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

Prepared by

Nuna Burnside Engineering and Environmental Ltd.
Box 175 Rankin Inlet NU X0C 0G0 Canada
15 Townline Orangeville ON L9W 3R4 Canada

November 2008

File No: N-0 14851

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

November 2008

Table of Contents

Figures

Appendices

1.0 Introduction

1.1 Hamlet Description

The Hamlet of Whale Cove is located within the Kivalliq Region, Nunavut, at general latitude 62°11'N and general longitude 92°35'W. The Hamlet is located approximately 80 km south of Rankin Inlet (Figure 1).

The community has a population of approximately 353 (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 at Fish Lake, treatment system and truckfill station water
- Trucked water to holding tanks in each building
- A Sewage Treatment Facility consisting of a sewage lagoon which receives trucked sewage collected from holding tanks in each building and sewage treatment via exfiltration from the lagoon to a Wetland Treatment Area discharging to the ocean
- A Solid Waste Management Facility, which includes a Bulky Metals Disposal area
- A contaminated soil Landfarm
- A rock quarry located beside the landfill
- Diesel powered generators
- Barge landing area.

The Hamlet of Whale Cove is predominately residential with a few small commercial establishments including a hotel and grocery store. Hunting and fishing in the traditional manner is still a prime occupation for many of the inhabitants. A layout of the entire community and infrastructure is displayed on Figure 2.

1.2 Nunavut Water Board License

The Hamlet of Whale Cove operates their municipal water, sewage, and solid waste facilities under the Nunavut Water Board (NWB) License 3BM-WHA0207, The licence dated September 1, 2002, expired on August 31, 2007. 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.

1.3 Geology

The Hamlet of Whale Cove is located on sheltered bay off of Hudson Bay. The terrain consists of grassy, boulder-strewn ground with overburden of sand and gravel with depths up to 1 m. A ridge of Precambrian rock 15 to 20 m in height surrounds the community. The Hamlet is located in a zone of continuous permafrost, which has an active layer of approximately 50 cm and 1 m (in poorly drained and well drained soils, respectively). A thin organic layer supports a limited growth of lichen and moss on the low-lying areas.

1.4 Climate

Whale Cove is affected by arctic air masses, and experiences a maritime arctic climate characterized by short cool summers, and long cold winters. The Whale Cove area receives an average of 340 mm of precipitation per year. July mean high and low temperatures are 13.6°C and 5.9°C, respectively. January mean high and low temperatures are -26.8°C and -33.9°C, respectively. Winds are generally north-west. (Whale Cove Weather Station, Climate Data 1985-2007, 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 Whale Cove 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 NWT has developed a standard for water consumption in communities of less than 2,000 residents on trucked services. The consumption rate is estimated a 90 L/person/day. The following formula from the NWT Standard is used:

$$\textit{Water Use (L/person/day)} = 90\ \textit{L/person/day} \times (1.0 + 0.00023 \times \textit{population})$$

Where the factor 0.00023 multiplied by the 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 (2018) is 15,016 m^3, while the 20-year (2028) annual volume will be 17,481

m^3. The current volume of wastewater produced for 2008 will be 12,918 m^3. The Table in Appendix B provide a summary of the sewage generation rate for the Hamlet of Whale Cove 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 Whale Cove provides trucked water and sewage services, as well as regular solid waste pickup for the Hamlet residents, businesses, and institutions.

The Sewage Treatment Facility operated by the Hamlet of Whale Cove is located approximately 0.7 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 a long flume pipe (cut in half culvert) spillway that prevents bank erosion during the discharge of the sewage into the lagoon.

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 Whale Cove 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.

The facility operates by holding sewage collected from the community and trucked to the lagoon. The sewage is discharged into the lagoon via a large flume consisting of a cut in half culvert. This protects the banks from erosion. Sewage is stored in the lagoon and slowly exfiltrates through the constructed berm discharging down gradient into a Wetland Treatment Area for approximately 600 m before discharging into Hudson Bay (Figure 3).

The lagoon is not fenced. A sign at the truck discharge station identifies the lagoon. The Sewage Treatment Facility should be identified in the Whale Cove Community Plan. The area should be off limits for other land uses and development. Summer trails in the Wetland Treatment Area should be limited.

3.1.1 Sewage Lagoon

The sewage lagoon was created by berming the end of a natural pond. Before becoming a sewage lagoon the pond had natural drainage that occurred at the east and west ends (DPW&H, 1988). The water drains west overland and underground through the overburden and fractures in the rock and between boulders. This natural drainage appears to be still occurring, now evident by the increase in vegetation on the east and west sides of the lagoon. The majority of the drainage occurs on the west side of the lagoon. Some local drainage occurs towards the east, but is limited by the local topography. The surface water drainage directions around the lagoon are shown in Figure 4.

Water in the lagoon exfiltrates out of the lagoon through the sandy berm and/or permeable ground that is seasonally thawed. Water is received by a wetland area with rich vegetation as a result of the added nutrients from the lagoon (Figure 4).

3.1.2 Lagoon Storage Capacity

The lagoon covers an area of approximately 15,000 m^2. Using an estimated usable depth of approximately 1.5 m, the capacity of the lagoon was calculated to be approximately 22,000 m^3. Calculations for the volume of the lagoon are included in Appendix B. Projected sewage volumes for the Hamlet of Whale Cove are included in Appendix B.

In addition to sewage generated by the Hamlet of Whale Cove, the volume of precipitation and the rate of evaporation must also be considered in establishing the influx of water into the lagoon. 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 Whale Cove is estimated at approximately 200 mm/year. Climate normal data from the Environment Canada website indicates that the average annual precipitation for the Hamlet of Whale Cove is 340 mm/year (climate data is included in Appendix C). The net addition of precipitation to the lagoon is 140 mm/year. The lagoon was originally a natural pond and therefore a natural area for runoff collection. The drainage area of the lagoon is estimated to be approximately 8.3 km^2, the net input of runoff into the lagoon from the drainage area is approximately 11,640 m^3/year.

The volume of accumulated sludge must also be considered in determining the total storage volume of the lagoon. The value of dry solids 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 0.3 m from the bottom of the lagoon floor, which is 20 percent volume of the lagoon. As shown on the table in Appendix B, 20 percent of the volume of the lagoon will not be exceeded until approximately Planning Year 25 (2033).

Over time biological sludge degradation due to stabilization and digestion of the solids by conversion to biogas, will result in a smaller volume of sludge accumulating in the bottom of the lagoon. If the height is exceeded it may be necessary for the lagoon to be desludged.

3.1.3 Sewage Retention

The level of the lagoon remains consistent indicating that the flow out of the lagoon is equal to the flow into the lagoon.

In Appendix B, the retention time for the sewage has been calculated for a planning period of 25 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 runoff from the drainage basin 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 natural water runoff and precipitation.

In 2008, the sewage retention time is 220 days with dilution and 608 days without dilution. In 20 years the retention time will be 231 days with dilution and 385 days without dilution. Currently (2008) the dilution ratio for the total input of water to sewage input is 2:1. In 20 years the dilution ratio will be 5:3.

These calculations illustrate that the lagoon holds the raw sewage for over a year, currently, and in 20 years for 231 days. This allows a significant period of time for natural decomposition prior to exfiltration into the wetland. The contribution of run-off into the lagoon results in a diluted effluent into the Wetland Treatment Area.

3.1.4 Wetland Treatment Area

The Wetland Treatment Area is an integral part of the Sewage Treatment Facility, Figure 4. Complex physical and biological processes in the wetland area harnessed to treat the wastewater. 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 considered the Secondary Treatment System for the effluent discharged from the Primary Treatment System (the facultative lagoon). 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.

There is approximately 600 metres of land between the Sewage Lagoon and the ocean. The wetland treatment area is a total of 8.2 ha and is identified in Figure 4. Drainage from the lagoon into the wetlands has resulted in enhanced plant growth, and a visible increase in height, density, and "greening" of the vegetation in the upper reaches of the wetland. This visible vegetative enhancement, caused by the nutrient load from the sewage, declined along the downstream flow path, indicating a lessening of the nutrient load, with distance downstream (see Figure 4 and Photographs in Appendix F).

3.2 Sewage Collection Procedures

The following sewage collection operational procedures shall be carried out by the staff of the Hamlet of Whale Cove 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 cut in half culvert discharge pipe overhanging the lagoon 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 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 Whale Cove* 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 Whale Cove 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

- The discharge pipe (cut in half culvert) to the Sewage Lagoon shall be inspected for damage or displacement monthly, and repaired 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 0.3 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.

The Sewage Treatment Facility consisting of the Sewage Lagoon and Wetland Treatment area, is expected to service the Hamlet of Whale Cove for at least the next 20 years (Appendix B). It is possible that it could continue to operate for a significant period of time beyond 20 years. Desludging of the lagoon could further extend its life (Appendix B).

In the future, should the Sewage Treatment Facility no longer be required, abandonment and restoration would be conducted as follows:

- Open the berm to allow natural drainage
- Remove or cover the sludge (approximately 0.5 m of clean coarse grained cover material contours) to promote run-off
- Berm would be regraded or left standing
- Regrade the berm and surrounding area to promote run-off
- The pond (former lagoon) and wetland area would return to natural conditions.

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. 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:

- BOD
- Faecal Coliforms
- pH
- Conductivity
- Total Suspended Solids
- Ammonia Nitrogen
- Nitrate-Nitrite
- Total Phenols
- Sulphate
- Sodium
- Potassium
- Total Hardness
- Magnesium
- Calcium
- Arsenic
- Cadmium
- Copper
- Chromium
- Iron
- Lead
- Mercury
- Nickel
- Zinc
- Chloride

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 shall be in accordance with the *Hamlet of Whale Cove 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 4. The following is a description of each monitoring location and the required analysis for the NWB license:

Station	Description	Frequency	Analysis Requirements	
WHA-1	Raw Water Supply Intake at Fish Lake prior to treatment	Monthly	Measure and record in cubic metres of water pumped from station.	
WHA-2	Water accumulation within bermed area of Solid Waste Management Facility	Annually and as needed (prior to any discharge)	• BOD • Faecal Coliforms • pH • Conductivity • Total Suspended Solids • Ammonia Nitrogen • Nitrate-Nitrite • Total Phenols • Sulphate • Sodium • Potassium • Total Hardness	• Magnesium • Calcium • Arsenic • Cadmium • Copper • Chromium • Iron • Lead • Mercury • Nickel • Zinc • Chloride
WHA-3	Runoff towards the ocean from Solid Waste Management Facility (final discharge point)	Monthly from May to August, Inclusive	Same as WHA-2	
WHA-4	Effluent within Lagoon beside truck discharge point (raw lagoon waste quality)	Annually	• BOD • Faecal Coliforms • pH • Conductivity • Total Suspended Solids • Ammonia Nitrogen • Nitrate-Nitrite • Total Phenols • Sulphate • Sodium • Potassium	• Magnesium • Calcium • Arsenic • Cadmium • Copper • Chromium • Iron • Lead • Mercury • Nickel • Zinc • Chloride • Total Hardness

Station	Description	Frequency	Analysis Requirements	
WHA-5	Effluent Discharge in Wetland Treatment Area of Sewage Disposal Facility (approximate halfway point)	Annually	• BOD • Faecal Coliforms • pH • Conductivity • Total Suspended Solids • Ammonia Nitrogen • Nitrate-Nitrite • Total Phenols • Sulphate • Sodium • Potassium	• Magnesium • Calcium • Arsenic • Cadmium • Copper • Chromium • Iron • Lead • Mercury • Nickel • Zinc • Chloride • Total Hardness
WHA-6	Discharge from the Wetland Treatment of Sewage Disposal Facility before discharging to ocean (Final Discharge Point)	Monthly from May to August, inclusive	Same as WHA-4	

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.

4.3.1 Current Conditions

The current effectiveness of the wetland treatment area is illustrated by the results of the sampling conducted on September 12, 2008. Photographs of site conditions, September 12, 2008, are displayed in Appendix F. Table 4.1 displays the results of the sampling of WHA-4 located at the discharge point in the lagoon, WHA-5 located in the wetland treatment area and WHA-6 located at the end of the wetland treatment area before discharge to Hudson Bay (final discharge point). Also displayed are the current NWB Water Licence effluent quality standards.

Table 4.1: September 12, 2008 Sampling Results Compared to License Requirements

Regulatory Parameter	NWB Standards	WHA-4 (Water in Lagoon)	WHA-5 (Mid-Point of the Wetland Treatment Area)	WHA-6 Final Discharge Point
BOD_5 (mg/l)	120	<5	<5	<5
TSS (mg/l)	180	<10	<10	<10
Total PO_4 (mg/l)	-	4.1	1.36	<0.05
Faecal Coliforms (CFU/100 ml)	1,000,000	12,000	7	300
pH	6.5-9	7.86	8.24	8.4
Oil and Grease	No sheen	No sheen	No sheen	No sheen

The results indicate that the lagoon and wetland treatment area is currently providing adequate treatment of discharged sewage as per the required NWB Water License effluent quality standards.

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 Whale Cove – SAO	Whale Cove	(867) 896-9917	(867) 896-9058
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	Whale Cove	(867) 896-9192	-
RCMP Detachment	Whale Cove	(867) 896-0123	-
Community Health Center	Whale Cove	(867) 896-9916	(867) 896-9115

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 Whale Cove* (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 – 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 – 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 Whale Cove* (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

This Operation and Maintenance Plan (O&M) has been prepared based on the current design of the Whale Cove Sewage Treatment Facility. This report should be reviewed annually and updated as required.

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 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
- Including the Sewage Treatment Facility land and buffer area, as outlined in Figure 4 on Hamlet land use plans restricting landuse in the area
- Encourage the public to avoid travel through the Sewage Treatment Facility Area.

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.

DPW&H (1988). *Whale Cove Solid Waste and Sewage Disposal, Design and Operations*, August 1988.

Environment Canada, Canadian Climate Data 1985-2007, Whale Cove A Weather Station. <<http://climate.weatheroffice.ec.gc.ca/climateData/monthlydata_e.html?timeframe=3&Prov=XX&StationID=1727&Year=2007&Month=1&Day=1>>. Accessed Nov 10, 2008.

Ferguson Simek Clark (FSC) (2001), *Whale Cove Sewage and Solid Waste Planning Study*, 2001.

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.

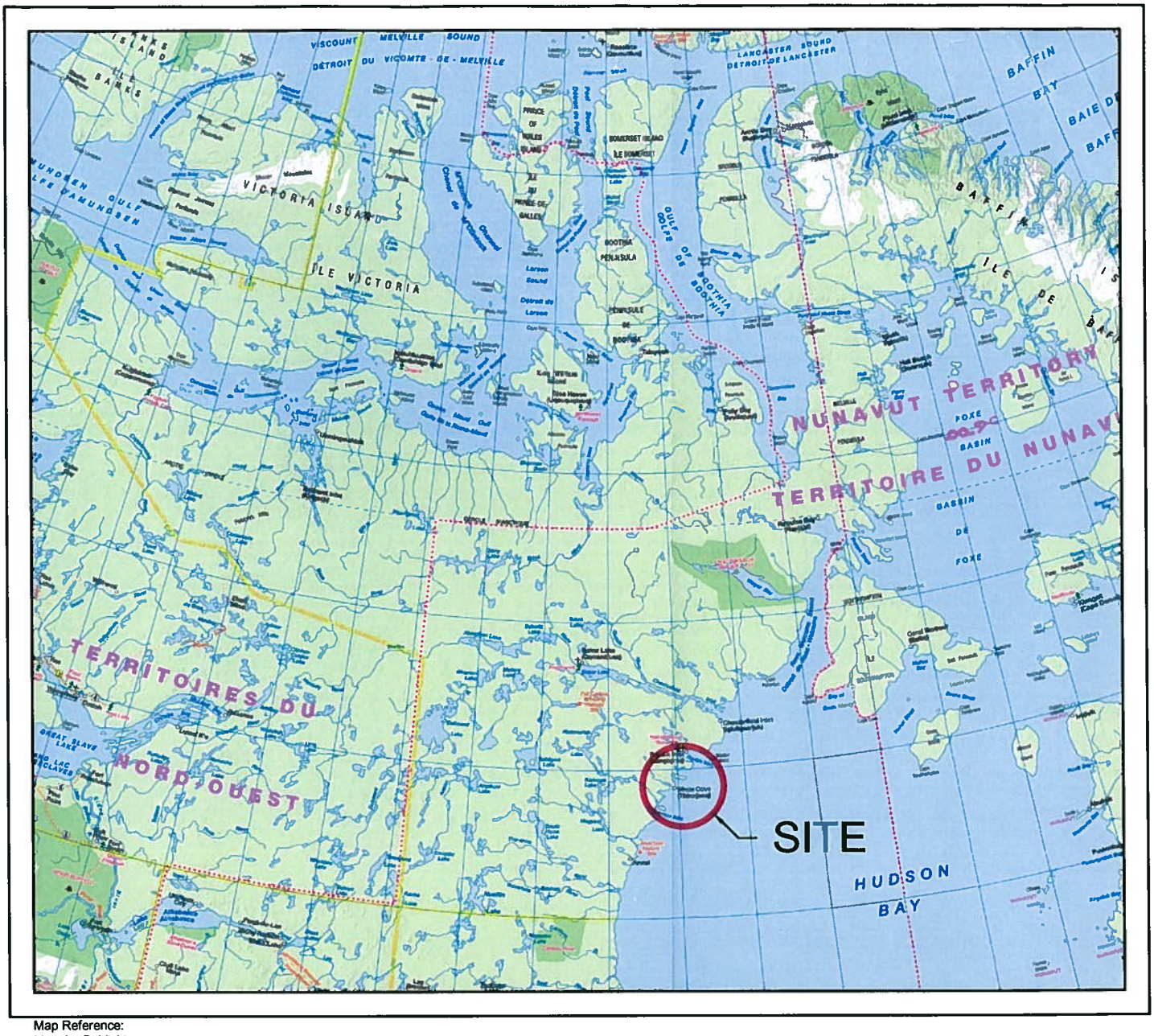
Nunavut Water Board, (2000). *Guidelines for the Discharge of Domestic Waste Water in Nunavut.*

Nunavut Water Board, September 2002. *Hamlet of Whale Cove Water Licence NWB3WHA0207.* Goja Haven, Nunavut.

Nuna Burnside Engineering & Environmental Ltd., (2008). *Environmental Emergency Contingency Plan, Hamlet of Whale Cove.*

Nuna Burnside Engineering & Environmental Ltd., (2008). *Environmental Monitoring Program and Quality Assurance/Quality Control Plan, Hamlet of Whale Cove.*

Figures



Map Reference:
Map Art Publishing

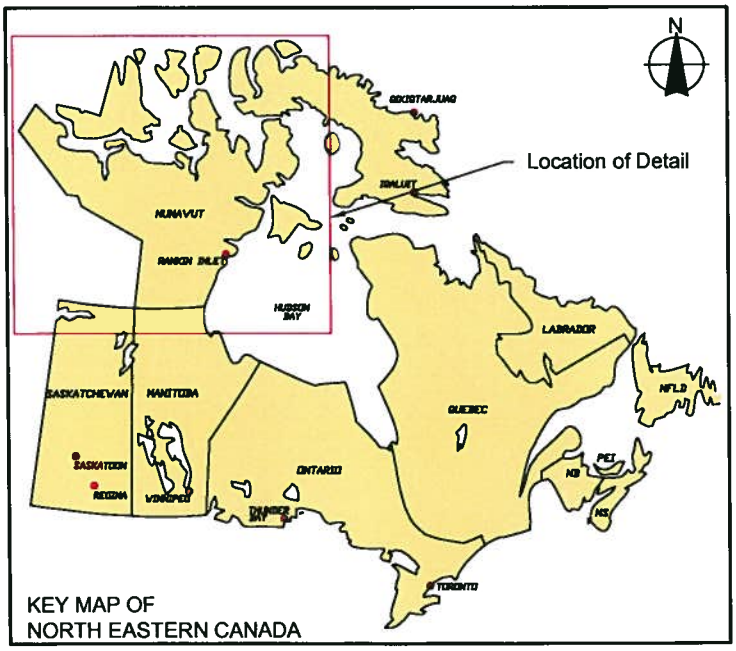


FIGURE 1 - SITE LOCATION MAP

HAMLET OF WHALE COVE
WHALE COVE, NUNAVUT

SEWAGE TREATMENT FACILITY OPERATIONS & MAINTENACE PLAN

November 2008
Project Number: N-O14851

Prepared by: C. Sheppard

Verified by: J. Walls

NUNA BURNSIDE

14851 SEWAGE TREATMENT O&M PLAN SL.dwg

Plot Time: Nov 28, 2008 - 1:06pm

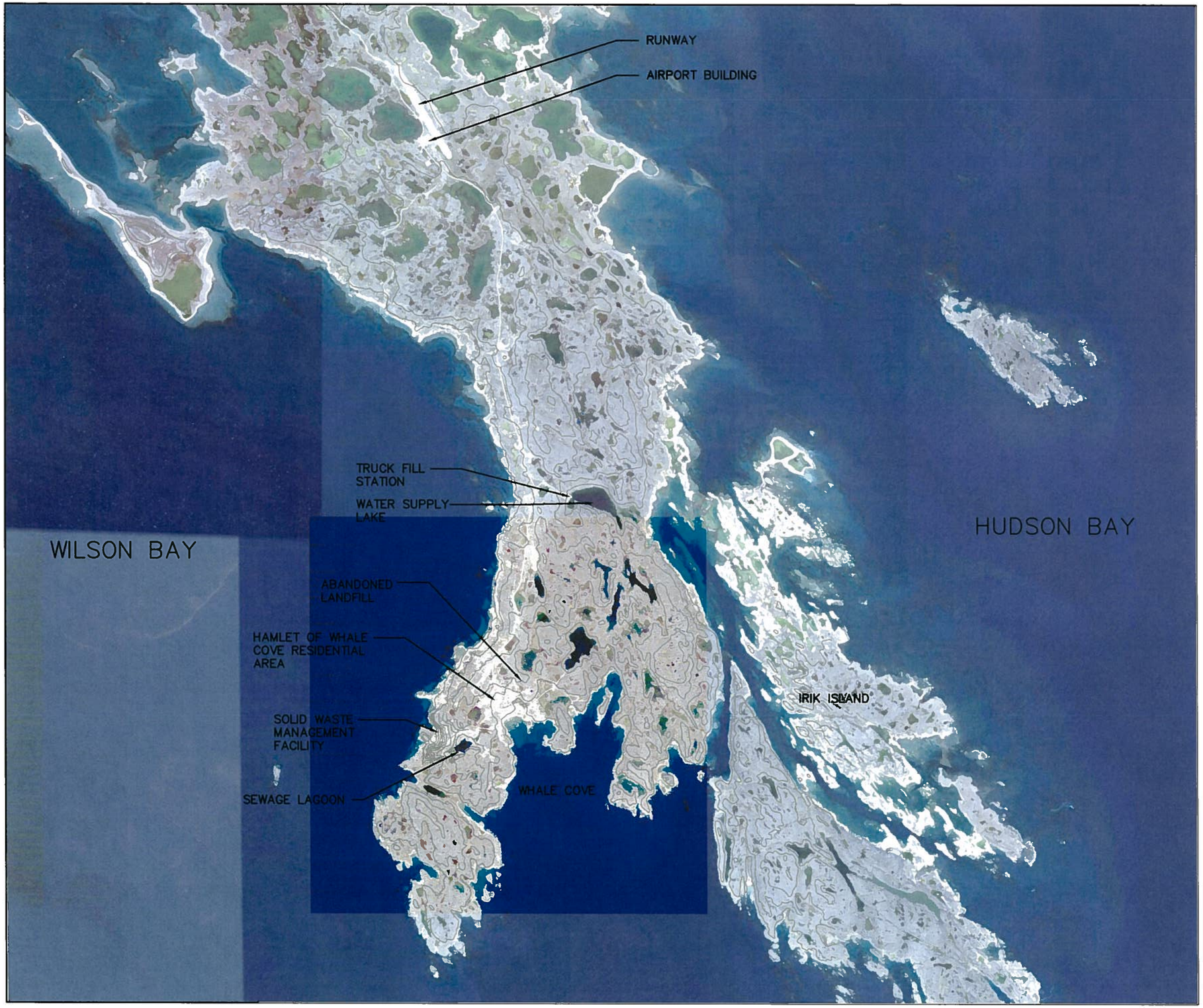


FIGURE 2

HAMLET OF WHALE COVE
WHALE COVE, NUNAVUT
SEWAGE TREATMENT FACILITY O&M PLAN

COMMUNITY PLAN

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

N

0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Kilometers

1:50,000
November 2008
Project Number: N-O14851

Projection: UTM Zone 15
Datum: NAD83

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

BURNSIDE

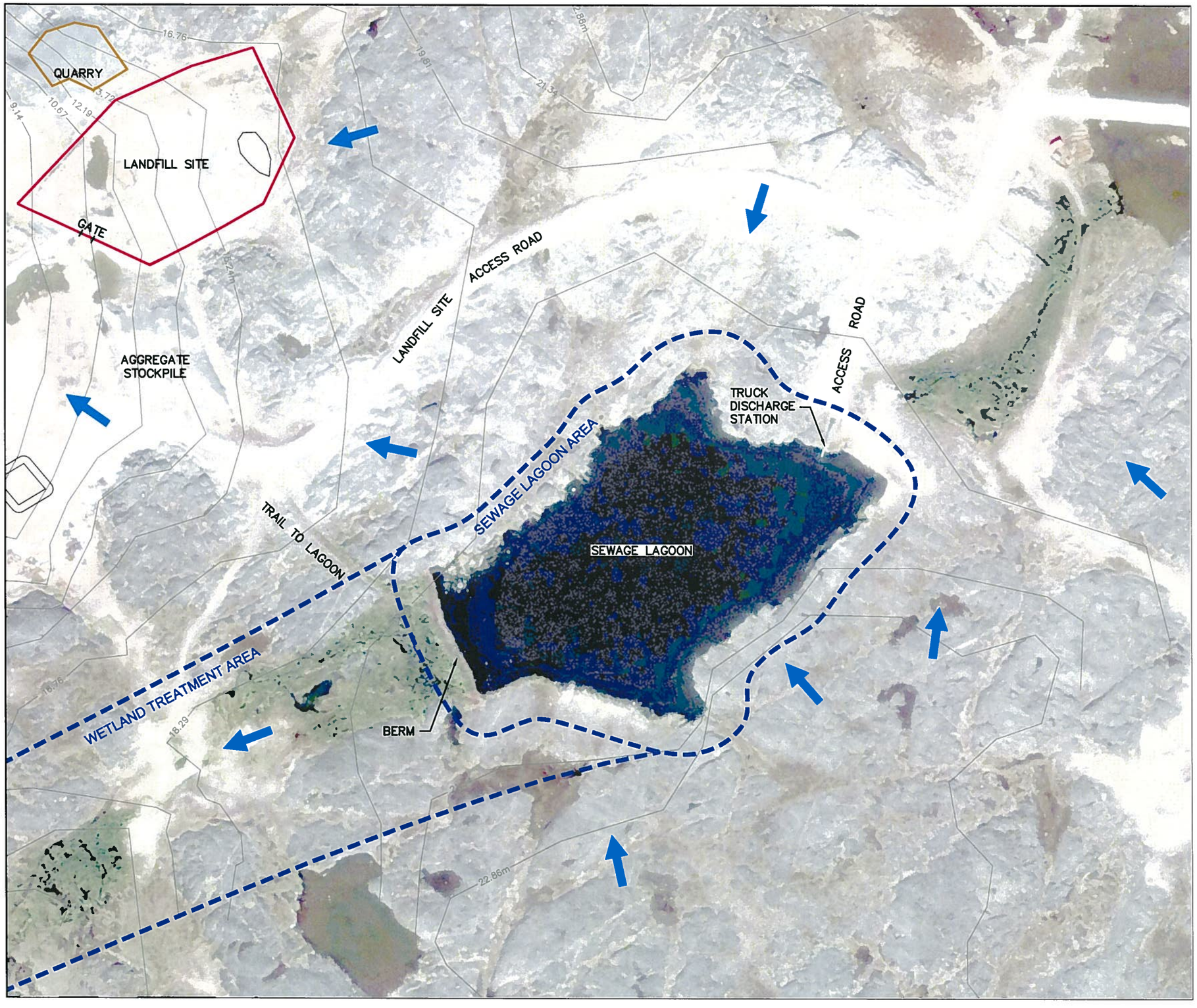
14851 SEWAGE TREATMENT O&M PLAN CP.dwg

Plot Time: Feb 02, 2009 - 2:43pm

FIGURE 3

HAMLET OF WHALE COVE
WHALE COVE, NUNAVUT
SEWAGE TREATMENT FACILITY O&M PLAN

SEWAGE TREATMENT FACILITY



LEGEND

- LANDFILL SITE OUTLINE *(Approximate area = 8,868m²)*
- BEDROCK QUARRY OUTLINE
- 7.62m (25 ft) CONTOUR LINES *(Obtained from the N.T.S. digital database)*
- 1.52m (5 ft) INTERPOLATED CONTOUR LINES *(Interpolated from the N.T.S. 25 ft contours)*
- INTERPRETED SURFACE WATER FLOW DIRECTION

Satellite Image Source:
Background 2006 Quickbird satellite image obtained from the Government of Nunavut.

N

0 20 40 60 80 100 120 140 160
Meters

1:2,000
November 2008
Project Number: N-O14851

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

Nunn BURNSIDE

Revision #: 1

14851 SEWAGE TREATMENT O&M PLAN STF.dwg

Plot Time: Feb 02, 2009 - 2:45pm

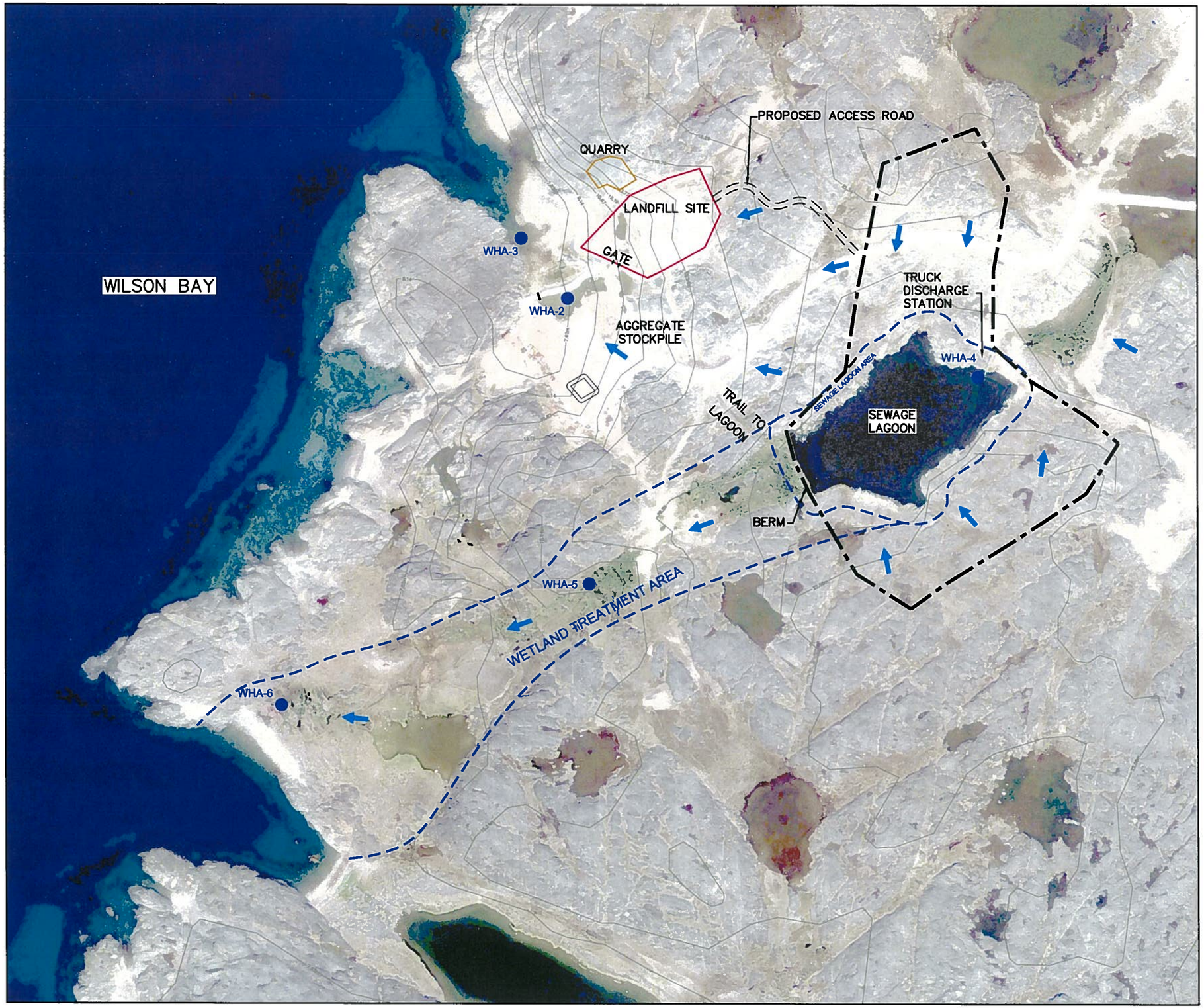


FIGURE 4

HAMLET OF WHALE COVE
WHALE COVE, NUNAVUT
SEWAGE TREATMENT FACILITY O&M PLAN

DRAINAGE AREA & MONITORING LOCATIONS

LEGEND

- LANDFILL SITE OUTLINE *(Approximate area = 8,868m²)*
- BEDROCK QUARRY OUTLINE
- 7.62m (25 ft) CONTOUR LINES *(Obtained from the N.T.S. digital database)*
- 1.52m (5 ft) INTERPOLATED CONTOUR LINES *(Interpolated from the N.T.S. 25 ft contours)*
- INTERPRETED SURFACE WATER FLOW DIRECTION
- MONITORING LOCATION
- INTERPRETED SURFACE WATER DRAINAGE DIVIDE

Satellite Image Source:
Background 2006 Quickbird satellite Image obtained from the Government of Nunavut.

N

0 40 80 120 160 200 240 280 320
Meters

1:4,000
September 2008
Project Number: N-O14851

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

Revision #: 1

14851 SEWAGE TREATMENT O&M PLAN DAML.dwg

Plot Time: Feb 02, 2009 - 2:47pm

BURNSIDE

Appendix A
Water Board Licence

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

ᓄᓇᕗᑦ ᐃᒪᓕᕆᔨᑦ ᑲᑎᒪᔨᖏᑦ
NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI

File No: NWB3WHA0207

September 18, 2002

Imalda Angootcluk
Senior Administrative Officer
Hamlet of Whale Cove
P.O. Box 120
Whale Cove, Nunavut X0C 0J0
Email: hamwhale@arctic.ca

RE: NWB Licence No. NWB3WHA0207

Dear Imalda:

Please find attached Licence No. NWB3WHA0207 issued to the Hamlet of Whale Cove by the Nunavut Water Board **(Motion #: 2002-10)** pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada*. The terms and conditions of the attached Licence related to water use and waste disposal are an integral part of this approval.

Sincerely,

Philippe di Pizzo
Executive Director

Enclosure: Licence No. **NWB3WHA0207**

cc: Paul Smith, DIAND Iqaluit
C. Bodykevich, DIAND Inspector
Tongola Sandy, KIA
Gladys Joudrey, NIRB
Josee Gallipeau, NWMBoard
P. Pacholek, EC
P. Partridge, DSD
J. DeGroot, DFO

P.O. BOX 119
GJOA HAVEN, NU X0B 1J0
TEL: (867) 360-6338
FAX: (867) 360-6369

ᓄᓇᕗᑦ ᐃᒪᓕᕆᔨᑦ ᑲᑎᒪᔨᖓ
NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI

DECISION

LICENCE NUMBER: NWB3WHA0207

This is the decision of the Nunavut Water Board (NWB) with respect to an application for a Licence dated 02 April 2002, made by:

Hamlet of Whale Cove

to allow for the use of water and disposal of waste for the Hamlet at Whale Cove, 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 go 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 NWB3WHA0207 be issued subject to the terms and conditions contained therein. (Motion #: 2002-10)

SIGNED this ______ day of September, 2002 at Gjoa Haven, NU.

Philippe di Pizzo
Chief Administrative Officer

Chief Administrative Officer

TABLE OF CONTENTS

I. INTRODUCTION

Following an application filed by the Hamlet of Whale Cove on April 2, 2002 to the Nunavut Water Board, the Board conducted an initial assessment of the Hamlet's request for a municipal water licence for water use and waste disposal activities within the Hamlet. The assessment was conducted so that the Nunavut Water Board could make a fully informed decision on the application. The application was referred for review and comments to Federal, Territorial and local organizations. Based upon the results of this initial assessment and the technical review, including consideration of any potential accidents, malfunctions, or cumulative environmental effects that the overall project might have in the area, the Board concluded that this application was complete and could go through the regulatory process.

In accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* S. 55.1 and Article 13 of the *Nunavut Land Claims Agreement*, public notice of the application was posted. No public concerns were expressed, and the NWB waived the requirement to hold a public hearing for the application. Authority to approve the application was delegated to the Chief Administrative Officer pursuant to S. 13.7.5 of the *Agreement*. After considering and reviewing the comments submitted by interested parties, the NWB has issued licence NWB3WHA0207.

II. GENERAL CONSIDERATIONS

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. The NWB believes that a term of five years is appropriate. Because this is the first licence issued to the Hamlet by the Nunavut Water Board, a 5-year licence will allow enough time for the Hamlet to establish a consistent compliance record. The 5-year licence will allow the Licensee to properly carry out the terms and conditions of the licence and to ensure that sufficient time is given to permit the Licensee to develop, submit, and implement the plans required under the licence to the satisfaction of the NWB.

Annual Report

The requirements imposed on the Licensee in this licence 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. Refer to attached standard form for completing Annual Report (see Attachment I).

Regulated Parameters

Effluent quality criteria imposed in this Licence are consistent with the *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories* (Northwest Territories Water Board; 1992), and follow advice received from both the Department of Indian and Northern Affairs and Environment Canada.

Operation and Maintenance Manual (O&M)

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 s and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories* (Duong and Kent, 1996; see Attachment II).

Abandonment and Restoration (A&R)

To ensure that all future abandoned facilities are reclaimed in an appropriate manner, the NWB has imposed the requirement for the submission of Abandonment and Restoration Plans. These plans should be submitted when the Licensee files preliminary design drawings for the construction of new facilities to replace existing ones.

Surveillance Network Program

The Surveillance Network Program (SNP) is a monitoring program 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. As this is the first Municipal Water Licence issued to the Hamlet by the Board, minimum requirements have been imposed, but additional sampling may be required by an Inspector.

Quality Assurance/Quality Control (QA/QC) Plan

The requirements to develop a QA/QC Plan imposed on the Licensee in this licence are for the purpose of ensuring the NWB that samples taken in the field as part of the SNP will maintain a high quality, so as to accurately represent the physical and chemical nature of the samples being taken.

LICENCE NWB3WHA0207

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 WHALE COVE
(Licensee)

of **WHALE COVE, NUNAVUT, X0C 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 **NWB3WHA0207**

Water Management Area **NUNAVUT 05**

Location **WHALE COVE, NUNAVUT**

Purpose **WATER USE AND WASTE DISPOSAL**

Description **MUNICIPAL UNDERTAKINGS**

Quantity of Water Not to be Exceeded **30,000 CUBIC METRES ANNUALLY**

Date of Licence **SEPTEMBER 1, 2002**

Expiry Date of Licence **AUGUST 31, 2007**

Dated this ____ of September 2002 at Gjoa Haven, NU.

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 Whale Cove, Nunavut (62°11'N, 92°35'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: **NWB3WHA0207**

"**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 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 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;

"**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;

"**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;

"**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 sewage as described in the Application for Water Licence filed by the Applicant on April 2, 2002;

"**Solid Waste Disposal Facilities**" comprises the area and associated structures designed to contain solid waste (landfill site) as described in the Application for Water Licence filed by the Applicant on April 2, 2002;

"**Surveillance Network Program**" means a monitoring program established to collect data on surface water and groundwater quality to assess impacts to the environment of an appurtenant undertaking.

"**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, Solid Waste Disposal Facilities, and Bagged Toilet Waste Disposal Facilities, as described in the Application for Water Licence filed by the Applicant on April 2, 2002; and

"**Water Supply Facilities**" comprises the area and associated intake infrastructure at Fish Lake, as described in the Application for Water Licence filed by the Applicant on April 2, 2002.

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 "Surveillance Network 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 "Surveillance Network Program" described in this Licence, and any amendments to the "Surveillance Network Program" as may be made from time to time, pursuant to the conditions of this Licence.

3. The "Surveillance Network 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 "Surveillance Network 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 and at the site of operation at all times. 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

8. 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 Fish Lake 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 30,000 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 piped and pumpout Sewage to the Sewage Disposal Facilities or as otherwise approved by the Board.

2. All Effluent discharged from the Sewage Disposal Facilities at "Surveillance Network Program" Station Number WHA-3 shall meet the following effluent quality standards:

Parameter	Maximum Average Concentration
Faecal Coliforms	1 x 10^6CFU/dl
BOD_5	120 mg/L
Total Suspended Solids	180 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 dykes and earthfill structures associated with the Sewage Disposal Facilities.

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

5. The sewage lagoon shall be maintained and operated in such a manner as to prevent structural failure.

6. The Licensee shall maintain the Sewage Disposal Facilities to the satisfaction of an Inspector.

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

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

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 the 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, before September 1, 2003 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).

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.

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 SURVEILLANCE NETWORK PROGRAM

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

Station Number	Description
WHA-1	Raw Water supply prior to treatment
WHA-2	Runoff from the Solid Waste Disposal Facilities
WHA-3	Effluent discharge from the Sewage Disposal Facilities

2. The Licensee shall sample monthly at Surveillance Stations WHA-2 and WHA-3 during the months of May to August, inclusive.

3. The Licensee shall analyze samples collected at Station Number WHA-2 and WHA-3 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	

4. Additional sampling and analysis may be requested by an Inspector;

5. The Licensee shall conform to the Quality Assurance/Quality Control (QA/QC) Plan which shall be provided to the Licensee by the NWB within 60 days of the issuance of this licence;

6. 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;

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

8. The Licensee shall measure and record in cubic metres the monthly and annual quantities of water pumped from Surveillance Network Program Station Number WHA-1 for all purposes;

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 "Surveillance Network Program" in the Licensee's Annual Report, as required *per* Part B, Item 1; and

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

Appendix B
Projected Sewage Generation Rates

Sewage Generation Rates for the Hamlet of Whale Cove

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[3] (m^3)	Available Volume of Lagoon (m^3)	Total Lagoon Retention Time (days)	Dilution Factor of Lagoon by Natural Water Input (Sewage / Total Input)	Lagoon Retention without Dilution (days)
	2006	353	97.3	34	12,538	6,442	129	21,782	329	52%	634
	2007	358	97.4	35	12,726	6,532	259	21,651	324	52%	621
0	2008	363	97.5	35	12,918	6,624	392	21,519	320	53%	608
	2009	368	97.6	36	13,113	6,717	526	21,384	315	53%	595
	2010	373	97.7	36	13,311	6,811	663	21,248	311	53%	583
	2011	378	97.8	37	13,513	6,906	801	21,110	306	54%	570
	2012	384	97.9	38	13,717	7,003	941	20,970	302	54%	558
5	2013	389	98.1	38	13,925	7,101	1,083	20,828	297	54%	546
	2014	395	98.2	39	14,136	7,200	1,227	20,684	293	55%	534
	2015	400	98.3	39	14,351	7,301	1,373	20,538	288	55%	522
	2016	406	98.4	40	14,569	7,403	1,521	20,390	284	56%	511
	2017	411	98.5	41	14,791	7,507	1,671	20,240	280	56%	499
10	2018	417	98.6	41	15,016	7,612	1,823	20,087	275	56%	488
	2019	423	98.8	42	15,245	7,718	1,978	19,933	271	57%	477
	2020	429	98.9	42	15,477	7,827	2,134	19,776	266	57%	466
	2021	435	99.0	43	15,714	7,936	2,293	19,618	262	57%	456
	2022	441	99.1	44	15,954	8,047	2,454	19,457	257	58%	445
15	2023	447	99.3	44	16,198	8,160	2,617	19,294	253	58%	435
	2024	453	99.4	45	16,446	8,274	2,782	19,128	249	59%	425
	2025	460	99.5	46	16,699	8,390	2,950	18,960	244	59%	414
	2026	466	99.6	46	16,955	8,507	3,120	18,790	240	59%	405
	2027	473	99.8	47	17,216	8,627	3,293	18,618	236	60%	395
20	2028	479	99.9	48	17,481	8,747	3,468	18,443	231	60%	385
	2029	486	100.1	49	17,750	8,870	3,645	18,265	227	60%	376
	2030	493	100.2	49	18,024	8,994	3,825	18,085	223	61%	366
	2031	500	100.3	50	18,302	9,120	4,008	17,903	218	61%	357
	2032	507	100.5	51	18,585	9,248	4,192	17,718	214	61%	348
25	2033	514	100.6	52	18,873	9,377	4,380	17,531	210	62%	339

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 with a population of less than 2000 people [90 L/c/d x (1 + 0.00023 x population)] (MACA, 1988).
3) A value of 5% dry solids is assumed for the liquid sludge accumulating at the bottom of the lagoon.

Calculations and Numbers Used

Lagoon Volume (m^3)	21910.5
Retention Time = Volume of Lagoon / Influx into Lagoon	
Population Growth Rate	1.4%
Sewage Generation Rate (lpcd)	90

Natural Waters Input in Lagoon

Annual Precipitation (m/year)	0.3402
Evapotranspiration (m/year)	0.2
Net Runoff (m^2)	0.1402
Lagoon Drainage Area (m^2)	83000
Total Precipitation in Drainage Area (m^3/year)	28236.6
Evapotranspiration in Drainage Area (m^3/year)	16600
Net Influx to Lagoon from Drainage Area (m^3/year)	11636.6

* 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 Whale Cove

Annual Precipitation (m/year)	0.3402
Evapotranspiration (m/year)	0.200

*Canadian Climate Data 1985-2007, Environment Canada, Whale Cove Weather Station

* specific values for Whale Cove were not available, estimated using several references, see below.

Whale Cove Sewage Lagoon

Lagoon Drainage Area (m^2)	83,000
Total Precipitation in Drainage Basin (m^3/year)	28,237
Evapotranspiration (m^3/year)	16,600
Net Influx to Lagoon from Drainage Area (m^3/year)	11,637

Fish Lake Drainage Basin

Lake Drainage Area (m^2)	2,130,000
Total Precipiation in Drainage Basin (m^3/year)	724,626
Evapotranspiration (m^3/year)	426,000
Net Recharge of Lake (m^3/year)	298,626

Fish Lake Volume

Lake Area (m^2)	109,454
Estimated Average Depth of Lake (m)	8
Estimated Lake Volume (m^3)	875,632

Annual 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 Govemment and Transportation, Government of Nunavut.

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

Yi Yip, Q.K. 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

VOLUME CALCULATIONS OF SEWAGE LAGOON

SEWAGE LAGOON DIMENSION ESTIMATES

d = depth of the lagoon	=	2.5 m
SS = slope of the sides of the lagoon	=	3
ES = slope of the ends of the lagoon	=	3
L = Length of the top of the lagoon	=	165 m
W = Width of the top of the lagoon	=	105 m
F = Freeboard Allowance	=	1 m
EXS = Esternal Slope	=	2 :1

Calculations

V = Total Volume Lagoon = 38437.5 m^3

Assume

2 m Berm top width along west side of lagoon

BERM DETAILS	=	14	[metres^2]/m
Width Berm	=	1509	m^3

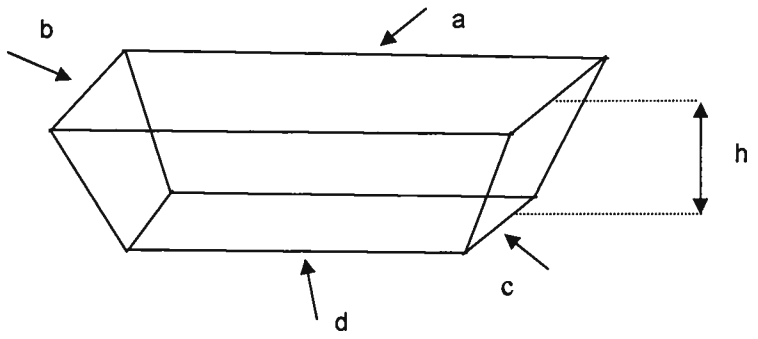
USABLE LAGOON CAPACITY DIMENSIONS

Usable Depth =	=	1.5 m
Top Length, L	=	159 m
Top Width, L	=	99 m
Bottom Length, BL	=	150 m
Bottom Width, BW	=	90 m

Calculations

V = Total USABLE Volume Lagoon = **21910.5 m^3**

Volume = $^1/_3$h(ab + cd + (ab)(cd))



Appendix C
Climate Data

Whale Cove Climate Station Data Summary (1985-2007)

Total Precipitation (mm) 1985-2007

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (mm)
1985			60.0	23.8	2.1	40.3	62.5	127.5	146.6		201.6	111.0	775.4
1986	14.8	1.0	10.6	2.2	48.8	26.8	13.9	73.3	40.8	101.4	16.2	35.4	385.2
1987	29.8	26.8	46.8	83.8	1.4	139.4	25.0	66.6	13.2	25.2	25.8	19.4	503.2
1988	2.6			17.6		36.1		28.2	32.2		62.5	29.8	209.0
1989	7.2	20.8	50.6	45.0	42.6	9.2	61.0	38.2	46.0	9.6	3.0	0.6	333.8
1990	26.6			21.2	32.8	61.0	65.6	53.2	24.6	34.4		16.8	336.2
1991	41.2	44.4	33.0	46.6	21.2	4.8	4.0	50.5	259.2	78.4	15.4	33.8	632.5
1992	24.0	4.4	16.6	8.8	11.8	50.9	7.4	38.8	54.0	16.6	22.0	23.8	279.1
1993	47.8	12.2	2.8	16.6	19.2	17.9	24.2	61.5	54.2	12.6	32.8	23.2	325.0
1994	6.2	3.0	20.0	41.8	26.0	33.7	10.2	70.8	78.6	36.4	44.2	33.8	404.7
1995	25.8	10.4	9.2	32.1	16.0	12.2	89.7	111.8	53.6	40.6	21.2	22.6	445.2
1996	13.8	9.1	13.8	2.4	2.6	31.6	17.8	85.6	40.8	15.6	10.0	7.6	250.7
1997	0.4	3.2	6.0	6.2	2.8	24.7	17.0	26.6	13.2	17.6	3.6	7.2	128.5
1998	5.8	4.0	4.8	13.2	6.4	11.2	60.8	43.0	51.8	22.6	18.0	3.2	244.8
1999	8.4	9.0	3.2	9.0	7.6	22.2	59.2	59.8	34.4	16.2	32.2	18.2	279.4
2000	10.6	16.8	17.3	5.8	2.2	4.0		92.5	40.0	20.0	2.2	11.6	223.0
2001	17.4	12.0	17.5	7.4	14.6	22.2	60.6	86.4	9.6	38.6	14.4	23.6	324.3
2002	22.6	5.2	1.8	16.8	15.6	20.6	47.6	98.8	22.8	28.0	7.2	2.2	289.2
2003	17.2	3.6	13.2	2.6	33.8	50.6	33.8	65.0	21.0	38.2	30.8	24.2	334.0
2004	2.4	11.8	6.2	18.8	3.4	22.6	33.6	42.4	63.8	22.0	25.4	4.4	256.8
2005	2.4	9.8	15.0	16.8	29.3	22.6	43.6	8.8	23.9	16.6	25.4	8.8	223.0
2006	16.2	3.6	3.4	9.4	13.8	47.0	51.0	40.2	19.4	58.4	18.6	19.4	300.4
2007	14.4	21.8	10.0	18.3	18.2	37.0	30.4	66.6	43.8	18.0			
Average	16.3	11.6	17.2	20.3	16.9	32.5	39.0	62.4	51.6	31.8	30.1	21.8	340.2

Average Temperature Values 1985-2007

Month	Mean Max Temp	Mean Temp	Mean Min Temp	Extreme Max Temp	Extreme Min Temp
Jan	-26.8	-30.3	-33.9	-13.4	-40.6
Feb	-25.6	-29.4	-33.1	-12.3	-40.6
Mar	-19.3	-23.9	-28.4	-4.9	-38.5
Apr	-9.9	-14.6	-19.3	-0.1	-30.9
May	-1.9	-5.1	-8.3	5.2	-19.9
Jun	6.6	3.5	0.4	15.8	-4.5
Jul	13.6	9.8	5.9	22.2	1.6
Aug	12.5	9.7	6.8	21.0	3.1
Sep	6.3	4.4	2.4	13.7	-3.4
Oct	-1.1	-3.5	-5.8	6.2	-16.6
Nov	-12.4	-16.2	-19.8	-1.0	-30.1
Dec	-19.9	-23.7	-27.5	-6.4	-36.7

Environment Canada, Monthly Data, Whale Cove A, Nunavut Station, Accessed Nov 21, 2008
<<http://climate.weatheroffice.ec.gc.ca/climateData/monthlydata_e.html?timeframe=3&Prov=XX&StationID=1727&Year=2007&Month=1&Day=1>>.

Appendix D
Site Forms

Form 1
Monthly Sewage Delivery Log
Hamlet of Whale Cove

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 Whale Cove

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		
Berm		
Sewage Level		

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

Form 3
Sewage Treatment Facility Planning Form
Hamlet of Whale Cove

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		

ᓄᓇᕗᑦ 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
Site Photographs

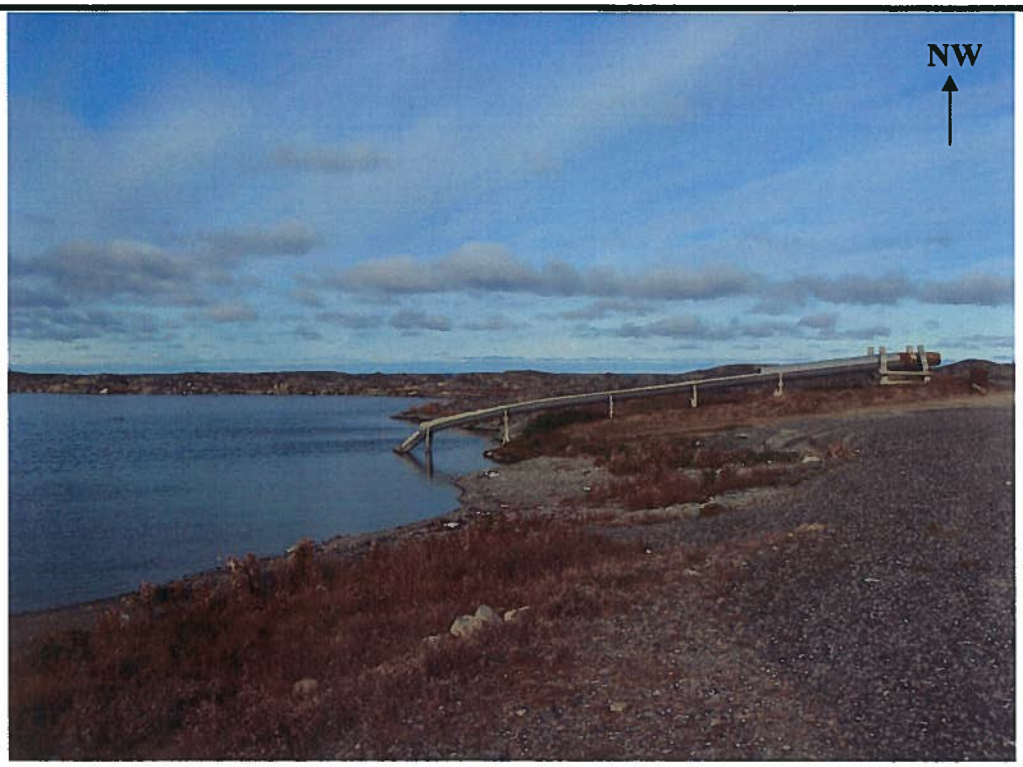


Photo 1: Truck Discharge Station, Sewage Flute

Photo 2: Sewage Flute pipe into sewage lagoon

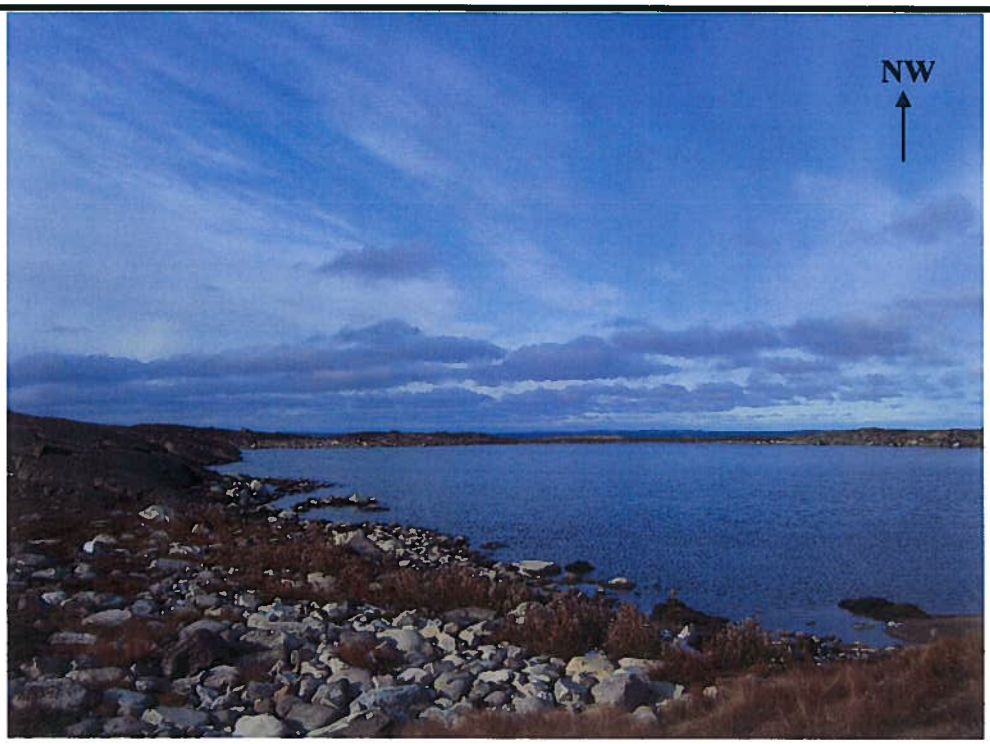


Photo 3: Shoreline of sewage lagoon

Photo 4: Sample location on edge of lagoon – SL-1

Photo 5: Vegetation north of lagoon indicating some leaching of lagoon to the north.

Photo 6: Lagoon Berm

Photo 7: Lush vegetation down gradient of lagoon

Photo 8: Wetland area on west side of lagoon berm.

Photo 9: Wetlands down gradient of lagoon

Photo 10: Wetland Treatment Area

Photo 11: Flowing water 460 m from lagoon within Wetland Treatment Area, SL-2

Photo 12: Flowing water 570 m from lagoon and 40 m from ocean, WHA-3

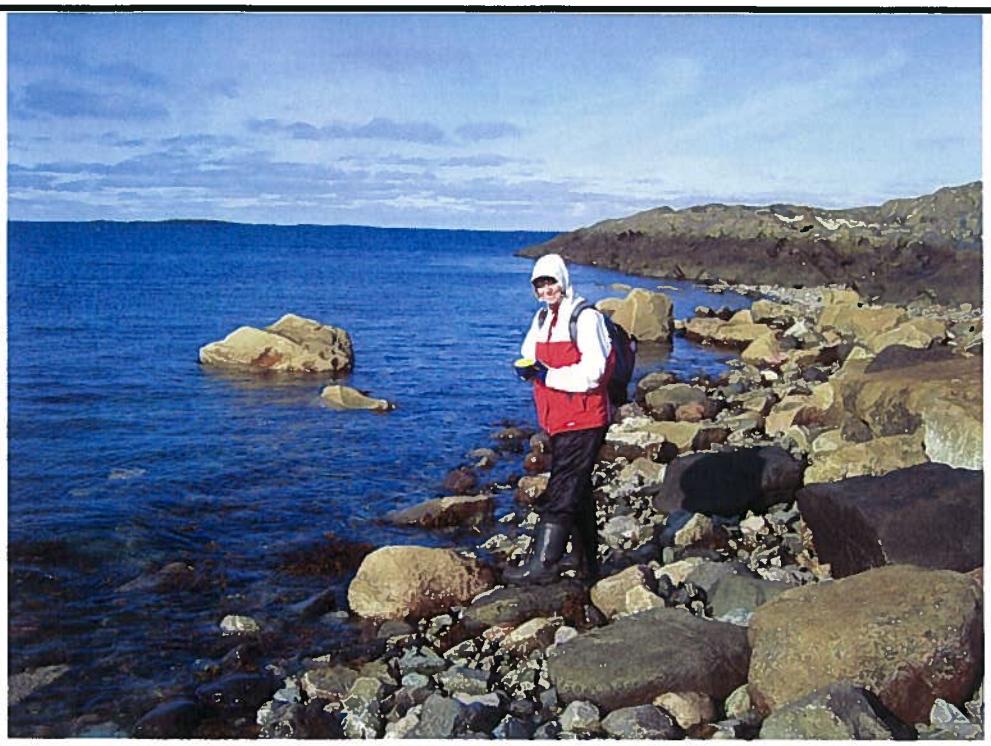


Photo 13: Discharge point at ocean down gradient of wetlands.