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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN

# Water Licence Application Supplementary Questionnaire for Municipalities

**Water License Application for the Hamlet of Whale Cove, Nunavut**

**December 2008**

## I. GENERAL

1. Date: November 3, 2008

2. Applicant: Hamlet of Whale Cove

3. Contacts: Name of Contact: Clayton Croucher
Position: Senior Administrative Officer
Telephone: (867) 896-9961
Fax: (867) 896-9109

4. Community Status: __ Village __ Town __ City
x Hamlet __ Settlement Corporation

5. Indicate the status of the municipality's license on the date of the application.
__ New Application
x Renewal - Water License # No. NWB3WHA0207

## II. ATTACHMENTS

1. Attach current or up-to-date detailed map(s) showing the locations of the:

a. raw water intake;
b. water storage and treatment facilities;
c. fuel and chemical storage;
d. sewage treatment facilities (lagoon, honey bag pit, wetland);
e. wastewater treatment area and discharge outlets;
f. solid waste disposal areas and drainage patterns;
g. hazardous waste disposal area;
h. transportation access routes;
i. existing water bodies/courses and any changes to these water bodies/courses that have or may occur as a result of water use or waste disposal facilities, locations of environmental monitoring sites. (Outline drainage basin);
j. Traditional use areas outlined on site map and areas around the community used for recreation, camping, fishing, etc.
k. abandoned and/or restored water treatment, sewage, and solid waste disposal facilities.

Are maps attached? x Yes __ No

If no, please indicate when they will be available.

Indicate which organization has provided the various maps or diagrams.

Nuna Burnside Engineering and Environmental Ltd.

## III. WATER SUPPLY

***Water Source***

1. Type of source: x Lake __ River __Well Other _____

2. Name of water source and alternative, if any.

   Primary Source: Fish Lake
   Secondary Source: Not applicable

3. Usual break-up: June
   Freeze-up period: October

***Water Intake***

1. Please provide short descriptions for the following:

   a. Freshwater intake facility

   The intake was constructed using a single vertically mounted drum screen and inclined shaft casing. The intake was installed at a depth of 6 m. A submersible pump is mounted on a skid and located inside the casing about 15 m from the intake. Water is supplied to the water trucks by means of an overhead truckfill arm.

   b. Operating capacity of pumps used

   1,000 Litres/minute

   c. Intake screen size

   The 100 mm diameter uninsulated, heat traced HDPE discharge line is carried inside the 300 mm diameter, 120 m long, HDPE insulated casing. The casing is ballasted and protected by a granular berm and rip-rap. The intake is a standard fish screen.

***Water Storage***

1. Type of water storage facility. (check where applicable)
   ___ Reservoir/Pond x Storage tank ___ None ____ Other

   Description:

2. If "reservoir" checked:

   Is the reservoir lined? ___ Yes x No

   What type of liner? _____ When was it installed?_____

***Water Treatment***

1. Indicate the quality of the water.

| | | | |
|---|---|---|---|
| Summer: | x good | ___ fair | ___ poor |
| Fall: | x good | ___ fair | ___ poor |
| Winter: | x good | ___ fair | ___ poor |
| Spring: | x good | ___ fair | ___ poor |

2. Describe.

Water is treated with chlorine. Chlorine is injected into water when water is being filled into water trucks. The hypochlorite feed pump is controlled by the flow rate of water supplied to the water trucks. The chlorine is supplied to the main line by a tube and chlorine injector. The design flow rate of the injection system provides 0.5 mg/L residual chlorine.

3. Type of water treatment.

___ Filtration and chlorination
x Chlorination only
___ None
___ Other _____
Description

***Water Use And Distribution***

1. Volume of water use:

Using population numbers from Census Reports between the years 1981 and 2006, a per capita growth rate of 1.4% was determined. Table 1 shows the projected population of the Hamlet for the next 20 years.

**Table 1. Whale Cove Projected Population**

| Year | Projected Population |
|---|---|
| 2006 | 353 |
| 2007 | 358 |
| 2008 | 363 |
| 2009 | 368 |
| 2010 | 373 |
| 2011 | 378 |
| 2012 | 384 |
| 2013 | 389 |
| 2014 | 395 |
| 2015 | 400 |
| 2016 | 406 |
| 2017 | 411 |
| 2018 | 417 |
| 2019 | 423 |
| 2020 | 429 |
| 2021 | 435 |
| 2022 | 441 |
| 2023 | 447 |
| 2024 | 453 |
| 2025 | 460 |
| 2026 | 466 |

| Year | Projected Population |
|---|---|
| 2027 | 473 |
| 2028 | 479 |

Using 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.

RWU x (1.0 + (0.0023 x Population).

Where the RWU (residential water use is estimated to be 90 L per capita per day (Lpcd).

The equation was used to produce Table 2. The table indicates that in 2008 the annual consumption is 12,958 $m^3$ and the 10 year annual volume of water consumption for the community will be 15,287 $m^3$.

**Table 2: Projected Water Use Requirements**

| Year | Projected Population | Projected Daily Consumption $m^3$ | Projected Annual Consumption $m^3$ |
|---|---|---|---|
| 2006 | 353 | 34 | 12,538 |
| 2007 | 358 | 35 | 12,729 |
| 2008 | 363 | 36 | 12,958 |
| 2009 | 368 | 36 | 13,189 |
| 2010 | 373 | 37 | 13,420 |
| 2011 | 378 | 37 | 13,651 |
| 2012 | 384 | 38 | 13,883 |
| 2013 | 389 | 39 | 14,116 |
| 2014 | 395 | 39 | 14,349 |
| 2015 | 400 | 40 | 14,583 |
| 2016 | 406 | 41 | 14,817 |
| 2017 | 411 | 41 | 15,051 |
| 2018 | 417 | 42 | 15,287 |

***General Condition of the water supply facilities***

1. General condition of the:

a. Water supply facility

x Satisfactory __ Unsatisfactory

If unsatisfactory, explain.

b. Storage facility

x Satisfactory __ Unsatisfactory

If unsatisfactory, explain.

c. Distribution system

x Satisfactory __Unsatisfactory

If unsatisfactory, explain.

***Modifications***

1. Are there any changes *planned* for the water supply system?

x No ___Yes

If yes, please attach a copy of the plan, or describe changes. Provide information on the implementation schedule.

Provisions for the potential of future fluoridation as a form of water treatment have been made by the installation of a supply fitting on the steel water discharge line and reserving space within the pump house for fluoridation equipment.

2. Does the community believe changes are needed to the water supply, storage or treatment facilities? Describe.

No

***Identification***

Are there signs identifying drinking water sources presently used by the municipality?

x Yes __ No

## IV. SEWAGE DISPOSAL

1. What type(s) of sewage treatment does the community have?

Lagoon
__ Mechanical system
___ Wetland
___ Honey bag
x Combination/Other: describe

The sewage treatment of the community consists of a lagoon to retain the waste and to discharge the sewage to the wetlands.

***Lagoon*** *(if applicable)*

1. Has there been any operating problems with the lagoon?

___ Yes x No

If yes, describe

***Mechanical System*** *(if applicable)*

1. Describe (type, specifications, operation and maintenance program for the mechanical wastewater treatment system).

2. Are sludges produced? __ Yes __ No

If yes, describe how the sludges are disposed of:

***Wetland****(if applicable)*

1. Describe the Wetland wastewater treatment system.

The wetlands wastewater treatment system utilizes complex physical and biological processes to treat the wastewater. A combination of sedimentation, absorption of pollutants in the surface soils, nutrient uptake by plants and oxidation of compounds by microorganisms are some of the processes that effect the treatment. There are approximately 400 metres of wetlands between the Whale Cove Sewage Lagoon and the ocean.

***Honey Bag Pit***

1. Does the municipality use a honey bag pit?
   ___ Yes x No
   If yes, describe the location, drainage, and operation/maintenance of the site:

***Commercial, Industrial and/or Hazardous Wastes***

1. Are there any sources of commercial or industrial *liquid* waste being discharged or deposited to the wastewater treatment system that may affect the quality of the effluent or leachate produced? *(The municipality should be aware that any commercial or industrial discharge has to be approved by the municipality)*
   ___ Yes x No

   If yes, indicate sources, types and quantities.

***Sewage Discharge***

1. Are fish, shell fish and other wildlife harvested in or near the discharge area ?
   x Yes ___ No

   If yes, indicate species harvested, and level of harvest.
   - Fishing for arctic char north of the shore near the lagoon
   - Domestic harvesting of mussels

***General Condition of the sewage treatment facilities***

1. General condition of the:

a. Sewage collection system
   x Satisfactory __ Unsatisfactory
   If unsatisfactory, explain.

b. Discharge control system
   x Satisfactory __ Unsatisfactory
   If unsatisfactory, explain.

c. Dams, diversion dykes, berms
   x Satisfactory __ Unsatisfactory
   If unsatisfactory, explain.

***Modifications***

1. Are there any changes *planned* in the sewage treatment facilities?
   x No __ Yes

If yes, please attach a copy of the plan, or describe changes. Provide information on the implementation schedule.

2. Does the municipality or residents believe changes are needed to the sewage treatment facilities? Describe. No

***Abandonment and Restoration***

1. List and describe abandoned or restored sewage treatment facilities.
   Refer to original attachment maps.

***Identification***

Are there signs identifying past and present sewage disposal sites ?
x Yes __ No

## V. SOLID WASTE DISPOSAL

1. Briefly describe how solid wastes are collected and delivered to the disposal area.

Hamlet has two garbage trucks that work on a schedule and collect and bring the garbage to the dump.

2. Is the solid waste site fenced? x Yes __ No

3. Is the fence adequate? __ Yes x No

   If no, describe:
   Fence is starting to fall down.

***Waste Reduction***

1. Does the municipality burn garbage?
   x Yes __No
   If yes, describe how and when this is done.
   Burning is done when winds are not directed towards the town.

2. Has the municipality considered measures for waste reduction such as recycling or reuse?
   __ Yes x No

***Animal Carcasses Pit***

1. Does the municipality have an area for the disposal of animal carcasses?
   __ Yes x No
   If yes, describe the location, drainage and operation/maintenance of the site

***Waste Oil Pit***

1. Describe the waste oil storage area.

The waste oil storage is located in the bulky waste area. Barrels containing waste oil are stored on pallets.

***Bulky Scrap Metal Waste Disposal Area***

1. Does the municipality have a scrap metal or bulky waste disposal area?

   x Yes __ No

   If yes, briefly describe its location and operation plan.

Bulky waste is separated from the solid waste and stored in an area on the west side of the landfill. The area is used to store old vehicles, machinery, appliances, tanks and other large metal items. There is no operation plan in place.

***Commercial, Industrial and/or Hazardous Wastes Disposal Area***

1. Are there any commercial or industrial waste being discharged or deposited in the solid waste disposal area? *(The municipality should be aware that any discharge of commercial or industrial waste has to be approved by the municipality)*

   ___ Yes x No

   If yes, please indicate sources, types and quantity.

2. Will the municipality use a hazardous waste disposal area?

   x Yes __ No

   If yes, describe its:

   a. Location
   b. Structure
   c. Operation and maintenance (describe special handling/disposal methods for these wastes).

The Hamlet currently segregates hazardous waste to the bulky metal waste area. The community is investigating the purchasing a sealift container that would be dedicated to the storage of batteries and other hazardous materials prior to proper disposal.

***General Condition of the Solid Waste Disposal Area***

1. Comment on the general conditions of the:

a. Solid waste disposal area

__ Satisfactory x Unsatisfactory

If unsatisfactory, explain.

The general condition of the site is under-maintained. Garbage that should be in the landfill area is in the bulky waste section. Waste has not been covered and litter is not contained by the fence.

***Modifications***

1. Are there any changes planned for the solid waste disposal area?

__ No x Yes

If yes, attach a copy of the plan, or describe changes. Provide information on the implementation schedule.

See attached plan for changes to solid waste disposal area.

2. Are changes needed to the solid waste disposal area? Describe.

Presently the entry point to solid waste site is from lower part of the site and the whole of the garbage is dumped just at the entry point of site. The garbage trucks can not go further due to this loose material. Moreover when this material will be covered for treatment, the level of site will be raised up and there will be no possibility to move further in the remaining site. So to sort out the problem permanently another approach road is required which provide the entry to garbage trucks from upper side. So keeping in view this problem a new approach road having approx. length of 174 mt. is proposed herewith. The funds will be provided by the Hamlet of Whale Cove, Nunavut.

***Abandonment and Restoration***

1. List and describe abandoned or restored solid waste facilities.
Indicate their location on a map.

An old abandoned solid waste site is located on the north side of the community.

**Identification**

Are there signs identifying past and present solid waste disposal sites?

x Yes __ No

## VI. INSPECTION AND MONITORING

1. When were municipal facilities inspected by:

| | |
|---|---|
| x Indian and Northern Affairs Inspector | Date: 2008/07/31 |
| ___ Municipal and Community Affairs | Date: _____ |
| x Other: Nuna Burnside | Date: September 2008 |

2. Is there a system in place for reporting spills?

x Yes ___ No

If yes, describe.

All spills are reported to the NT-NU 24 Hour Spill Report Line.

3. Is there a contingency plan for clean up of spills?
x Yes ___ No
If yes, describe.

An environmental emergency contingency plan will be submitted to the Board for their review.

4. Have any spills occurred in the past five years?
__ Yes x No
If yes, describe and show on a map the locations of the spills. What action has been taken to clean the affected areas?

No significant spills have occurred in the past 5 years. Historically spills have occurred at the tank farm in the community. The soil from these spills was transported to the Whale Cove landfarm which is currently part of another licence.

***Monitoring Program***

1. Is water sampling and analysis done?
x Yes ___No

If Yes, answer the questions a to e.

a. Briefly describe how samples are taken and sent to the laboratory.

Samples are collected by an experienced technician. They are collected in appropriate bottles provided by an accredited laboratory. Samples are put into coolers with ice to keep at a temperature of 4°C and shipped to a laboratory within the required holding times.

b. Briefly describe any monitoring done for wastewater effluent and leachate.

Monitoring of wastewater effluent and leachate was completed by Nuna Burnside on September 12, 2008. Sampling was also completed in summer 2008 by Fleming Collage students for the Polar Year projects. Sampling will be completed as per licence requirements by the Hamlet Public Works Department.

c. Who is responsible for water sampling?
Name: Guy Enuapik
Position: Public Works Foreman
Telephone #: (867) 896-9248
Fax # : (867) 896-9109
Level of training: _____

Guy Enuapik is the Public Works Forman for the Hamlet. He is responsible for the upkeep of the water intake, sewage collection and waste management site. There has not been anyone at Public

Works assigned to conducting sampling. All sampling in the past has been conducted by INAC or by hired consultants such as Nuna Burnside.

d. Recognized laboratory performing analysis of samples.

Name: Taiga Environmental Laboratory
Address: 4601-52 Avenue, Yellowknife, NWT
Telephone #: (867) 669-2788
Fax #: (867) 669-2718

e. Are any changes planned in the water quality monitoring program?
___ Yes x No
If yes, describe.

## VII. PUBLIC CONCERNS

1. What concerns does the municipality or residents have regarding the municipal water supply or waste disposal facilities? List the concerns and describe what steps have been taken to address those concerns.

Discussions with the SAO of the Hamlet identified that the municipality and residents of the Hamlet have concerns regarding the location of the waste disposal facility. They cannot burn garbage at the landfill because the winds which are generally north and westerly blow the smoke into town. They also have concerns about the landfill being to close to the community and would like to see if somewhere further away. The fence is currently inadequate and falling down on the northern side of the landfill.

## VIII. PUBLIC HEALTH *(Help may be obtained from the Regional Environmental Health Officer if you have difficulty with this section.)*

The Kivalliq region does not currently have a Regional Environmental Health Officer; the Iqaluit Region Environmental Health Officer is filling in at this time.

1. Date:

2. Municipality: Hamlet of Whale Cove

3. Contact: Bob Hunley
Environmental Health Officer Contract
Telephone - 867-645-2171 ext. 241
Fax – 867-645-2409

4. Have there been any problems or health/environmental concerns with drinking water ?
___ Yes x No

If yes, describe

5. Have there been any problems or health/environmental concerns with sewage disposal/treatment?
___ Yes x No

If yes, describe

6. Have there been any problems or health/environmental concerns with solid waste disposal?
x Yes ___ No

If yes, describe

***Monitoring Program***

1. Does the Regional Health Board perform water quality sampling?
x No ___If Yes, answer questions (a) to (e)

a. Briefly describe the sampling methodology.

b. Briefly describe any monitoring of wastewater effluent and leachate.

c. Who is responsible for sampling?

Name:
Position:
Telephone #:

d. Recognized laboratory performing analysis of samples.

Name:
Address:
Telephone #:
Fax # :

e. Are any changes planned in the water quality monitoring program?
__ Yes x No
If yes, describe.

## IX. TECHNICAL INFORMATION *(Assistance may be obtained from the Regional Community Government (CG&T) office if you have difficult with this section).*

1. Date:

2. Municipality: Hamlet of Whale Cove

3. Contact:
(Community Government and Transportation Representative)

Telephone #:

Fax #:

4. Population (according to most recent census results): 353 (2006 Census)

5. Estimated growth rate over next 5 years: 1.4%

6. Has any baseline data collection and evaluation been undertaken with respect to the physical, biological, and chemical characteristics of the main water bodies in the area?

x Yes ___No

If yes, provide a summary of program details or site title, authors, cities, and dates:

| Prepared by | Title | Completion Date |
|---|---|---|

Ferguson Simek Clark, Whale Cove Sewage and Solid Waste Planning Study, August, 2001

If no, are such studies being planned?

___ No ___Yes (If yes, when and by whom):

7. Have Elders been consulted in the collection of baseline data on main water bodies in the area?

x No __Yes

If yes, specify.

8. Have any baseline data collection and evaluation been undertaken with respect to the various biophysical components of the environment potentially affected by the project?

x No __Yes

If yes, provide details below.

| Prepared by | Title | Completion Date |
|---|---|---|

If no, are such studies being planned?

x No __Yes.

If yes, specify:

***Attachments***

1. Attach detailed plan or drawing(s) of the present *solid waste disposal area*. Include the following information:

   a. details of pond size and elevation;
   b. details of all retaining structures (dimensions, materials of construction, etc.);
   c. details of the drainage basin, and existing and proposed drainage modifications;
   d. details of all decant, siphon mechanisms etc., including sewage treatment facilities;
   e. details regarding direction and path of wastewater flow from the area;

f. distance from watercourses and fish bearing waters;
g. location and construction of liners;
h. leachate and groundwater collection systems; and
i. control structures.

2. Attach detailed plan or drawing(s) of the present *sewage treatment system.* The drawing(s) should include the following:

a. details of all retaining structures (dimensions, materials of construction, etc.);
b. details of the drainage basin, and existing and proposed drainage modifications;
c. details regarding direction and path of wastewater flow from the area;
d. indications of the distance from watercourses and fish bearing waters;
e. all sources of seepage presently encountered near these areas, including volumes ($m^3$/day) and directions.
f. the volume of seepage flow ($m^3$ / day); and
g. the direction of each flow.

3. Are drawings for the solid waste disposal area and sewage treatment system attached?

x Yes ___No

If yes, who has provided them?

Nuna Burnside and the Government of Nunavut

If no, indicate when they will be available?

***Hydrology***

1. Effects on surface water flow:

| | | |
|---|---|---|
| Are any stream channels altered? | __ Yes | x No |
| Is the natural storage or water level of any lake or pond changed? | __ Yes | x No |
| Are there changes in water flow downstream of the project? | __ Yes | x No |
| Is a storage reservoir created in a natural channel? | __ Yes | x No |

If yes to any of the above, briefly describe the expected change in flow or storage:

2. Drainage Area:

What is the drainage area? Fish Lake drainage basin is 2,130,000 $m^2$

What is the average elevation of the drainage basin?

27.4 m to 0 m (drains to ocean)

Is the drainage basin outlined on an attached map? x Yes ___No

Describe the drainage basin characteristics, (vegetation, general soil type, lakes, swamps and permafrost areas, etc.)

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 Pre-Cambrian rock 15 to 20 m in height surrounds the community. The Community 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 (FSC, 2001).

3. Channel characteristics:
   Is the course of any channel changed? ___ Yes x No

   If yes, describe measures to maintain stream bed and bank stability.

4. Will the cross-section of any watercourse be changed?__ Yes x No
   If yes, describe the change and its effect on the flow capacity of the channel.

***Water Supply***

1. What is the rate of withdrawal from the source? __40__ $m^3$/day.

2. Is water drawn from the source ___ intermittently x continuously

3. If it is drawn intermittently, during what month(s) is it drawn? _____

4. For what period is it drawn (days/weeks/months)? 365 days

5. What is the rate of flow of source (if river) or size (if lake)? 194,000 $m^3$

6. At the intended rate of water usage, describe the effects on the river or lake from which water will be drawn.

There is nearly 93,000 $m^3$ of water per year available as recharge for the lake, compared to the annual consumption of 13,458 $m^3$. There are no anticipated effects on the lake due to water withdrawn.

***Water Intake***

1. Please provide short descriptions of the following:

   a. freshwater intake facility

   The intake was constructed using a single vertically mounted drum screen and inclined shaft casing. The intake was installed at a depth of 6 m. A submersible pump is mounted on a skid and located inside the casing about 15 m from the intake. Water is treated inside the pumphouse with chlorine. Water is supplied to the water trucks by means of an overhead truckfill arm.

   a. Operating capacity of pumps used

   1,000 Litres/minute

b. Intake screen size

The 100 mm diameter uninsulated, heat traced HDPE discharge line is carried inside the 300 mm diameter, 120 m long, HDPE insulated casing. The casing is ballasted and protected by a granular berm and rip-rap. The intake is a standard fish screen.

***Water Storage***

1. Is a dam or dyke being used to store or alter the flow of water? ___Yes x No

2. What are the dimensions of the dam or dyke?
   Length:_____ Width: _____ Height:_____
   U/S slope: _____ D/S slope: _____

3. Does the proposed dam create a reservoir in a natural watercourse?
   ___ Yes x No
   If yes, what is the storage capacity and surface area of the reservoir?
   _____ $m^3$ _____ ha.

4. Will the dam or dyke affect fish migration or movement?
   ___ Yes x No
   If yes, describe all measures for compensation of fish habitat lost due to the dam or dyke, and mitigation for fish migration or movement.

***Water Treatment***

1. Indicate the capacity of the treatment facility. ___1,000____ L/min

2. What is the capacity of the water storage facility._____ $m^3$

   Water storage is Fish Lake (approximately ___ $m^2$ area) with an average estimated depth of 5 m. Total volume approximately ___ $m^3$ with storage approximately 30 percent less ___ $m^3$.

3. Describe the method of water treatment (i.e., backwash, flocculation, sedimentation, chemicals used), and provide the results of the most recent bacteriological and chemical analysis. Attach a diagram, if possible.

   Water is treated with chlorine. Chlorine is injected into water when water is being filled into water trucks. The hypochlorite feed pump is controlled by the flow rate of water supplied to the water trucks. The chlorine is supplied to the main line by a tube and chlorine injector. The design flow rate of the injection system provides 0.5 mg/L residual chlorine.

4. Are there any changes planned in the water treatment facilities?
   x No ___Yes
   If yes, attach a copy of the plan or indicate changes and include an implementation schedule.

***Sewage Disposal***

1. Indicate the level of sewage treatment:

___ primary ___ secondary ___ tertiary
Pre-treatment (if applicable): ___ screening ___ maceration
Lagoons (if applicable): ___ anaerobic x aerobic ___facultative

2. Indicate the capacity of the sewage treatment facility 21,000 $m^3$

3. Based on current population projections, the facility will meet the needs of the community until the year 2,028 .

4. Average depth of the wastewater lagoon 1.2 m.

5. What is the design freeboard? n/a m.

6. Indicate the retention time of the sewage while in the treatment facility 608 days.

7. Indicate the estimated rate of discharge of wastewater 0.46 L/sec.

8. Indicate the location of the discharge point 640 metres from lagoon on Hudson Bay

9. Is the discharge: ___seasonal x continuous
If the discharge is seasonal, during what month(s) is it done? _____
What is the duration of the discharge (days/weeks/months) ? _____

10. Are there any changes planned in the sewage disposal facilities?
x No ___Yes
If yes, attach a copy of the plan or indicate changes and include an implementation schedule.

***Solid Waste Disposal***

1. Indicate the capacity of the disposal area 31,000 $m^2$.

2. The *average* depth of the solid waste disposal site 4.5 m.

3. The current facility will meet community needs until the year 2023.

4. Do any natural watercourse enter the solid waste disposal area? What methods are used to decrease the amount of runoff water entering these areas?

none

5. Indicate the volume of water that may enter these areas from any source(s) and attach all pertinent details of the diversions.

| Source | Volume |
|---|---|
| none | |

6. Please describe any diversions of watercourses:

none

7. Are there any changes planned in the solid waste disposal facilities?
___ No x Yes
If yes, attach a copy of the plan or indicate changes and include an implementation schedule.

A Landfill Rehabilitation Plan outlining recommended improvements to the landfill is planned for 2009. Refer to the Municipal Solid Waste O&M Plan.

***Other***

1. Describe any additional details on the existing municipal facilities which should be considered by the Nunavut Water Board during it review.

Refer to other documents submitted with the application including:

- Water License Annual Report 2008, Whale Cove Water Use and Waste Disposal
- Solid Waste Management Facility, Operation and Maintenance (O&M) Plan, Hamlet of Whale Cove
- Sewage Treatment Facility Operation and Maintenance (O&M) Plan, Hamlet of Whale Cove
- Water Supply Facility Operation and Maintenance (O&M) Plan, Hamlet of Whale Cove
- Environmental Emergency Contingency Plan, Hamlet of Whale Cove
- Environmental Monitoring Program and QA/QC Control Plan, Hamlet of Whale Cove.

Nunavut Water Board
P.O. Box 119
Gjoa Haven, Nunavut
X0E 1J0

**Re: Water License Application for the Hamlet of Whale Cove**

## 1. Name and Mailing Address of Applicant/Licensee

This application is being submitted on behalf of the Hamlet of Whale Cove, P.O. Box 120, Whale Cove, Nunavut, X0C 0J0 Telephone: (867)-896-9961 Fax: (867) 896-9109, Contact: Mr. Clayton Croucher, SAO.

## 2. Address if Head Office in Canada if Incorporated

N/A

## 3. Location of Undertaking

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

Whale Cove is a sheltered bay that faces southward. The Hamlet is situated on a grassy, boulder-stream area that gently slopes upward from the sea. The overburden consists of coarse gravel and sand over Precambrian bedrock. Rock outcrop are common and the active layer above permafrost is approximately 1.0 m in late summer.

The Whale Cove area receives an average of 34 cm 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 A.

## 4. Description of Undertaking

This application is for the renewal of a Nunavut Water Board License, NWB3WHA207 that includes all municipal water intake, sewage disposal and waste disposal activities for the Hamlet of Whale Cove. The facilities that operate under the License include the Fish Lake Water Intake Pumphouse and Truck-Fill Station, the Sewage Lagoon and the Solid Waste Management Facility (Figure 2). A contaminated soil landfarm located in the Whale Cove Solid Waste Management Facility has a separate licence, 3BM-WCL0712.

### *Water Intake System*

The Hamlet of Whale Cove obtains its potable water from Fish Lake, located approximately 3.5 km north of the community (Figure 2). The total drainage area of Fish Lake is 213 hectares. Using an annual precipitation rate of 340 mm and an annual evapotranspiration rate of 200 mm, the total recharge to the lake is approximately 300 000 $m^3$ per year.[1] The lake has a winter storage capacity of 97,000 $m^3$, assuming 50 percent ice coverage.

The intake was constructed using a single vertically mounted drum screen and inclined shaft casing. The intake was installed at a depth of 6 m. A submersible pump mounted on a skid and is located inside the casing about 15 m from the intake. Water is supplied to the water trucks by means of an overhead truck fill arm. The pump fills the trucks at a rate of 1000 L/min.

Water treatment consists of chlorine injection as water is filled into the water trucks. The hypochlorite feed pump is controlled by the flow rate of water supplied to the water trucks. The chlorine is supplied to the main line by a tube and chlorine injector. The design flow rate of the injection system provides 0.5 mg/L residual chlorine.

### *Solid Waste Collection and Disposal*

The Solid Water Management Facility is located as shown in Figure 2. Solid waste in the community is collected by a garbage compactor truck and deposited in the community landfill located 1.1 km southeast of the community (Figure 3). The solid waste landfill area is 40,000 $m^2$. Bulky metals disposal is located outside of the main landfill area and contains old vehicles, machinery, old tanks and appliances.

---

[1] See Appendix B: Hydrology Calculations

*Sewage Collection and Disposal*

Sewage collection is provided by the Hamlet. Each building has a sewage holding tank that is pumped out by the Hamlet's sewage pump out truck daily. Pump out sewage is treated at the community sewage lagoon located approximately 0.7 km from the Hamlet (Figure 2). The lagoon is approximately 200 metres long and 110 metres wide. A berm of sand and gravel is constructed on the southwest side of it. Water from the lagoon slowly leaches through the berm into the wetland treatment area immediately down-gradient and eventually discharges to Hudson Bay 600 metres away.

The wetland wastewater treatment system utilizes complex physical and biological processes to treat the wastewater. A combination of sedimentation, absorption of pollutants in the surface soils, nutrient uptake by plants and oxidation of compounds by microorganisms are some of the processes that effect the treatment. There are approximately 600 metres of Wetland Treatment Area between the Sewage Lagoon and the ocean. The drainage area around the sewage lagoon is approximately 8.3 ha. Figure 4 illustrates the drainage around the lagoon.

## 5. Type of Undertaking

The undertakings included in this application are classified as Municipal Undertakings.

## 6. Water Use

The water use in this licence is to obtain water for the use by the Hamlet, as their primary water supply.

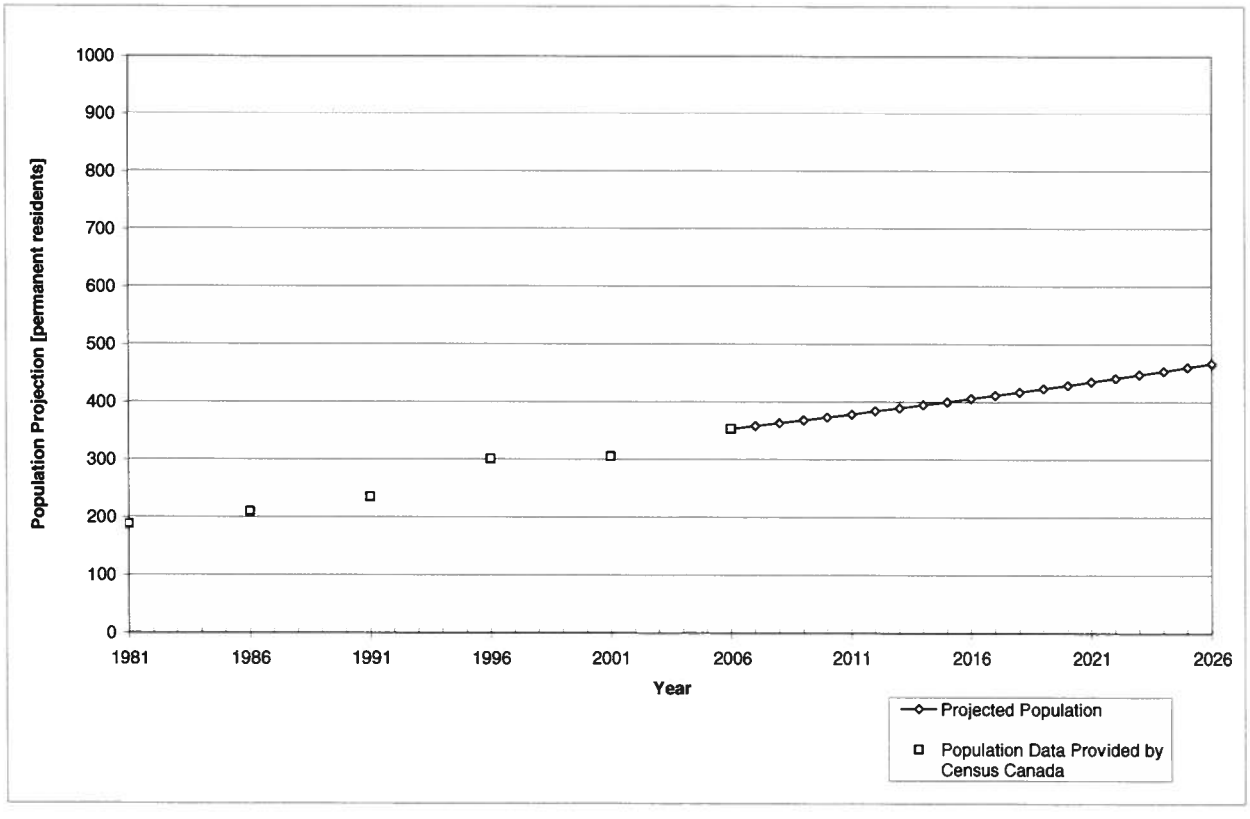
## 7. Quantity of Water Involved

Using population numbers from Census Reports between the years 1981 and 2006 and average provincial growth rate projections from Statistics Canada (Statistics Canada, 2000), a growth rate of 1.4 percent was determined. Table 1 and Figure A show the projected population of the Hamlet for the next 10 years. Detailed calculations are shown in Appendix B.

## Table 1: Whale Cove Projected Population

| Year | Projected Population |
|---|---|
| 2009 | 370 |
| 2010 | 376 |
| 2011 | 382 |
| 2012 | 388 |
| 2013 | 394 |
| 2014 | 400 |
| 2015 | 406 |
| 2016 | 412 |
| 2017 | 418 |
| 2018 | 424 |
| 2019 | 430 |
| 2020 | 437 |
| 2021 | 444 |
| 2022 | 451 |
| 2023 | 458 |
| 2024 | 465 |

## Figure A: Projected Population in Whale Cove, Nunavut



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.

RWU x (1.0 + (0.0023 x Population)

Where the RWU (residential water use is estimated to be 90 L per capita (Lpcd)) and the factor 0.00023 x population represents the commercial and industrial water use.

This equation was used to produce projected water use requirements for the next 10 years (Table 2).

The table indicates that in 2008 the annual consumption is approximately 12,958 $m^3$ and that in 10 years the annual volume of water consumption for the community will be 15,287 $m^3$. The current licence states that the allowable water use for the community is 30,000 $m^3$ per year.

**Table 2: Projected Water Use Requirements**

| Year | Projected Population | Projected Daily Consumption $m^3$ | Projected Annual Consumption $m^3$ |
|---|---|---|---|
| 2008 | 363 | 36 | 12,958 |
| 2009 | 370 | 36 | 13,189 |
| 2010 | 376 | 37 | 13,420 |
| 2011 | 382 | 37 | 13,651 |
| 2012 | 388 | 38 | 13,883 |
| 2013 | 394 | 39 | 14,116 |
| 2014 | 400 | 39 | 14,349 |
| 2015 | 406 | 40 | 14,583 |
| 2016 | 412 | 41 | 14,817 |
| 2017 | 418 | 41 | 15,051 |
| 2018 | 424 | 42 | 15,287 |

## 8. Waste

### *Sewage*

The volume of sewage waste water roughly corresponds to the annual water use of the Hamlet. The estimated volume of waste water for 2008 is 12,988 $m^3$. In 2018, the annual volume of sewage generated by the Hamlet of Whale Cove will be 15,016 $m^3$ (Appendix B).

### *Greywater*

Greywater is collected with the liquid sewage and deposited in the sewage lagoon.

### *Sludges*

Sludges generated from wastewater sink to the bottom of the sewage lagoon. The sludge has not interfered with the efficiency of the lagoon and has not been removed from the lagoon since commissioning of the lagoon. If the sludges interfered with the sewage treatment process they would need to be removed from the lagoon and transported to an approved facility.

### *Solid Waste*

Solid waste projections for the Hamlet are provided in Table 3. The table is based on the Census 2006 population of 353 and a growth rate of 1.4 percent. The table assumes that there is 20 percent reduction in waste due to burning and that no compaction is occurring at the landfill. Based on the calculations shown in Appendix B, the landfill will be at capacity by 2024.

There is space in the area of the landfill to expand the footprint in the future if required.

**Table 3: Solid Waste Projection Estimates for the Hamlet of Whale Cove**

| Year | Projected Population | Annual Volume of Solid Waste [$m^3$] |
|---|---|---|
| 2009 | 370 | 1890.7 |
| 2010 | 376 | 1921.4 |
| 2011 | 382 | 1952.0 |
| 2012 | 388 | 1982.7 |
| 2013 | 394 | 2013.3 |
| 2014 | 400 | 2044.0 |
| 2015 | 406 | 2074.7 |
| 2016 | 412 | 2105.3 |
| 2017 | 418 | 2136.0 |
| 2018 | 424 | 2166.6 |
| 2019 | 430 | 2197.3 |
| 2020 | 437 | 2233.1 |
| 2021 | 444 | 2268.8 |
| 2022 | 451 | 2304.6 |
| 2023 | 458 | 2340.4 |
| 2024 | 465 | 2376.2 |

***Bulky Metals***

Bulky metals is separated from the solid waste and stored on the west side, outside of the fenced area of the landfill. The area is used to store old vehicles, machinery, appliances, tanks and other large metal items.

***Hazardous Waste***

The Hamlet currently segregates hazardous waste to the bulky metal waste area. The community is investigating the purchasing a sealift container that would be dedicated to the storage of batteries and other hazardous materials prior to proper disposal. A constructed hazardous waste area will be proposed in the Landfill Rehabilitation Plan.

## 9. Persons or Properties Affected by this Undertaking

There are no persons or properties affected by this undertaking. A land use permit was completed by the DIAND on 2000/07/27.

## 10. Predicted Environmental Impacts of Undertaking and Proposed Mitigation

There are concerns from the community regarding leachate migration into the ocean from the landfill site. A berm has been constructed to prevent the leachate from migrating towards the ocean. Regular monitoring of landfill leachate migration towards ocean will record the quality of the water discharging into the ocean.

## 11. Inuit Water Rights

The project or activity will not substantially affect the quality, quantity, or flow of water flowing through Inuit Owned Lands and the rights of Inuit under Article 20 of the Nunavut Land Claims Agreement.

## 12. Contractors and Sub-Contractors

None.

## 13. Studies Undertaken to Date

- NWB Annual Report, 2008, Whale Cove Water Use and Waste Disposal by Nuna Burnside Engineering and Environmental Ltd., December 2008
- Environmental Emergency Contingency Plan, Hamlet of Whale Cove, by Nuna Burnside Engineering and Environmental Ltd., December 2008
- Environmental Monitoring Program and Quality Assurance / Quality Control Plan, Hamlet of Whale Cove, by Nuna Burnside Engineering and Environmental Ltd., December 2008
- Solid Waste Management Facility, Operation and Maintenance Plan, Hamlet of Whale Cove, by Nuna Burnside Engineering and Environmental Ltd., December 2008
- Sewage Treatment Facility Operation and Maintenance Plan, Hamlet of Whale Cove, by Nuna Burnside Engineering and Environmental Ltd., December 2008
- Water Supply Facility Operation and Maintenance Plan, Hamlet of Whale Cove, by Nuna Burnside Engineering and Environmental Ltd., December 2008 .

## 14. Attachments

The following are attached with this document.

- Figures 1 to 4
  1. Site Location
  2. Community Plan

3. Solid Waste Management Facility
4. Sewage Lagoon

- Appendices
  A. Climate Data
  B. Water and Waste Calculation Tables
- Water License Application Supplementary Questionnaire for Municipalities
- Executive Summary of Project.

## 15. Proposed Time Schedule

We propose that the licence be a 5 year license starting immediately upon approval.

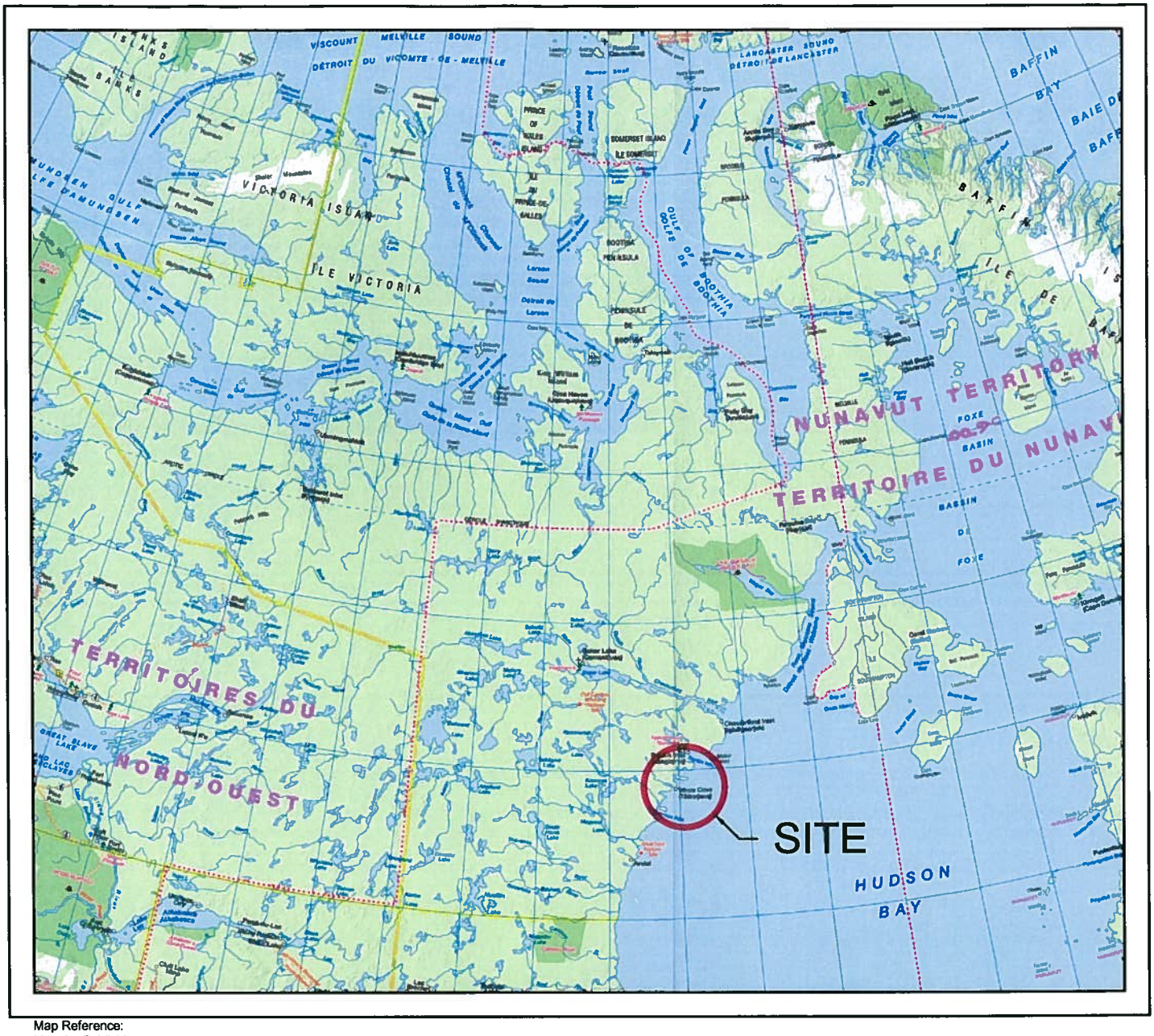
## 16. References

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

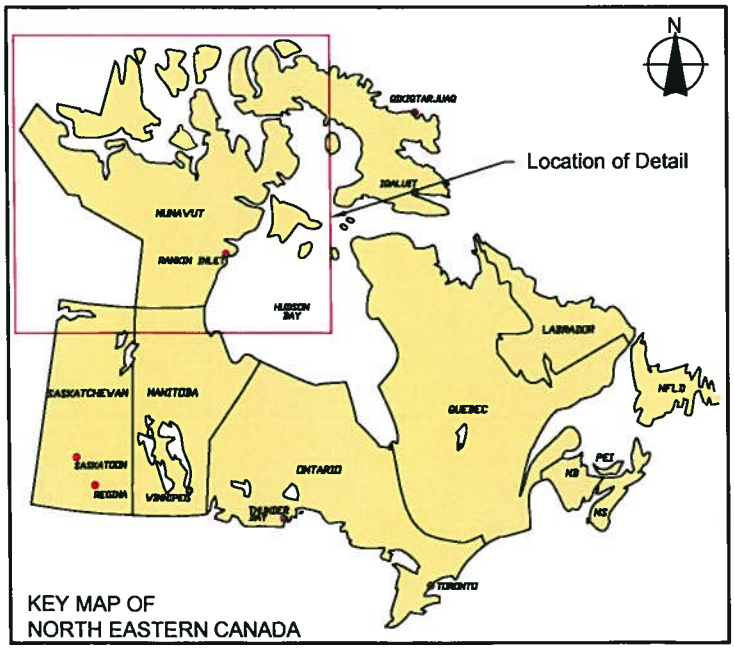
Canadian Climate Data 1985-2007, Whale Cove A Weather Station, Environment Canada. http://climate.weatheroffice.ec.gc.ca/climateData/monthlydata_e.html?timeframe=3&Prov=XX&StationID=1727&Year=2007&Month=1&Day=1. Accessed Nov 10, 2008.

Statistics Canada, 2000. Population Projections for Canada, Provinces and Territories 2000 – 2026.

# Figures




Map Reference:
Map Art Publishing




KEY MAP OF
NORTH EASTERN CANADA

# FIGURE 1 - SITE LOCATION MAP

## HAMLET OF WHALE COVE
## *WHALE COVE, NUNAVUT*

# WATER LICENCE SUBMISSION

November 2008
Project Number: N-O14851

Prepared by: C. Sheppard

Verified by: J. Walls

Nuna BURNSIDE

14851 WATER LICENCE SUBMISSION SL.dwg

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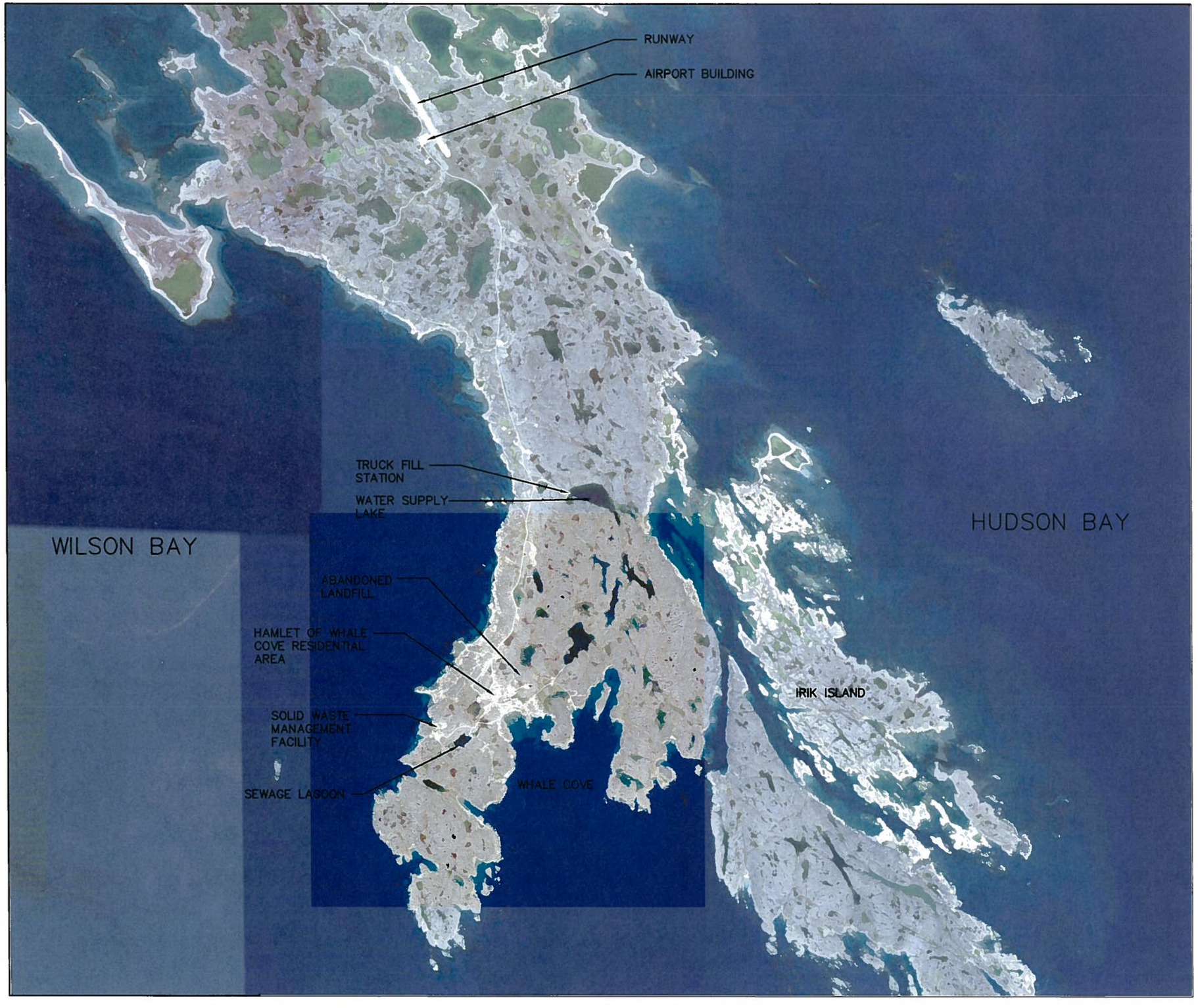


# FIGURE 2

## HAMLET OF WHALE COVE
## WHALE COVE, NUNAVUT
*WATER LICENCE SUBMISSION*

## 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
September 2008
Project Number: N-O14851

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

Revision #: 1

14851 WATER LICENCE SUBMISSION CP.dwg

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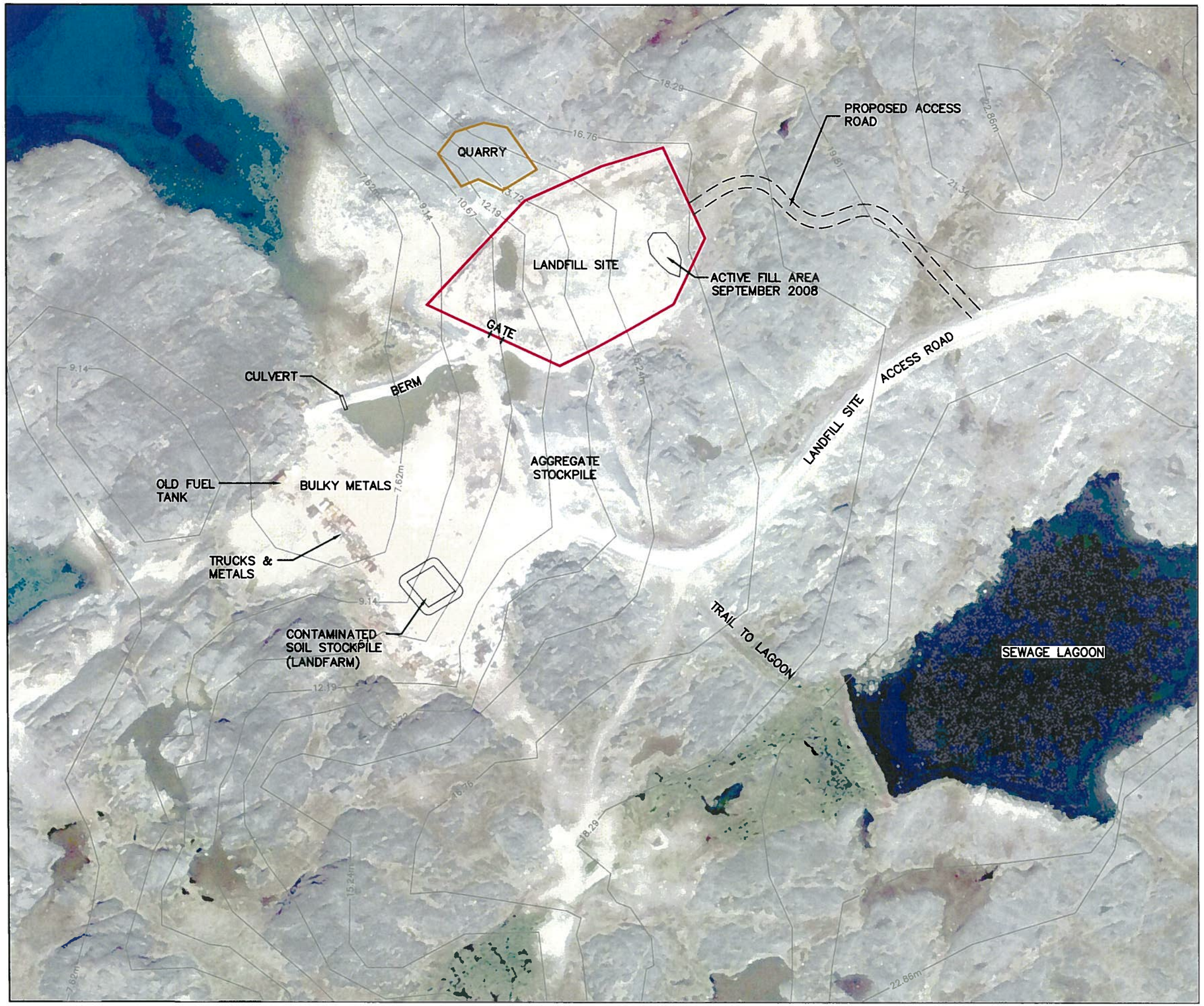



# FIGURE 3

## HAMLET OF WHALE COVE
## WHALE COVE, NUNAVUT
*WATER LICENCE SUBMISSION*

## SOLID WASTE MANAGEMENT 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)*

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
September 2008
Project Number: N-O14851

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

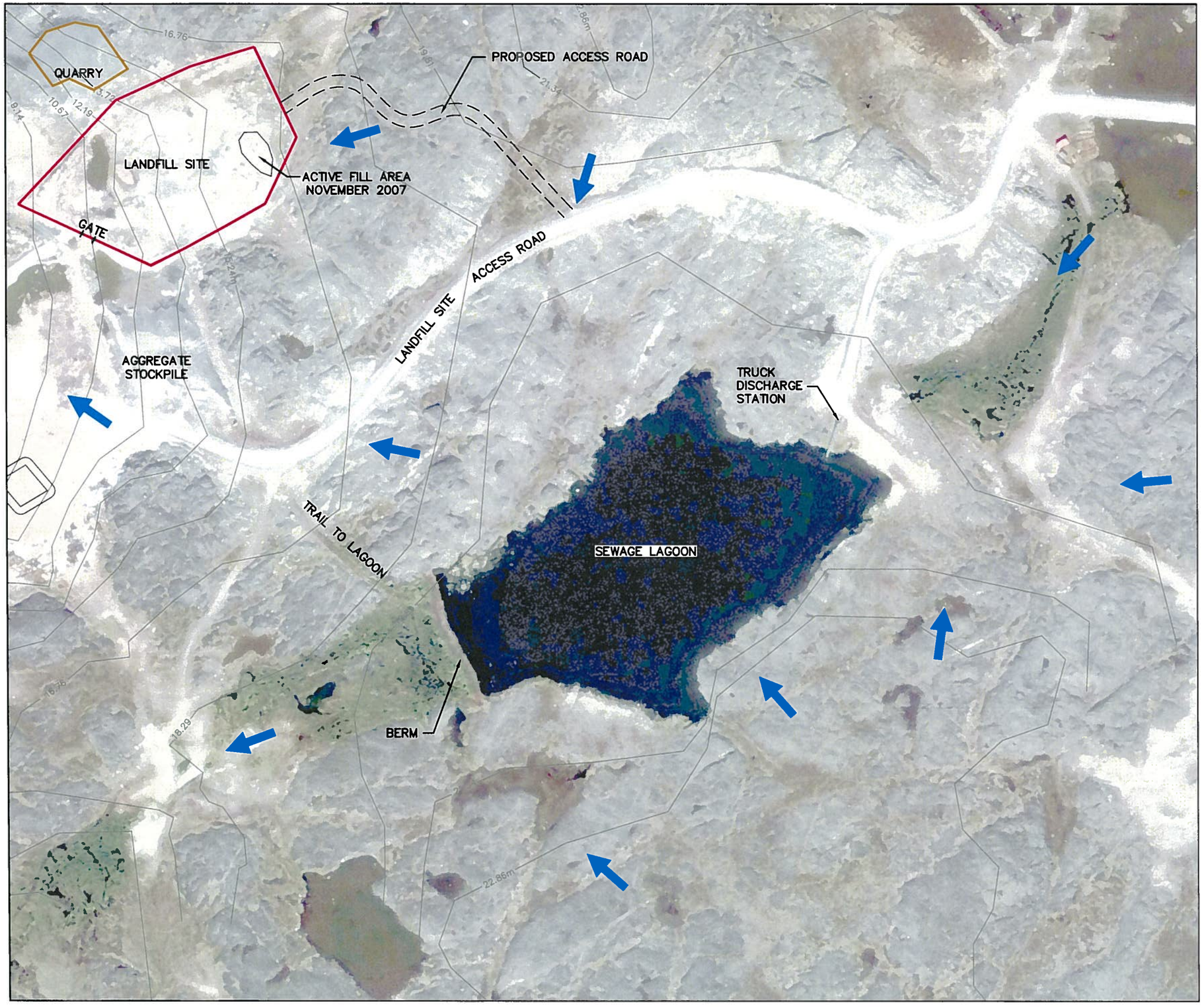
Verified by: J. Walls

Nunn Burnside

Revision #: 1

14851 WATER LICENCE SUBMISSION SWDF.dwg

Plot time: Feb 03, 2009 - 9:43am




# FIGURE 4

## HAMLET OF WHALE COVE
## WHALE COVE, NUNAVUT
*WATER LICENCE SUBMISSION*

## SEWAGE LAGOON

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
September 2008
Project Number: N-O14851

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

Revision #: 1

14851 WATER LICENCE SUBMISSION SLF.dwg

Plot time: Feb 03, 2009 - 9:38am

BURNSIDE

# Appendix A
# 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>>.

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# Appendix B
# Water and Waste
# Calculation Tables

# Water Requirements for the Hamlet of Whale Cove, Nunavut

| Planning Year | Calendar Year | Projected Population[1] | Projected Water Consumption[2] | Projected Total Consumption Volume | | |
|---|---|---|---|---|---|---|
| | | | [Lpcd] | [Litres/day] | [m3/day] | [m3/year] |
| | 2006 | 353 | 97.3 | 34349 | 34 | 12538 |
| | 2007 | 358 | 97.4 | 34873 | 35 | 12729 |
| 0 | 2008 | 364 | 97.5 | 35503 | 36 | 12958 |
| | 2009 | 370 | 97.7 | 36134 | 36 | 13189 |
| | 2010 | 376 | 97.8 | 36766 | 37 | 13420 |
| | 2011 | 382 | 97.9 | 37401 | 37 | 13651 |
| | 2012 | 388 | 98.0 | 38036 | 38 | 13883 |
| 5 | 2013 | 394 | 98.2 | 38673 | 39 | 14116 |
| | 2014 | 400 | 98.3 | 39312 | 39 | 14349 |
| | 2015 | 406 | 98.4 | 39952 | 40 | 14583 |
| | 2016 | 412 | 98.5 | 40594 | 41 | 14817 |
| | 2017 | 418 | 98.7 | 41237 | 41 | 15051 |
| 10 | 2018 | 424 | 98.8 | 41881 | 42 | 15287 |
| | 2019 | 430 | 98.9 | 42527 | 43 | 15523 |
| | 2020 | 437 | 99.0 | 43283 | 43 | 15798 |
| | 2021 | 444 | 99.2 | 44041 | 44 | 16075 |
| | 2022 | 451 | 99.3 | 44800 | 45 | 16352 |
| 15 | 2023 | 458 | 99.5 | 45562 | 46 | 16630 |
| | 2024 | 465 | 99.6 | 46326 | 46 | 16909 |
| | 2025 | 472 | 99.8 | 47092 | 47 | 17188 |
| | 2026 | 479 | 99.9 | 47859 | 48 | 17469 |
| | 2027 | 486 | 100.1 | 48629 | 49 | 17750 |
| 20 | 2028 | 493 | 100.2 | 49401 | 49 | 18031 |
| | 2029 | 500 | 100.4 | 50175 | 50 | 18314 |
| | 2030 | 507 | 100.5 | 50951 | 51 | 18597 |
| | 2031 | 515 | 100.7 | 51840 | 52 | 18922 |
| | 2032 | 523 | 100.8 | 52732 | 53 | 19247 |
| 25 | 2033 | 531 | 101.0 | 53627 | 54 | 19574 |
| | 2034 | 539 | 101.2 | 54524 | 55 | 19901 |
| | 2035 | 547 | 101.3 | 55424 | 55 | 20230 |
| | 2036 | 555 | 101.5 | 56326 | 56 | 20559 |
| | 2037 | 563 | 101.7 | 57231 | 57 | 20889 |
| 30 | 2038 | 571 | 101.8 | 58139 | 58 | 21221 |

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 water consumption 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).

# 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 Precipitation 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 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.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

# Waste Quantity Calculations, Hamlet of Whale Cove

| Planning Year | Calendar Year | Projected Population [people] | Annual Volume of Solid Waste [$m^3$] | Cumulative Volume of Solid Waste [$m^3$] | Annual Volume of Combustible Solid Waste [$m^3$] | Annual Volume of Combustible Solid Waste After Burning [$m^3$] | Annual Volume of Uncombustible Solid Waste [$m^3$] | Total Annual Volume of Uncombustible and Combusted (Burned) Solid Waste [$m^3$] | Annual Volume of Cover Material [$m^3$] | Total Annual Volume of Waste and Cover Material [$m^3$] | Cumulative Landfill Volume [m3] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2009 | 370 | 1890.7 | 7384.0 | 1588.2 | 1270.6 | 302.5 | 1573.1 | 125.8 | 1698.9 | 2,700 |
| 1 | 2010 | 376 | 1921.4 | 9305.4 | 1613.9 | 1291.2 | 307.4 | 1598.6 | 127.9 | 1726.5 | 4,426 |
| 2 | 2011 | 382 | 1952.0 | 11257.4 | 1639.7 | 1311.8 | 312.3 | 1624.1 | 129.9 | 1754.0 | 6,180 |
| 3 | 2012 | 388 | 1982.7 | 13240.1 | 1665.5 | 1332.4 | 317.2 | 1649.6 | 132.0 | 1781.6 | 7,962 |
| 4 | 2013 | 394 | 2013.3 | 15253.4 | 1691.2 | 1353.0 | 322.1 | 1675.1 | 134.0 | 1809.1 | 9,771 |
| 5 | 2014 | 400 | 2044.0 | 17297.4 | 1717.0 | 1373.6 | 327.0 | 1700.6 | 136.0 | 1836.7 | 11,608 |
| 6 | 2015 | 406 | 2074.7 | 19372.1 | 1742.7 | 1394.2 | 331.9 | 1726.1 | 138.1 | 1864.2 | 13,472 |
| 7 | 2016 | 412 | 2105.3 | 21477.4 | 1768.5 | 1414.8 | 336.9 | 1751.6 | 140.1 | 1891.8 | 15,364 |
| 8 | 2017 | 418 | 2136.0 | 23613.4 | 1794.2 | 1435.4 | 341.8 | 1777.1 | 142.2 | 1919.3 | 17,283 |
| 9 | 2018 | 424 | 2166.6 | 25780.0 | 1820.0 | 1456.0 | 346.7 | 1802.6 | 144.2 | 1946.9 | 19,230 |
| 10 | 2019 | 430 | 2197.3 | 27977.3 | 1845.7 | 1476.6 | 351.6 | 1828.2 | 146.3 | 1974.4 | 21,204 |
| 11 | 2020 | 437 | 2233.1 | 30210.4 | 1875.8 | 1500.6 | 357.3 | 1857.9 | 148.6 | 2006.5 | 23,211 |
| 12 | 2021 | 444 | 2268.8 | 32479.2 | 1905.8 | 1524.7 | 363.0 | 1887.7 | 151.0 | 2038.7 | 25,250 |
| 13 | 2022 | 451 | 2304.6 | 34783.8 | 1935.9 | 1548.7 | 368.7 | 1917.4 | 153.4 | 2070.8 | 27,320 |
| 14 | 2023 | 458 | 2340.4 | 37124.2 | 1965.9 | 1572.7 | 374.5 | 1947.2 | 155.8 | 2103.0 | 29,423 |
| 15 | 2024 | 465 | 2376.2 | 39500.4 | 1996.0 | 1596.8 | 380.2 | 1977.0 | 158.2 | 2135.1 | 31,558 |

**Notes**

Based upon a waste generation rate of 0.014$m^3$ per capita per day (NWT-MACA)
Percentage remaining after burning 80%
No compaction is taking place at landfill
Cover material required calculated as 8% of fill added
Cumulative Landfill Volume starts in 2009, assuming volume after rehabilitation as 2700 $m^3$

**Estimated Volume of Waste in Fill Area After Rehabilitation**

| | |
|---|---|
| Volume of Waste in Landfill Year 0 (2009) | 2000 |
| Volume of Waste Outside of Landfill Area that Needs to be Put into Landfill Area | 500 |
| Volume of Cover Needed | 200 |
| Total Volume of Waste in Fill Area After Rehabilitation (2007) | 2700 |