QC Plan document for sample collection and handling details.

3.7.4 Monitoring Results

Results of analytical testing and monitoring are to be recorded on a regular basis by the Hamlet's operation staff. Copies of the analytical certificates and Chain of Custody forms are to be kept for future reference to determine the effectiveness of the treatment facility. The monitoring results will be included in the Annual Monitoring Report.

3.7.5 Abandonment and Restoration

Part G of the Water License (Appendix B), requires the submission of Abandonment and Restoration Plan at least six months prior to abandoning any facilities and construction of new facilities to replace existing ones. This Detailed Design Report provides the required information for the exiting facilities.

The Sewage Treatment Facility consisting of the lagoon and Wetland Treatment Area, has been designed to meet the required 20 design period. It is expected that it could continue to operate for a significant period of time beyond 20 years. Desludging on a regular basis would extend its life as it approaches year 20. Once sewage volume exceeds the capacity of the lagoon, the lagoon can be expanded or an additional lagoon constructed. As shown in Figures 2 and 4, there is a large area to the northwest where a

new lagoon could be located. In addition, there is significant land area consisting of small drainage streams among raised beaches, which could be further developed to increase the size of the wetland treatment area.

The Sewage Treatment Facility O&M Plan provides details for site staff. The O&M Plan includes a short term and long term planning process, which would prompt the Hamlet to prepare for expansion and closure as the facility reaches the later years of its design life.

4.0 Emergency Response and Contingencies

In the event of an emergency, guidance regarding containment and site emergency response can be obtained from the following sources (Table 1):

Table 1: Emergency Contacts

Contact	Location	Telephone Number	Fax Number
AANDC – Water/Wastewater Resources Manager	Iqaluit	(867) 975-4550	(867) 979-6445
Hamlet of Kugluktuk – SAO	Kugluktuk	(867) 982-6500	(867) 982-3060
Government of Nunavut (Regional Engineer)	Cambridge Bay	(867) 983-4125	(867) 983-4123
Environment Canada – Inspector	Iqaluit	(867) 975-4644	(867) 975-4594
Fire Department	Kugluktuk	(867) 982-2222	(867) 982-3407
RCMP Detachment	Kugluktuk	(867) 982-1111	(867) 982-3390
Community Health Center	Kugluktuk	(867) 982-4531	(867) 982-3115

Contingency plans are designed to provide site staff with direction and options when there is an unexpected event or accident.

The Environmental Emergency Contingency Plan, Hamlet of Kugluktuk (prepared as a separate document) provides procedures and direction in the case of a spill or accident.

As outlined in the Contingency Plan, the health and safety of workers and the public are the first priority.

5.0 Reporting

The Nunavut Water Board License on Part B: General Conditions include the requirement to file an Annual Report with the NWB no later than March 31st of the next calendar year. The report shall include:

- Tabular summaries of all data generated under the "Monitoring Program"
- The monthly and annual quantities in cubic metres of freshwater obtained from all sources
- The monthly and annual quantities in cubic metres of each and all waste discharged
- A summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures
- A list of unauthorized discharges and summary of follow-up action taken
- A summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year
- A summary of any studies, reports and plans (i.e. Operation and Maintenance, Abandonment and Restoration, QA/QC) requested by the Board that relate to waste disposal, water use or reclamation, and a brief description of any future studies planned
- Any other details on water use or waste disposal requested by the Board by November 1st of the reporting year.

The format of the NWB Annual Report is included in Appendix D.

The creation of the report can be greatly simplified by staff regularly filling in and filing the Site Forms included in Appendix D. The forms include:

- Form 1 – Monthly Sewage Delivery Log – describing the day to day delivery of sewage and site activities
- Form 2 – Monthly Sewage Treatment Facility Inspection Form – to document the inspection and observation of the site operations and infrastructure
- Form 3 – Effluent Discharge Log – to document the decanting of the lagoon during the 120 day discharge period

- Form 4 – Sewage Treatment Facility Planning Form – which provides a list of items to be discussed by the site foreman and Hamlet Council related to short term and long term sewage handling and treatment decision making.

In addition to these forms, there would be sampling information and analytical data collected. The Monitoring Plan and QA/QC Plan (prepared as a separate document) outlines sample collection and analytical data handling protocols. Using the forms and following the procedures provided herein should make submitting the annual monitoring report relatively straight forward.

6.0 Summary

This Operation and Maintenance Plan (O&M) has been prepared based on the proposed new design for the Sewage Treatment Facility.

A Sewage Treatment Planning Form has been included in Appendix D, to assist the Hamlet in tracking and evaluating the various aspects of the Sewage Lagoon Treatment Facility including costs and long term planning.

Appropriate training for site staff is necessary as part of the implementation of this O&M Plan. This document should be reviewed and updated annually, and whenever the NWB Water License is amended or new relevant legislation is issued.

7.0 References

Department of Municipal and Community Affairs, Government of Northwest Territories, October 1996. *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories.* Queen's Printer: Yellowknife, Northwest Territories.

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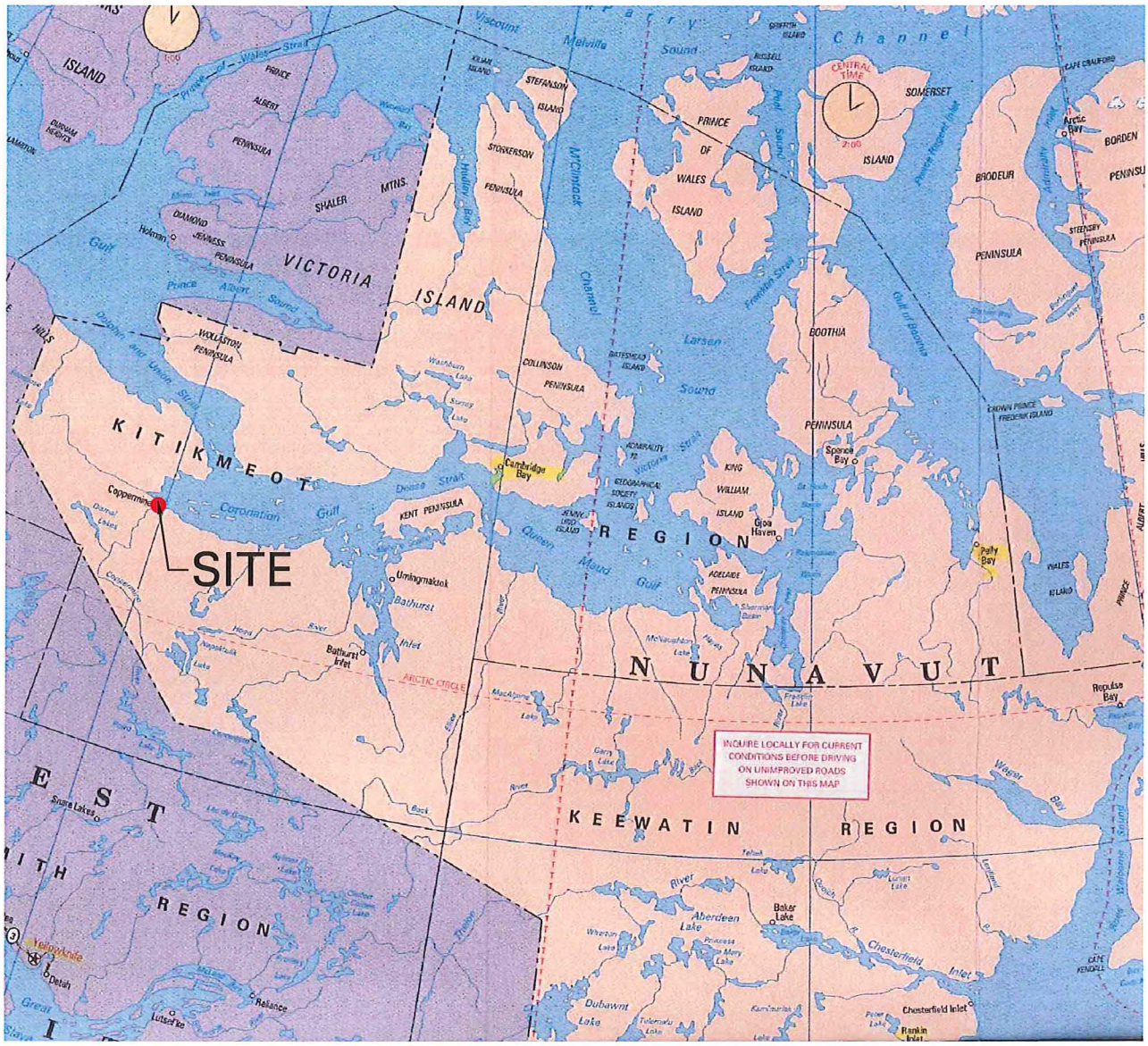
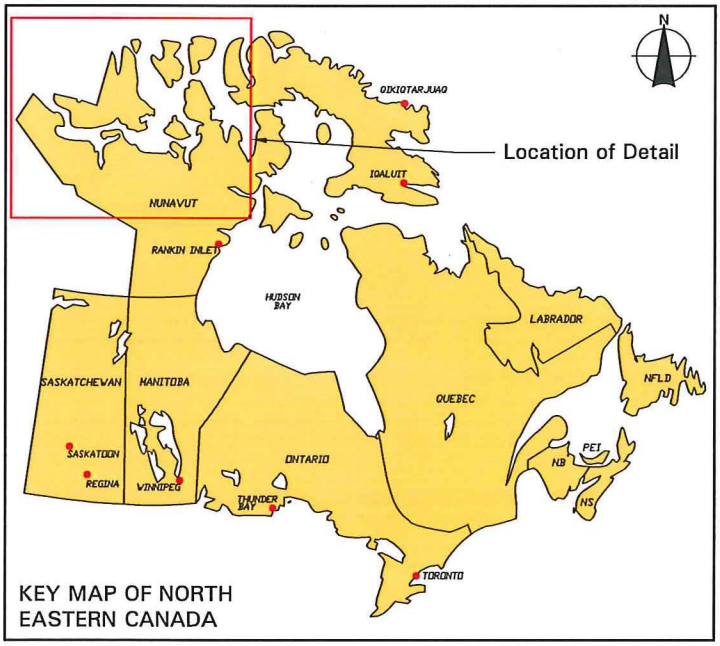
Figures



Map Reference:
Map of Canada
Published by the CAA



KEY MAP OF NORTH EASTERN CANADA

FIGURE 1 - SITE LOCATION

THE HAMLET OF KUGLUKTUK, NUNAVUT

SEWAGE TREATMENT FACILITY OPERATION AND MAINTENANCE (O&M) PLAN - MARCH 2007

March 2007
Project Number: FE009754

Prepared by: J. Amsen

Verified by: J. Walls

BURNSIDE

FE009754 O&M SL MARCH 2007 SL.DWG

FIGURE 2

HAMLET OF KUGLUKTUK
SEWAGE TREATMENT FACILITY OPERATION & MAINTENANCE (O&M) PLAN - MARCH 2007

KEY FEATURES OF COMMUNITY

Image Platform: Quick Bird (Satellite)
Image Acquisition: 01 July, 2002
Spatial Resolution: 0.6m

N

0 200 400 600 800 1000 1200 1400 1600
Meters

1:20,000
March 2007
Project Number: FE009754

Projection: UTM Zone 16
Datum: NAD83

Prepared by: J. Amsen

Verified by: J. Walls

NUNA BURNSIDE

FE009754 O&M SL MARCH 2007 COMMUNITY PLAN.dwg

FIGURE 3

HAMLET OF KUGLUKTUK
SEWAGE TREATMENT FACILITY OPERATION & MAINTENANCE (O&M) PLAN - MARCH 2007

SAMPLE LOCATIONS LAGOON AND SOLID WASTE DISPOSAL FACILITY (LANDFILL)

Legend

- KUG–2 — SURFACE WATER SAMPLING LOCATION (To be replaced once new facilities are in place)
- WS–2 — WETLAND WATER SAMPLING LOCATION
- KUG–2A — PROPOSED SURFACE WATER SAMPLING LOCATION (For new facilities)
- OUTLINE OF WETLAND TREATMENT AREA (10 ha)
- OUTLINE OF EXPANDED WETLAND TREATMENT AREA (5.1 ha)
- OUTLINE OF POTENTIAL FUTURE WETLAND TREATMENT AREA (If required) (30 ha)

Image Platform: Quick Bird (Satellite)
Image Aquisition: 01 July, 2002
Spatial Resolution: 0.6m

N

0 20 40 60 80 100 120 140 160 180 200 220 240
Meters

1:3,000
March 2007
Project Number: FEO09754

Projection: UTM Zone 16
Datum: NAD83

Prepared by: C. Reynolds

Verified by: J. Walls

BURNSIDE

FEO09754 O&M SL MARCH 2007 REGIONAL PLAN.dwg

FIGURE 4

HAMLET OF KUGLUKTUK
SEWAGE TREATMENT FACILITY OPERATION & MAINTENANCE (O&M) PLAN - MARCH 2007

SAMPLE LOCATIONS

Legend

- KUG-2 — SURFACE WATER SAMPLING LOCATION (To be replaced once new facilities are in place)
- WS-2 — WETLAND WATER SAMPLING LOCATION
- KUG-2A — PROPOSED SURFACE WATER SAMPLING LOCATION (For new facilities)
- 50m — EXISTING CONTOURS (m amsl) obtained from National Topographic Survey Digital Data, Contour interval 10m
- OUTLINE OF WETLAND TREATMENT AREA (10 ha)
- OUTLINE OF EXPANDED WETLAND TREATMENT AREA (5.1 ha)
- OUTLINE OF POTENTIAL FUTURE WETLAND TREATMENT AREA (If required) (30 ha)

Image Platform: Quick Bird (Satellite)
Image Aquisition: 01 July, 2002
Spatial Resolution: 0.6m

N

0 100 200 300 400 500 600
Meters

1:7,500
March 2007
Project Number: FEO09754

Projection: UTM Zone 17
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

NUNA BURNSIDE

Revision #: 1

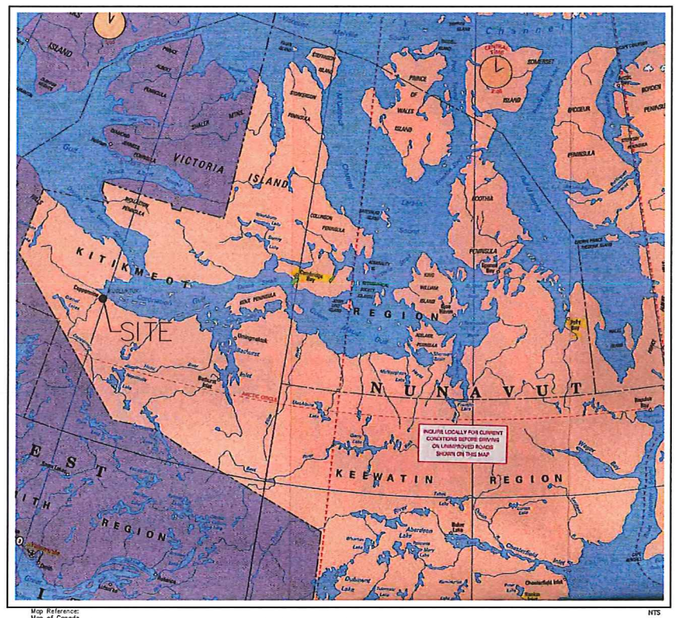
FEO09754 O&M SL MARCH 2007 SAMPLES.DWG

BURNSIDE

Appendix A
As-Built Drawings

PROPOSED SEWAGE LAGOON AND SOLID WASTE FACILITY UPGRADES HAMLET OF KUGLUKTUK, NUNAVUT

GOVERNMENT OF NUNAVUT
COMMUNITY AND GOVERNMENT SERVICES
P.O. BAG 200, CAMBRIDGE BAY, NUNAVUT X0B 0C0



Map Reference:
Map of Canada
Published by the CAA

NTS

KEY MAP

DRAWING INDEX

RECORD DRAWING

ORIGINAL SIGNED BY G.J. POPOWICH, P. Eng.

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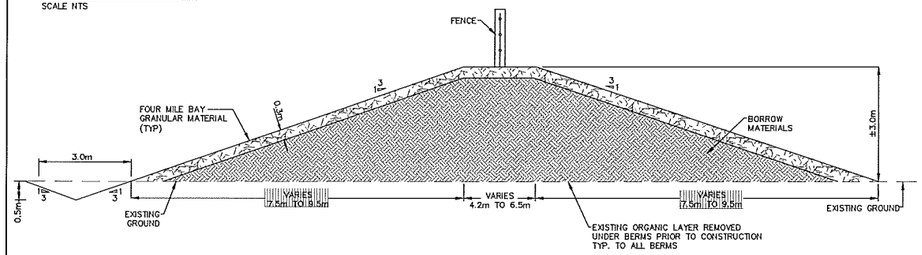
15 Townline, Orangeville, Ontario
telephone (519) 941-0342 **fax** (519) 941-8120
email info@nunaburnside.com
web www.nunaburnside.com

GN PROJECT NO. 04-4406

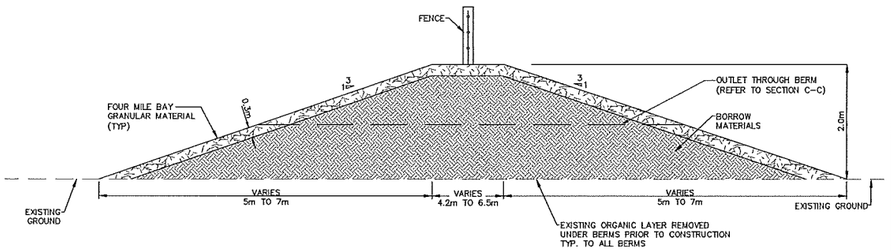
X:\Office\Files 2005(E)\N-O 09755 Kugluktuk Sewage & Solid Waste\700 Drawings\Record Drawings\FE009754 COVER PAGE AND INDEX SHEET.dwg
May 06, 2014 - 11:06am

LANDFILL PERIMETER BERM CROSS SECTION A–A
SCALE NTS

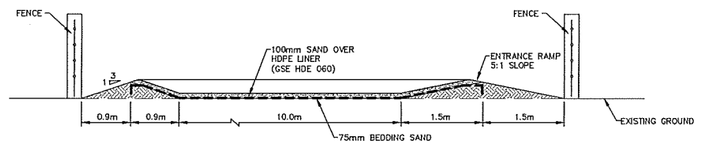
NOTE: FOUR MILE BAY GRANULAR MATERIAL PLACED OVER INTERIOR & EXTERIOR SLOPE OF PERIMETER BERM



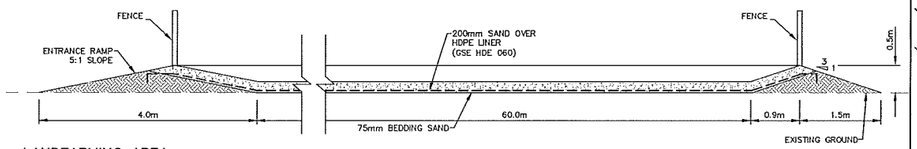
WATER RETENTION AREA CROSS SECTION B–B
SCALE NTS



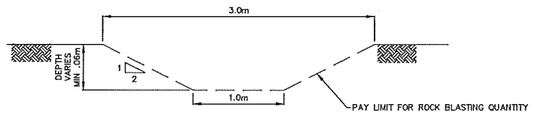
HAZARDOUS WASTE STORAGE AREA CROSS SECTION D–D
SCALE NTS



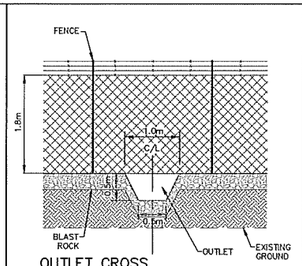
LANDFARMING AREA CROSS SECTION E–E
SCALE NTS

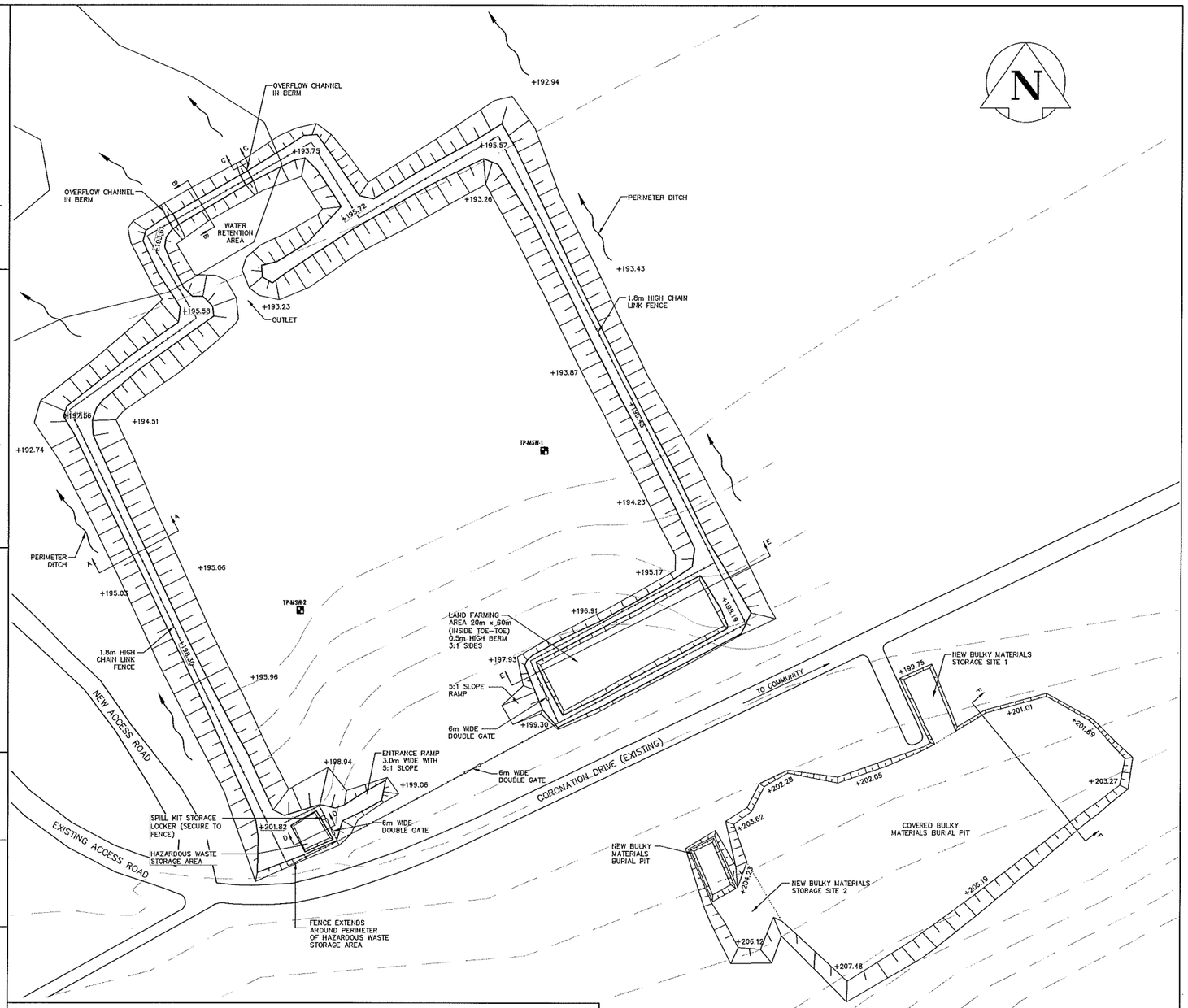


TYPICAL PERIMETER DITCH DETAIL
SCALE NTS

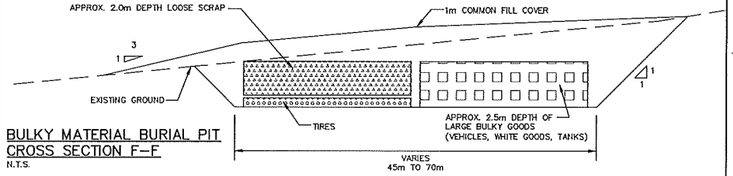


OUTLET CROSS SECTION C–C
SCALE 1:50





BULKY MATERIAL BURIAL PIT CROSS SECTION F–F
N.T.S.



SOLID WASTE DISPOSAL SITE PLAN
SCALE 1:750

NOTES:

1. ALL AREAS DISTURBED BY CONTRACTOR DURING CONSTRUCTION ACTIVITIES SHALL BE REINSTATED TO ORIGINAL CONDITION OR BETTER, BY THE CONTRACTOR.
2. CONTRACTOR SHALL LOAD, HAUL AND PLACE AS SHOWN EXISTING TIRES, BULKY GOODS AND LOOSE SCRAP FROM EXISTING STORAGE AREA TO BULKY MATERIALS BURIAL PIT.
3. TOPOGRAPHIC CONTOURS SHOWN ARE APPROXIMATE AND ARE DERIVED FROM REGIONAL TOPOGRAPHIC MAPS.

No.	Issue / Revision	Date
1	Client Review and Approval	April 10, 2006
2	Client Review and Approval	June 26, 2006
3	Issued for tender	July 17, 2006
4	General Revisions – Client Review and Approval	March 21, 2007
5	Issued for Construction	May 2, 2007
6	Record Drawing	November 18, 2008

RECORD DRAWING

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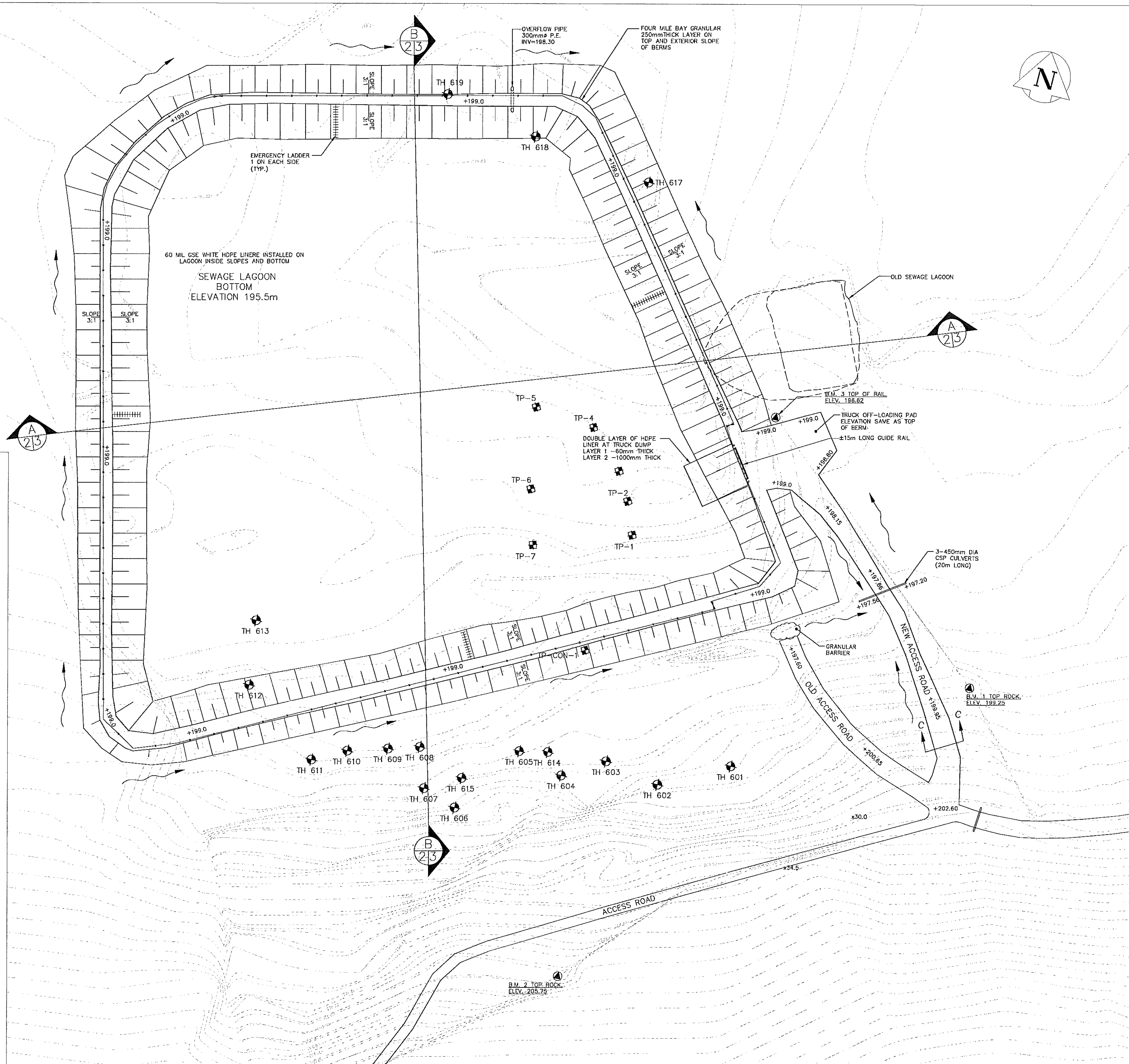
DEPARTMENT OF COMMUNITY AND GOVERNMENT SERVICES (CGS)
KITIKMEOT REGION
P.O. BAG 200
CAMBRIDGE BAY, NUNAVUT
X0B 0C0

Drawing Title
THE HAMLET OF KUGLUKTUK

SOLID WASTE DISPOSAL FACILITY IMPROVEMENTS

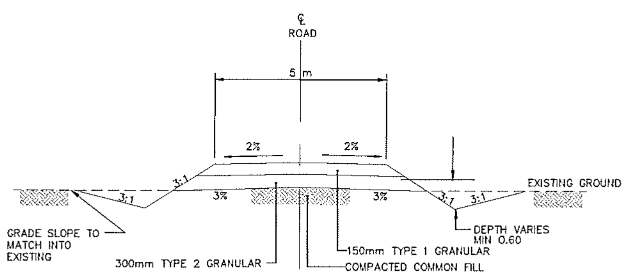
Drawn By	Checked By	Drawing
T.T.	K. Hunter	1
Scale: AS SHOWN	Nuna Burnside Project No.: N–0 09755.0	
GN Project No.: 04–4406		

X:\Office\Files 2005\E\N-0 09755 Kugluktuk Sewage & Solid Waste\700 Drawings\Record Drawings\N-09755-G1-may 8.dwg



BENCHMARK COORDINATE TABLE		
BENCHMARK	NORTHING	EASTING
B.M. 1	5039.54	5047.52
B.M. 2	4889.69	4917.33
B.M. 3	5124.14	4946.78

LAGOON COORDINATE TABLE				
CORNER	INSIDE TOE		INSIDE TOP	
	NORTHING	EASTING	NORTHING	EASTING
NE	5204.42	4859.06	5217.94	4863.70
NW	5159.65	4679.19	5168.40	4664.65
SE	5073.24	4962.16	5069.35	4980.49
SW	4951.31	4731.04	4933.56	4723.08



ACCESS ROAD CROSS SECTION C–C

N.T.S.

LEGEND		
EXISTING	FEATURE	
+89.00	ELEVATION	
	BENCHMARK	
	DITCH FLOW DIRECTION	
	FENCE	
	CULVERT	
	TEST HOLE	
	GROUND CONTOURS	

1. This drawing is the exclusive property of R. J. Burnside & Associates Limited and the reproduction of any part without prior written consent of this office is strictly prohibited.

2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.

3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

4. Do not scale the drawings.

No.	Issue / Revision	Date
1	Client Review	Jan 01, 2000
2	Client Review and Approval	June 26, 2006
3	Issued for tender	July 17, 2006
4	Client Review and Approval	March 21, 2007
5	Issued for Construction	May 2, 2007
6	Record Drawing	November 18, 2008

RECORD DRAWING

ORIGINAL SIGNED BY G.J. POPOWICH, P. Eng.

Nunavut

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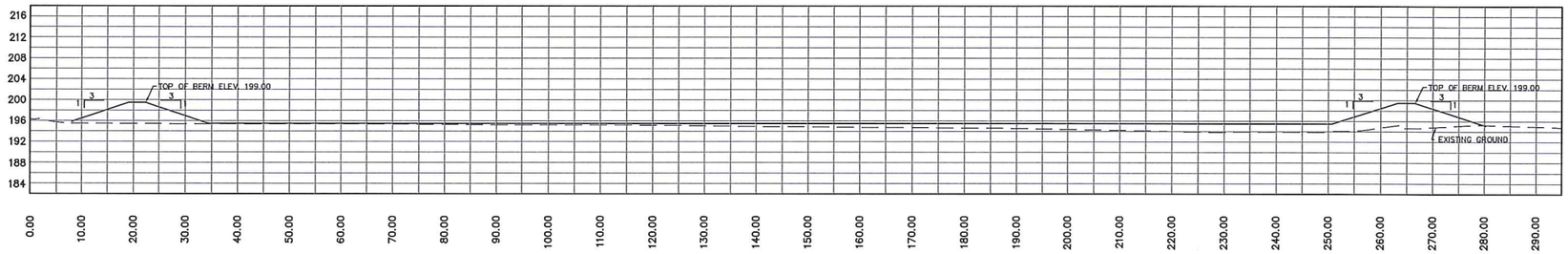
DEPARTMENT OF COMMUNITY AND GOVERNMENT SERVICES (CGS)
KITIKMEOT REGION
P.O. BAG 200
CAMBRIDGE BAY, NUNAVUT
XOB 0C0

Drawing Title

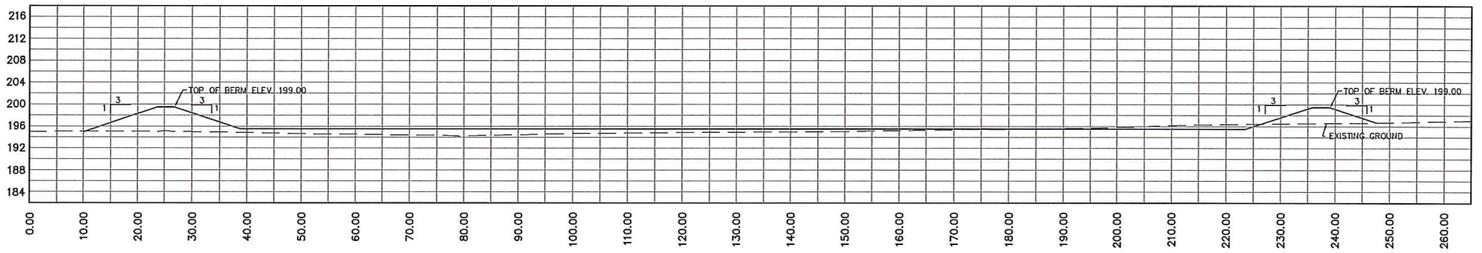
THE HAMLET OF KUGLUKTUK SEWAGE LAGOON PLAN

Drawn By	Checked By	Drawing No.
J. McREDMOND	G. POPOWICH	2
Scale: 1:750	Project No.: N-O 09755.0	

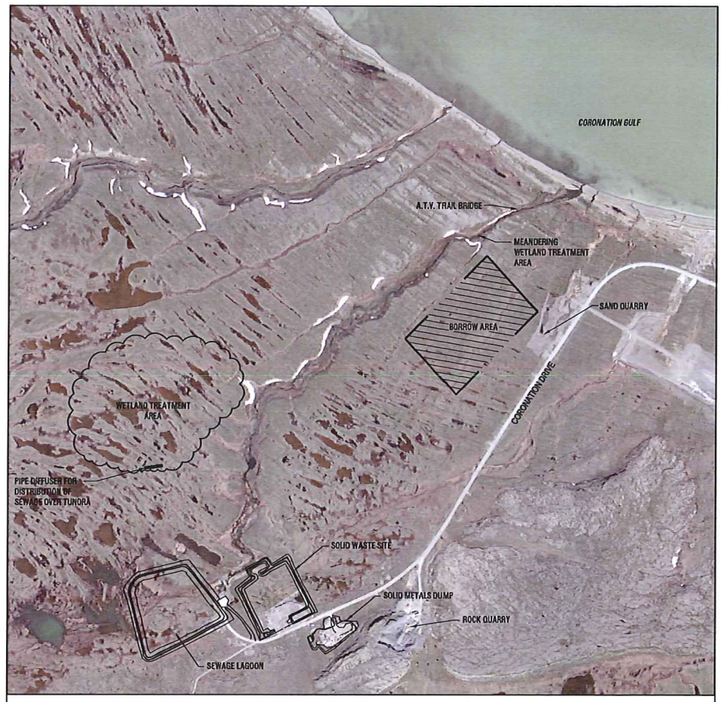
XREF ????.DWG ????.DWG



A SECTION A–A



B SECTION B–B



SEWAGE LAGOON,
SOLID WASTE SITE AND
CONSTRUCTION BORROW AREA
Scale 1:8000

TRUCK HAUL DISTANCE = 1.5 KM

N

No.	Issue / Revision	Date
1	Client Review and Approval	April 10, 2006
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4	General Revisions – Client Review and Approval	March 21, 2007
5	Issued for Construction	May 2, 2007
6	Record Drawing	November 18, 2008

RECORD DRAWING

ORIGINAL SIGNED BY G.J. POPOWICH, P. Eng.

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KITIMEOT REGION
P.O. BAG 200
CAMBRIDGE BAY, NUNAVUT
X0B 0C0

GN Project No. 04-4406

Drawing Title
THE HAMLET OF KUGLUKTUK
SEWAGE LAGOON SECTIONS

Drawn By	Checked By	Drawing
R.A.	M.O'Hara/ X. Fernandes	3
Scale H 1:500 V 1:500	Nuna Burnside Project No. N–0 09755.0	

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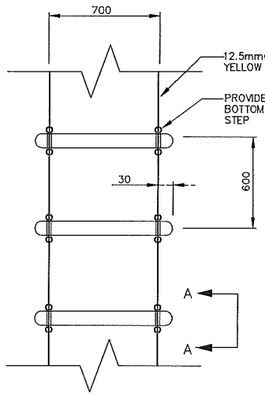
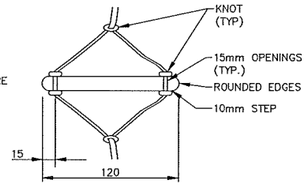
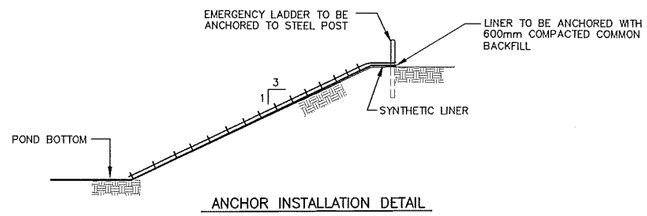


LADDER ASSEMBLY



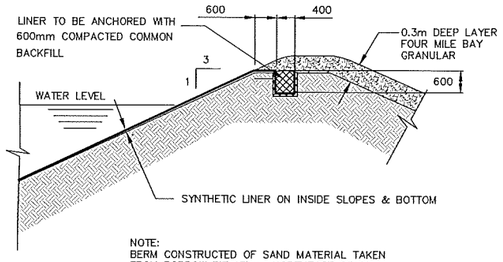
SECTION A–A



ANCHOR INSTALLATION DETAIL

EMERGENCY LADDER DETAILS

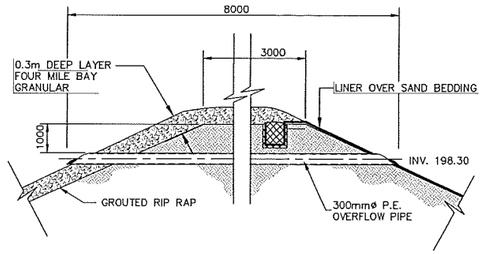
N.T.S.



NOTE:
BERM CONSTRUCTED OF SAND MATERIAL TAKEN FROM BORROW PIT 15kms NORTHEAST OF SITE. PLACED IN LIFTS AND COMPACTED TO 95% STANDARD PROCTOR DENSITY.

TYPICAL LINER ANCHOR DETAIL

N.T.S.



TYPICAL OVERFLOW DETAIL

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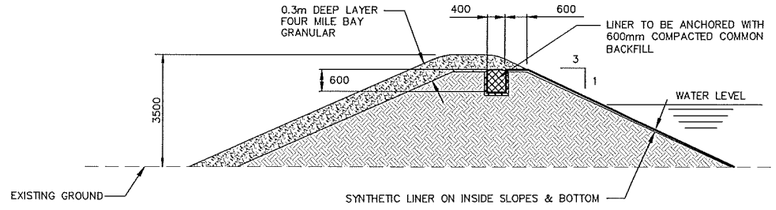
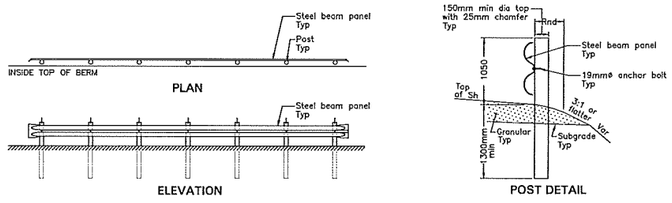


NOTE:
FENCE NOT SHOWN FOR CLARITY

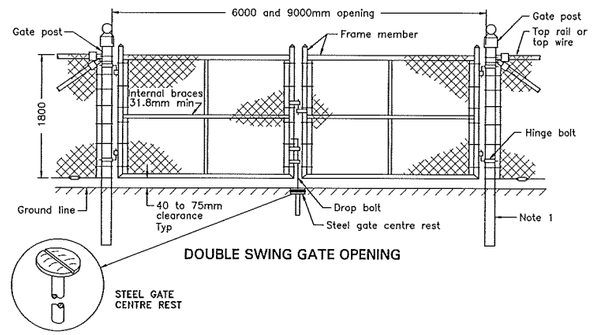
LAGOON BERM CROSS SECTION (TYP)

N.T.S.

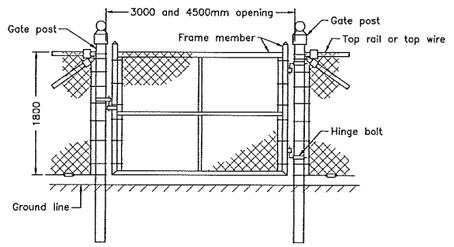


GUIDE RAIL AT TRUCK DUMP

NTS



DOUBLE SWING GATE OPENING



SINGLE SWING GATE OPENING

GATE AND GATE POST DETAILS			
Gate type and max opening m	Frame member min OD mm	Post dia min OD mm	Post length standard m
Single swing 3.0 Double swing 6.0	42.9	88.9	2.6
Single swing 4.5 Double swing 9.0	48.3	114.3	2.9

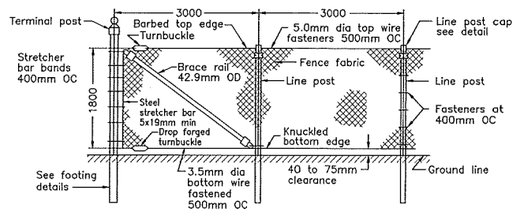
NOTES:

A Gate frames greater than 3.6m in width are supplied with diagonal braces.

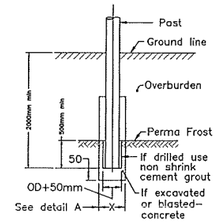
B All dimensions are in millimetres unless otherwise shown.

FENCE, CHAIN LINK COMPONENT – GATE

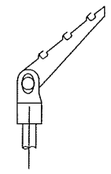
NTS



CHAIN LINK FENCE WITH TOP WIRE



TERMINAL AND LINE POST DETAIL (TYPICAL)



NOTE:
A All dimensions are in millimetres unless otherwise shown.

LINE POST WITH BARBED WIRE ARM

CHAIN LINK FENCE DETAILS

N.T.S.

No.	Issue / Revision	Date
1	Client Review and Approval	April 10, 2006
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3	Issued for tender	July 17, 2006
4	General Revisions – Client Review and Approval	March 21, 2007
5	Issued for Construction	May 2, 2007
6	Record Drawing	November 18, 2008

RECORD DRAWING

ORIGINAL SIGNED BY G.J. POPOMICH, P. Eng.

NOTES:

1. ALL AREAS DISTURBED BY CONTRACTOR DURING CONSTRUCTION ACTIVITIES SHALL BE REINSTATED TO ORIGINAL CONDITION OR BETTER, BY THE CONTRACTOR.

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PROJECT MANAGEMENT DIVISION
DEPARTMENT OF COMMUNITY AND GOVERNMENT SERVICES (CGS)
KITIKMEOT REGION
P.O. BAG 200
CAMBRIDGE BAY, NUNAVUT
X0B 0C0

Drawing Title
THE HAMLET OF KUGLUKTUK
SEWAGE LAGOON DETAILS

Drawn By	Checked By	Drawing
R.A.	M.O'Hara / X. Fernandes	4
Scale: NTS	Nuna Burnside Project No.: N-0 09755.0	

QN Project No. 04-4406

X:\Office\Files 2005(E)\N-0 09755 Kugluktuk Sewage & Solid Waste\700 Drawings\Record Drawings\FE009754 SL- DETAILS-redesign.dwg

359m

REMOVABLE CAPS
ON END (TYP.)

90m x 300mmø HDPE
EFFLUENT OUTLET PIPE
(SEE FIGURE 2 FOR DETAIL)

EXISTING RIDGE

300ø PORTABLE DISCHARGE LINE

300m

EXISTING RIDGE

300ø PORTABLE DISCHARGE LINE

OVERFLOW PIPE
300mmø P.E.
INV=198.30

+199.0

+199.0

+199.0

SLOPE
3:1

SLOPE
3:1

N

NUNA BURNSIDE

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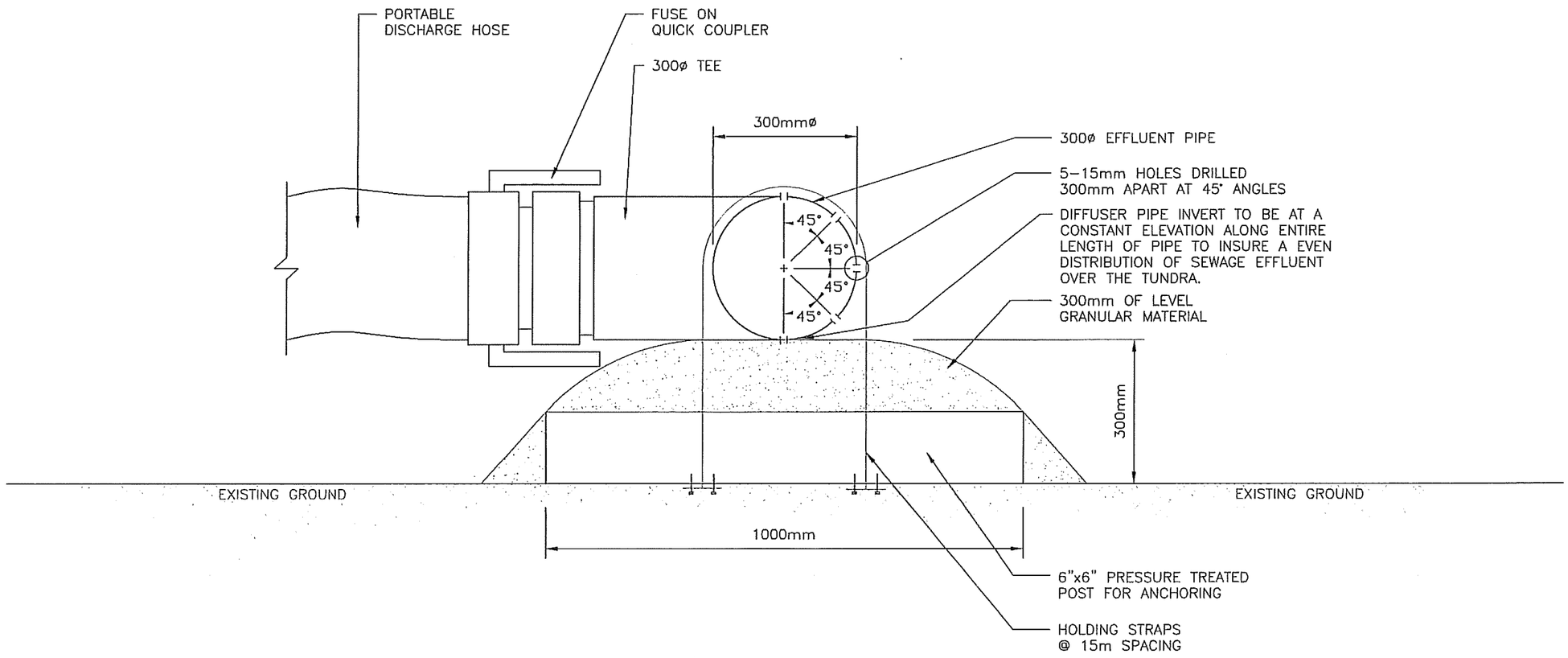
email info@nunaburnside.com
web www.nunaburnside.com

KUGLUKTUK SEWAGE & SOLID WASTE LAGOON
DISCHARGE SITE LAYOUT

SCALE:	DATE:	PROJECT No:	DWG BY:	CHK BY:	FIGURE:
1:1250	MARCH, 2009	N-0 09755	J.Mc.	M.S.	CCN3-3

X:\Office\Files 2005(E)\N-0 09755 Kugluktuk Sewage & Solid Waste\545- Lagoon Const Survey\Construction Survey\dwg\012009 Discharge survey.dwg



EFFLUENT PIPE DETAIL

1:10

NUNA BURNSIDE

Nuna Burnside Engineering and Environmental Ltd.
Building 764, Fred Coman Street, Iqaluit NU, X0A 0H0
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web www.nunaburnside.com

KUGLUKTUK SEWAGE & SOLID WASTE
LAGOON
EFFLUENT PIPE DETAIL

SCALE:	DATE:	PROJECT No:	DWG BY:	CHK BY:	FIGURE:
AS SHOWN	MARCH, 2009	N-0 09755	J.Mc.	M.S.	CCN3-4

X:\Office\Files 2005(E)\N-0 09755 Kugluktuk Sewage & Solid Waste\545- Lagoon Const Survey\Construction Survey\dwg\012009 Discharge survey.dwg

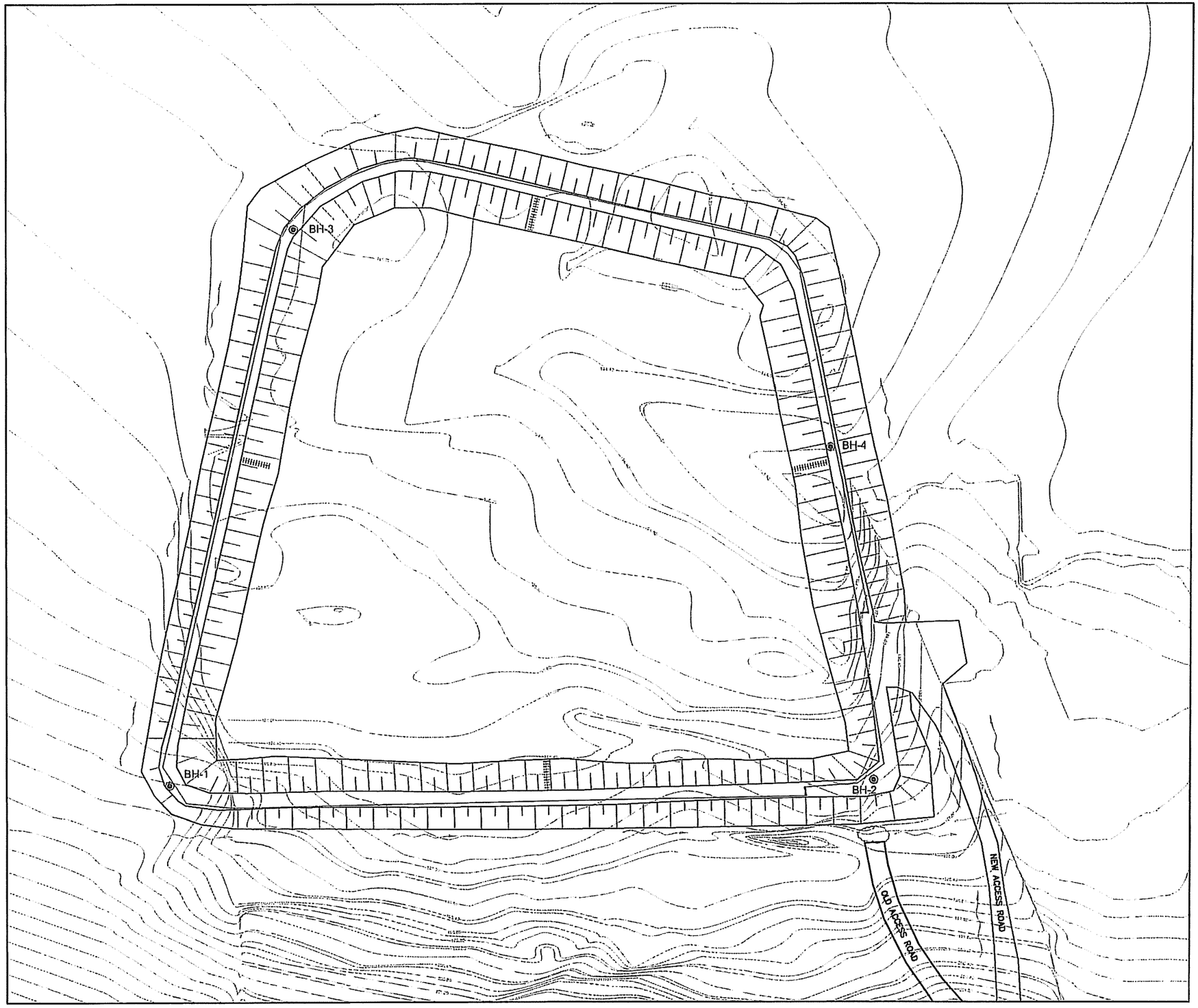


FIGURE 1

GOVERNMENT OF NUNAVUT
HAMLET OF KUGLUKTUK, NUNAVUT
THERMISTER BOREHOLE INSTALLATION

SEWAGE LAGOON SITE PLAN WITH BOREHOLE LOCATIONS

LEGEND

◎ THERMISTER BOREHOLE LOCATION
(by Nuna Burnside, 2009)

N

0 10 20 30 40 50 60 70 80 90 100 110 120

Metres

1:1,500
April 2009
Project Number: N-O09755

Projection: UTM Zone 11
Datum: NAD83

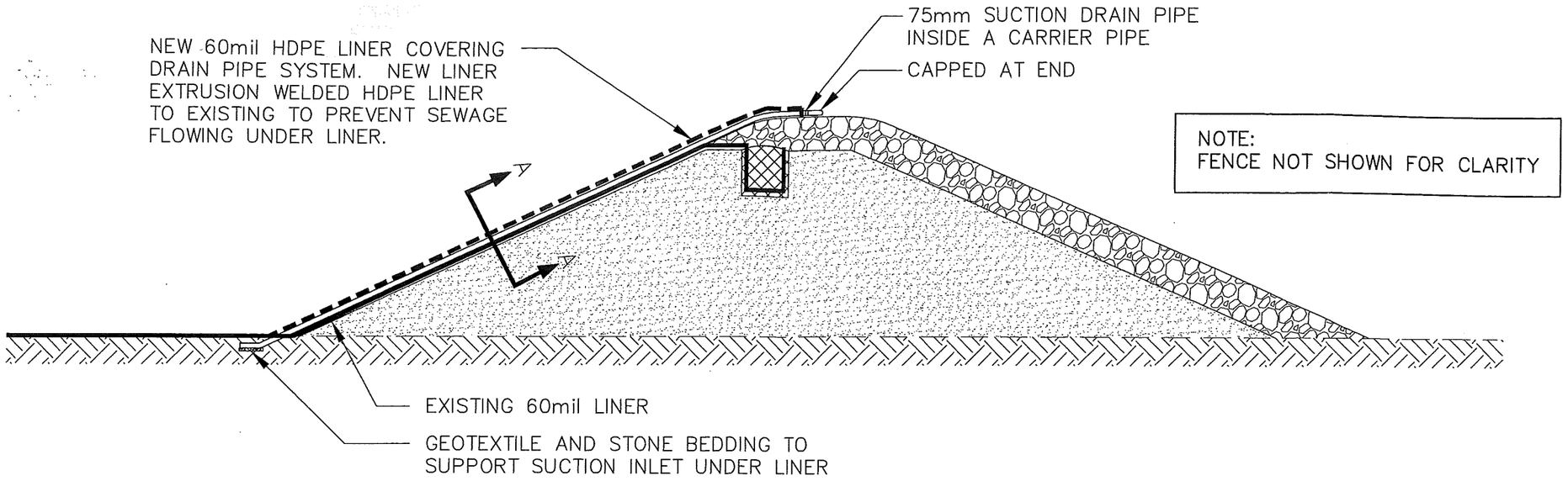
Prepared by: C. Sheppard

Verified by: J. Walls

NUNA BURNSIDE

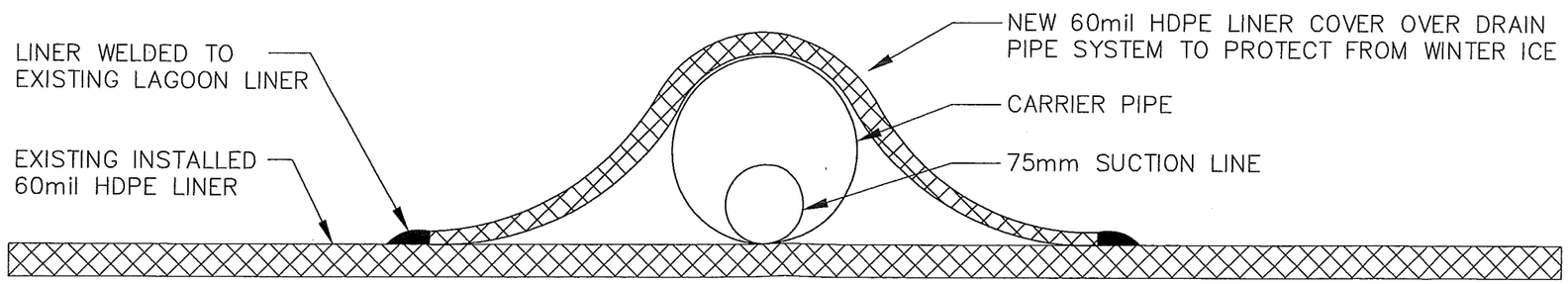
N-O09755 THERMISTER BH INSTALLATION SP.dwg

Plot Time: May 05, 2009 - 11:01am



SUCTION PIPE CROSS SECTION

N.T.S.



SECTION A–A

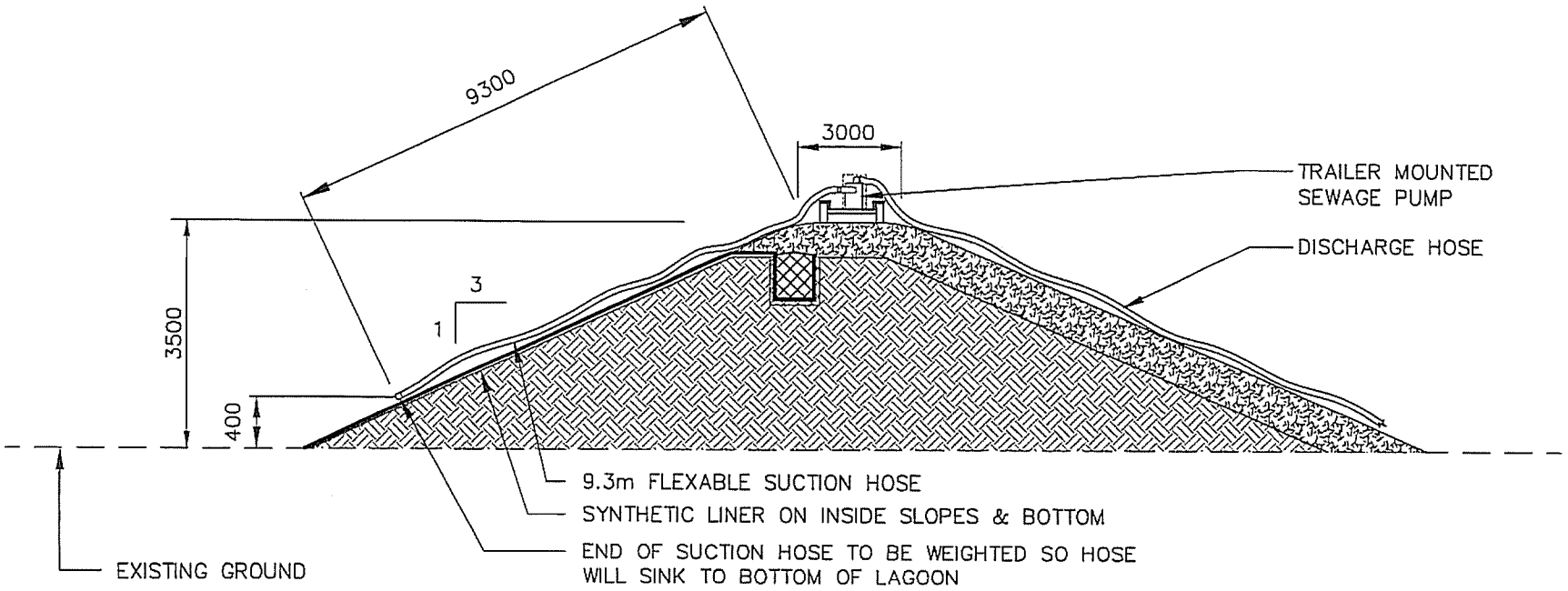
N.T.S.

NUNA BURNSIDE

NUNA BURNSIDE LTD.
106 B SCURFIELD BLVD, WINNIPEG, MB. CANADA R3Y 1G4
TELEPHONE: 204–949–7110 FAX: 204–949–7111

THE HAMLET OF KUGLUKTUK
SEWAGE LAGOON
UNDERSIDE LINER DRAINAGE SYSTEM

SCALE:	DATE:	PROJECT No:	DWG BY:	CHK BY:	FIGURE:
N.T.S.	AUG 30, 2011	N–O 09755	C.G.	G.P.	2.0



NOTE:
FENCE NOT SHOWN FOR CLARITY

SUCTION PIPE CROSS SECTION

N.T.S.

NEEGAN BURNSIDE

NEEGAN BURNSIDE LTD.
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THE HAMLET OF KUGLUKTUK
SEWAGE LAGOON
DISCHARGE PUMP AND PIPING

SCALE:	DATE:	PROJECT No:	DWG BY:	CHK BY:	FIGURE
N.T.S.	APRIL 20, 2009	N-O 09755	J.MC.	M.S.	3.0

BURNSIDE

Appendix B
Climate Data

Appendix B
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Temperature: Temperature:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Daily Average (°C)	-27.8	-27.4	-25.3	-17	-5.3	5.2	10.7	8.8	2.8	-7.2	-19.6	-25.5		C
Standard Deviation	3.8	4.2	3.2	3	3.2	2	2	1.9	1.5	2.5	4.3	3.4		C
Daily Maximum (°C)	-23.7	-23	-20.6	-12.1	-1.4	9.5	15.4	13.1	6	-4	-15.7	-21.4		C
Daily Minimum (°C)	-31.9	-31.7	-29.8	-21.8	-9.2	0.8	6	4.5	-0.4	-10.3	-23.4	-29.6		C
Extreme Maximum (°C)	0.8	-1.2	-0.1	14	19.8	31.1	**34.9**	29.2	22.6	13.4	2.8	27.4		
Date (yyyy/dd)	1981/16	1980/07	1999/22	2000/06	1994/24	1996/25	**1989/15**	2000/01	1994/01	1988/06	1983/03	1999/19		
Extreme Minimum (°C)	-46.9	-47.2	-47	-39.7	-30.2	-12.1	0.3	-4.4	-18.9	-35.4	-41	-44.5		
Date (yyyy/dd)	2002/21	**1998/20**	1979/05	1979/04	1983/03	2000/01	1978/04+	1995/29	2000/26	1996/29	1985/24	1977/12		
Precipitation: Precipitation:														
Rainfall (mm)	0	0	0	0.6	5.8	12.8	36.3	40.8	32.1	5.1	0	0	133.5	C
Snowfall (cm)	15.4	16.5	16	17.8	16.6	2.7	0	0.3	8.1	34.1	19.7	18.6	165.8	C
Precipitation (mm)	11	9.9	10.6	13.3	19.5	15.1	36.3	41.1	39	29.5	12.6	11.5	249.4	C
Average Snow Depth (cm)	35	43	47	48	28	3	0	0	0	9	20	28		C
Median Snow Depth (cm)	36	42	47	49	28	1	0	0	0	9	19	28		C
Snow Depth at Month-end (cm)	38	45	48	42	15	0	0	0	2	17	24	32		C
Extreme Daily Rainfall (mm)	0	0	0	7.4	20.6	27.4	30.5	**53.7**	28.8	19.3	3.4	0		
Date (yyyy/dd)	1978/01+	1978/06+	1978/01+	1980/27	1992/27	1987/13	1983/10	**1982/12**	1983/07	1980/08	2001/17	1977/01+		
Extreme Daily Snowfall (cm)	**26.2**	24.6	8.6	16	21	13	0.4	5	13.5	23	12.4	26		
Date (yyyy/dd)	**1988/01**	1981/21	2000/27	1980/30	1993/07	1991/05	1985/07	1986/23	1981/22	1981/29	1981/06	1994/25		
Extreme Daily Precipitation (mm)	25.8	9.1	6	16	21.8	27.4	30.5	**53.7**	28.8	23	12.4	14.8		
Date (yyyy/dd)	1988/01	1981/21	1990/07+	1980/30	1978/25	1987/13	1983/10	**1982/12**	1983/07	1981/29	1981/06	1994/25		
Extreme Snow Depth (cm)	80	92	104	107	**128**	64	3	0	23	43	49	73		
Date (yyyy/dd)	1993/30+	1993/22+	1991/31	1991/03+	**1993/08**	1993/01	1986/01+	1978/01+	1981/24	1995/29	1992/30	1994/26+		

Appendix B
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Days with Maximum Temperature: Days with Maximum Temperature:														
<= 0 °C	31	28.3	31	28.4	18.7	1.1	0	0	2.5	23.1	29.6	30.9		C
> 0 °C	0.05	0	0	1.6	12.3	28.9	31	31	27.5	7.9	0.45	0.08		C
> 10 °C	0	0	0	0.04	0.91	12	25.6	20.8	5.4	0.1	0	0.08		C
> 20 °C	0	0	0	0	0	2.5	6	3.9	0.22	0	0	0.08		C
> 30 °C	0	0	0	0	0	0.09	0.26	0	0	0	0	0		C
> 35 °C	0	0	0	0	0	0	0	0	0	0	0	0		C
Days with Minimum Temperature: Days with Minimum Temperature:														
> 0 °C	0	0	0	0	0.95	17.9	31	27.7	14	0.71	0	0		C
<= 2 °C	31	28.3	31	30	30.8	20.7	2.7	7.6	22.7	30.9	30	31		C
<= 0 °C	31	28.3	31	30	30.1	12.1	0	3.3	16	30.3	30	31		C
< -2 °C	31	28.3	31	29.8	27.1	5.1	0	0.59	8.6	27.7	30	31		C
< -10 °C	30.9	28.2	30.9	28	12.8	0.09	0	0	0.39	14.6	28.6	30.9		C
< -20 °C	28.7	26.7	28.5	18.4	2	0	0	0	0	3.1	20	27.9		C
< - 30 °C	20.1	18	16.5	4.7	0.05	0	0	0	0	0.29	6.6	16.2		C
Days with Rainfall: Days with Rainfall:														
>= 0.2 mm	0	0	0	0.35	2.1	6.4	10.2	12.5	10.4	1.9	0.05	0		C
>= 5 mm	0	0	0	0.04	0.27	0.65	2.6	2.4	1.9	0.27	0	0		C
>= 10 mm	0	0	0	0	0.18	0.13	0.78	0.73	0.65	0.09	0	0		C
>= 25 mm	0	0	0	0	0	0.04	0.04	0.23	0.04	0	0	0		C
Days With Snowfall: Days With Snowfall:														
>= 0.2 cm	9.4	9.8	10.7	9.4	6.5	1.6	0.09	0.27	3.9	13.9	11.7	10.1		C
>= 5 cm	0.52	0.65	0.35	0.87	0.86	0.17	0	0.05	0.52	2.1	0.91	0.63		C
>= 10 cm	0.13	0.04	0	0.17	0.27	0.04	0	0	0.09	0.55	0.18	0.25		C
>= 25 cm	0.04	0	0	0	0	0	0	0	0	0	0	0.04		C

Appendix B
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Days with Precipitation: Days with Precipitation:														
>= 0.2 mm	8.6	9.1	10	8.9	7.3	7.4	10.2	12.6	12.9	14.5	10.7	9.4		C
>= 5 mm	0.3	0.22	0.17	0.52	1	0.83	2.6	2.4	2.3	1.7	0.18	0.33		C
>= 10 mm	0.04	0	0	0.13	0.45	0.17	0.78	0.73	0.74	0.32	0.05	0.08		C
>= 25 mm	0.04	0	0	0	0	0.04	0.04	0.23	0.04	0	0			
Days with Snow Depth: Days with Snow Depth:														
>= 1 cm	31	28.3	31	30	29.5	9.8	0.7	0	2.4	25.5	29.9	31		C
>= 5 cm	31	28.3	31	29.9	26.1	6.4	0	0	0.7	17.8	29.1	31		C
>= 10	31	28.3	31	29.8	22.8	3.1	0	0	0.39	11.4	25.7	31		C
>= 20	22.9	24.6	26.6	25.7	16.8	1.4	0	0	0.13	4.8	12	20.5		C
Wind: Wind:														
Speed (km/h)	19	18.5	15.6	13.4	13.9	14	14.4	15.5	16.8	17.4	16.8	18.2		C
Most Frequent Direction	SW	SW	SW	SW	E	E	E	E	E	SW	SW	SW		C
Maximum Hourly Speed	93	76	83	72	74	61	67	74	74	80	83	**93**		
Date (yyyy/dd)	1988/01	1978/08+	1980/03	1984/16	1986/28	1995/26	1991/25	1986/22+	2002/24	1982/27	1994/19	**1983/25**		
Direction of Maximum Hourly Speed	NW	S	NW	E	NW	NW	N	NW	NW	NW	NW	NW		
Maximum Gust Speed	106	**106**	106	83	89	74	81	83	85	89	100	104		
Date (yyyy/dd)	1988/01	**1978/06**	1980/03	1984/16	1986/28	1992/11+	1988/23	1984/10+	1983/28	1982/27	1994/05	1983/26		
Direction of Maximum Gust	NW	SW	NW	E	NW	W	NW	NW	NW	NW	NW	NW		
Days with Winds >= 52 km/hr	1.8	2.7	1.7	0.9	0.6	0.1	0.2	0.8	1.2	1.3	0.9	2.2		C
Days with Winds >= 63 km/hr	0.5	0.8	0.4	0.2	0.3	0	0	0.2	0.4	0.5	0.2	0.7		C

Appendix B
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Degree Days: Degree Days:														
Above 24 °C	0	0	0	0	0	0	0	0	0	0	0	0		C
Above 18 °C	0	0	0	0	0	0.6	3.1	0.8	0	0	0	0		C
Above 15 °C	0	0	0	0	0	1.8	12.3	5.7	0	0	0	0		C
Above 10 °C	0	0	0	0	0.1	13.8	60.3	37.7	2.3	0	0	0		C
Above 5 °C	0	0	0	0	1.9	56.7	178.7	129.1	20.6	0.3	0	0		C
Above 0 °C	0	0	0	0.3	14	160.6	332.2	274.9	100.3	5.2	0	0		C
Below 0 °C	855.2	783.1	782.7	510.1	177.8	6	0	0	15.8	225.4	581.5	790.4		C
Below 5 °C	1010.2	924.5	937.7	659.7	320.7	52.2	1.5	9.2	86.1	375.5	731.5	945.4		C
Below 10 °C	1165.2	1065.8	1092.7	809.7	474	159.2	38.1	72.8	217.9	530.2	881.5	1100.4		C
Below 15 °C	1320.2	1207.2	1247.7	959.7	628.9	297.3	145.1	195.8	365.6	685.2	1031.5	1255.4		C
Below 18 °C	1413.2	1292	1340.7	1049.7	721.9	386	228.9	283.9	455.6	778.2	1121.5	1348.4		C
Bright Sunshine: Bright Sunshine:														
Total Hours		75.8	161.8	221.7	242.5	376.2	342.9	213.2	88.2	52.4	19.7			C
Days with measurable		18	25.8	25.8	25.9	28.6	29.4	27.4	21.1	15.9	9.1			C
% of possible daylight hours		34.8	44.8	47.2	38	52.3	48.7	39.5	22.1	18.1	12.8			C
Extreme Daily	5.2	8.4	12.9	17.2	22.9	24	24	19.1	14.1	10.5	6.4	1		C
Date (yyyy/dd)	1998/30	1980/27	1997/28	1994/28	1985/31	1981/09+	1982/05+	1987/01	2000/01	1988/02	2000/05	1981/01		
Humidex: Humidex:														
Extreme Humidex	0.3	-1.7	-0.3	7.9	19.8	30.3	36.8	**36.8**	22.7	12.3	2.2	-1.5		
Date (yyyy/dd)	1981/16	1980/07	1999/22	1995/28	1994/24	1996/25	1989/15	**1992/02**	1994/01	1988/06	1983/03	1999/24		
Days with Humidex >= 30			0	0	0	0	0.5	0.2	0	0	0	0		C
Days with Humidex >= 35			0	0	0	0	0.1	0	0	0	0	0		C
Days with Humidex >= 40			0	0	0	0	0	0	0	0	0	0		C

Appendix B
Climate Normals for Kugluktuk
Information provided by http://www.climate.weatheroffice.ec.gc.ca/Kuglugtuk Nunavut

Wind Chill: Wind Chill:														
Extreme Wind Chill	-64.3	-64.4	**-65**	-54.4	-39.7	-15.6	-6.2	-11.8	-22.9	-46.5	-54.1	-61.5		
Date (yyyy/dd)	1990/26	1985/21	**1979/05**	1979/04	1983/04	1978/09	1985/21	1995/29	1992/25	1996/27	1985/25	1984/09		
Days with Wind Chill < -20	30.7	28.1	30.4	25.5	7.8	0	0	0	0.2	10.5	27.1	30.7		C
Days with Wind Chill < -30	28.4	25.3	27.2	14.7	1.2	0	0	0	0	2.4	18.8	27.1		C
Days with Wind Chill < -40	22.3	18.9	17.2	4.6	0	0	0	0	0	0.2	8.1	18		C
Humidity: Humidity:														
Average Vapour Pressure (kPa)			0.1	0.2	0.4	0.7	1	0.9	0.6	0.4	0.1	0.1		C
Average Relative Humidity - 0600LST (%)			78.4	82.8	87.4	84.1	81.9	87.7	88.8	87	81.5	78		C
Average Relative Humidity - 1500LST (%)			78.4	83	84.1	71.2	64.2	68.4	75.9	84.9	81.1	78.3		C
Pressure: Pressure:														
Average Station Pressure (kPa)	101.6	101.7	101.8	101.8	101.7	101.2	101.1	101	101	101.2	101.4	101.5		C
Average Sea Level Pressure (kPa)	101.9	102	102.1	102.1	102	101.5	101.4	101.3	101.3	101.5	101.7	101.8		C
Visibility (hours with): Visibility (hours with):														
< 1 km	21.2	29.8	18.6	23.6	27.9	9	11.1	5.9	4.8	9.1	11.8			D
1 to 9 km	138.3	129.8	122.9	101.1	74.9	23.2	26	27.7	45	106	97.9			D
> 9 km	584.6	518.1	602.5	595.3	641.2	687.8	706.9	710.4	670.2	628.9	610.3			D
Cloud Amount (hours with): Cloud Amount (hours with):														
0 to 2 tenths	298.4	261.5	290	240.6	171	188.4	146.1	111.1	80.2	105.5	200.2			D
3 to 7 tenths	136	130.8	132.5	120.3	106.3	151.6	181	155.6	105.7	89.9	140.8			D
8 to 10 tenths	309.6	285.4	321.5	359.1	466.7	380.1	416.9	477.4	534.1	548.6	379.1			D

BURNSIDE

Appendix C
Projected Water Requirements and Sewage Generation Rates

Table 4
Sewage Generation Rate for the Hamlet of Kugluktuk, Nunavut

Planning Year	Calendar Year	Total Population[1]	Projected Sewage generation[2] (lpcd)	Projected Volume (litres/day)	Projected Volume (litres/year)	Projected Sludge Quantity (kg/annum)	Cumulative Sludge Volume[3] (m^3)	BOD (mg/l)	TSS (mg/l)	T-PO_4 (mg/l)	TKN (mg/l)	Faecal Coliforms (C.F.U./100ml)
0	2006	1585	136.5	216,281	78,942,629	28,926.3	964.2	329.8	351.8	16.9	87.9	6.96E+07
	2007	1618	137.2	222,012	81,034,472	29,528.5	1,948.5	328.0	349.8	16.8	87.5	6.92E+07
	2008	1653	138.0	228,145	83,273,074	30,167.3	2,954.1	326.0	347.8	16.7	86.9	6.88E+07
	2009	1686	138.8	233,980	85,402,593	30,769.5	3,979.7	324.3	345.9	16.6	86.5	6.85E+07
	2010	1720	139.6	240,043	87,615,768	31,390.0	5,026.1	322.4	343.9	16.5	86.0	6.81E+07
5	2011	1760	140.5	247,245	90,244,352	32,120.0	6,096.7	320.3	341.7	16.4	85.4	6.76E+07
	2012	1793	141.2	253,242	92,433,157	32,722.3	7,187.5	318.6	339.8	16.3	85.0	6.73E+07
	2013	1827	142.0	259,472	94,707,414	33,342.8	8,298.9	316.9	338.0	16.2	84.5	6.69E+07
	2014	1859	142.8	265,385	96,865,621	33,926.8	9,429.8	315.2	336.2	16.1	84.1	6.65E+07
	2015	1893	143.5	271,719	99,177,554	34,547.3	10,581.4	313.5	334.4	16.0	83.6	6.62E+07
10	2016	1928	144.3	278,295	101,577,760	35,186.0	11,754.2	311.8	332.5	15.9	83.1	6.58E+07
	2017	1965	145.2	285,308	104,137,484	35,861.3	12,949.6	309.9	330.6	15.8	82.6	6.54E+07
	2018	2000	146.0	292,000	106,580,000	36,500.0	14,166.3	308.2	328.8	15.8	82.2	6.51E+07
	2019	2041	146.9	299,911	109,467,392	37,248.3	15,407.9	306.2	326.7	15.7	81.7	6.47E+07
	2020	2076	147.7	306,725	111,954,570	37,887.0	16,670.8	304.6	324.9	15.6	81.2	6.43E+07
15	2021	2107	148.5	312,835	114,184,737	38,455.3	17,952.6	303.1	323.3	15.5	80.8	6.40E+07
	2022	2139	149.2	319,082	116,465,007	39,032.1	19,253.7	301.6	321.7	15.4	80.4	6.37E+07
	2023	2171	149.9	325,470	118,796,633	39,617.6	20,574.3	300.1	320.2	15.3	80.0	6.34E+07
	2024	2203	150.7	332,002	121,180,905	40,211.9	21,914.7	298.7	318.6	15.3	79.6	6.30E+07
	2025	2236	151.4	338,683	123,619,146	40,815.1	23,275.2	297.2	317.0	15.2	79.2	6.27E+07
20	2026	2270	152.2	345,514	126,112,716	41,427.3	24,656.1	295.6	315.4	15.1	78.8	6.24E+07
	2027	2304	153.0	352,501	128,663,012	42,048.7	26,057.7	294.1	313.7	15.0	78.4	6.21E+07
	2028	2339	153.8	359,648	131,271,469	42,679.4	27,480.3	292.6	312.1	15.0	78.0	6.18E+07
	2029	2374	154.6	366,958	133,939,561	43,319.6	28,924.3	291.1	310.5	14.9	77.6	6.15E+07
	2030	2409	155.4	374,435	136,668,802	43,969.4	30,390.0	289.6	308.9	14.8	77.2	6.11E+07
25	2031	2445	156.2	382,084	139,460,748	44,629.0	31,877.6	288.0	307.2	14.7	76.8	6.08E+07

Reference: Nunavut Bureau of Statistics, 2000. "Nunavut: Community Population Projections 2000 - 2020".

Note: 1) The Nunavut document referenced above was utilized up to 2020. A population growth of 1.5% was applied to the subsequent years (2021 - 2031).

2) The projected sewage generation is based on the Nunavut water usage formula [100 L/c/d x (1 + 0.00023 x population)].

3) A value of 3% dry solids is assumed for the liquid sludge accumulating at the bottom of the lagoon.

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Appendix D
Site Forms

Form 1
Monthly Sewage Delivery Log
Hamlet of Kugluktuk

Month: _____ **Truck #:** _____

Date	Number of Trips	Volume per Trip	Total Daily Volume (liters)	Comments and Concerns
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				

Date	Number of Trips	Volume per Trip	Total Daily Volume (liters)	Comments and Concerns
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
Monthly Totals				

Form 2
Monthly Sewage Treatment Facility Inspection Form
Hamlet of Kugluktuk

Inspected By:_____ Date:_____

Wind Direction:_____ Temperature:_____

Precipitation:_____ Ground Cover:_____

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Health and Safety (dangers and concerns)		
Wildlife		
Access Road (condition, ditches, snow, surface, etc.)		
Signs		
Inlet Flume		
Berms and Fences		
Sewage Level		

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Sludge Thickness		
Gate Value at Discharge Manhole		
Odours/Appearance		
Wetland Treatment Area		
Equipment (septic truck, pump, etc.)		
Complaints		
Site Planning (discharge schedule)		
Other Issues and Concerns		

Form 3
Effluent Discharge Log
Hamlet of Kugluktuk

Month: _____ **Truck #:** _____

Date	Time Value Opened	Time Value Closed	Discharge Period (days)	Approximate Flow Rate m^3/day	Approximate Volume Discharged m^3	Start Lagoon Depth (cm)	End Lagoon Depth (cm)	Change in Depth (cm)	Approximate Volume Change (m^3)	Comments
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										

Date	Time Value Opened	Time Value Closed	Discharge Period (days)	Approximate Flow Rate m^3/day	Approximate Volume Discharged m^3	Start Lagoon Depth (cm)	End Lagoon Depth (cm)	Change in Depth (cm)	Approximate Volume Change (m^3)	Comments
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
Monthly Totals										

Form 4
Sewage Treatment Facility Planning
Hamlet of Kugluktuk

Prepared By: _____

Date: _____

Sewage Treatment Planning Issue	Current Operations	To Do Items and Schedule
Health and Safety		
Site Inspection Results/Concerns		
Current Volume		
Wetland Treatment Area		
Environmental Monitoring		
Annual Reporting		

Sewage Treatment Planning Issue	Current Operations	To Do Items and Schedule
Nunavut Water Board License Requirements		
Staffing		
Equipment		
Costs		
Other Issues/Concerns		

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Appendix E
Annual Monitoring Report Forms

NWB Annual Report **Year being reported:** Select

License No: **Issued Date:**
Expiry Date:

Project Name:

Licensee:

Mailing Address:

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

General Background Information on the Project (*optional):

Licence Requirements: the licensee must provide the following information in accodance with

Select Select

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s):
Water Quantity:

- Quantity Allowable Domestic (cu.m)
- Actual Quantity Used Domestic (cu.m)
- Quantity Allowable Drilling (cu.m)
- Total Quantity Used Drilling (cu.m)

Waste Management and/or Disposal

- ☐ Solid Waste Disposal
- ☐ Sewage
- ☐ Drill Waste
- ☐ Greywater
- ☐ Hazardous
- ☐ Other:

Additional Details:

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: (as reported to the Spill Hot-line)
Date of Spill:
Date of Notification to an Inspector:
Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc)

Revisions to the Spill Contingency Plan

Select

Additional Details:

Revisions to the Abandonment and Restoration Plan

Select

Additional Details:

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Select

Additional Details:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Select

Additional Details:

Results of any additional sampling and/or analysis that was requested by an Inspector

Select

Additional Details: (date of request, analysis of results, data attached, etc)

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

Select

Additional Details: (Attached or provided below)

Any responses or follow-up actions on inspection/compliance reports

Select

Additional Details: (Dates of Report, Follow-up by the Licensee)

Any additional comments or information for the Board to consider

Date Submitted:
Submitted/Prepared by:
Contact Information:
Tel:
Fax:
email:

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Appendix G
Dyke Temperature Recording Form
Portable Diesel Driven Sewage Pump
Discharge Calcuation

Kugluktuk Sewage Lagoon
Dyke Temperature Readings
Date: _____

Switch	2195 SW			2196 SE			2197 NW			2198 NE		
Position	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C
1	0.5			0.5			0.5			0.5		
2	1			1			1			1		
3	2			2			2			2		
4	3			2.9			3			3		
5	4			3.7			4			4		
6	4.9						5			5		
7							6.3			6		
8										7		
9										7.9		

Kugluktuk Sewage Lagoon
Dyke Temperature Readings
Date: _____

Switch	2195 SW			2196 SE			2197 NW			2198 NE		
Position	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C
1	0.5			0.5			0.5			0.5		
2	1			1			1			1		
3	2			2			2			2		
4	3			2.9			3			3		
5	4			3.7			4			4		
6	4.9						5			5		
7							6.3			6		
8										7		
9										7.9		

Kugluktuk Sewage Lagoon
Dyke Temperature Readings
Date: _____

Switch	2195 SW			2196 SE			2197 NW			2198 NE		
Position	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C
1	0.5			0.5			0.5			0.5		
2	1			1			1			1		
3	2			2			2			2		
4	3			2.9			3			3		
5	4			3.7			4			4		
6	4.9						5			5		
7							6.3			6		
8										7		
9										7.9		

Kugluktuk Sewage Lagoon
Dyke Temperature Readings
Date: _____

Switch	2195 SW			2196 SE			2197 NW			2198 NE		
Position	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C
1	0.5			0.5			0.5			0.5		
2	1			1			1			1		
3	2			2			2			2		
4	3			2.9			3			3		
5	4			3.7			4			4		
6	4.9						5			5		
7							6.3			6		
8										7		
9										7.9		

Kugluktuk Sewage Lagoon
Dyke Temperature Readings
Date: _____

Switch	2195 SW			2196 SE			2197 NW			2198 NE		
Position	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C
1	0.5			0.5			0.5			0.5		
2	1			1			1			1		
3	2			2			2			2		
4	3			2.9			3			3		
5	4			3.7			4			4		
6	4.9						5			5		
7							6.3			6		
8										7		
9										7.9		

Kugluktuk Sewage Lagoon
Dyke Temperature Readings
Date: _____

Switch	2195 SW			2196 SE			2197 NW			2198 NE		
Position	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C	Depth (m)	Ω	°C
1	0.5			0.5			0.5			0.5		
2	1			1			1			1		
3	2			2			2			2		
4	3			2.9			3			3		
5	4			3.7			4			4		
6	4.9						5			5		
7							6.3			6		
8										7		
9										7.9		

Kugluktuk Sewage Lagoon Discharge Pump Sizing Calculations
March 16, 2009
NBL File No. N-O 09755.530

20 Year Lagoon Capacity = 130,000 m^3

Option # 1 Discharge over a 3 month period and 24hr/day

$$\frac{130{,}000\ m^3 \times 219.96\ \text{Imp gal}/m^3}{3\ \text{months} \times 30\text{days} \times 24\text{hrs} \times 60\text{min/hr}} = 220.6\ \text{IGM}(265\ \text{USGPM})$$

Option # 2 Discharge over a 2 month period and 24hr/day

$$\frac{130{,}000\ m^3 \times 219.96\ \text{Imp gal}/\ m^3}{2\ \text{months} \times 30\ \text{days} \times 24\ \text{hrs} \times 60\ \text{min/hr}} = 331\ \text{IGM}\ (397.15\ \text{USGPM})$$

Option # 3 Discharge over a 3 month period and 12 hr/day

$$\frac{130{,}000\ m^3 \times 219.96\ \text{Imp gal}/\ m^3}{3\ \text{months} \times 30\ \text{days} \times 12\ \text{hours} \times 60\ \text{min/hr}} = 441\ \text{IGM}\ (529\ \text{USGPM})$$

The Supplier of the pump will provide a flow range in which the pump can be throttled to very the discharge flow.

Nuna Burnside is recommending a maximum flow of 400 USGPM because it provides the most flexibility for the operator to discharge the lagoon if required quickly. According to the pump manufacturer the discharge flow can be controlled from 50 to 550 USGPM if there is a requirement for a slower discharge.