



**Water Supply Facility
Operation and Maintenance (O&M) Plan
Hamlet of Arviat**

Prepared by

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May 2009

File No: N-O 15746

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1.0 Introduction

1.1 Purpose

The purpose of the Operation and Maintenance (O&M) Plan is to provide guidance for Water Supply Facility Operations, with regard to meeting the requirements of the Water License. This O&M Plan does not include the requirements or detailed guidance of the handling and treatment of water for domestic consumption. The NWB Water License is for water with drawl and impacts to the environment. This O&M Plan focuses on withdrawal of water from the environment without causing a significant impact, and how the potential for environmental impact is monitored annually.

1.2 Hamlet Description

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

The community is situated on the northern shore of a peninsula that extends easterly into Hudson Bay. The topography surrounding the Hamlet of Arviat is relatively flat with a slight rise when moving inland away from Hudson Bay. Local bedrock is generally overlain by glacial fluvial sediments. Arviat is located in the physiographic region of the Hudson Bay lowlands, characterized by low topographic relief, occasional bedrock outcrops and glacial and glacio-fluvial overburden sediments. Boulder fields and eskers are common. Approximately 20 to 30 percent of the land is shallow ponds with depths of 1 m or less. Land between the ponds is marshy, vegetated by grasses and sedges.

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

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

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

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1.3 Nunavut Water Board License

The Hamlet of Arviat operates their municipal water, sewage, and solid waste facilities under the Nunavut Water Board (NWB) License NWB3ARV0308 (Appendix A). The licence dated January 9, 2004, expired on December 31, 2008. Part G, Section 1 requires that an Operation and Maintenance (O&M) Plan be submitted for the facilities in accordance with applicable regulations and guidelines. The Hamlet is currently in the process of renewing the licence. This O&M Plan may need to be updated when the NWB license is renewed.

The O&M Plan of the Water Supply 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.

1.4 Climate

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

1.5 Wolf River Water Supply

The Hamlet of Arviat obtains its water from Wolf River located 8.0 km southwest of the Hamlet. The drainage basin of Wolf River is estimated to be 650,000,000 m² (IEG Environmental, 2005).

Using an annual precipitation rate of 297 mm and an annual evapotranspiration rate of 200 mm, the net recharge to the catchment area is approximately 63,180,000 m³ per year (calculation details are included in Appendix C).

1.6 Water Use Volumes

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% was determined. Table 1 shows the projected population of the Hamlet for the next 20 years.

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Table 1: Arviat Population Projections

Year	Projected Population
2006	2060
2007	2089
2008	2119
2009	2149
2010	2180
2011	2211
2012	2242
2013	2274
2014	2306
2015	2339
2016	2372
2017	2406
2018	2440
2019	2475
2020	2510
2021	2546
2022	2582
2023	2619
2024	2656
2025	2694
2026	2732
2027	2771
2028	2810
2029	2850

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 be calculated using the following formulae. Although Arviat has a population greater than 2000, they are still on a truck distribution system and therefore this formula has been used.

$$\text{RWU} \times (1.0 + (0.00023 \times \text{Population}))$$

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

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This equation was used to produce projected water use requirements for the next 10 years (Table 2 and Figure B). Calculations are included in Appendix B.

Table 2: Projected Water Use Requirements

Year	Projected Population	Projected Daily Consumption m ³	Projected Annual Consumption m ³
2006	2060	197	72,030
2007	2089	201	73,374
2008	2119	205	74,775
2009	2149	209	76,185
2010	2180	213	77,653
2011	2211	217	79,131
2012	2242	221	80,620
2013	2274	225	82,168
2014	2306	229	83,727
2015	2339	234	85,346
2016	2372	238	86,977
2017	2406	243	88,671
2018	2440	248	90,376

1.7 Health and Safety

Health and safety of workers and the public is the first priority while operating the Water Supply 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.

1.8 Training

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

1.9 Land Use Planning

The Wolf River drainage basin should be recognized in community land use plans and zoning. The drainage basin should be classified as a sensitive area where land uses must be restricted to prevent impacts to the lake water supply. A 400 metre setback around the

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water reservoirs is identified in the Arviat Community Plan, Schedule 2 – Land Use Map. The area is designated as protective development.

1.10 Impact on Wolf River

The estimated withdrawal rate of approximately 92,145 m³/year by year 2019 is less than 1% of the estimated river catchment recharge rate of approximately 63,180,000 m³ year. Therefore the withdrawal of water from the river for Hamlet usage is unlikely to cause a significant impact on the river flows.

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2.0 Operation and Maintenance for Environmental Protection

2.1 Overview

The Hamlet of Arviat provides trucked water services for the Community's residents, businesses, and institutions. The community obtains its potable water from Wolf River, located approximately 8.0 km southwest of the community (Figure 2). The water supply system consists of a pumphouse, a water intake line, two lined water reservoirs and a truck fill station (Figure 3). Photographs of the facility taken in October 2008 are included in Appendix E.

2.2 Water Supply Facility Design

The raw water source is Wolf River. The NWB Water Licence contained in Appendix A, identifies the maximum water withdrawal rate from Wolf River.

A pump house is located beside Wolf River 7 to 8 km south of the Hamlet. An intake line pumps from pooled area along creek at a depth of approximately 4 metres. Portable diesel power pumps housed in the pump house are used to pump the water from the river to an 8" HDPE pipe which transports the water 8 km over the tundra to Arviat's water reservoirs.

Two water reservoirs are used to store water for the Hamlet. Water is pumped to the reservoirs in the summer and provides water for the Hamlet for the entire year. The water reservoirs have a combined storage capacity of 143,000,000 Litres. Cell 1 has a capacity of 87,000 m³ and cell two is 56,000 m³ (IEG, 2005). The reservoirs are lined with impermeable HDPE membranes. A fence protects the reservoirs from outsiders.

A truck fill station is located beside the water reservoirs. An overhead truckfill arm is used to supply the water to the water trucks. The truckfill arm has a flexible downspout, with thaw capability controlled by a manually activated heat trace. Water for the hypochlorite-mixing tank is supplied from the discharge line. The hypochlorite feed pump is controlled by the flow rate of water supplied to the water trucks. Chlorine is injected into water as water is filled into the water trucks. The chlorine is supplied to the main line by a tube and chlorine injector. The estimated chlorine residual at the point of domestic supply is 0.2 mg/L for the typical truck delivery system.

2.3 Water Supply Facility Operational Procedures

The following water distribution operational procedures shall be carried out by the Hamlet of Arviat on a daily basis (weather dependent):

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- Residential, institutional, and commercial water storage tanks shall be filled from Hamlet-operated water delivery vehicles, with water obtained from the Hamlet Water Reservoirs
- Daily water usage volumes obtained from the Hamlet Water Supply Facility, as well as trip counts shall be recorded on the recording form attached in Appendix D
- In the event of an accident, a spill of petroleum products or a fire during water distribution operations, *the Hamlet of Arviat Environmental Emergency Response Plan* (separate document) shall be implemented.

2.4 Water Supply Facility Truckfill Station General Operational Procedures

The following general operational procedures are to be carried out by the Hamlet of Arviat during water treatment and truckfill operations at the Hamlet Water Supply Facility:

- Untreated water from the reservoirs shall be transferred by submersible pump to the water distribution vehicles through the truckfill station, at a rate of approximately 1,000 L/min (minimum recommended for fire protection)
- The monitoring level of treatment shall be primary and secondary disinfection, through the addition of sodium hypochlorite
- The chlorine feed system shall be inspected daily
- Water being transferred to the distribution vehicles shall be dosed with sodium hypochlorite at a rate sufficient that a free chlorine residual of 0.2 mg/L, after thorough mixing and 20 minutes of contact time is maintained, in accordance with the Public Health Act (1992) and associated Regulations
- Chlorine residuals shall be monitored daily, or as directed by a Public Health Inspector (as defined by the Public Health Act (1992))
- Facility generators and associated fuel storage shall be monitored daily.

These general operational procedures are for guidance and are not to be considered as the legal requirements to operate the facility, to treat, and supply drinking water for human consumption. The training, procedures, and guidelines for operating the system and complying with the regulations for provision of drinking water are provided elsewhere.

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2.5 Periodic and Seasonal Maintenance Procedures

The following general procedures shall be undertaken by the staff of the Hamlet of Arviat during periodic and seasonal maintenance operations at the Water Supply Facility:

- The roadway and truck pad shall be maintained by snow clearing in the winter and grading in the summer, and repaired as necessary
- Ditches and drainage channels at the Water Supply Facility shall be inspected during the summer for erosion and repaired as necessary
- Site warning signage, which identifies the boundaries of the Water Supply Facility shall be inspected weekly, and repaired or replaced as necessary
- The truck fill station at the Water Supply Facility shall be inspected for damage or displacement weekly, and repaired as necessary
- Any airborne litter shall be removed from the Water Supply Facility to the Hamlet landfill weekly, or as required
- The berms at the Water Supply Facility reservoirs shall be inspected during the summer for erosion and settlement weekly, and repaired as necessary
- No motorized vehicles should be operated in the river or on the ice of the lake due to risk of fuel spills
- If the river is used for fishing, no motorized augers shall be used and there should be no materials that could contaminate the water brought onto the ice of the river.

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.

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2.6 Water Intake System Monitoring Procedures

All water sampling completed by the Hamlet of Arviat shall be in accordance with the *Hamlet of Arviat Environmental Monitoring Program and Quality Assurance/Quality Control (QA/QC) Plan* (separate document).

Daily monitoring of residual chlorine levels shall be undertaken, to facilitate and confirm the maintenance of a free chlorine residual in treated water in accordance with the *Public Health Act* (1992) and associated Regulations.

2.6.1 Water License Requirements

As outlined in the NWB water license, regular monitoring of the quantities of water obtained from the Water Supply Facility is required.

As part of the general conditions, the licence requires that monthly and annual quantities in cubic metres of fresh water obtained be recorded and reported in the Annual Reports. It also requires that meters, devices or other such methods to record the volume of water used be installed, operated and maintained by the Licensee. The Licensee must maintain the Facilities to the satisfaction of the Inspector.

A Surveillance Station will be established at the raw water supply before treatment (ARV-1), as shown on Figure 4. Monthly and annual quantities of raw water pumped will be measured and recorded in the official operations logbook on a form similar to that presented in Appendix D.

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3.0 Emergency Response and Contingencies

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

Table 1: Emergency Contacts

Contact	Location	Telephone Number	Fax Number
INAC – Water/Wastewater Resources Manager	Iqaluit	(867) 975-4550	(867) 979-6445
Hamlet of Arviat – SAO	Arviat	(867) 857-2841	(867) 857-2591
Government of Nunavut (Regional Engineer)	Rankin Inlet	(867) 645-8156	(867) 645-8196
Environment Canada – Inspector	Iqaluit	(867) 975-4644	(867) 975-4594
Fire Department	Arviat	(867) 867-2525	-
RCMP Detachment	Arviat	(867) 867-1111	-
Community Health Center	Arviat	(867) 867-3100	-

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

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

In the event of a contaminant being released into the river or reservoirs, the operator would be required to contact the Nunavut Spill Hot-line and the regional Environmental Health Officer of Health Canada. The operator would based on consultation with these offices determine the required course of action to be taken.

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

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4.0 Reporting

The Nunavut Water Board License in 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 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 water use or reclamation, and a brief description of any future studies planned
- Any other details on water use requested by the Board by November 1st of the reporting year.

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

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 Water Delivery Log – describing the day to day delivery of water and site activities
- Form 2 – Water Supply Facility Monthly Inspection Form – to document the inspection and observation of the site operations and infrastructure
- Form 3 – Water Supply 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 water supply and treatment decision making.

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

Water Supply Facility
Operation and Maintenance (O&M) Plan
Hamlet of Arviat

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5.0 References

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

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

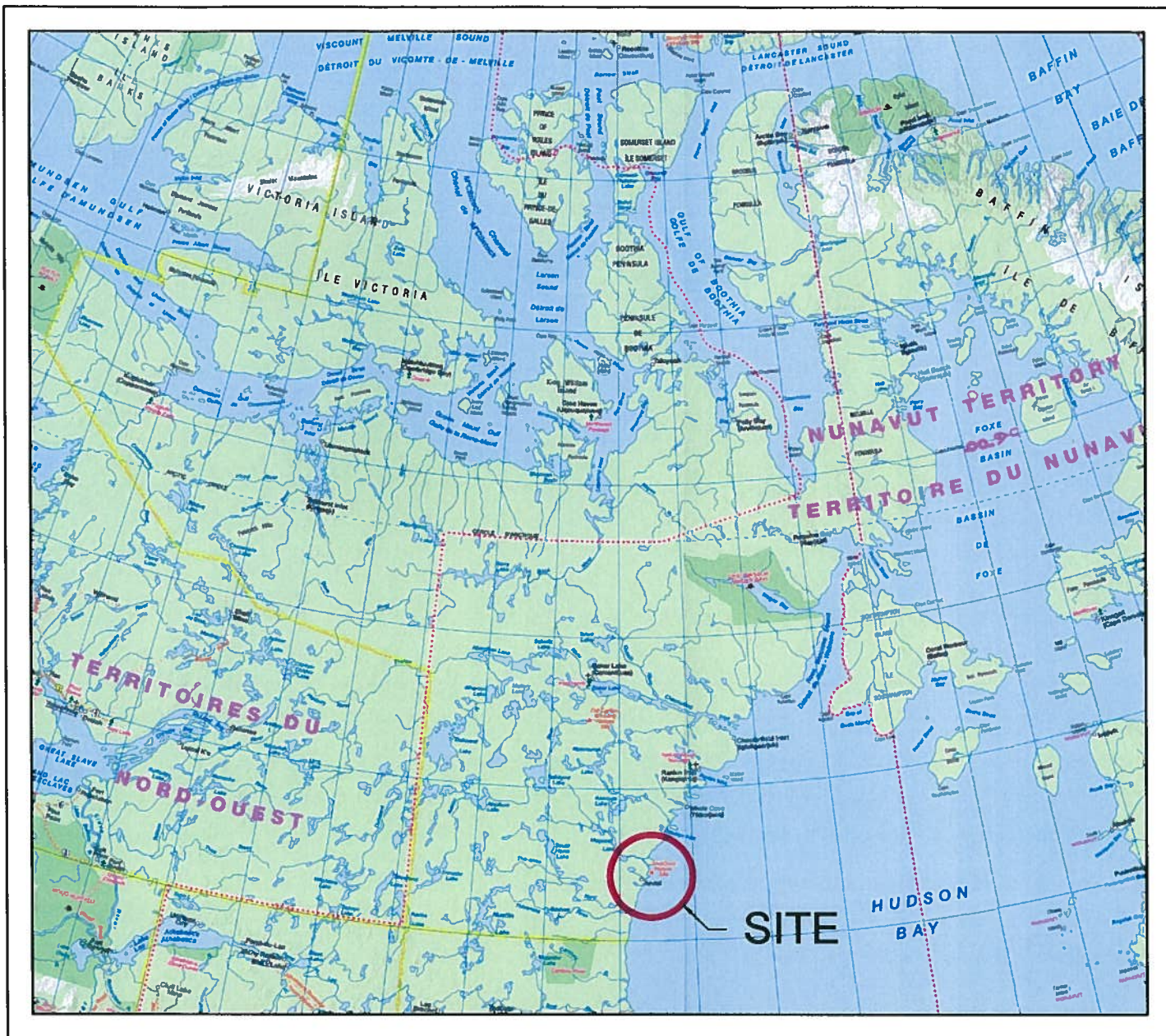
IEG Environmental, *Potable Water Supply Study, Arviat, NU*, prepared for the Government of Nunavut, December 2005.

Nunavut Water Board. 9 Jan 2004. *Hamlet of Arviat Water License NWB3ARV0308*. Gjoa Haven, Nunavut.

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

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

Figures



Map Reference:
Map Art Publishing

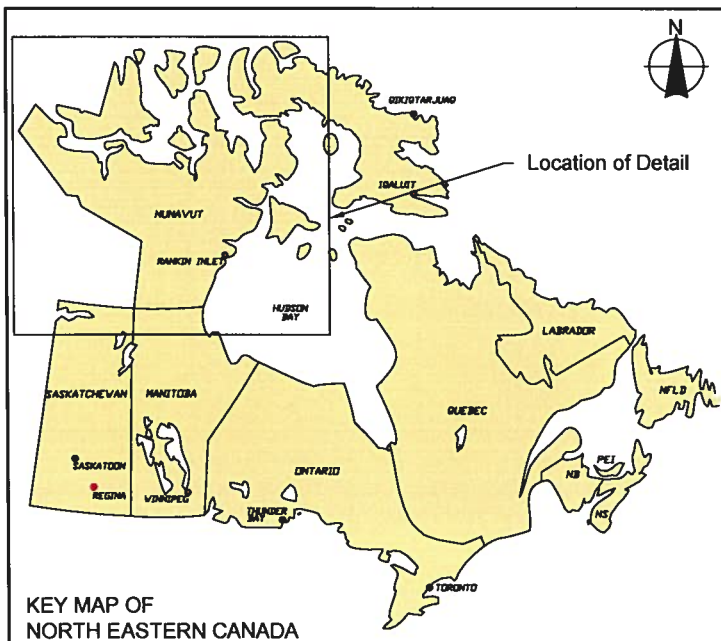


FIGURE 1 - SITE LOCATION MAP

HAMLET OF ARVIAT HAMLET OF ARVIAT, NUNAVUT

WATER SUPPLY FACILITY OPERATIONS & MAINTENANCE PLAN

January 2009

Project Number: N-O15746

Prepared by: C. Sheppard

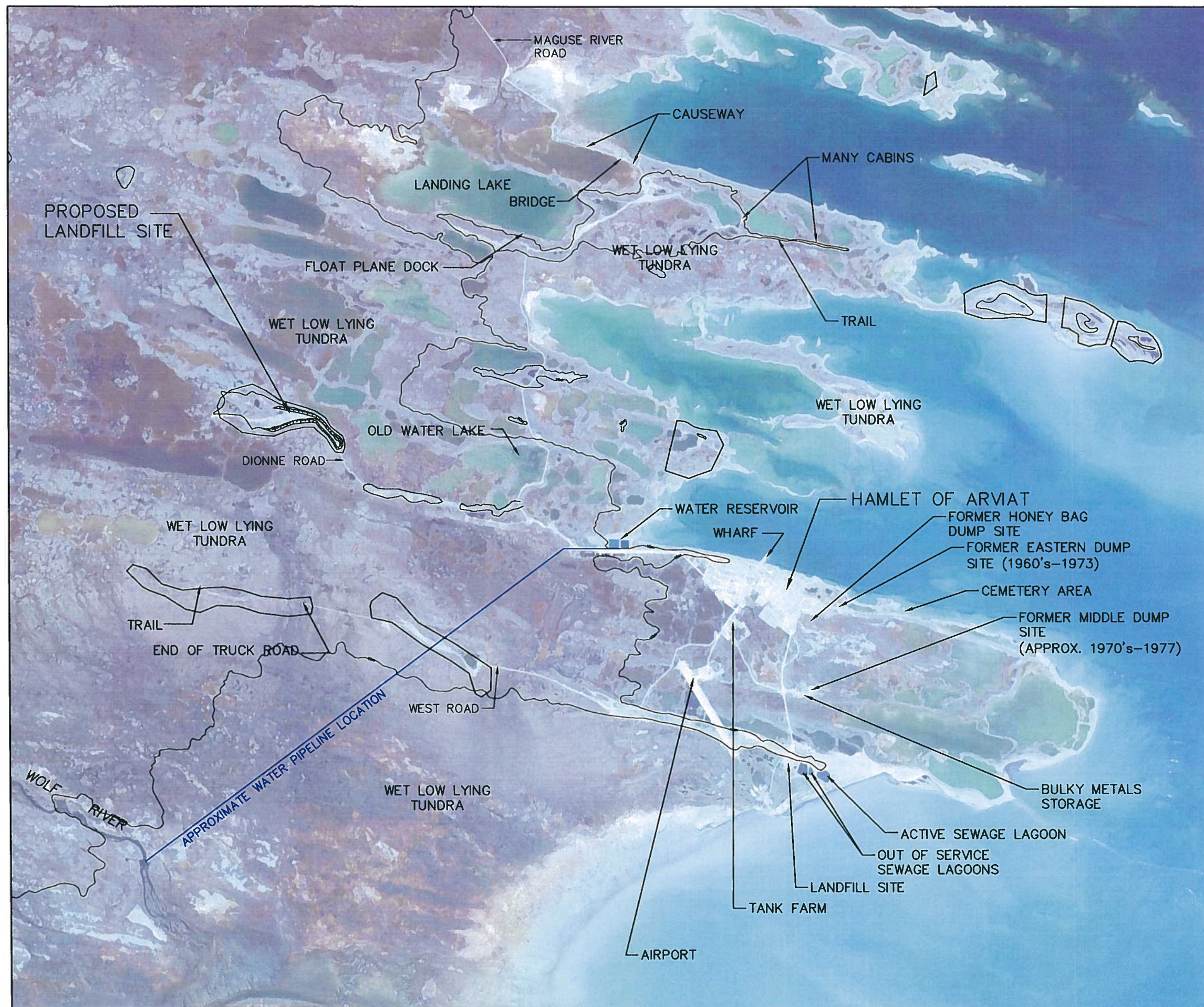
Verified by: J. Walls

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N-O15746 WATER SUPPLY O&M PLAN SL.dwg

FIGURE 2
HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT
WATER SUPPLY FACILITY O&M PLAN

COMMUNITY PLAN



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

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



1:50,000
 December 2008
 Project Number: N-015746

Projection: UTM Zone 15
 Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

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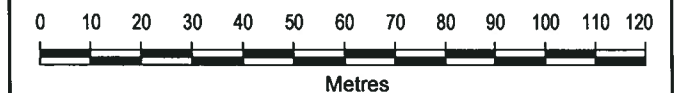
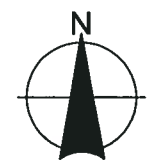
FIGURE 3
HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT
WATER SUPPLY FACILITY O&M PLAN

WOLF RIVER
WATER INTAKE

LEGEND

▶ WATER FLOW DIRECTION

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



1:1,500
December 2008
Project Number: N-015746
Prepared by: C. Sheppard

Projection: UTM Zone 15
Datum: NAD83
Verified by: J. Walls

บริษัท BURNSIDE

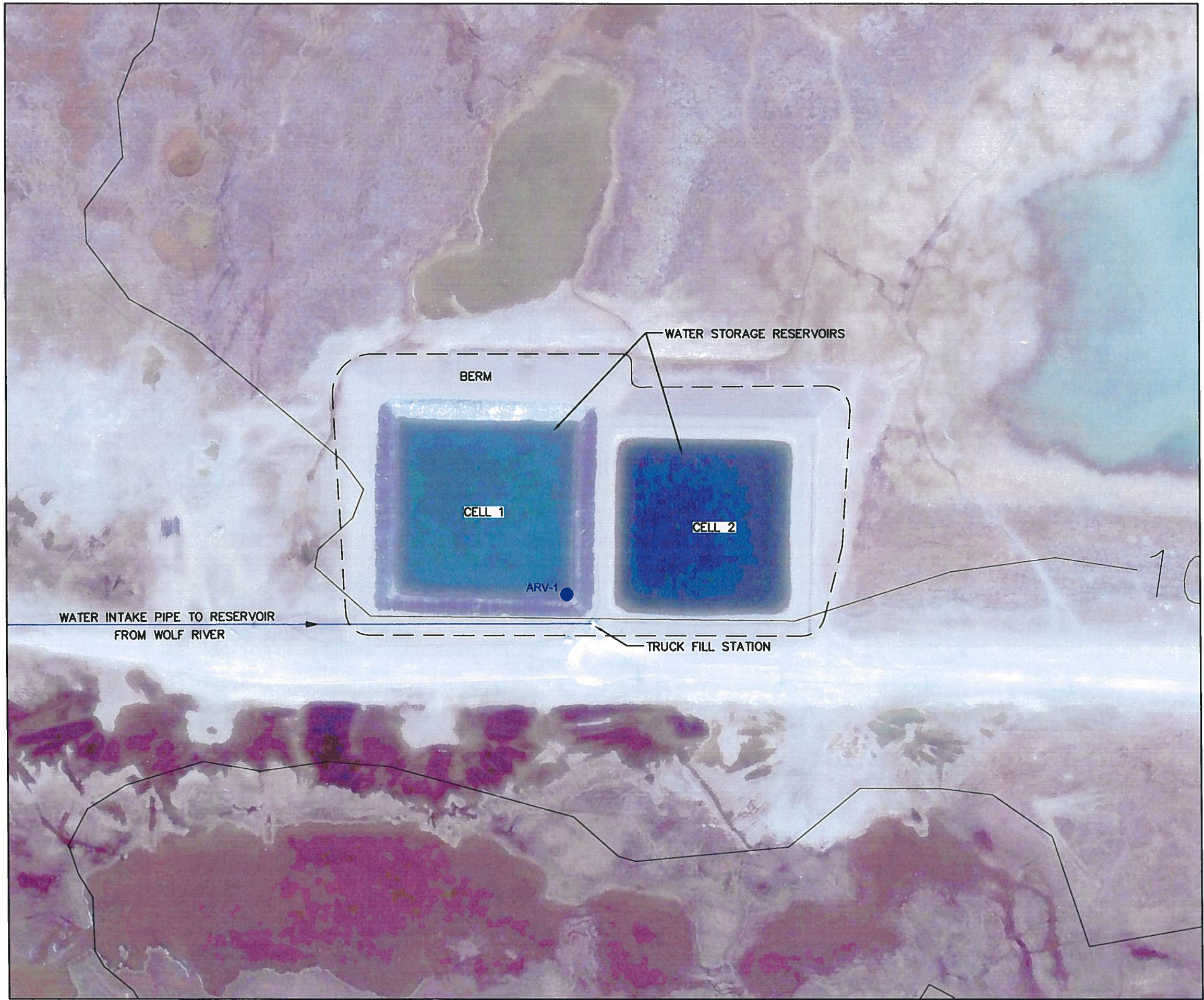


FIGURE 4

HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT
WATER SUPPLY FACILITY O&M PLAN

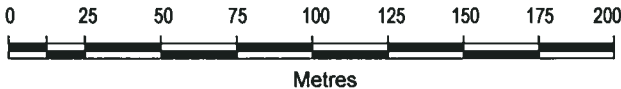
WATER RESERVOIRS &
TRUCK FILL STATION

LEGEND

ARV-1 ● MONITORING LOCATION

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

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



1:2,500
December 2008
Project Number: N-015746
Prepared by: C. Sheppard

Projection: UTM Zone 15
Datum: NAD83
Verified by: J. Walls

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Appendix A
Nunavut Water Licence



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

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATTMAYINGI

DECISION

LICENCE NUMBER: NWB3ARV0308

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

Hamlet of Arviat

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

DECISION

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

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

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



Philippe di Pizzo
Chief Administrative Officer

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I. BACKGROUND

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

II. PROCEDURAL HISTORY

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

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

III. ISSUES

Term of the Licence

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

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

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

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

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

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

Water Use

The Municipality currently receives water from the Wolf Creek water supply located 8.0 km southwest of the Hamlet. Water is stored in a 57,000 m³, 2-cell reservoir located 1.5 km west of the Hamlet, adjacent to the truck fill station. The water receives a chlorine treatment and is then distributed to the community by truck. Water requirements for 2003 were reported as 64,871 m³. Demand for 2008 was not reported in application. Utilizing the water demand formula developed by the Department of Municipal and Community Affairs (Government of the Northwest Territories), projected demand requirements for 2008 was calculated at 78,273 m³.

No concerns were expressed by the parties in their written submissions as to the amount of water required by the Applicant or the manner in which this water will be used. Based upon the projected requirements of the Hamlet, the Board has set the terms and conditions in the water licence, which govern water usage. Accordingly, and based upon the projected requirements of the Hamlet, the Board has set the terms and conditions in the water licence, which govern water usage and which are contained herein. The maximum permitted usage of water by the Hamlet of Arviat, over the term of the water license and for all purposes, has been set at 81,000 m³ *per annum*.

Deposit of Waste

Sewage

The Hamlet of Arviat utilizes a Sewage Disposal Facility approximately 2.8 km southeast of the Municipality. This Sewage Disposal Facility is located in an area adjacent to the Solid Waste Disposal Facility, and consists of a 55,000 m³ single-cell exfiltration lagoon. The effluent from this lagoon proceeds downstream to the marine environment through an undefined, natural wetland along a 200 m flow path prior to entering Hudson Bay.

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

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

Solid Waste

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

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

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

LICENCE NWB3ARV0308

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

HAMLET OF ARVIAT

(Licensee)

of

ARVIAT, NUNAVUT, X0A 0J0

(Mailing Address)

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

NWB3ARV0308

Licence Number

NUNAVUT 06

Water Management Area

ARVIAT, NUNAVUT

Location

WATER USE AND WASTE DISPOSAL

Purpose

MUNICIPAL UNDERTAKINGS

Description

81,000 CUBIC METRES ANNUALLY

Quantity of Water Not to be Exceeded

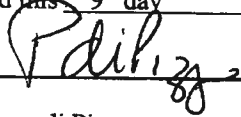
JANUARY 9, 2004

Date of Licence

DECEMBER 31, 2008

Expiry Date of Licence

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


Philippe di Pizzo
Chief Administrative Officer

Philippe di Pizzo
Chief Administrative Officer

PART A: SCOPE AND DEFINITIONS

1. Scope

- a. This Licence allows for the use of water and the disposal of waste for municipal undertakings at the Hamlet of Arviat, Nunavut (63°21' N; 90° 42'W);
- b. This Licence is issued subject to the conditions contained herein with respect to the taking of water and the depositing of waste of any type in any waters or in any place under any conditions where such waste or any other waste that results from the deposits of such waste may enter any waters. Whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, or other statutes imposing more stringent conditions relating to the quantity or type of waste that may be so deposited or under which any such waste may be so deposited, this Licence shall be deemed, upon promulgation of such Regulations, to be subject to such requirements; and;
- c. Compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with the requirements of all applicable Federal, Territorial and Municipal legislation.

2. Definitions

In this Licence: NWB3ARV0308

“**Act**” means the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*;

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

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

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

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

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

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

“Chief Administrative Officer” means the Executive Director of the Nunavut Water Board;

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

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

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

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

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

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

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

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

“Licensee” means the holder of this Licence;

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

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

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

“Sewage” means all toilet wastes and greywater;

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

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

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

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

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

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

PART B: GENERAL CONDITIONS

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

- i. tabular summaries of all data generated under the "Monitoring Program";
 - ii. the monthly and annual quantities in cubic metres of fresh water obtained from all sources;
 - iii. the monthly and annual quantities in cubic metres of each and all waste discharged;
 - iv. a summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures and facilities;
 - v. a list of unauthorized discharges and summary of follow-up action taken;
 - vi. a summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year;
 - vii. a summary of any studies, reports and plans (e.g., Operation and Maintenance, Abandonment and Restoration, QA/QC) requested by the Board that relate to waste disposal, water use or reclamation, and a brief description of any future studies planned;
 - viii. any other details on water use or waste disposal requested by the Board by November 1st of the year being reported; and
2. The Licensee shall comply with the "Monitoring Program" described in this Licence, and any amendments to the "Monitoring Program" as may be made from time to time, pursuant to the conditions of this Licence.
 3. The "Monitoring Program" and compliance dates specified in the Licence may be modified at the discretion of the Board.
 4. Meters, devices or other such methods used for measuring the volumes of water used and waste discharged shall be installed, operated and maintained by the Licensee to the satisfaction of an Inspector.
 5. The Licensee shall, within ninety (90) days after the first visit of the Inspector, post the necessary signs, where possible, to identify the stations of the "Monitoring Program." All signage postings shall be in the Official Languages of Nunavut, and shall be located and maintained to the satisfaction of an Inspector.

6. The Licensee shall immediately report to the 24-Hour Spill Report Line (867-920-8130) any spills of Waste, which are reported to or observed by the Licensee, within the municipal boundaries or in the areas of the Water Supply or Waste Disposal Facilities.
7. The Licensee shall ensure a copy of this Licence is maintained at the municipal office at all times.
8. Any communication with respect to this Licence shall be made in writing to the attention of:

(i) Chief Administrative Officer:

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

(ii) Inspector Contact:

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

(iii) Analyst Contact:

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

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

PART C: CONDITIONS APPLYING TO WATER USE

1. The Licensee shall obtain all fresh water from the Wolf Creek Water Supply using the Water Supply Facilities or as otherwise approved by the Board.
2. The annual quantity of water used for all purposes shall not exceed 81,000 cubic metres.
3. The Licensee shall maintain the Water Supply Facilities to the satisfaction of the Inspector.
4. The water intake hose used on the water pumps shall be equipped with a screen with a mesh size sufficient to ensure no entrainment of fish.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. The Licensee shall direct all Sewage to the Sewage Disposal Facilities or as otherwise approved by the Board.
2. All Effluent discharged from the Sewage Disposal Facilities at Monitoring Program Station ARV-4 shall meet the following effluent quality standards:

Parameter	Maximum Average Concentration
Faecal Coliforms	1×10^4 CFU/dl
BOD ₅	80 mg/L
Total Suspended Solids	100 mg/L
Oil and grease	No visible sheen
pH	between 6 and 9

3. A Freeboard limit of 1.0 metre, or as recommended by a qualified geotechnical engineer and as approved by the Board, shall be maintained at all dams, dykes or structures intended to contain, withhold, divert or retain water or wastes.
4. The Licensee shall advise an Inspector at least ten (10) days prior to initiating any decant of the sewage lagoon.

5. The Sewage Disposal Facility shall be maintained and operated, to the satisfaction of an Inspector in such a manner as to prevent structural failure.
6. The Licensee shall dispose of and contain all solid wastes at the Solid Waste Disposal Facilities or as otherwise approved by the Board.
7. The Licensee shall implement measures to ensure hazardous materials and/or leachate from the Solid Waste Disposal Facility does not enter water.
8. The Licensee shall submit to the Board for review within six (6) months of the issuance of this license a report identifying each Final Discharge Point. The report shall at least include:
 - a. Plans, specifications and a general description of each Final Discharge Point together with its specific geo-referenced location;
 - b. A description of how each Final Discharge Point is designed and maintained.
9. If, during the term of this Licence, additional Final Discharge Points are identified, the Licensee shall submit the information as required by Part D, Item 8 for each new Final Discharge Point within 30 days after the discharge point is identified and at least 60 days prior to depositing Effluent from the new Final Discharge Point and/or proposed changes are made to a Final Discharge Point.

PART E: CONDITIONS APPLYING TO MODIFICATION AND CONSTRUCTION

1. The Licensee shall submit to the Board for approval design drawings stamped by a qualified engineer registered in Nunavut prior to the construction of any dams, dykes or structures intended to contain, withhold, divert or retain water or wastes.
2. The Licensee may, without written approval from the Board, carry out modifications to the Water Supply and Waste Disposal Facilities provided that such modifications are consistent with the terms of this Licence and the following requirements are met:
 - i. the Licensee has notified the Board in writing of such proposed modifications at least sixty (60) days prior to beginning the modifications;
 - ii. said modifications do not place the Licensee in contravention of the Licence or the *Act*;

- iii. the Board has not, during the sixty (60) days following notification of the proposed modifications, informed the Licensee that review of the proposal will require more than sixty (60) days; and
 - iv. the Board has not rejected the proposed modifications.
- 3. Modifications for which all of the conditions referred to in Part E, Item 1, have not been met may be carried out only with written approval from the Board.
 - 4. The Licensee shall provide as built plans/drawings of the modifications referred to in this Licence within ninety (90) days of completion of the modifications.

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

- 1. The Licensee shall, within 6 months of the issuance of this license, submit to the Board for approval, a Plan for the Operation and Maintenance of the Sewage and Solid Waste Disposal Facilities in accordance with "*Guidelines for Preparing an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities*" (October 1996). This Plan shall specifically address hazardous waste disposal and operational issues at the Solid Disposal Facility.
- 2. The Licensee shall implement the Plan specified in Part F, Item 1 as and when approved by the Board.
- 3. The Licensee shall revise the Plan referred to in Part F, Item 1, if not acceptable to the Board. The revised Plan shall be submitted to the Board for approval within thirty (30) days of notification of the Board decision
- 4. If, during the period of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:
 - i. employ the appropriate contingency plan as provided for in the Operation and Maintenance Plan;
 - ii. report the incident immediately via the 24-Hour Spill Reporting Line at (867) 920-8130 and to an Inspector; and
 - iii. submit to an Inspector a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.
- 5. In the absence of a contingency plan contained within an approved Operation and Maintenance Plan, and should during the period of this Licence an unauthorized discharge of

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

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

PART G: CONDITIONS APPLYING TO ABANDONMENT AND RESTORATION

1. The Licensee shall submit to the Board for approval an Abandonment and Restoration Plan at least six (6) months prior to abandoning any facilities and the construction of new facilities to replace existing ones. The Plan shall include, but not be limited to where applicable:
 - i. water intake facilities;
 - ii. the water treatment and waste disposal sites and facilities;
 - iii. petroleum and chemical storage areas;
 - iv. any site affected by waste spills;
 - v. leachate prevention;
 - vi. an implementation schedule;
 - vii. maps delineating all disturbed areas, and site facilities;
 - viii. consideration of altered drainage patterns;
 - ix. type and source of cover materials;
 - x. future area use;
 - xi. hazardous wastes; and
 - xii. a proposal identifying measures by which restoration costs will be financed by the Licensee upon abandonment.
2. The Licensee shall implement the plan specified in Part G, Item 1 as and when approved by the Board.
3. The Licensee shall revise the Plan referred to in Part G, Item 1 if not approved. The revised Plan shall be submitted to the Board for approval within thirty (30) days of receiving notification of the Board's decision.
4. The Licensee shall complete the restoration work within the time schedule specified in the Plan, or as subsequently revised and approved by the Board.

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

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

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

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

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

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

5. Additional sampling and analysis may be requested by an Inspector.
6. The Licensee shall conform to the Quality Assurance/Quality Control (QA/QC) Plan which shall be provided to the Licensee by the NWB within 120 days of the issuance of this license.
7. All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of *Standard Methods for the Examination of Water and Wastewater*, or by such other methods approved by the Board.
8. All analyses shall be performed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) Certified Laboratory, or as otherwise approved by an Analyst.
9. The Licensee shall measure and record the annual quantities of sewage solids removed from the Sewage Disposal Facility.
10. The Licensee shall, unless otherwise requested by an Inspector, include all of the data and information required by the "Monitoring Program" in the Licensee's Annual Report, as required *per* Part B, Item 1.
11. Modifications to the Monitoring Program may be made only upon written approval of the Chief Administrative Officer.



Appendix B

Climate Data

Climate Data

Table 1: Rankin Inlet Climate Normals Data Summary

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

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

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



Appendix C

Water Use Calculations

Water Use Projections for the Hamlet of Arviat, Nunavut

Key Assumptions

Starting Year:	2006	Starting Population:	2060
Population Growth Rate:	1.4%	Residential Water Usage Rate [L/cd]:	65.0

Planning Year	Calendar Year	Projected Population ¹	Projected Water Consumption ²	Projected Total Consumption Volume			
			[Lpcd]	[Litres/day]	[Litres/year]	[m3/day]	[m3/year]
	2006	2060	95.8	197342	72,029,764	197	72,030
	2007	2089	96.2	201026	73,374,351	201	73,374
	2008	2119	96.7	204863	74,774,961	205	74,775
0	2009	2149	97.1	208727	76,185,393	209	76,185
	2010	2180	97.6	212748	77,653,159	213	77,653
	2011	2211	98.1	216798	79,131,412	217	79,131
	2012	2242	98.5	220877	80,620,153	221	80,620
	2013	2274	99.0	225118	82,167,919	225	82,168
5	2014	2306	99.5	229389	83,726,860	229	83,727
	2015	2339	100.0	233825	85,346,223	234	85,346
	2016	2372	100.5	238294	86,977,471	238	86,977
	2017	2406	101.0	242933	88,670,581	243	88,671
	2018	2440	101.5	247606	90,376,307	248	90,376
10	2019	2475	102.0	252453	92,145,379	252	92,145
	2020	2510	102.5	257336	93,927,821	257	93,928
	2021	2546	103.1	262398	95,775,136	262	95,775
	2022	2582	103.6	267498	97,636,596	267	97,637
	2023	2619	104.2	272779	99,564,502	273	99,565
	2024	2656	104.7	278102	101,507,348	278	101,507
	2025	2694	105.3	283612	103,518,255	284	103,518
	2026	2732	105.8	289164	105,544,922	289	105,545
	2027	2771	106.4	294908	107,641,308	295	107,641
	2028	2810	107.0	300697	109,754,294	301	109,754
20	2029	2850	107.6	306681	111,938,702	307	111,939
	2030	2890	108.2	312714	114,140,572	313	114,141
	2031	2931	108.8	318947	116,415,610	319	116,416
	2032	2973	109.4	325384	118,765,159	325	118,765
	2033	3015	110.1	331874	121,133,960	332	121,134
	2034	3058	110.7	338573	123,579,106	339	123,579
	2035	3101	111.4	345327	126,044,430	345	126,044
	2036	3145	112.0	352296	128,587,976	352	128,588
	2037	3190	112.7	359483	131,211,184	359	131,211
	2038	3235	113.4	366730	133,856,492	367	133,856
30	2039	3281	114.1	374201	136,583,426	374	136,583

- Note:
- 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 is based on the Nunavut water usage formula [RWU L/c/d x (1 + (0.00023 x [population]))].
 - 3) The Residential Water Usage Rate is estimated to be 90 L/c/d for municipalities where water is not distributed by a piping system. To fit the recorded water use data the RWU rate was lowered to 65 L/c/d.

Hydrology Calculations, Hamlet of Arviat

Annual Rainfall (m/year)	0.2972
Evapotranspiration (m/year)	0.200

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

* Specific values for Arviat were not available, estimated using several references, see below.

Wolf River Drainage Basin

River Catchment Area (m ²)*	650,000,000
Rain and Runoff (m ³ /year)	193,180,000
Evapotranspiration (m ³ /year)	130,000,000
Net Recharge of Catchment Area (m ³ /year)	63,180,000

* IEG Environmental, 2005

Evapotranspiration Rates

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

References:

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

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

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

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



Appendix D
Site Forms

Form 1
Daily Water Delivery Log
Hamlet of Arviat

Month: _____

Truck #: _____

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

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

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Form 2
Monthly Water Supply Facility Inspection Form
Hamlet of Arviat

Inspected By: _____ Date: _____

Wind Direction: _____ Temperature: _____

Precipitation: _____ Ground Cover: _____

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Health and Safety (dangers and concerns)		
Signs		
Access Road and Truck Pad (condition, drainage, snow, surface, etc.)		
Truck Fill Station		
Chlorine Feed System		
Berm		
Water Intake Pipe		

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Pumphouse and Fuel Storage Tank		
Equipment (water truck, pump, etc.)		
Ice		
Litter		
Other Issues and Concerns		

Form 3
Water Supply Facility Planning Form
Hamlet of Arviat

Prepared By: _____

Date: _____

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

Water Supply Facility Planning Issue	Current Operations	To Do Items and Schedule
Flow Monitoring		
Staffing		
Equipment		
Costs		
Other Issues/Concerns		



Appendix E
Site Photographs



Photo 1: Truck Fill Station



Photo 2: Water Reservoir



Photo 3: Water Pipeline



Appendix F

Annual Monitoring Report Format

NWB Annual Report

Year being reported: ▼

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 accordance with

 ▼ ▼

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):	<input type="text"/>
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: