Sewage Treatment Facility
Operation and Maintenance (O&M) Plan
Hamlet of Arviat

Prepared by

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May 2009
Revised May 2010

File No: N-O 15746

Executive Summary

The Hamlet of Arviat provides sewage treatment and disposal services for the community.

Nunavut Water Board (NWB) License Number NWB3ARV0308 expired December 31, 2008 and a new license application is in progress.

An Operation and Maintenance (O&M) Plan for the Sewage Treatment Facility dated May 2009 was prepared by Nuna Burnside Engineering and Environmental Ltd (Nuna Burnside), as required by the original license and in support of the application for a new license.

As noted in the December 2009 O&M Plan, as per the NWB License, the Plan is to be reviewed and updated annually.

This May 2010 update of the Plan also addresses comments provided by review agencies during the license renewal application process.

It is noted that there are a number of outstanding issues and compliance requirements of the previous license that have not yet been met. Additional work is required to address these issues and achieve compliance.

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May 2009
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1.0 Introduction

1.1 Hamlet Description

The Hamlet of Arviat is located within the Kivalliq Region, Nunavut, at general latitude 61°6'N and general longitude 94°3'W (Figure 1). The Community is located approximately 225 km south of Rankin Inlet and 265 km north of Churchill Manitoba.

The community has a population of approximately 2060 (2006), with an approximate 1.4 percent projected growth rate over the 20-year design period. Community infrastructure includes:

- A Water Supply Facility consisting of a water intake pumphouse on Wolf River, two water reservoirs, treatment system and truckfill water station
- A Sewage Treatment Facility consisting of a sewage lagoon which receives trucked sewage collected from holding tanks in each building and sewage treatment via an exfiltration lagoon to a wetland discharging to the ocean
- A Solid Waste Management Facility, which includes a Bulky Metals Disposal area
- Diesel powered generators.

A layout of the entire community and infrastructure is displayed on Figure 2.

1.2 Nunavut Water Board License

The Hamlet of Arviat operates their municipal water, sewage, and solid waste facilities under the Nunavut Water Board (NWB) License NWB3ARV0308, The licence dated January 9, 2004, expired on December 31, 2008. 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. The Hamlet is currently in the process of renewing the licence. This O&M Plan may need to be updated when the NWB license is renewed.

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 focuses on those aspects of the facility and operations related to the mandate of the NWB.

1.3 Physiography

The topography surrounding the Hamlet of Arviat is relatively flat with a sight rise when moving inland away from Hudson Bay. Local bedrock is generally overlain by glacial fluvial sediments. Arviat is located in the physiographic region of the Hudson Bay lowlands, characterized by low topographic relief, occasional bedrock outcrops and glacial and glacio-

fluvial overburden sediments. Boulder fields and eskers are common. Approximately 20 to 30 percent of the land is shallow ponds with depths of 1 m or less. Land between the ponds is marshy, vegetated by grasses and sedges.

1.4 Climate

The closest climate station to Arviat is the Rankin Inlet Airport Weather Station. The Rankin Inlet area receives an average of 18.1 cm of rainfall and 107 cm of snowfall per annum. Mean annual precipitation totals 29.7 cm per annum. July mean high and low temperatures are 14.9°C and 5.9°C, respectively. January mean high and low temperatures are -28.3°C and -35.5°C, respectively. Winds are generally north-west, and average 23 km/h (Rankin Inlet Weather Station, Climate Normals 1991-2000, Environment Canada, 2008). Climate data is included in Appendix C.

1.5 Sewage Volumes

In trucked service communities, it is normally assumed that the sewage generated is equivalent to water consumption. Accordingly, the daily and annual sewage generation rates for the Hamlet of Arviat are conservatively assumed to be equal to the water consumption rates.

Sewage volumes were determined using the projected population, associated water requirements and sewage generation rates using information from the Nunavut Bureau of Statistics. The Government of Nunavut has adopted the standards of the Government of the North West Territories (NWT) Department of Municipal and Community Affairs.

The Municipal and Community Affairs (MACA) planning guidelines suggest that the increase in the projected per capita water use in a community of less than 2000 people should calculated using the following formulae. Although Arviat has a population greater than 2000, they are still on a truck distribution system and therefore this formula has been used.

RWU x (1.0 + (0.00023 x Population)

The RWU is the residential water use rate per capita. In the MACA guidelines it is assumed to be 90 L per capita. To fit the recorded water usage rates for the Hamlet, the RWU residential water use was modified to be 65 L per capita (Lpcd). This is a lower RWU than most communities however it has been confirmed that Arviat has a lower water use rate per capita than other communities. The same RWU was used in the Potable Water Supply Study completed by IEG in 2005. The factor 0.00023 x population represents the commercial and industrial water use.

Based on the above criteria, the projected annual volume of sewage generated at the end of 10 years (2019) is 92,145 m^3, while the 20-year (2029) annual volume will be 111,939 m^3. The current volume of wastewater produced for 2009 will be 76,185 m^3. The Table in

Appendix B provides a summary of the sewage generation rate for the Hamlet of Arviat over the 20-year design period.

1.6 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 D.

1.7 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 understand and operate the facility.

2.0 Sewage Collection and Delivery

The Hamlet of Arviat provides trucked water and sewage services for the Hamlet residents, businesses, and institutions.

The Sewage Treatment Facility operated by the Hamlet of Arviat is located approximately 2.8 km south-west from the Hamlet (Figure 2). Sewage is collected daily by truck from all the houses and occupied buildings with holding tanks. The sewage is collected from the holding tanks via external discharge ports on the exterior wall of these buildings. The trucks discharge the sewage into the lagoon by way of a long flume that prevents bank erosion during the discharge of the sewage into the lagoon.

There is one active lagoon and two inactive former lagoons that have reverted to ponds as shown on Figures 2 and 3.

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 will have not have 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 liquid waste. Liquid wastes meeting the criteria are acceptable for discharge into the Sewage Treatment Facility. Liquid wastes that do not meet the criteria must be pre-treated until they do, or be stored in barrels as hazardous waste for future disposal at a licensed facility located outside of the community.

Liquid wastes not suitable for disposal at the Sewage Treatment Facility must be stored in a secure storage area at Hazardous Waste Storage Area at the Solid Waste Management Facility.

3.0 Operation and Maintenance of the Sewage Treatment Facility

3.1 Sewage Treatment Facility Design

The Arviat Sewage Treatment Facility consists of two components:

- **Lagoon** – a facultative lagoon, which provides retention time for the settlement of solids aerobic and anaerobic processes, which decomposes the sewage through microbial activity

- **Wetland Treatment Area** – which receives the discharge of the treated effluent from the lagoon for final treatment via filtering and biological digestion by plants and micro-organisms in a designated wetland.

3.1.1 Sewage Lagoons

There are three sewage lagoons in the Hamlet. The newest lagoon located closest to the ocean was commissioned in 2005. The two older lagoons are no longer in use.

The lagoon seeps discharge at a slow continuous rate through the lagoon berm and into the wetland treatment area. The sewage moves through the wetland treatment area towards Hudson Bay approximately 100 m from the lagoons' discharge point, via a controlled path directed by man-made berms.

There is no seasonal decanting.

The lagoon is fenced and warning signs are posted. A 450 metre setback surrounding the lagoons is designated in the Community Land Use plan as restrictive development.

Detailed as-built drawings have not been confirmed to exist. A drawing and photographs of construction included in Appendix F. Design concept drawings are included in Appendix H. If additional as-built drawings cannot be located they may have to be recreated from examining existing conditions. No documents were available describing how the site was to operate in accordance with design.

3.1.2 Lagoon Storage Capacity

The lagoon covers an area of approximately 18,980 m^2. Using an estimated usable depth of approximately 2.0 m, the capacity of the lagoon was calculated to be approximately 37,960 m^3. Calculations for the volume of the lagoon are included in Appendix B.

The level of the lagoon remains consistent indicating that the flow out of the lagoon is equal to the flow into the lagoon. Projected sewage volumes for the Hamlet of Arviat are included in Appendix B.

To establish the influx of water into the lagoon the volume of precipitation and the rate of evaporation must also be considered. It is assumed that water evaporates from a sewage lagoon at the same rate as from a lake. It is also assumed that sublimation rates, which is the evaporation from a frozen surface, is not a significant factor. The annual evaporation rate for the Hamlet of Arviat is estimated at approximately 200 mm/year. Climate normal data from the Environment Canada website indicates that the average annual precipitation for the closest weather station to Arviat, Rankin Inlet is 297 mm/year (climate data is included in Appendix C). The net addition of precipitation to the lagoon is 97 mm/year.

The lagoon has raised berms therefore there should be no runoff draining into the lagoon.

The volume of accumulated sludge must also be considered in determining the total storage volume of the lagoon. Sludge has not been removed from the lagoon since it was commissioned in 2005. Typically, the value of dry solids within sewage can range from 3 to 5 percent. A 5 percent dry solids accumulation has been used in these conservative calculations. The height of the sludge accumulation in the lagoon will be monitored at intervals to ensure accumulation does not exceed a certain percent volume of the lagoon. This height is presently set at 0.4 m from the bottom of the lagoon floor, which is 20 percent volume of the lagoon. As shown on the table in Appendix B, the volume of sludge will reach 20 percent of the volume of the lagoon by Planning Year 5 (2014). At this time the removal of sludge should be considered to maintain the capacity of the lagoon.

3.1.3 Sewage Retention

In Appendix B, the retention time for the sewage has been calculated for a planning period of 20 years using the volume of the lagoon divided by total flow rate into the lagoon. The calculations take into account the input of sewage, the annual input from precipitation and the volume of cumulative sludge in the lagoon. It should be noted that during the winter, the lagoon and surrounding ground is predominately frozen and therefore, the flow out of the lagoon is severely restricted. At the same time dilution due to the input of precipitation is also greatly decreased. Two retention times have been calculated, one based on the diluted sewage (total input into the lagoon) and one based on sewage input, without dilution from precipitation.

The calculations illustrate that the lagoon currently holds the raw sewage for approximately 149 days, and that in 20 years the retention time of the lagoon will decrease to 44 days. Sludge removal will increase the capacity of the lagoon and increase the retention time.

There is currently very limited information to demonstrate that the sewage treatment facility is providing adequate treatment to comply with the water licence criteria. Sampling results from work conducted by the University of Waterloo in cooperation with Fleming College is included in Appendix G. As more information becomes available, the design and operation of the lagoons may need to be modified to meet the discharge criteria of the water licence.

3.1.4 Wetland Treatment Area

There is approximately 100 metres of land between the Sewage Lagoon and the ocean which is identified as the wetland treatment area in Figure 3.

The wetland treatment area is a secondary treatment system from the primary treatment system (the facultative lagoon). Wetland systems operate by dispersing sewage lagoon-treated effluent over an area of sufficient size, to allow natural processes such as sedimentation, adsorption by soil particles, uptake, and digestion of nutrient components by plants, microbial decomposition of complex molecules, physical entrainment in changing flow regimes, and dilution by intermixing with the natural water system. The Wetland Treatment Area is designed as a part of the Sewage Treatment Facility and the land area is formally set aside for this land use, and all other land use that could be a conflict with this use is prohibited in the designated Wetland Treatment Area.

To data there has been no comprehensive study of the functioning of the wetland area, so its effectiveness is in question. Recent data is included in Appendix G.

3.2 Sewage Collection Procedures

The following sewage collection operational procedures shall be carried out by the staff of the Hamlet of Arviat 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 into a long flume spillway that prevents bank erosion during the discharge of the sewage into the lagoon

- Daily waste volumes deposited to the Sewage Lagoon (and trip counts) shall be recorded on the recording form included 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 Arviat* shall be implemented (separate document)

- Any non-sewage liquid wastes must be properly assessed prior to discharge to the lagoon.

3.3 Sewage Lagoon Operational Procedures

The following procedures shall be undertaken by the staff of the Hamlet of Arviat 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 shall be inspected monthly

- 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

- Any airborne litter shall be removed from the Sewage Treatment Facility to the Hamlet landfill as required

- The Sewage Lagoon shall be inspected annually to determine the thickness of sludge (from a small boat in the summer or through a hole in the ice in the winter)

- Desludging of the lagoon shall be conducted, based on the sludge thickness in the lagoon. A trigger sludge depth of 0.4 m (average) will be used to determine the need for desludging

- Monitoring and inspections will occur as outlined in the NWB Water License and described in this O&M Plan. Refer to the *Environmental Monitoring and Quality Assessment/Quality Control Plan* for details (separate document).

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

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.

3.4 Discharge of Non-Sewage Waste Water

Prior to the discharge of any non-sewage wastewater, the quality of the water must be assessed to ensure it does not cause a deleterious impact to the Sewage Lagoon (impact microbial processes or contaminates the water and soil), of the Wetland Treatment Area (contaminates the water, soil, and impact the vegetation and aquatic life). The source and nature of the wastewater must be assessed, and if there is any question of the chemical content the water must be sampled and the results assess prior to discharge.

The sample results must meet the requirements of the Canadian Water Quality Guidelines for the Protection of Aquatic Life (for non-sewage related parameters) and confirm to Guideline, Industrial Waste Discharges in Nunavut, Government of Nunavut, 2002.

3.5 Abandonment and Restoration

Part G of the Water License (Appendix A), 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. An abandonment and restoration plan for the two old sewage lagoons no longer in use needs to be completed to meet this requirement.

4.0 Sewage Treatment Facility Monitoring Program

4.1 Water License Requirements

As outlined in the NWB water license, regular monitoring of the effluent from the Sewage Treatment Facility is required. Sampling shall be in accordance with the *Hamlet of Arviat Environmental Monitoring Program and Quality Assurance/Quality Control (QA/QC) Plan*, which has been prepared as a separate document.

Monthly quantities of raw wastewater offloaded will be measured and recorded (number of truck loads) in the official operations logbook on a form similar to that presented in Appendix D.

4.2 Monitoring Locations

Monitoring stations for the Sewage Treatment Facility are displayed on Figure 3. The following is a description of each monitoring location and the required analysis for the NWB license:

Station	Description	Frequency	Analysis Requirements
ARV-1	Raw water supply at the Wolf River Water Supply prior to treatment	Monthly and annual	Measure and record in cubic metres of water pumped from station.
ARV-2	Effluent discharge from the Final Discharge Point of the Solid Waste Disposal Facility	Monthly from May to August, Inclusive	• BOD • Fecal Coliforms • pH • Conductivity • Total Suspended Solids • Ammonia Nitrogen • Nitrate-Nitrite • Oil and Grease (visual) • Total Phenols • Sulphate • Sodium • Potassium Magnesium • Calcium • Total Arsenic • Total Cadmium • Total Copper • Total Chromium • Total Iron • Total Lead • Total Mercury • Total Nickel • Total Zinc
ARV-3	Raw sewage at truck offload point	Monthly and annual	Measure and record in cubic metres the raw sewage offloaded from trucks.
ARV-4	Effluent Discharge from Final Discharge Point of the Sewage Disposal Facilities	Monthly from May to August, Inclusive	Same as ARV-2

In addition, Environment Canada recommends a Pass/Fail Bioassay Toxicity test prior to effluent discharge to the receiving environment (ARV-2). Toxicity testing provides an evaluation of effluent quality that integrates all measured parameter's and provides an indication of overall effluent characterization with respect to deleteriousness.

4.3 Monitoring Results

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

Monitoring results from baseline and intensive studies conducted in 2008 are included in Appendix G.

The researchers observed that effluent flows from Sample Site 9a and Baseline 2 flows towards Sites 1a, 1b, and 1c. Some lateral flow towards the ocean was observed, but the main flow paths move westward and then down to the ocean near Sample Site 3. This data was provided by Mr. Colin Yates, University of Waterloo.

With the exception of samples collect by INAC during inspections in 2008 and 2009, no other monitoring data was available.

5.0 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 5.1):

Table 5.1: Emergency Contacts

Contact	Location	Telephone Number	Fax Number
INAC – Water/Wastewater Resources Manager	Iqaluit	(867) 975-4550	(867) 979-6445
Hamlet of Arviat – SAO	Arviat	(867) 857-2841	
Government of Nunavut (Regional Engineer)	Rankin Inlet	(867) 645-8159	(867) 645-8196
Environment Canada – Inspector	Iqaluit	(867) 975-4644	(867) 975-4594
Fire Department	Arviat	(867) 857-2525	-
RCMP Detachment	Arviat	(867) 857-1111	-
Health Center	Arviat	(867) 857-3100	-

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 Arviat* (prepared as a separate document) provides procedures and direction in the case of a spill or accident.

For the Sewage Treatment Facility, serious emergencies are unlikely, however the following indicates the response to potential events:

- Discharge of deleterious materials of wastes into the lagoon – treat as a spill situation and contain and control discharge to the natural environment

- Failure of the retaining berm and massive discharge of lagoon contents – increase flow pathway to Hudson Bay by damming and restricting flow through the wetland as much as possible and restore berm. Human health and safety and environment protection is the priority of any discharge of wastewater.

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

6.0 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 each 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 E.

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 – Daily 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 – Sewage Lagoon Discharge Log – to document the time and volume of sewage discharged out of lagoon during the various seasons when seepage is occurring through the berm

- 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 *Environmental Monitoring Program and QA/QC Plan, Hamlet of Arviat* (prepared as a separate document) outlines sample collection and analytical data handling protocols. Using the forms and following the procedures provided herein will simplify the submission of the NWB Annual Report.

7.0 Summary

7.1 Overview

This Operation and Maintenance Plan (O&M) has been prepared based on the current information available regarding the design of the Arviat Sewage Treatment Facility. This report should be reviewed annually and updated when a new water license is issued, or when there are changes to the facility or operations.

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

The following items should be implemented:

- Fence around the lagoon to prevent access by humans and animals
- Monitoring stations to be marked with a sign
- Signage on the fence and at locations in the Wetland Treatment Area indicating the presence of sewage impacted surface water
- Encourage the public to avoid travel through the Sewage Treatment Facility Area
- Prepare an Abandonment and Restoration Plan for the two old lagoons.

7.2 Outstanding Issues

In the process of applying for a NWB water license renewal, data gaps and missing information to meet the requirements of various regulatory agencies, as well as to meet the requirements of the expired license were identified.

Many of these items were documented in the Compilation of Issues generated from the Technical Meeting/Pre-Hearing Conference in March 2010.

Many of these items will require study during the summer and fall seasons, and the creation of base maps and engineering drawings. The issues include:

- Accumulation and management of sludge
- Monitoring discharge criteria
- Abandonment and restoration of the two old lagoons
- Evaluation of the effluent discharge flow path and long term attenuative capacity of the flow path/wet land treatment system
- Lagoon discharge period and flows

- Quantification of retention times during different seasons (i.e. thawed and unthawed)
- Evaluation of the seepage area in the berm and its long term structural integrity
- The need for seasonal decanting
- Sludge thickness assessment and monitoring protocol.

Since these issues cannot be resolved without further study, it is recommended that the outstanding issues be included as "Conditions" in the new water license with the delivery of the applicable studies, to address the issues by December 31, 2010. Any engineering and construction activities to bring the facility into compliance to be competed by December 31, 2011.

8.0 References

Canadian Council of Ministers of the Environment (CCME), 2007. *Canadian Water Quality Guidelines for the Protection of Aquatic Life: Summary table*. Updated September, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of the Environment, Winnipeg.

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.

Environment Canada, 2008. *Canadian Climate Normals 1971-2000, Rankin Inlet A Weather Station*, Environment Canada. <http://climate.weatheroffice.ec.gc.ca/climate_normals/results_e.html?StnID=1721&autofwd=1>. Accessed Nov 10, 2008.

FSC Architects & Engineers, *Design Concept for Arviat Sewage Lagoon Design*, prepared for the Government of Nunavut, May 2003. (Partial)

Government of Nunavut (2002), *Guideline: Industrial Waste Discharges in Nunavut*.

National Research Council. August 2004. *National Guide to Sustainable Municipal Infrastructure: Optimization of Lagoon Operations*. Ottawa, Ontario.

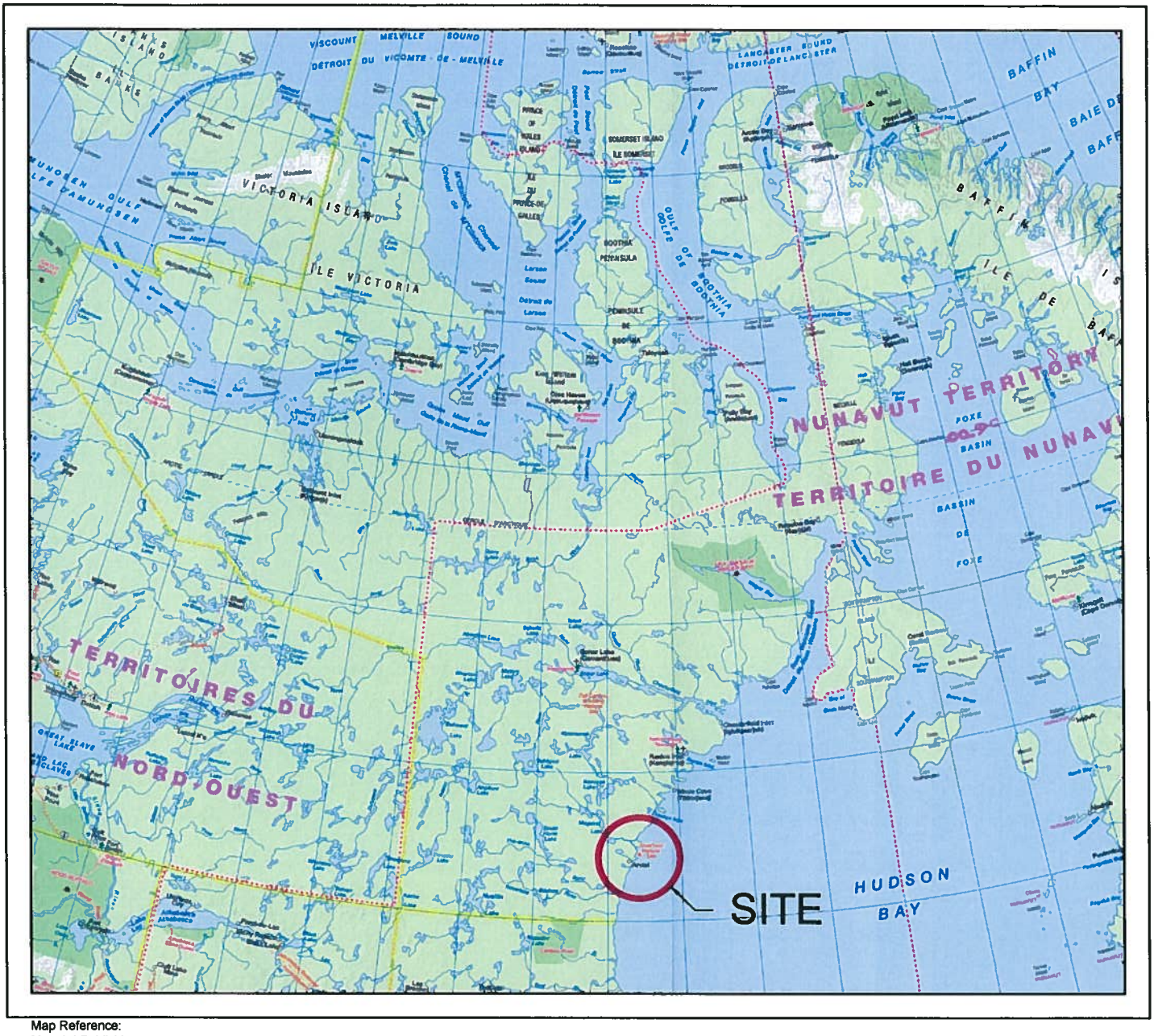
Nunavut Water Board, (2000). *Guidelines for the Discharge of Domestic Waste Water in Nunavut*.

Nunavut Water Board, January 2004. *Hamlet of Arviat Water Licence NWB3ARV0308*. Gjoa Haven, Nunavut.

Nuna Burnside Engineering & Environmental Ltd., (May 2009, revised May 2010). *Environmental Emergency Contingency Plan, Hamlet of Arviat*.

Nuna Burnside Engineering & Environmental Ltd., (May 2009, revised May 2010). *Environmental Monitoring Program and Quality Assurance/Quality Control Plan*, *Hamlet of Arviat*.

Figures



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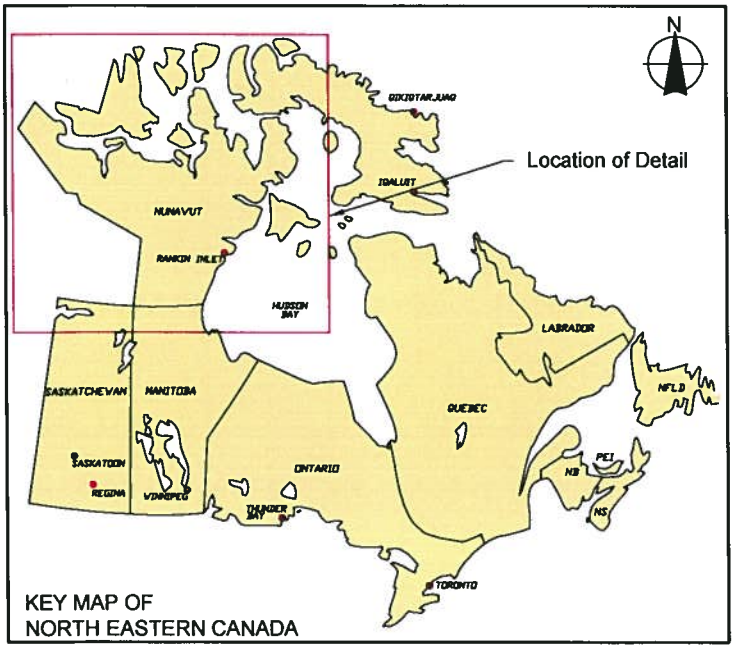


KEY MAP OF
NORTH EASTERN CANADA

FIGURE 1 - SITE LOCATION MAP

HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT

SEWAGE TREATMENT FACILITY OPERATIONS & MAINTENANCE PLAN

January 2009
Project Number: N-O15746

Prepared by: C. Sheppard Verified by: J. Walls

NUNA BURNSIDE

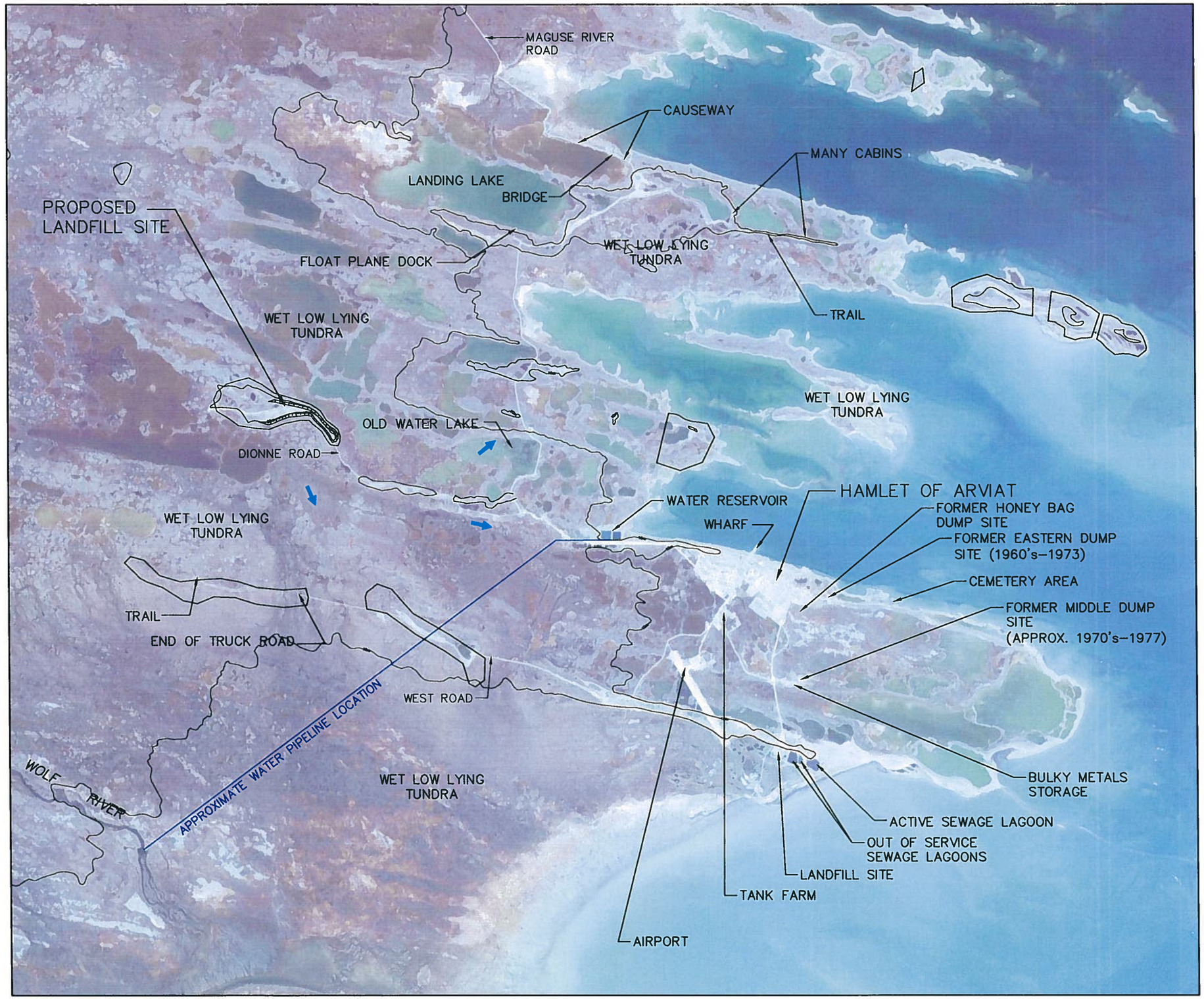
N-O15746 SEWAGE TREATMENT O&M PLAN SL.dwg

Plot Time: Jun 08, 2009 - 9:39am

FIGURE 2

HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT
SEWAGE TREATMENT FACILITY O&M PLAN

COMMUNITY PLAN



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Map Source:
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December 2008
Project Number: N-O15746

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

NUNA BURNSIDE

N-O15746 SEWAGE TREATMENT O&M PLAN CP.dwg

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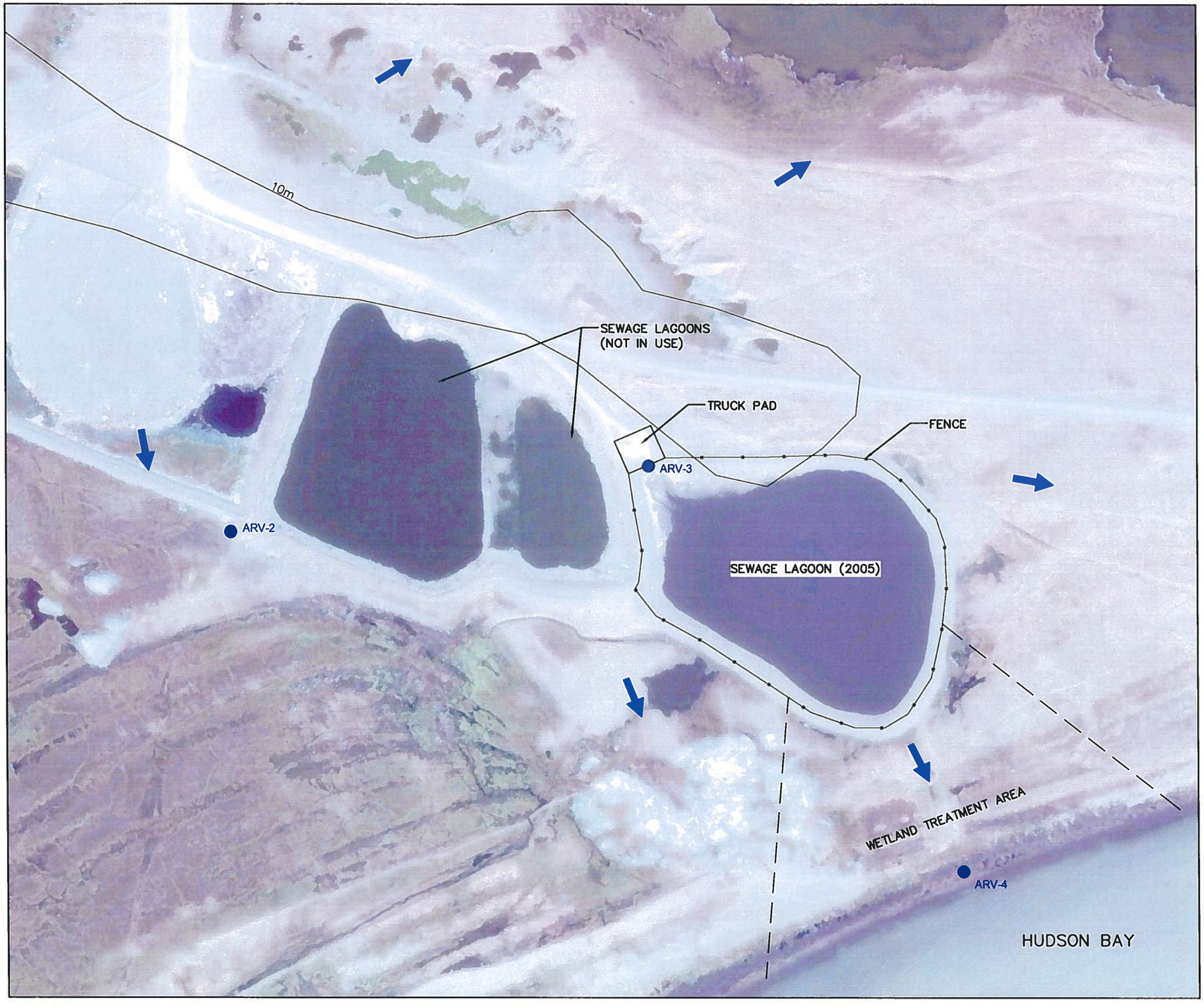

FIGURE 3

HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT
SEWAGE TREATMENT FACILITY O&M PLAN

SEWAGE TREATMENT FACILITY

LEGEND

- INTERPRETED SURFACE WATER FLOW DIRECTION
- MONITORING LOCATION

Satellite Image Source:
Background colour satellite image obtained from Google Earth Pro.

Map Source:
Background physical features obtained from the National Topographic Database Website.

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December 2008
Project Number: N-O15746

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Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

N-O15748 SEWAGE TREATMENT O&M PLAN STF.dwg

Plot Time: Jun 08, 2009–10:35am

Appendix A

Water Board Licence

P.O. Box 119
Gjoa Haven, NU X0B 1J0
Tel: (867) 360-6338
Fax: (867) 360-6369

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI

DECISION

LICENCE NUMBER: NWB3ARV0308

This is the decision of the Nunavut Water Board (NWB) with respect to an application for a Licence dated September 2, 2003, made by:

Hamlet of Arviat

to allow for the use of water and disposal of waste by the Hamlet of Arviat, Nunavut. With respect to this application, the NWB gave notice to the public that the Hamlet had filed an application for a water licence.

DECISION

After having been satisfied that the application was exempt from the requirement for screening by the Nunavut Impact Review Board in accordance with S. 12.3.2 of the *Nunavut Land Claim Agreement* (NLCA), the NWB decided that the application could proceed through the regulatory process. After reviewing the submission of the Applicant and written comments expressed by interested parties, the NWB, having given due regard to the facts and circumstances, the merits of the submissions made to it and to the purpose, scope and intent of the *Nunavut Land Claims Agreement* and of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA), decided to waive the requirement to hold a public hearing and furthermore to delegate its authority to approve the application to the Chief Administrative Officer pursuant to S. 49(a) of the NWNSRTA and determined that:

Licence Number NWB3ARV0308 be issued subject to the terms and conditions contained therein. (Motion #: 2003-39)

SIGNED this 9th day of January 2004 at Gjoa Haven, NU.

P diPizzo

Philippe di Pizzo
Chief Administrative Officer

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I. BACKGROUND

The Hamlet of Arviat is located on the northern shore of a peninsula on the west coast of Hudson Bay. Arviat is located at 61°05' N and 94° 00'W, and is 241 km southwest of Rankin Inlet and 265 air km north of Churchill, Manitoba. The topography of Arviat, which is located on a low and narrow coastal strip, is characterized by low topographic variations, occasional bedrock outcrops and a thick mantle of glacio- fluvial debris. Features include till, fine- grained marine deposits, and extensive beaches. The permafrost is continuous, extending to depths from 30 m to over 100 m. The active layer varies between 0.5 m and 0.3 m. Numerous ponds and lakes are present in the vicinity of the Hamlet, making drainage difficult. The average annual precipitation in Arviat consists of 16 cm of rainfall and 118 cm of snowfall. The mean high in July is 13.1 degrees with a mean low of 4.5 degrees. In January, the mean high is -27.9 degrees and a mean low of -35.0 degrees. The predominant local vegetation consists of mosses and lichens on rocky outcrops, with hardy grasses and sages in swampy and/or more sheltered areas.

II. PROCEDURAL HISTORY

On September 2, 2003, an application for a water licence was filed by the Hamlet of Arviat, which was previously un-licensed by the NWB. The Nunavut Water Board publicly posted notice of this application, in accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* S.55.1 and Article 13 of the *Nunavut Land Claims Agreement,* on October 7, 2003. An assessment of the Hamlet's request for a municipal water licence for water use and waste disposal activities within the Hamlet was then undertaken, so that the Board could make a fully informed decision on the merits of application. This assessment process included the referral of the application to a variety of Federal, Territorial and local organizations for their review and comment. As no public concern was expressed, the NWB waived the requirement to hold a public hearing for the application.

Based upon the results of the detailed assessment, which was completed, including consideration of any potential accidents, malfunctions, or cumulative environmental effects that the overall project might have in the area, the Board delegated to the Chief Administrative Officer authority to approve the application pursuant to S. 13.7.5 of the *Agreement.*

III. ISSUES

Term of the Licence

In accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* S. 45, the NWB may issue a licence for a term not exceeding twenty-five years. In determining an appropriate term of a water licence, the Board considers a number of factors, including the results of the annual Department of Indian Affairs and Northern Development (DIAND) site inspection and the

compliance record of the Applicant. Specifically, the August 12, 2002 DIAND Inspection Report indicated:

1. The lagoon currently in operation does not have sufficient freeboard, and capacity should be increased;
2. Concentrations of ammonia exceeded the levels recommended in the *Canadian Guidelines for the Protection of Freshwater Aquatic Life*; and
3. Levels of Total Suspended Solids and BOD exceeded the *Municipal Wastewater Effluent Quality Guidelines*.

The NWB has imposed the requirement to produce an Annual Report. These Reports are for the purpose of ensuring that the NWB has an accurate annual update of municipal activities during a calendar year. This information is maintained on the public registry and is available to any interested parties upon request. The Licensee's attention is drawn to the attached standard form for completing the Annual Report (see Attachment I).

The NWB has also imposed on the Licensee the requirement to produce an Operations and Maintenance Manual for their sewage and solid waste operations. The purpose of an Operation and Maintenance Manual is to assist Hamlet staff in the proper operation and maintenance of their waste disposal facilities. The manual should demonstrate to the Nunavut Water Board that the Hamlet is capable of operating and maintaining all waste disposal sites adequately. The Plan should be completed using the *Guidelines for the Preparation of an Operations and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories* (Duong and Kent, 1996; see Attachment II). Additionally, the Plan shall address the operational issues identified at the Sewage Disposal Facility in the July 11, 2002 DIAND Inspection Report

The NWB believes that a term of five (5) years is appropriate, and will allow enough time for the Hamlet to establish a consistent compliance record with the terms and conditions of its licence. It will also ensure that sufficient time is given to permit the Licensee to develop, submit, and implement the plans required under its licence to the satisfaction of the NWB.

Water Use

The Municipality currently receives water from the Wolf Creek water supply located 8.0 km southwest of the Hamlet. Water is stored in a 57,000 m^3, 2-cell reservoir located 1.5 km west of the Hamlet, adjacent to the truck fill station. The water receives a chlorine treatment and is then distributed to the community by truck. Water requirements for 2003 were reported as 64,871 m^3. Demand for 2008 was not reported in application. Utilizing the water demand formula developed by the Department of Municipal and Community Affairs (Government of the Northwest Territories), projected demand requirements for 2008 was calculated at 78,273 m^3.

No concerns were expressed by the parties in their written submissions as to the amount of water required by the Applicant or the manner in which this water will be used. Based upon the projected requirements of the Hamlet, the Board has set the terms and conditions in the water licence, which govern water usage. Accordingly, and based upon the projected requirements of the Hamlet, the Board has set the terms and conditions in the water licence, which govern water usage and which are contained herein. The maximum permitted usage of water by the Hamlet of Arviat, over the term of the water license and for all purposes, has been set at 81,000 m^3 *per annum*.

Deposit of Waste

Sewage

The Hamlet of Arviat utilizes a Sewage Disposal Facility approximately 2.8 km southeast of the Municipality. This Sewage Disposal Facility is located in an area adjacent to the Solid Waste Disposal Facility, and consists of a 55,000 m^3 single-cell exfiltration lagoon. The effluent from this lagoon proceeds downstream to the marine environment through an undefined, natural wetland along a 200 m flow path prior to entering Hudson Bay.

Specific comments relevant to sewage disposal operations in the Hamlet were provided by DIAND, and Environment Canada. DIAND and Environment Canada recommended that the Hamlet develop appropriate Operations and Maintenance and Spill Contingency Plans. DIAND and Environment Canada further recommended that the Hamlet take steps to remedy capacity and effluent quality issues currently evidenced at the Sewage Disposal Facility.

Additionally, DIAND provided recommendations concerning effluent discharge criteria, which are consistent with the *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories* (Northwest Territories Water Board; 1992), as well as specific recommendations concerning the Monitoring Program. This Program is established to collect data on water quality to assess the effectiveness of treatment for protection of public health and to assess potential impacts to the environment associated with the municipal facilities. The Board concurs with these recommendations, which are reflected in the terms and conditions of the Water Licence. The Board also draws the attention of the Licensee to their requirements to implement the Quality Assurance/Quality Control (QA/QC) Plan to be provided by the NWB. The purpose of the QA/QC Plan is to ensure that samples taken in the field as part of the Monitoring Program will maintain a high quality, so as to accurately represent the physical and chemical nature of the samples being taken. It should also be noted that while minimum sampling requirements have been imposed, additional sampling may be requested by an Inspector.

Solid Waste

The Hamlet's solid waste management site is located adjacent to the Sewage Disposal system, approximately 2.8 km southeast of the community. Waste is segregated, with a generic landfill area,

a bulky wastes area, and an area segregated for hazardous wastes. Combustible wastes are burned regularly, and the landfill is compacted and covered annually.

Recommendations relevant to solid waste disposal operations in the Hamlet were provided by DIAND, DFO and Environment Canada. DIAND and Environment Canada recommended that the Hamlet develop appropriate Operations and Maintenance and Spill Contingency Plans. DIAND further recommended that the Hamlet segregate hazardous materials such as waste oils and batteries from municipal solid waste, and that these materials be disposed of off-site in an approved facility. DIAND, Environment Canada and DFO recommended the appropriate management of waste oil at the solid waste site, so as to prevent the deposition of hydrocarbons into water in contravention of the *Fisheries Act*. The Board concurs with these recommendations, which are reflected in the terms and conditions of the Water Licence.

LICENCE NWB3ARV0308

Pursuant to the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada*, the Nunavut Water Board, hereinafter referred to as the Board, hereby grants to

HAMLET OF ARVIAT

(Licensee)

of **ARVIAT, NUNAVUT, X0A 0J0**

(Mailing Address)

hereinafter called the Licensee, the right to alter, divert or otherwise use water for a period subject to restrictions and conditions contained within this licence:

Licence Number **NWB3ARV0308**

Water Management Area **NUNAVUT 06**

Location **ARVIAT, NUNAVUT**

Purpose **WATER USE AND WASTE DISPOSAL**

Description **MUNICIPAL UNDERTAKINGS**

Quantity of Water Not to be Exceeded **81,000 CUBIC METRES ANNUALLY**

Date of Licence **JANUARY 9, 2004**

Expiry Date of Licence **DECEMBER 31, 2008**

Dated ~~this~~ 9th day of January 2004 at Gjoa Haven, NU.

Philippe di Pizzo
Chief Administrative Officer

Philippe di Pizzo
Chief Administrative Officer

PART A: SCOPE AND DEFINITIONS

1. Scope

a. This Licence allows for the use of water and the disposal of waste for municipal undertakings at the Hamlet of Arviat, Nunavut (63°21' N; 90° 42'W);

b. This Licence is issued subject to the conditions contained herein with respect to the taking of water and the depositing of waste of any type in any waters or in any place under any conditions where such waste or any other waste that results from the deposits of such waste may enter any waters. Whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, or other statutes imposing more stringent conditions relating to the quantity or type of waste that may be so deposited or under which any such waste may be so deposited, this Licence shall be deemed, upon promulgation of such Regulations, to be subject to such requirements; and;

c. Compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with the requirements of all applicable Federal, Territorial and Municipal legislation.

2. Definitions

In this Licence: **NWB3ARV0308**

"Act" means the *Nunavut Waters and Nunavut Surface Rights Tribunal Act;*

"Amendment" means a change to original terms and conditions of this licence requiring correction, addition or deletion of specific terms and conditions of the licence; modifications inconsistent with the terms of the set terms and conditions of the Licence;

"Analyst" means an Analyst designated by the Minister under Section 85 (1) of the *Act*;

"Appurtenant undertaking" means an undertaking in relation to which a use of waters or a deposit of waste is permitted by a licence issued by the Board;

"Average Concentration" means the arithmetic mean of the last four consecutive analytical results for contained in composite or grab samples collected from the Waste Disposal Facility's final discharge point;

"**Average Concentration For Faecal Coliforms**" means the geometric mean of the last four consecutive analytical results for faecal coliforms contained in composite or grab samples collected from the Waste Disposal Facility's final discharge point;

"**Board**" means the Nunavut Water Board established under the *Nunavut Land Claims Agreement*;

"**Chief Administrative Officer**" means the Executive Director of the Nunavut Water Board;

"**Commercial Waste Water**" means water and associated waste generated by the operation of a commercial enterprise, but does not include toilet wastes or greywater;

"**Composite Sample**" means a water or wastewater sample made up of four (4) samples taken at regular periods over a 24 hour period;

"**Effluent**" means treated or untreated liquid waste material that is discharged into the environment from a structure such as a settling pond or a treatment plant;

"**Final Discharge Point**" means an identifiable discharge point of a Waste Disposal Facility beyond which the Licensee no longer exercises care and control over the quality of the Effluent;

"**Freeboard**" means the vertical distance between water line and crest on a dam or dyke's upstream slope;

"**Grab Sample**" means a single water or wastewater sample taken at a time and place representative of the total discharge;

"**Greywater**" means all liquid wastes from showers, baths, sinks, kitchens and domestic washing facilities, but does not include toilet wastes;

"**Inspector**" means an Inspector designated by the Minister under Section 85 (1) of the *Act*;

"**Licensee**" means the holder of this Licence;

"**Modification**" means an alteration to a physical work that introduces new structure or eliminates an existing structure and does not alter the purpose or function of the work, but does not include an expansion, and changes to the operating system that are consistent with the terms of this Licence and do not require amendment;

"**Monitoring Program**" means a monitoring program established to collect data on surface water and groundwater quality to assess impacts to the freshwater aquatic environment of an appurtenant undertaking;

"**Nunavut Land Claims Agreement**" **(NLCA)** means the *"Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada"* , including its preamble and schedules, and any amendments to that agreement made pursuant to it;

"**Sewage**" means all toilet wastes and greywater;

"**Sewage Disposal Facilities**" comprises the area and engineered lagoon and decant structures designed to contain and treat sewage as described in the Application for Water Licence filed by the Applicant on September 2, 2003 and illustrated in Drawing # 2003-0440-04/1-3;

"**Solid Waste Disposal Facilities**" comprises the area and associated structures designed to contain solid waste as described in the Application for Water Licence filed by the Applicant on September 2, 2003 and illustrated in Drawing # 2003-08-26;

"**Toilet Wastes**" means all human excreta and associated products, but does not include greywater;

"**Waste**" means, as defined in S.4 of the *Act*, any substance that, by itself or in combination with other substances found in water, would have the effect of altering the quality of any water to which the substance is added to an extent that is detrimental to its use by people or by any animal, fish or plant, or any water that would have that effect because of the quantity or concentration of the substances contained in it or because it has been treated or changed, by heat or other means;

"**Waste Disposal Facilities**" means all facilities designated for the disposal of waste, and includes the Sewage Disposal Facilities and Solid Waste Disposal Facilities, as described in the Application for Water Licence filed by the Applicant on September 2, 2003 and illustrated in Drawing # 2003-0440-04/1-3; and

"**Water Supply Facilities**" comprises the area and associated intake infrastructure at the Wolf Creek Water Supply, as described in the Application for Water Licence filed by the Applicant on September 2, 2003 and illustrated in Drawing # 1998-08-24/2.

PART B: GENERAL CONDITIONS

1. The Licensee shall file an Annual Report with the Board not later than March 31st of the year following the calendar year reported which shall contain the following information:

i. tabular summaries of all data generated under the "Monitoring Program";

ii. the monthly and annual quantities in cubic metres of fresh water obtained from all sources;

iii. the monthly and annual quantities in cubic metres of each and all waste discharged;

iv. a summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures and facilities;

v. a list of unauthorized discharges and summary of follow-up action taken;

vi. a summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year;

vii. a summary of any studies, reports and plans (e.g., 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;

viii. any other details on water use or waste disposal requested by the Board by November 1st of the year being reported; and

2. The Licensee shall comply with the "Monitoring Program" described in this Licence, and any amendments to the "Monitoring Program" as may be made from time to time, pursuant to the conditions of this Licence.

3. The "Monitoring Program" and compliance dates specified in the Licence may be modified at the discretion of the Board.

4. Meters, devices or other such methods used for measuring the volumes of water used and waste discharged shall be installed, operated and maintained by the Licensee to the satisfaction of an Inspector.

5. The Licensee shall, within ninety (90) days after the first visit of the Inspector, post the necessary signs, where possible, to identify the stations of the "Monitoring Program." All signage postings shall be in the Official Languages of Nunavut, and shall be located and maintained to the satisfaction of an Inspector.

6. The Licensee shall immediately report to the 24-Hour Spill Report Line (867-920-8130) any spills of Waste, which are reported to or observed by the Licensee, within the municipal boundaries or in the areas of the Water Supply or Waste Disposal Facilities.

7. The Licensee shall ensure a copy of this Licence is maintained at the municipal office at all times.

8. Any communication with respect to this Licence shall be made in writing to the attention of:

(i) Chief Administrative Officer:
Executive Director
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0
Telephone: (867) 360-6338
Fax: (867) 360-6369

(ii) Inspector Contact:
Water Resources Officer
Nunavut District, Nunavut Region
P.O. Box 100
Iqaluit, NU X0A 0H0
Telephone: (867) 975-4298
Fax: (867) 979-6445

(iii) Analyst Contact:
Taiga Laboratories
Department of Indian and Northern Affairs
4601 - 52 Avenue, P.O. Box 1500
Yellowknife, NT X1A 2R3
Telephone: (867) 669-2781
Fax: (867) 669-2718

9. The Licensee shall submit one paper copy and one electronic copy of all reports, studies, and plans to the Board. Reports or studies submitted to the Board by the Licensee shall include a detailed executive summary in Inuktitut.

PART C: CONDITIONS APPLYING TO WATER USE

1. The Licensee shall obtain all fresh water from the Wolf Creek Water Supply using the Water Supply Facilities or as otherwise approved by the Board.

2. The annual quantity of water used for all purposes shall not exceed 81,000 cubic metres.

3. The Licensee shall maintain the Water Supply Facilities to the satisfaction of the Inspector.

4. The water intake hose used on the water pumps shall be equipped with a screen with a mesh size sufficient to ensure no entrainment of fish.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. The Licensee shall direct all Sewage to the Sewage Disposal Facilities or as otherwise approved by the Board.

2. All Effluent discharged from the Sewage Disposal Facilities at Monitoring Program Station ARV-4 shall meet the following effluent quality standards:

Parameter	Maximum Average Concentration
Faecal Coliforms	1 x 10^4CFU/dl
BOD_5	80 mg/L
Total Suspended Solids	100 mg/L
Oil and grease	No visible sheen
pH	between 6 and 9

3. A Freeboard limit of 1.0 metre, or as recommended by a qualified geotechnical engineer and as approved by the Board, shall be maintained at all dams, dykes or structures intended to contain, withhold, divert or retain water or wastes.

4. The Licensee shall advise an Inspector at least ten (10) days prior to initiating any decant of the sewage lagoon.

5. The Sewage Disposal Facility shall be maintained and operated, to the satisfaction of an Inspector in such a manner as to prevent structural failure.

6. The Licensee shall dispose of and contain all solid wastes at the Solid Waste Disposal Facilities or as otherwise approved by the Board.

7. The Licensee shall implement measures to ensure hazardous materials and/or leachate from the Solid Waste Disposal Facility does not enter water.

8. The Licensee shall submit to the Board for review within six (6) months of the issuance of this license a report identifying each Final Discharge Point. The report shall at least include:

    a. Plans, specifications and a general description of each Final Discharge Point together with its specific geo-referenced location;

    b. A description of how each Final Discharge Point is designed and maintained.

9. If, during the term of this Licence, additional Final Discharge Points are identified, the Licensee shall submit the information as required by Part D, Item 8 for each new Final Discharge Point within 30 days after the discharge point is identified and at least 60 days prior to depositing Effluent from the new Final Discharge Point and/or proposed changes are made to a Final Discharge Point.

PART E: CONDITIONS APPLYING TO MODIFICATION AND CONSTRUCTION

1. The Licensee shall submit to the Board for approval design drawings stamped by a qualified engineer registered in Nunavut prior to the construction of any dams, dykes or structures intended to contain, withhold, divert or retain water or wastes.

2. The Licensee may, without written approval from the Board, carry out modifications to the Water Supply and Waste Disposal Facilities provided that such modifications are consistent with the terms of this Licence and the following requirements are met:

    i. the Licensee has notified the Board in writing of such proposed modifications at least sixty (60) days prior to beginning the modifications;

    ii. said modifications do not place the Licensee in contravention of the Licence or the *Act*;

iii. the Board has not, during the sixty (60) days following notification of the proposed modifications, informed the Licensee that review of the proposal will require more than sixty (60) days; and

iv. the Board has not rejected the proposed modifications.

3. Modifications for which all of the conditions referred to in Part E, Item 1, have not been met may be carried out only with written approval from the Board.

4. The Licensee shall provide as built plans/drawings of the modifications referred to in this Licence within ninety (90) days of completion of the modifications.

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

1. The Licensee shall, within 6 months of the issuance of this license, submit to the Board for approval, a Plan for the Operation and Maintenance of the Sewage and Solid Waste Disposal Facilities in accordance with *"Guidelines for Preparing an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities"* (October 1996). This Plan shall specifically address hazardous waste disposal and operational issues at the Solid Disposal Facility.

2. The Licensee shall implement the Plan specified in Part F, Item 1 as and when approved by the Board.

3. The Licensee shall revise the Plan referred to in Part F, Item 1, if not acceptable to the Board. The revised Plan shall be submitted to the Board for approval within thirty (30) days of notification of the Board decision

4. If, during the period of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:

   i. employ the appropriate contingency plan as provided for in the Operation and Maintenance Plan;
   ii. report the incident immediately via the 24-Hour Spill Reporting Line at (867) 920-8130 and to an Inspector; and
   iii. submit to an Inspector a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.

5. In the absence of a contingency plan contained within an approved Operation and Maintenance Plan, and should during the period of this Licence an unauthorized discharge of

waste occur, or if such a discharge is foreseeable, the Licensee shall:

i. take whatever steps are immediately practicable to protect human life, health and the environment;
ii. without delay seek guidance from the Departments of Community Government and Transportation and Sustainable Development with regards to mitigation and remedial actions required to address the discharge;
ii. report the incident immediately *via* the 24-Hour Spill Reporting Line at (867) 920-8130 and to an Inspector; and
iii. submit to an Inspector a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.

PART G: CONDITIONS APPLYING TO ABANDONMENT AND RESTORATION

1. The Licensee shall submit to the Board for approval an Abandonment and Restoration Plan at least six (6) months prior to abandoning any facilities and the construction of new facilities to replace existing ones. The Plan shall include, but not be limited to where applicable:

   i. water intake facilities;
   ii. the water treatment and waste disposal sites and facilities;
   iii. petroleum and chemical storage areas;
   iv. any site affected by waste spills;
   v. leachate prevention;
   vi. an implementation schedule;
   vii. maps delineating all disturbed areas, and site facilities;
   viii. consideration of altered drainage patterns;
   ix. type and source of cover materials;
   x. future area use;
   xi. hazardous wastes; and
   xii. a proposal identifying measures by which restoration costs will be financed by the Licensee upon abandonment.

2. The Licensee shall implement the plan specified in Part G, Item 1 as and when approved by the Board.

3. The Licensee shall revise the Plan referred to in Part G, Item 1 if not approved. The revised Plan shall be submitted to the Board for approval within thirty (30) days of receiving notification of the Board's decision.

4. The Licensee shall complete the restoration work within the time schedule specified in the Plan, or as subsequently revised and approved by the Board.

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

1. The Licensee shall maintain Monitoring Stations at the following locations:

Monitoring Station	Description
ARV-1	Raw water supply at the Wolf Creek Water Supply prior to treatment
ARV-2	Effluent discharge from the Final Discharge Point of the Solid Waste Disposal Facilities
ARV-3	Raw Sewage at truck offload point
ARV-4	Effluent discharge from the Final Discharge Point of the Sewage Disposal Facilities

2. The Licensee shall sample monthly at Monitoring Station ARV-2 and ARV-4 during the months of May to August, inclusive. Samples shall be analyzed for the following parameters:

BOD	Faecal Coliforms
pH	Conductivity
Total Suspended Solids	Ammonia Nitrogen
Nitrate-Nitrite	Oil and Grease (visual)
Total Phenols	Sulphate
Sodium	Potassium
Magnesium	Calcium
Total Arsenic	Total Cadmium
Total Copper	Total Chromium
Total Iron	Total Lead
Total Mercury	Total Nickel
Total Zinc	

3. The Licensee shall measure and record in cubic metres the monthly and annual quantities of water pumped from Monitoring Station ARV-1 for all purposes.

4. The Licensee shall measure and record in cubic metres the monthly and annual quantities of raw sewage offloaded from trucks at Monitoring Station ARV-3 for all purposes.

5. Additional sampling and analysis may be requested by an Inspector.

6. The Licensee shall conform to the Quality Assurance/Quality Control (QA/QC) Plan which shall be provided to the Licensee by the NWB within 120 days of the issuance of this license.

7. All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of *Standard Methods for the Examination of Water and Wastewater*, or by such other methods approved by the Board.

8. All analyses shall be performed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) Certified Laboratory, or as otherwise approved by an Analyst.

9. The Licensee shall measure and record the annual quantities of sewage solids removed from the Sewage Disposal Facility.

10. The Licensee shall, unless otherwise requested by an Inspector, include all of the data and information required by the "Monitoring Program" in the Licensee's Annual Report, as required *per* Part B, Item 1.

11. Modifications to the Monitoring Program may be made only upon written approval of the Chief Administrative Officer.

Appendix B
Calculations and Tables

Sewage Generation Rates for the Hamlet of Arviat

Planning Year	Calendar Year	Total Population[1]	Projected Sewage generation[2] (lpcd)	Projected Volume (m^3/day)	Projected Volume (m^3/year)	Projected Sludge Quantity (kg/annum)	Cumulative Sludge Volume[4] (m^3)	Available Volume of Lagoon (m^3)	Total Lagoon Retention Time (days)	Dilution Factor of Lagoon by Precipitation (Sewage / Total Input)	Lagoon Retention without Dilution (days)
	2006	2060	96	197	72,030	37,595	752	34,547	169	96%	175
	2007	2089	96	201	73,374	38,124	1,514	33,785	162	97%	168
	2008	2119	97	205	74,775	38,672	2,288	33,011	156	97%	161
0	2009	2149	97	209	76,185	39,219	3,072	32,227	149	97%	154
	2010	2180	98	213	77,653	39,785	3,868	31,431	143	97%	148
	2011	2211	98	217	79,131	40,351	4,675	30,624	137	97%	141
	2012	2242	99	221	80,620	40,917	5,493	29,806	131	97%	135
	2013	2274	99	225	82,168	41,501	6,323	28,976	125	97%	129
5	2014	2306	99	229	83,727	42,085	7,165	28,134	119	97%	123
	2015	2339	100	234	85,346	42,687	8,019	27,280	113	97%	117
	2016	2372	100	238	86,977	43,289	8,884	26,415	108	97%	111
	2017	2406	101	243	88,671	43,910	9,763	25,536	102	97%	105
	2018	2440	101	248	90,376	44,530	10,653	24,646	97	97%	100
10	2019	2475	102	252	92,145	45,169	11,557	23,742	91	97%	94
	2020	2510	103	257	93,928	45,808	12,473	22,826	86	97%	89
	2021	2546	103	262	95,775	46,465	13,402	21,897	81	97%	83
	2022	2582	104	267	97,637	47,122	14,345	20,955	76	97%	78
	2023	2619	104	273	99,565	47,797	15,300	19,999	71	97%	73
15	2024	2656	105	278	101,507	48,472	16,270	19,029	67	97%	68
	2025	2694	105	284	103,518	49,166	17,253	18,046	62	97%	64
	2026	2732	106	289	105,545	49,859	18,250	17,049	58	98%	59
	2027	2771	106	295	107,641	50,571	19,262	16,037	53	98%	54
	2028	2810	107	301	109,754	51,283	20,287	15,012	49	98%	50
20	2029	2850	108	307	111,939	52,013	21,328	13,971	44	98%	46

Notes: 1) Population in 2006 taken from Statistics Canada 2006 Census of Population. A population growth of 1.4% was applied to the subsequent years.
2) The projected sewage generation rate is based on the Nunavut water usage formula for municipalities that do not have piped water [RWU L/c/d x (1 + 0.00023 x population)] (MACA, 1988).
3) The Residential Water Usesage Rate is estimated to be 90 L/c/d for municipalities where water is not distributed by a piping system. To fit the recorded water use data the RWU rate was lowerd to 65 L/c/d.
4) A value of 5% dry solids is assumed for the liquid sludge accumulating at the bottom of the lagoon.

Calculations and Numbers Used

Area of Lagoon (m^2)	18980
Freeboard (m)	1
Average Usable Depth (m)	2
Useable Lagoon Volume (m^3)	37960
Population Growth Rate	1.4%
Sewage Generation Rate (lpcd)	65

Natural Waters Input in Lagoon

Annual Precipitation (m/year)	0.3402
Evaporation (m/year)	0.2
Lagoon Suface Area (m^2)	18980
Net Influx to Lagoon from Precipitation (m^3/year)	2661

* MACA, 1988. Guidelines for the Planning, Design and Operation and Maintenance of Wastewater Lagoon Systems in NWT. Prepared for Municipal and Community Affairs, Government of Northwest Territories. Yellowknife, Northwest Territories.

** Evapotranspiration estimated based on several references. See Hydrology Calculations in Appendices.

Hydrology Calculations, Hamlet of Arviat

Annual Rainfall (m/year)	0.2972	*Canadian Climate Normals 1971-2000, Environment Canada, Rankin Inlet Airport Weather Station
Evapotranspiration (m/year)	0.200	* Specific values for Arviat were not available, estimated using several references, see below.

Arviat Sewage Lagoon

Surface Area of Lagoon (m^2)	18,980
Average usable depth of Lagoon (m)	2
Volume of Lagoon (m^3)	37960
Rain (m^3/year)	5,641
Evapotranspiration (m^3/year)	3,796
Net Precipitation Input to Sewage Lagoon (m^3/	1,845
Total Lagoon Capacity for Sewage (m^3)	36,115

Runoff was not considered since the berms of the lagoon are raised and no runoff should enter lagoon.

Evapotranspiration Rates

Location	Value (mm)	Reference
Arviat, Nunavut	203	FSC Architects & Engineers, 2003
Mackenzie Basin, Yukon	241	Serrereze et al, 2003
Lena Basin, Russai	182	Serrereze et al, 2003
Knob Lake, Quebec	280	Church, 1974
Boot Creek, Inuvik, NWT	75	Church, 1974
Mackenzie River Basin, Yukon	216	Yi Yip, 2008
Average	**200**	

References:

FSC Architects & Engineers, 2003. Design Concept for Arviat Sewage Lagoon prepared for Department of Community Government and Transportation, Government of Nunavut.

Church, M. 1974. Hydrology and Permafrost with Reference to Northern North America. In Proceedings: Workshop Seminar on Permafrost Hydrology, 7-20. Ottawa: Canadian National Committee, International Hydrological Decade (IHD).

Yi Yip, Q.M. 2008. Climate Impacts on Hydrometric Variables in Mackenzie River Basin. University of Waterloo, Waterloo, 2008.

Serreze, M.C., D.H. Bromwich, M.P. Clark, A.J. Etringer, T. Zhang and R. Lammers, 2003. Large-scale hydro-climatology of the terrestrial Arctic drainage system. Journal Geophysical Research, 108(D2). Doi:10. 1029/2002JD000919

Appendix C
Climate Data

Climate Data

Table 1: Rankin Inlet Climate Normals Data Summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Total Precipitation (mm)	6.6	8.9	12.6	14.3	18.4	29.8	39.5	57.6	43.8	34.6	19.8	11.3	297.2
Rain (mm)	0.0	0.1	0.0	1.0	7.4	25.0	39.5	57.3	39.2	11.9	0.1	0.0	181.5
Snow (cm)	6.7	9.3	12.9	13.6	11.5	4.9	0.0	0.3	4.6	23.1	20.9	11.9	107.8
Wind Speeds (km/hour)	23.9	23.9	23.4	22.4	22.1	19.8	19.2	21.1	24.2	26.5	25.3	24.0	
Average Temperatures (°C)	-31.9	-30.1	-25.2	-16.3	-5.9	4.2	10.4	9.5	3.4	-5.3	-17.8	-26.7	

*Canadian Climate Normals 1971-2000, Environment Canada, Rankin Inlet Airport Weather Station

Specific climate data for Arviat was not available. The closest weather station is located in Rankin Inlet, 225 km north of Arviat.

BURNSIDE

Appendix D

Site Forms

Form 1
Daily Sewage Delivery Log
Hamlet of Arviat

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 Arviat

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		
Berms and Fences		
Sewage Level		
Sludge Thickness		

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

Form 3
Sewage Lagoon Decant Log
Hamlet of Arviat

Month: _____

Date	Time Valve Opened	Time Valve 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 Valve Opened	Time Valve 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										

15746_STF Decant Form 2008-12-09 1:38 PM

Form 4
Sewage Treatment Facility Planning
Hamlet of Arviat

Prepared By: _____

Date: _____

Sewage Treatment Planning Issue	Current Operations	To Do Items and Schedule
Health and Safety		
Site Inspection Results/Concerns		
Current Volume		
Treatment Process		
Annual Reporting		
Nunavut Water Board License Requirements		

Sewage Treatment Planning Issue	Current Operations	To Do Items and Schedule
Environmental Monitoring		
Staffing		
Equipment		
Costs		
Other Issues/Concerns		

BURNSIDE

Appendix E
Annual Monitoring Report Format

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

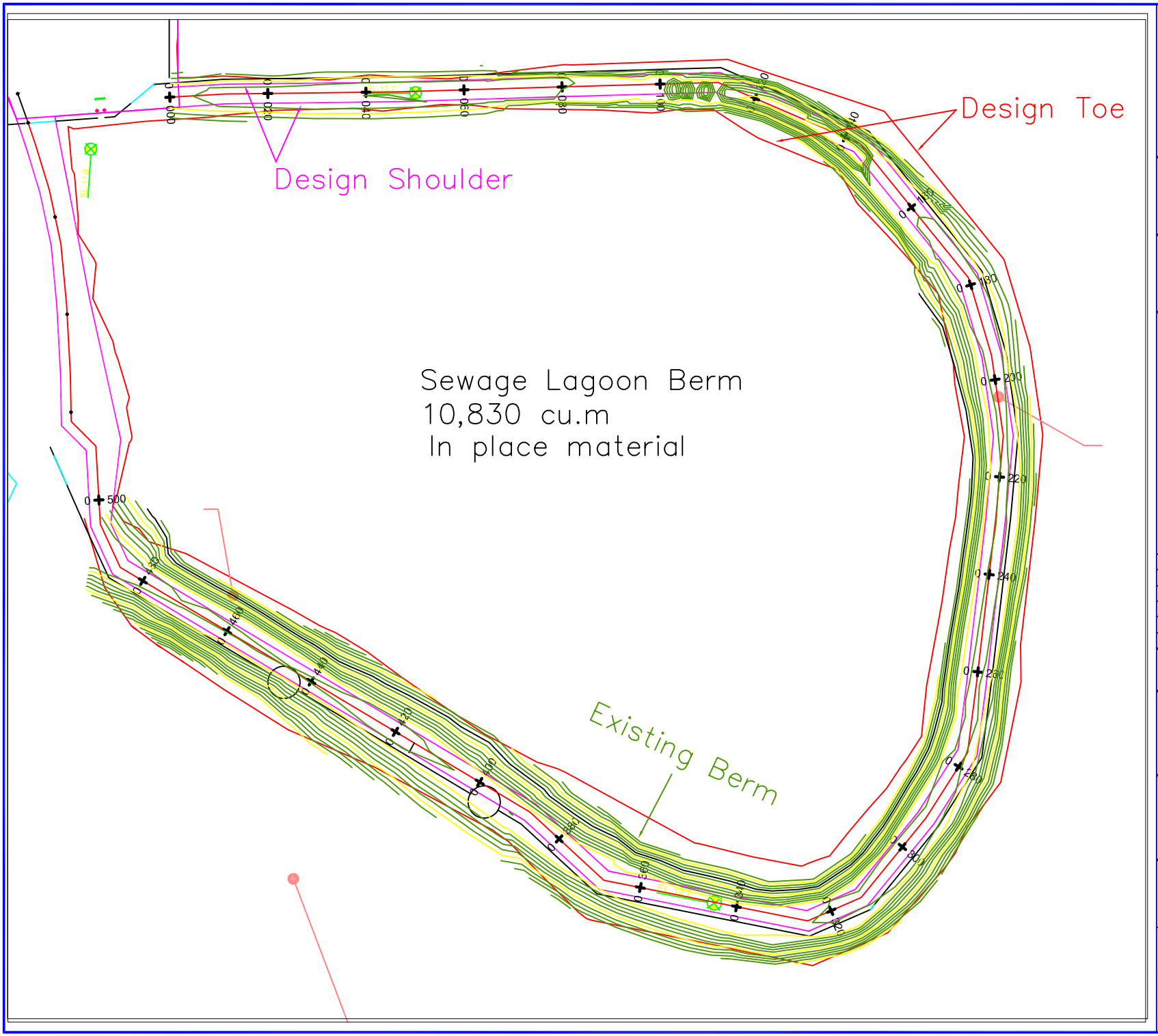
Select

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:

Appendix F
Sewage Lagoon Drawing and Construction Photos



ABORIGINAL ENGINEERING LTD.

PERMIT TO PRACTICE
ABORIGINAL ENGINEERING LTD.
Signature
Date
PERMIT NUMBER: P 290
The Association of Professional Engineers, Geologists and Geophysicists of the NWT/NU

ASSOCIATION OF PROFESSIONAL ENGINEERS GEOLOGISTS & GEOPHYSICISTS NWT

LEGEND

NOTES:

Nunavut Government
Community and
Government Services

Arviat, NU
Sewage Lagoon Berm
August 31, 2004

PROJECT

DRAWING
In Place Volume

DESIGNED	SCALE	DATE
DRAWN	PROJECT No.	
CHECKED	DRAWING No.	REVISION
APPROVED	Fig 1	

DWGSTAMP


16 8 2004

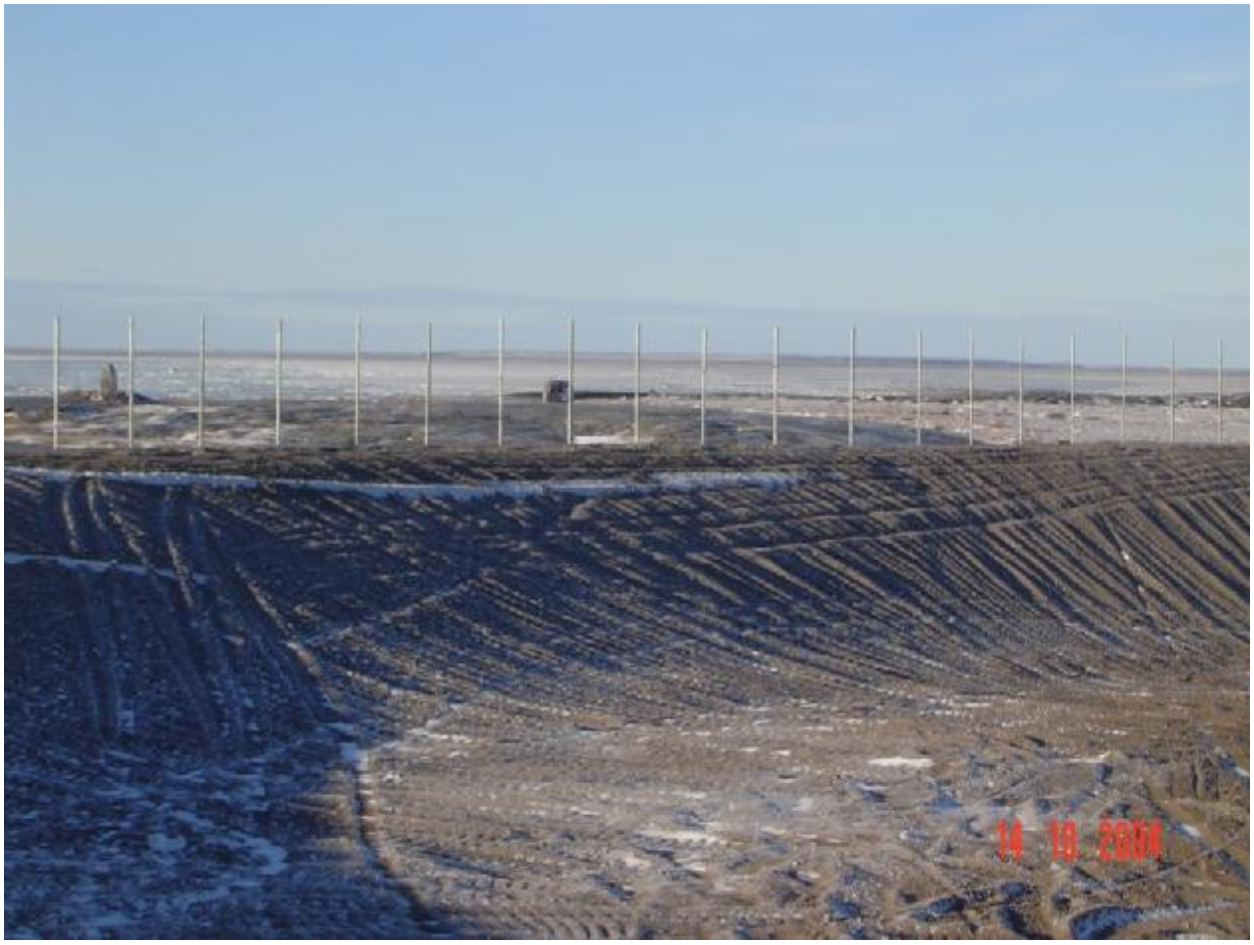

16 7 2004


16 9 2004


16 8 2004


14 10 2004


14 10 2004


14 10 2004


14 10 2004


30 9 2004

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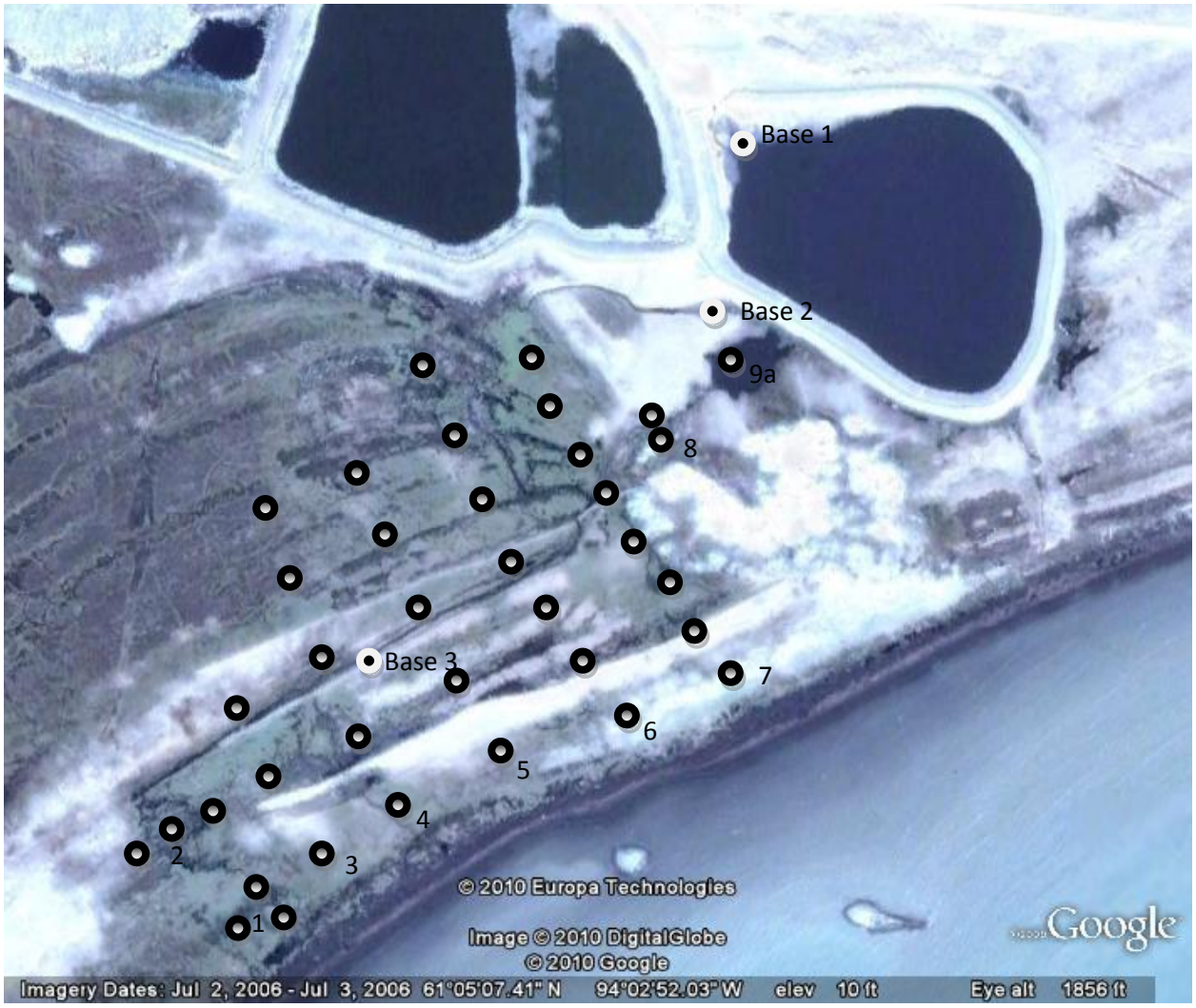
Appendix G

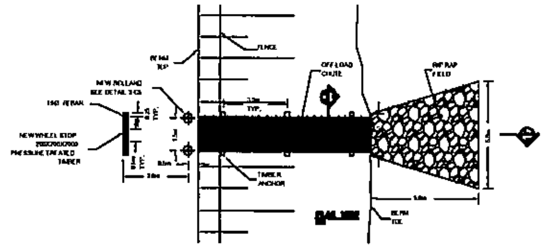
Sewage Lagoon Sampling Data from 2008


Base 1
Base 2
9a
8
Base 3
7
6
5
4
3
2
1
© 2010 Europa Technologies
Image © 2010 DigitalGlobe
© 2010 Google
Google
Imagery Dates: Jul 2, 2006 - Jul 3, 2006 61°05'07.41" N 94°02'52.03" W elev 10 ft Eye alt 1856 ft

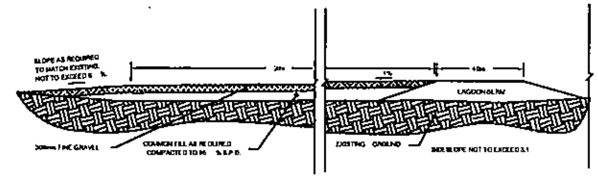
BURNSIDE

Appendix H

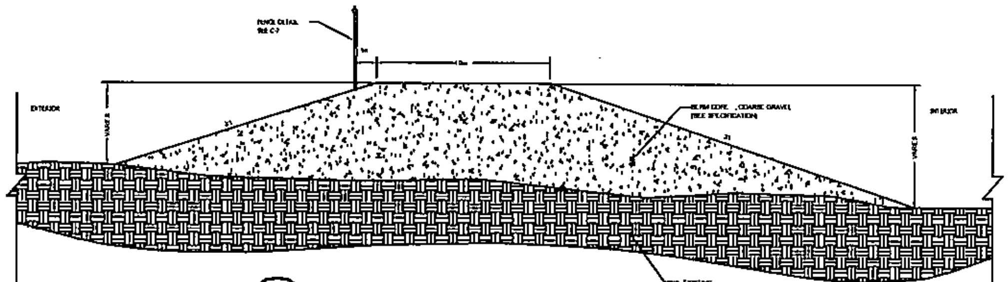
Design Concept by FSC, 2003



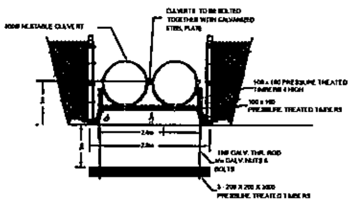
3 EN2 OFFLOAD CHUTE



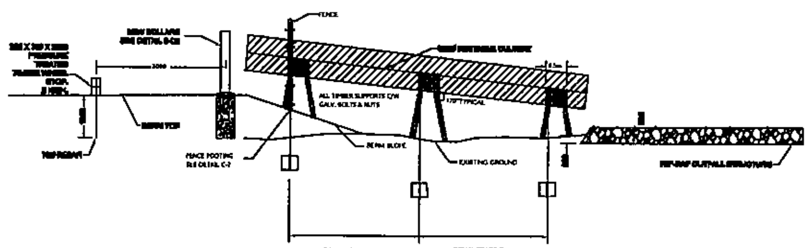
2 EN2 TYPICAL TURNAROUND SECTION
N.T.S.



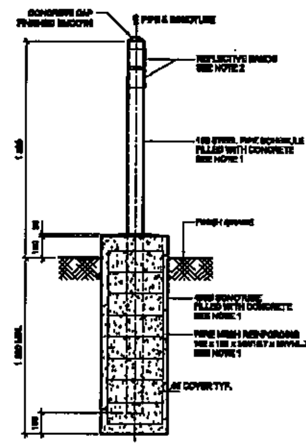
1 EN2 TYPICAL BERM SECTION
1:50



OFF LOAD CHUTE SECTION



OFF-LOAD CHUTE SECTION



NOTES
1. CONCRETE MUST HAVE 25 MPa COMPRESSIVE STRENGTH AFTER 28 DAYS
2. WIRE MESH
3. BOLLARDS MUST BE PAINTED RED WITH REFLECTIVE BANDS

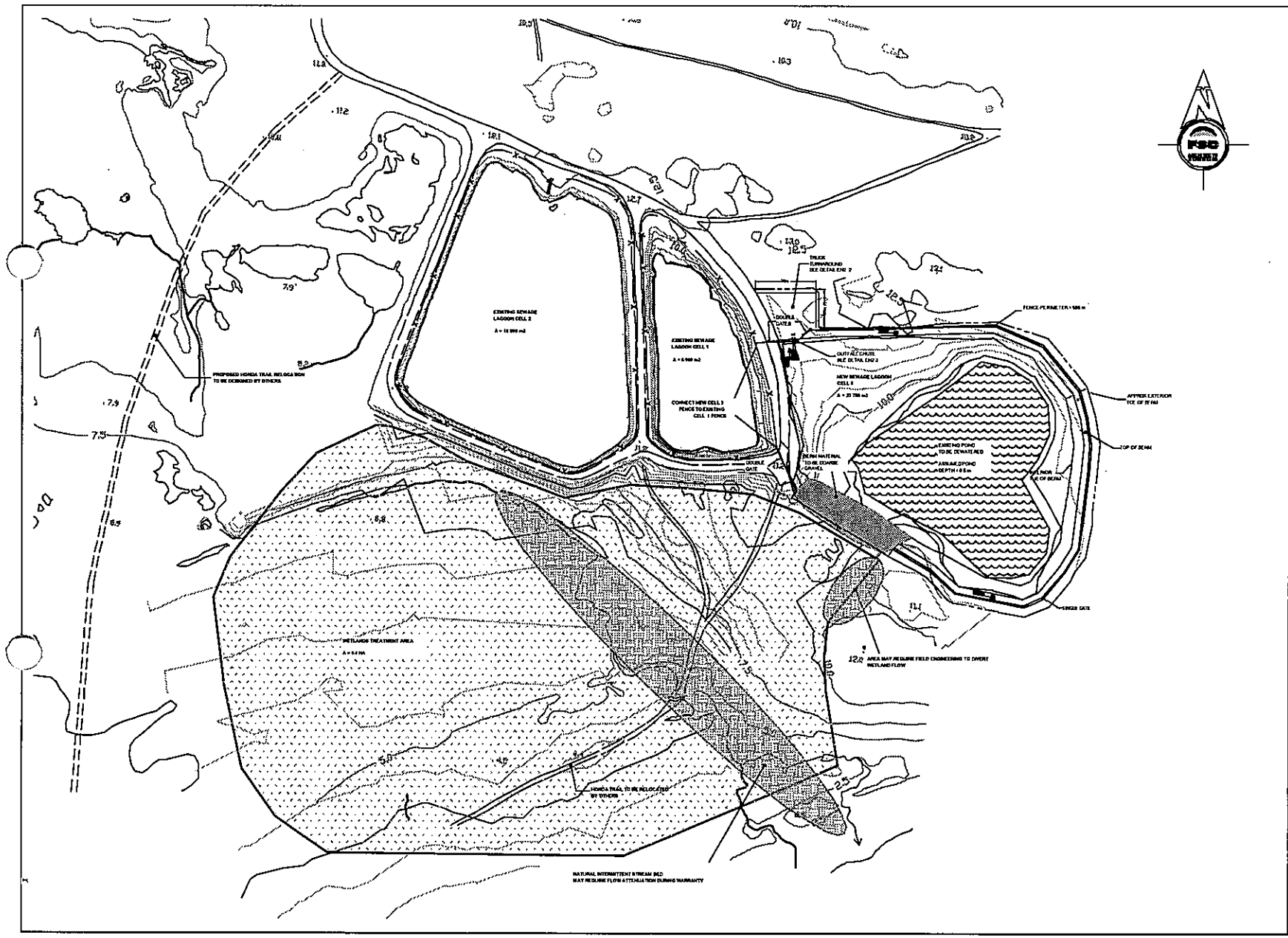
4 EN2 BOLLARD DETAIL

FSC
ARCHITECTS & ENGINEERS

Nunavut

ARVIAT SEWAGE LAGOON
ARVIAT, NU
DETAILS

	AS SHOWN
	JULY 7, 2003
03-0140-C5.DWG	2003-0140
2 - 3	EN-2



FSC
ARCHITECTS &ENGINEERS

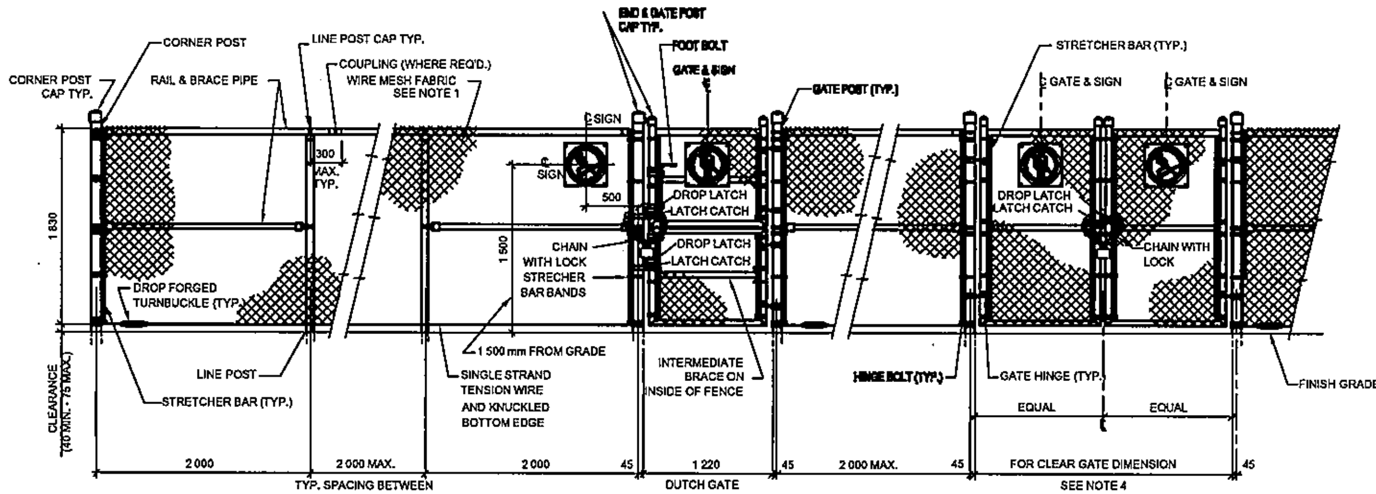
Nunavut

ARVIAT SEWAGE LAGOON

ARVIAT, NU

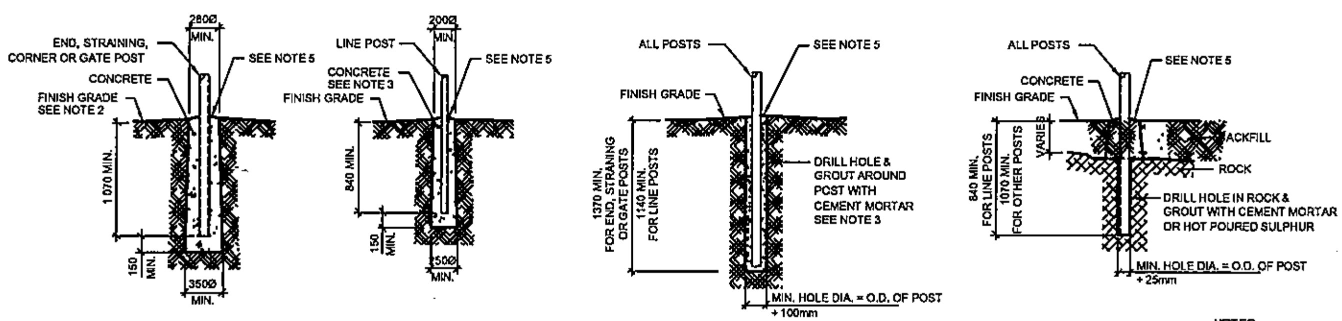
SITE LAYOUT

20/08	1:500
BD	JULY 7, 2023
PK	
05-0446-03.000	3003-040
1 = 3	EN1



1-A SINGLE GATE

1-B DOUBLE GATE



TYPE I
IN BACKFILL OR EARTH (WITH CONCRETE FOOTINGS)

TYPE II
IN EARTH WITH LARGE BOLDERS (DRILLED HOLE WITH GROUT)

TYPE III
IN SOLID ROCK

1-C FOOTING SECTIONS

NOTES:

1- FOR FENCE MATERIAL SEE SPECIFICATIONS.

2- FOR BACKFILL MATERIALS & SOIL CLASSIFICATION SEE SPECIFICATIONS.

3- FOR CONCRETE MATERIAL SEE SPECIFICATIONS.

4- FOR TYPE AND DIMENSION OF GATE REFER TO PARTICULAR PROJECT DRAWINGS.

5- TOP OF FOOTING DOMED 20 mm HIGH (TO SHED AWAY SURFACE WATER) (TYP.)

6- FENCE POSTS AND FENCING TO BE PLUMB AND STRAIGHT

FSC
ARCHITECTS & ENGINEERS

Nunavut

ARVIAT SEWAGE LAGOON

ARVIAT, NU

FENCE DETAIL

JULY 7, 2003

EN-8