



*Hamlet of Gjoa Haven, Nunavut*

# **Sewage Treatment Facility**

## **Operation and Maintenance (O&M) Plan**

*Prepared by*

*Shah Alam, P. Eng.  
Municipal Planning Engineer,  
Cambridge Bay, NU*

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**The Department of Community and Government Services, Government of Nunavut**

Sewage Waste Treatment Facility- Operation and Maintenance (O&M) Plan  
Hamlet of Gjoa Haven, Nunavut

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**Purpose of O & M manual:**

The purpose of O & M manual is to assist community staff in the proper operation and maintenance of their sewage waste disposal and treatment facilities. The O & M manual includes a description-

- How facilities are operated and maintained
- How often the activities are performed and who is responsible for the compliance
- Location of facilities and proximity to receiving water body
- Frequency of inspection of berms, sewage overflow flume and dyke
- Removal of floating materials from sewage disposal facilities
- Controlling effluent discharge quality
- Runoff and discharge control within and outside the facility
- Treatment of contaminated sewage effluent if any
- Prevention of windblown debris into sewage lagoon
- Managing hazardous waste and metals in sewage lagoon
- Segregation and disposal of sewage sludge if sedimentation is more than allowable
- Method and frequency of site maintenance including berm, fence, gate, access way
- Frequency and method of dumping sludge into dump site.

The manual demonstrates to the Water Board that the community is capable of operating and managing their sewage disposal facility. The following is a list (but not limited) of the main components of the O & M manual for sewage waste disposal and treatment facilities:

**A. Introduction:**

- Purpose of the manual
- Location of the community
- Basic geographical information such as precipitation data, permafrost, hydrological information
- Map of community and location of sewage waste facility
- Population and projected growth trend

**B. Background:**

- Where the water source
- How sewage waste are collected and quantity of daily/weekly/monthly collection
- Sewage generation and composition projections, sewage treatment & disposal system
- History of facility development, time of operation, change and modification if any
- Location of wetland and trend of wetland condition during summer, winter and fall

**C. Operation and Maintenance of Sewage Disposal Facility**

- Site location of sewage treatment facility, discharge and distance of water bodies
- Type of lagoon: engineered or natural
- Discharge method: continuous (short detention and long detention) or intermittent (storage lagoon) or Zero discharge
- Drainage swale: around outside perimeter of the lagoon
- Overflow Flume and discharge flume
- Decanting system
- Operators name and contact numbers
- Sampling procedure and frequency of sampling: with a sampling program
- SNP and station locations with GPS locator
- Site records showing volume of sewage collected, effluent discharged and maintenance undertaken
- Safety procedure of operator
- Method of controlling access to site and adequate signs
- Sludge management and treatment if any

**D. Emergency Responses**

- Fire - procedure to follow in case of an event, persons and department to notify
- Spill – contingency plan for spills and reporting procedure

**E. References of reports, guidelines and other documents used to develop the manual****Spill Contingency plan:**

Possible sources for sewage spills are sewage trucks, sewage holding tanks (home or community building), breach of sewage lagoon walls etc. In the event of a sewage spill, personal safety should be considered first.

The source of the spill should be identified and if safe, the source should be shut off or plugged. The area should be secured: no vehicles or persons may enter and if safe to do so, spill should be contained so that it does not spread. Appropriate authorities should then be notified to activate the Spill Recovery Plan and to notify relevant government departments. Then they will proceed with spill contaminant and collection, preferably using back-up sewage truck and a loader. The contaminated materials may be disposed in the soil remediation land farm. Spill contact area may be treated with lime and covered by means of covered materials (may be soil).

## **1.0 Introduction**

### **1.1 Hamlet Description**

The Hamlet of Gjoa is on the south-east coast of King William Island on the north-west Passage at 68<sup>0</sup> N latitude and 96<sup>0</sup> W longitudes, approximately 1100 km North-East of Yellowknife, sitting 40 m above sea level on sand and boulders form terrain within the Kitikmeot region of Nunavut. It is a zone of continuous permafrost, on sand, gravel bedrock predominates in the higher hills and gently rolling terrain comprising numerous lakes and ponds, covered with thin layer of tundra vegetation & grasses. Despite poor soil quality, various types of lichen, moss, willow, heather and wildflowers grow in the area. Wildlife in the area mainly ground squirrels, lemmings, weasels, arctic hares, arctic foxes, ringed seals and numerous species of birds and fish.

Climate of Gjoa Haven is reasonable summers and extremely cold winter, average mean temperature in January -39<sup>0</sup>C to -23<sup>0</sup>C and July high & low 13.9<sup>0</sup> C and 7.2<sup>0</sup>C. Seasonal rainfall average 5 cm, snow fall average 25 cm and mean precipitation 8 cm.

The community has a population of approximately 1260 (2006), with an approximate 5.0 percent projected growth rate over the 20-year design period. Community infrastructure includes:

- A water treatment plant, which draws water from the Swan Lake, transport it to the treatment plant through a 2.3 km buried line and store it after treatment for trucked out to house holding tanks in each building
- A sewage lagoon which receives trucked sewage collected from holding tanks in each building and houses.
- Sewage treatment was historically via an exfiltration lagoon to a wetland discharging north to the ocean
- A hazardous waste storage area is next to the sewage waste site.

### **1.2 Nunavut Water Board Licence**

The Hamlet of Gjoa Haven operates their municipal water, sewage, and solid waste facilities under the Nunavut Water Board (NWB) License 3GJO-0409, dated of issue January 08, 2004 and Expiry January 31, 2009. Part G, Section 1 requires that an Operation and Maintenance (O&M) Plan be submitted for the facilities in accordance with applicable regulations and guidelines. This document was created to provide staff with O&M procedures for the proposed Sewage Treatment Facility. A renewal to the NWB license is being requested.

The O&M Plan of the Sewage Treatment Facility will be used in conjunction to the normal operating procedures. This document provides a list of tasks and procedures that will assist the Hamlet staff in the operation of the facility. This O&M Plan should be updated when the amended NWB license is issued.

### **1.3 Climate of the Community**

Gjoa Haven is affected by Arctic air masses and experiences a maritime Arctic climate characterized by short cool summers, and long cold winters. The mean annual air temperature is -12°C. Monthly averages range from -39°C low, -23°C high in January to 7°C & 13°C in July. Gjoa haven receives about 8 cm of precipitation per year, of which 5 cm falls as rain between June and September. Prevailing winds are from the east in the summer and from the southwest in the winter. The mean wind speed is approximately 17.5 km/hr. Tracking weather conditions will be important during lagoon discharge in the summer.

## **2.0 Sewage Treatment Facility**

### **2.1 Site Facility:**

The Hamlet of Gjoa Haven Sewage Treatment Facility consists of two main components:

- Detention cell Sewage Lagoon – storage capacity 22,700 m<sup>3</sup> for whole winter
- Natural wetland - treatment system through BOD, sunlight and vegetation

The site includes a truck discharge point and turn around pad approximately 55 m wide, two discharge chute 15 m each, main lagoon cell 22,700 m<sup>3</sup>, effluent overflow chute with more than 1.5 m freeboard on sewage water storage and earthen-gravel berm all around. About 1050 m natural channel on wetland before meeting to ocean for contamination remediation of effluent, thus total linear distance from truck off load to ocean is about 1275 m.

The facility operates by a detention cell, accommodating sewage and sanitary waste collected from the community through vacuum truck for approximately one year prior to flow out to next cell by an overflow chute and then naturally flow onto a wetland treatment area. The primary settling pond is used to treat sewage and waste water through settling of sewage solids at the bottom and leaving main part sewage-water (almost 90 % of total sewage disposal) for some retention time. The lagoon maintains the freeboard via the French drain cut and the effluent migrates along 1050 m tundra wetland pathway to the ocean.

Annual Reports 2011 and 2012 show the amount of sewage collection and disposal for Gjoa Haven within 31,000 m<sup>3</sup> and 35,000 m<sup>3</sup> respectively. Summer decanting and continuous discharge through overflow chute in main cell facilitates for more sewage accommodation

during winter. Based on annual sewage and sanitary waste collection and allowable disposal which is 60,000 m<sup>3</sup> limits, current lagoon system is not good enough to accommodate waste for a whole one year without continuous summer discharge and decanting. Moreover, the lagoon has been noticing signs of leaking sewage through the berm due to side erosion and losing support. Under capacity and improvement in containment of sewage waste has lead the necessity of a new engineered lagoon.

## 2.2 Sewage Collection and Delivery

The Hamlet of Gjoa Haven provides trucked sewage pickup service for residents, business centres and institutions of the community and transport to the disposal facility for dumping.

The Sewage Treatment Facility operated by the Hamlet, is located about 1.5 km from the Hamlet office in town. Sewage is collected daily by trucks from all houses and occupied building holding tanks and discharged into the sewage lagoon.

The lagoon is designed to receive municipal sewage only as outlined in the water licence and termed as sewage and sanitary wastes- both grey water and black water. The discharge of other type of liquid wastes is prohibited unless it can be demonstrated that the waste quality do not have deleterious impact on the Sewage Treatment Facility.

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

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

## 2.3 Sewage Volume

The quantity of the lagoon facility for annual sewage volume accumulation has been determined from the projected population, associated sewage generation rate using information from the Nunavut Bureau of Statistics. The tables with the detailed calculations are included.

The rate of sewage generation based on Government of Nunavut Guidelines which is based on MACA guideline is 90L/c/d water uses.

The equation for calculation of sewage waste generation water (90 % of sewage) is:

$$\text{Water use (l/c/d)} = 90 \text{ l/c/d} \times (1 + 0.00023 \times \text{population})$$

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The factor of 0.00023 x population represents the commercial and industrial water use.

Population data for Gjoa Haven obtained from the Nunavut Bureau of Statistics (2010). Using available data information, population projections for 2009 to 2020 with estimated average growth rate of 5% per year. The Table below illustrates the estimated population of Gjoa Haven from 2009 to 2020. Based on these estimates, Gjoa Haven's population will be 1,974 in the year 2020.

Based on sewage waste generation per year per person, amount of sewage waste in Gjoa Haven by the year 2014 is over 53,000 m<sup>3</sup> and at the end of year 2020 be over 62,000 m<sup>3</sup>.

Year	Population the year	Sewage disposal / year (m <sup>3</sup> )
2009	1154	47,926
2010	1211	48,988
2011	1272	49,906
2012	1336	51,238
2013	1403	52,585
2014	1472	53,698
2015	1546	54,950
2016	1624	56,468
2017	1703	57,950
2018	1790	59,512
2019	1880	62,080
2020	1974	62,698

Typical composition included the physical, chemical and biological characteristics of sewage waste. Water deliver by truck generates higher amount of sewage waste.

### **3.0 Operation and Maintenance of Sewage Treatment Facility**

#### **3.1 Overview**

The Hamlet of Gjoa Haven Sewage Treatment Facility consists of two main components:

- Detention cell Sewage Lagoon – storage for whole winter
- Natural wetland - treatment system through BOD, sunlight and vegetation

Annual maintenance includes mainly: snow cleaning during the winter from the discharge turn around and maintain access road, discharge flume and berm protection during the summer for the main lagoon facility. Other maintenance activities involve for wetland and monitoring stations, signage, fence, gate and illegal dumping at the facility. Based on the



scope and requirements, maintenance of total facility can be addressed on the items of the whole system as described in following types.

### 3.2 Discharge Method

Sewage collected from household tank by vacuum truck and then discharge into main cell lagoon for the whole year. In the winter, the discharge forms an ice pack in the lagoon which melts and flow through the overflow chute, summer discharge naturally settle down the sludge portion (about 10% of the total) at the bottom and flow out remaining watery portion (almost 90 % volume) through the overflow chute into the secondary cell while temperatures are above freezing point. Effluents from secondary cell pass through semi-permeable dike and French drain to wetland where maximum remediation takes place naturally to the sewage run-off before completing the travel to the ocean.

Sewage disposal flumes requires inside perimeter cleaning for sewage flow to the maximum rate and to its targeted distance without any backing up to the side. Also, for it is important to keep those flumes in place permanently and tie down with slope for discharging sewage in its flow rate. Hamlet of Gjoa Haven maintains a Maintenance Log sheet for identifying and in taking necessary steps for sewage facility maintenance. A full time employed Forman with the help of operators are making this effort with continuity until this facility in operation.

### 3.3 Resource and Personnel

The Hamlet Forman is responsible for overall operation of the sewage collection, storage, transportation and disposal to treatment facility as well as general operation and monitoring. One person is employed to operate each sewage truck and another person in connecting house tank outlet to the hose at the vacuum truck for each team out of two teams in operation, daily 8:00 am to 5:00 P M and 5 days a week. The Hamlet is operating such two trucks with two full time drivers and one truck as backup in case of failure of regular one. Regular 5 days a week service with overtime operation during Saturday and Sunday in the case of emergency.

Contact person for any information and action as below:

<u>Operators Name</u>	<u>Title</u>	<u>contact number</u>
Jacob Keanik	Hamlet Forman	867-360-6138
Adam Halluqtalik	Hamlet Operator/Forman	867-360-6138
Troy Beaulieu	Land Administrator	867-360-7141 x6
Gord Dinny	SAO	867-360-7141

### 3.4 Monitoring points

Monitoring points are located at the outlet point of overflow discharge from the primary cell lagoon (detention cell) to the secondary cell, and at selected locations down-stream on wetland before mixing with solid waste effluent point prior to entering the ocean.

Monitoring Stations of sewage and solid waste sample collection

Sampling Station	GPS Location		Description	comments
	Latitude	Longitude		
<b>GJO-1</b>	N 68° 39' 22.9 "	W 95° 55' 06.5 "	Raw Water supply at Swan Lake	Volume of water collected from lake
<b>GJO-2</b>	N 68° 37' 05 "	W 95° 50' 42 "	Effluent Final discharge point from Solid Waste	Outside the berm, on meandering wetland
<b>GJO-3</b>	N 68° 37' 28.8 "	W 95° 50' 21.9 "	Raw Sewage at Truck offload point	Detention cell sewage lagoon
<b>GJO-4</b>	N 68° 37' 23 "	W 95° 50' 39 "	Effluent Final discharge point of sewage facility	Natural flow On wetland shallow channel
<b>GJO-5</b>	N 68° 37' 05 "	W 95° 50' 44 "	Solid Waste Leachate retention inside berm	New station. Sample collect only when decanting requires

The lagoon is sized to contain the annual volume of sewage of its life when designed and developed in early 2000. Due to population increases and changes in monitoring guidelines and requirement, the containment is good for full winter and early summer time and then follow control discharge through wetland and finally mixing with ocean water after remediation process with limiting parameters values as outlined in water Licences and CCME guidelines. The wetland treatment system is designed to natural flow channel which gradually become a more biologically rich area to provide natural biological attenuation processes as the discharge volume increases year by year.

The lagoon is protected from overflowing onto upstream by earthen berm without any

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fence around and identified with signs to alert public transference. The wetland treatment area is full of seasonal mosses and spongy grasses not for public walk.



### 3.5 Operational procedure

The following sewage collection operational procedures are carried out by the staff of the Hamlet of Gjoa Haven on a daily basis depending on weather conditions:

- Household and commercial sewage holding tanks are pumped out using a vacuum truck and hauled to the sewage treatment facility.
- Sewage from the vacuum truck are discharge to the sewage lagoon via a pair of flumes designed to prevent erosion and spill on sides before completely discharging to main cell lagoon. The lagoon gradually fills throughout the year until mid-June of each year, when climate conditions are suitable to discharge from melting and flowing through overflow pipe into the secondary cell and finally discharge over earthen dyke and partly through seepage onto wetland.
- Discharge of sewage begins when the wetland is sufficiently recovered from winter and becomes biologically active. Such discharge continue from mid- June to mid-October when conditions are optimum.
- The lagoon discharge flume set at a level high enough so there is always a layer of water over the maximum thickness of sludge when it is fully discharged. This prevents 'Flow through' of sewage during discharge period and maintains active effluent treatment conditions during discharge.
- Daily waste volume depositing to the sewage lagoon calculate from trip count are recorded on the record book. The existing main cell lagoon is designed for an operational capacity of **27,000** m<sup>3</sup> with the aim of only winter storage and continuous discharging through discharge flume during whole summer and fall when melts and rise above the chute level. Annual decanting facilitates more for winter storage to a maximum volume of **27,000** m<sup>3</sup>. Any additional volume above the discharge chute stays inside as ice stack during the winter and discharge out when melts in mid -June. Additional height of more than 1.5 m above the Free-board facilitates such additional volume in timely fashion.
- In the event of an accident, a spill of sewage or petroleum products or a fire during sewage collection operations, the *Environmental Emergency Contingency Plan, Hamlet of Gjoa Haven* shall be implemented.
- The Hamlet of Gjoa Haven will advise the AANDC Inspector and the Nunavut Water Board at least 10 days prior to starting the decant operations of the sewage lagoon between June and October dependant on weather conditions.

### 3.6 Maintenance Procedure

The maintenance of sewage collection and disposal system includes sewage truck, sewage drop-off point, berm and wet land. The following maintenance procedures shall be taken by Hamlet staffs to ensure wastewater treatment infrastructure operation efficiently:

- The roadway and truck pad shall be maintained by snow clearing in the winter and surface grading in the summer with any defects repaired as necessary.

*Hamlet Forman has been employed with responsibility in maintaining the access road, turn around pad and side protection.*

- Berms shall be inspected periodically during the summer and fall.

*A geotechnical investigation is planned to inspect the dam stability and containment of sewage to its capacity for the time until the new lagoon takes over the program. GN has retained EXP consultant to complete this investigation and report within this FY 2013-14. The investigation will also cover to the discharge point from main cell and second cell to wetland. Based on investigation report, maintenance works to lagoon berm and its outside discharge area is undertaken by the Hamlet.*

- Wetland drainage channels shall be inspected during summer and repaired as necessary. *Maintenance to the wetland also undertaken by the Hamlet for any dredging and cleaning debris to regulate the flow of effluent on wetland shallow channel towards the Ocean.*
- Site warning signage which identifies the boundaries of the Sewage Treatment Facility shall be inspected monthly, and repaired or replaced as necessary.

*New signage has been installed at facilities identified location and monitoring stations with GPS locator with clear visible to the public and user.*

- The discharge flume shall be inspected for displacement or damage monthly and repair as necessary. Hamlet Forman remains in responsible in reporting and taking steps in maintaining discharge flume as needed-mostly requires in summer & fall.
- Any airborne litter shall be removed from sewage lagoon periodically and dump at dump site.

#### 3.6.1 Sewage Trucks and Holding Tanks

Sewage collected from household tanks using hamlet operator driven vacuum trucks. It is important to keep these trucks in good condition over the year. Following actions are considered:

- 
- Repair of sewage trucks shall be completed as a priority basis.
  - Sewage trucks shall not sit idle for long time during winter season
  - Holding tanks must be kept in good working condition with heat trace inside in order for preventing from freezing during winter.

*Hamlet Maintenance shop and maintenance team is available in taking care of any maintenance works for sewage trucks and its services. Currently engaged 3 trucks are in good working condition and available drivers and operators employed locally. The operators are trained properly in taking care of sewage collection service and maintaining sewage trucks.*

### 3.6.2 Wetland Treatment Area

The Wetland Treatment Area is an integral part of the Sewage Treatment Facility. It consists of a meandering stream pathway that reaches across the tundra a distance of approximately 1.2 km between the lagoon and ocean. Monitoring of the existing wetland downstream has shown that the wetland has been providing adequate treatment that NWB license requirements were being met before discharging into the ocean. Continuous monitoring will allow ample warning if maintenance efforts such as diverting some of the flow into adjacent drainage systems is required.

As mentioned below, there are several small drainage systems that could be used to expand the Wetland Treatment area if required. The proposed system operates as follows:

- Discharge of melted sewage from the lagoon (retained from October to June)
- Discharge from the lagoon when climate and vegetation conditions are optimized
- Controlled discharge with monitoring overflow flume
- Discharge is initially collected behind an exfiltration berm, which slows the flow and spreads it over a wider area. This expands the distribution and lengthens the flow path

Annual maintenance requires to wetland and monitoring stations for continuity of flow of sewage run-off through the travel path. Shallow dredging to the channel and debris cleaning from collection pits are important to maximize the BOD on run-off effluent surface. Also, continuity of flow makes room for the wetland hydraulic channel at every section to help in remediation rather than holding them at stagnant point. Debris free on channel surface helps in sunlight pass through the shallow depth of run-off; thus remediate effluent parameters as well as wetland section. It is also important for minimum continuity flow for annual effluent discharge during the summer and fall for making room for the winter disposal to main cell.

The operation of the Wetland Treatment area is based on continued close monitoring at the stations along the length of the flow path. This provides ample forewarning of a potential problem such that maintenance measures can be implemented.

### 3.7 Sewage Treatment Facility Monitoring Program

Results of analytical testing and monitoring are to be recorded on a regular basis by the Hamlet's operation staff. Copies of the analytical certificates and Chain of Custody forms are to be kept for future reference to determine the effectiveness of the treatment facility. The monitoring results will be included in the Annual Monitoring Report. A Log Sheet Form is in used for updating information of the facility in taking treatment works naturally but systematically. GN and Hamlet shares cooperation in updating such information in reporting to the Board for any modification, alteration or changes in operation.

#### 3.7.1 Water License Requirements

As outlined in the NWB water license, regular monitoring of the effluent from the Sewage Treatment Facility is required. The Monitoring Program is to include effluent samples collected at various places including the Final Discharge Point of the Wetland Treatment System, during the months of June to October, inclusive. Several factors are particularly important to produce the required results:

- Collection of samples at suitable time outlined in the requirement of the licence
  - Use of correct and clean sampling container for parameters being tested
  - Sampling from correct location and representing level or depth of flowing effluent
  - Labelling of samples with correct time and date and filling necessary information
  - Correct handling of sample bottles during sampling and storing for shipping out
  - Shipping samples as quickly as possible in the correct container as outlined and recommended by the laboratory for complete testing procedure.
- |  |   |
|--|---|
| • Biological Oxygen Demand (BOD)           | • Faecal Coliforms (FC)   |
| • Total Suspended Solids (TSS)             | • pH  |
| • Conductivity                             | • Nitrate and Nitrite as Nitrogen (NO <sub>3</sub> -NO <sub>2</sub> ) |
| • Oil and Grease (OGG) (Visual)            | • Total Phenols (Total-P)   |
| • Magnesium (Mg)                           | • Calcium (Ca)  |
| • Sodium (Na)                              | • Potassium (K)   |
| • Chloride (Cl)                            | • Sulphate (SO <sub>4</sub> )   |
| • Total Hardness                           | • Total Alkalinity  |
| • Ammonia as Nitrogen (NH <sub>3</sub> -N) | • Total Zinc (Zn)   |
| • Total Cadmium (Cd)                       | • Total Iron (Fe)   |
| • Total Cobalt (Co)                        | • Total Manganese (Mn)  |
| • Total Chromium (Cr)                      | • Total Nickel (Ni)   |
| • Total Copper (Cu)                        | • Total Lead (Pb)   |
| • Total Aluminium (Al)                     | • Total Arsenic (As)  |
| • Total Mercury (Hg)                       | • Total Organic Carbon (TOC)  |

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

Sampling completed by the Hamlet of Gjoa Haven shall be in accordance with the Hamlet of Gjoa Haven Monitoring Program and Quality Assurance/Quality Control (QA/QC) Plan. *Results of samples taken this year 2013 (latest) are added for information and verification.*

Sample location GJO-3 is the run-off discharge point from the sewage lagoon and station GJO-4 is location of effluent run-off on wetland prior to entering to ocean. Sampling and monitoring is to be conducted by collecting grab samples of effluent collected shall be analyzed for the following parameters:

### 3.8 Record Keeping

Records should be kept to assist in planning of yearly operation and evaluation effectiveness to the sewage treatment facility. Copies of such record shall be kept at the Hamlet office for review and reference. Records shall be contained with information such as:

- Number of trips makes per day and approximate volume of sewage discharged
- Information of any monitoring for the day of a plan for next day(s)
- Results of monitoring program
- Any maintenance carried, required or in plan for the day or later the date

*Hamlet Operator also keeps copy of such information along with their work book. Customers or clients are billed based on this information if not listed in Hamlet's regular service. Community Posters also carries some important information regarding the services, service interruption or any emergency maintenance program. Such information keeps mandatory in hamlet's notice board and in common public place such as Co-op store or Community Hall.*

#### 3.8.1 Records of Sewage and sanitary waste collection:

Hamlet operates sewage, water and solid waste trucks with full time employed operators. The average number of trips for total 3 trucks as shown below:



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Description	number	capacity
Total sewage trucks	3	10,000 L each
Daily operation and back up trucks	2- trucks in operation, 1-truck back-up	
Daily trips/truck	3-5 trips/day/truck	
Daily loads	7-10 loads, 7days/week	
Daily average sewage volume	70,000 – 100,000 L	

Template Form of Records shows details information about daily/monthly status of services and facility condition.

### **3.8.2 Records of Sewage collection vehicle maintenance:**

The waste collecting vehicles or trucks shall be maintained in a good working condition to ensure the collection services not interrupted or delayed or disrupted. For this reason, it is planned for a backup vehicle by the hamlet or available for contracting services. This maintenance consideration includes:

- Collection vehicle should be equipped with a shovel and brush to clean up accidental spills during sewage collection
- Collection vehicle should be facilitated to all weather condition and provision for keeping basic safety tools
- The collection vehicles should be cleaned periodically and as needed, serviced and inspected with changing serving fluids as recommended from manufacturer.
- Operator log book shall be maintained with inspection documentation in taking action by the next user.
- The collection vehicle shall be parked inside heated garage during winter when idle.
- The standby backup truck shall be available for use when primary vehicle is down for maintenance.

### **3.8.3 Records of Health and Safety measures**

Health and safety of workers and the public is first priority while operating the sewage lagoon facility for waste treatment. The requirements of the Nunavut Safety Act must be followed all the time. All actions and operations must be undertaken with safety as the first priority. Template Form to assist staff in operating the facility, planning and costing the short term and long term use of the facility are included in this manual.

### 3.9 Training

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

Hamlet operators are mandatorily required basic training of facility operation and maintenance in regards to public safety and environmental protection. Hamlet operators have been facilitated with raining of Environmental Awareness, MSW Management and Municipal Facility Operations in conjunction to Water, Sewage and Solid Waste. These training are integral part of annual monitoring and maintenance of facilities.



Sampling technique from sewage run-off on wetland at station GJO -4

GN has retained consultant for training Hamlet operators in doing regular services for facility operation and compliance requirements to the Water Licence. Such training program remains in effect starting summer 2012 and continued to next year. Training included with materials presentation, discussion and field operation in monitoring the facility.

## 4.0 Sewage Treatment Facility Design

### 4.1 Current Lagoon

The existing sewage lagoon system will remain in operation until the new lagoon is constructed which is expected at the end of 2013. Once the new facility is commissioned, the existing lagoon will be decommissioned with the sludge transferred to the Solid Waste Disposal Facility for initial treatment followed by use as interim cover. The Licensee or its agent will submit such decommissioning A & R plan with the Board sometime in Dec 2013 ahead of starting operation to the new facility.

### 4.2 New Sewage Treatment Facility

A detailed construction drawing of the new facility has been submitted to the Board for information. The new engineered lagoon will be fully liner cell with annual decanting facility. There will be a new entry channel to the existing wetland for effluent run-off through overflow flume across the berm. Additional volume discharge shall be done by pump decanting. AANDC inspector will be acknowledged 10 days in advance accordingly for direction.

Trucks will discharge sewage onto discharge flumes. The lagoon will gradually fill throughout the year until mid-June of each year, when climatic conditions are suitable for discharge. This would be when the discharge valve area is ice free, and the wetland treatment area vegetation has become active and green. Discharge should begin when the wetland is sufficiently recovered from winter frost and becomes biologically active.

The lagoon is designed for an operational capacity of approximately 62,000 m<sup>3</sup> in a year up to 20 years design life. The maximum flow rate through the overflow flume is considered 1.5m<sup>3</sup>/min depending on the height of sewage waste in the lagoon. At this time, with the average flow rate of 1.5 m<sup>3</sup>/minute, approximately 53 days are required to empty the lagoon when filled to capacity. This must be accomplished during the 120 day discharge window between mid-June and mid-October when conditions are optimum.

The lagoon is designed with a discharge pipe set at a level high enough so there is always a layer of water over the maximum thickness of sludge when it is fully discharged. This prevents “flow through” of sewage during the period of discharge and maintains active effluent treatment conditions at that period. The lagoon will be de-slugged when the sludge level reaches approximately 0.3 m thick at the bottom sedimentation which is estimated to

occur in 5 to 10 years. Over the 20 year design life, de-slugging would be needed only on two or three occasions.

The following procedures are followed for decanting:

- Inform the NWB a minimum of 10 days prior to the planned discharge period
- Approximate mid-June – evaluate ice and Wetland Treatment Area condition
- Discharge will empty into an area in front of the exfiltration berm, which is designed to slow and spread the flow over a wide area and multiple channels, to maximize flow paths and minimize flow depths
- Monitor the discharge and Wetland Treatment Area
- Allow the discharge flow to open for the remainder of the 120 day discharge period until mid-October
- Approximately mid-October, evaluate climate conditions and close the valve prior to freeze up and prior to the Wetland Treatment Area becoming biologically inactive.

During the discharge period, reducing the discharge rate or stopping the discharge during high volume storm events that could cause flooding of the Wetland Treatment Area and overland flow. Re-start discharge when water levels return to normal.

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

The facility is designed for a minimum of 20 years of operation based on population growth projections. Maintenance, including de-sledging is scheduled when sludge thickness reaches 0.3 m throughout the 20 year period.

## **5.0 Abandonment and Restoration**

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

The Sewage Treatment Facility consisting of the Lagoon and Wetland area has been designed to meet the required 20 design period. It is expected that it could continue to operate for a significant period of time beyond 20 years. De-slugging on a regular basis would extend its life as it approaches year 20. Once sewage volume exceeds the capacity of the lagoon, the lagoon can be expanded or an additional lagoon constructed.

In the future, should the Sewage Treatment Facility no longer be required, abandonment

**The Department of Community and Government Services, Government of Nunavut**

Sewage Waste Treatment Facility- Operation and Maintenance (O&M) Plan  
Hamlet of Gjoa Haven, Nunavut

would be straight forward as follows:

- Drain the lagoon during the discharge period
- De-sludge the lagoon
- Open the berms to allow natural drainage
- Contour the area to match the surrounding tundra
- Berms would be regarded or left standing
- The Wetland Treatment Area would return to natural conditions.

*The current facility will remain in operation until the new lagoon comes in operation, expected completion of new lagoon at the end of 2013 with operation sometime in April 2014. Before switching the operation to new facility, Abandonment and Restoration information will be updated with the Board in writing.*

## 6.0 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):

**Table: Emergency Contacts**

Contact	Location	Telephone Number	Fax Number
INAC – Water/Wastewater Resources Manager	Iqaluit	(867) 975-4550	(867) 979-6445
Hamlet of Gjoa Haven– SAO	Gjoa Haven	(867) 360-7141	(867) 360-6309
Government of Nunavut (Regional Engineer)	Cambridge Bay	(867) 983-4156	(867) 983-4123
Environment Canada – Inspector	Iqaluit	(867) 975-4644	(867) 975-4594
Fire Department	Gjoa Haven	(867) 360-7141	
RCMP Detachment	Gjoa Haven	(867) 360-0123	(867) 360-3390
Community Health Center	Gjoa Haven	(867) 360-4531	(867) 360-3115

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

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

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

## 7.0 Reporting

The Nunavut Water Board License on Part B: General Conditions include the requirement to file an Annual Report with the NWB no later than **March 31<sup>st</sup>** of the next calendar year. The creation of the report can be greatly simplified by staff regularly filling in and filing the Site Forms included in this manual. The Forms included information for:

- Monthly Sewage Delivery Log – describing the day to day delivery of sewage and site activities
- Monthly Sewage Treatment Facility Inspection Form – to document the inspection and observation of the site operations and infrastructure
- Effluent Discharge Log – to document the decanting of the lagoon during the 120 day discharge period
- Sewage Treatment Facility Planning Form which provides a list of items

In addition to these Forms, there would be sampling information and analytical data collected. The Monitoring Plan and QA/QC Plan (prepares in 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 more relatively straight forward.

## 8.0 Summary

This Operation and Maintenance Plan (O&M) has been prepared based on the design and operation of the current Sewage Treatment Facility of Gjoa Haven.

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

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

## Truck # -----

[illegible]

**Form:        Monthly Sewage Treatment Facility Inspection**

**Hamlet of Gjoa Haven**

**Inspected by-----**

**Date -----**

**Wind Direction-----**

**Temperature -**

**Precipitation -----**

Issues and conditions	Description	Action/maintenance
Health and Safety concerns		
Wild life concerns		
Access road condition		
Signage		
Berm and fence		
Sewage level		
Sludge thickness		
Odour/appearance		
Wetland treatment area		
Equipment/pump		
Discharge/decanting		
Other issues		



## **Part H: Monitoring program.**

Item No.1: Four monitoring stations: - (i) GJO-1 (Raw Water at Swan lake)

(ii) GJO-2 (Effluent from Solid waste site (iii) GJO-3: (Raw Sewage at truck offload and (iv) GJO-4: (Effluent Final discharge point)

### **item 2: samples at monitoring stations:**

samples collected on july 16, Aug 24 and Sep 17, 2012 and tested results

Wastewater/Sewage parameters

Parameter	MAC	units	July 16,2012		Aug 24,2012		17-Sep-12	
	Limits		GJO-2	GJO-4	GJO-2	GJO-4	GJO-2	GJO-4
Alkalinity		mg/L	327	314	312	358	288	317
Conductivity		µS/cm	2650	1020	1000	1100	910	989
p <sup>H</sup>	6-9		6.92	7.5	7.74	7.4	7.78	7.74
TSS	100	mg/L	86	12	18	106	<3	4
Ammonia N2	80	mg/L	8.77	11.3	12.8	17.0	4.31	9.45
BOD		mg/L	77	5			3	4
Organic Carbon		mg/L	150	51.6	52	67.5	62.5	80
Nitrate N2		mg/L	<0.01	0.02	1		0.94	1.02
Calcium		mg/L	352	40.2	43.6	44.6	48.3	41.7
Chloride		mg/L	194	137	123	132	120	130
Hardness		mg/L	1120	224	238	240	254	233
Magnesium		mg/L	58.1	30	31.4	31.4	32.3	31.4
Potassium		mg/L	44.3	17.4	14.1	18.3	11.7	16.6
Sodium		mg/L	171	112	98	112	89.7	109
Sulphate		mg/L	892	4	1	2	11	8
Fecal Coliform	10000	CFU/100mL	820	125			124	48
Oil and Gas	5000	µg/L	non-vis	non-vis	non-vis	non-vis	non-vis	non-vis
Aluminium		µg/L	87	45.6	30.6	103	19.4	30.2
Arsenic	100	µg/L	12.9	7.7	7.4	27.1	3.8	6.3
Cadmium	10	µg/L	1.1	<0.1	<0.05	<0.1	<0.05	<0.05
Chromium	100	µg/L	3.4	0.3	0.7	1.1	1.2	0.5
Cobalt	50	µg/L	7.1	<0.1	3.1	2.4	2.3	4.0
Copper	200	µg/L	88.9	0.7	4.4	3.3	4.3	7.1
Iron		µg/L	25800	3130	2400	16400	1600	2540
Lead	50	µg/L	54.5	0.2	0.4	0.4	<0.1	<0.1
Manganese		µg/L	1090	155	193	279	122	167
Nickel	200	µg/L	22.7	6.8	9.4	7.9	9.2	12.8
Zinc	500	µg/L	826	<5	7	<0.4	11.9	0.8
Mercury	0.6	µg/L	0.12	0.03	<0.01	<0.01	0.02	0.01
PCB	1000	µg/L						
Phenols	20	µg/L						



**Taiga Environmental Laboratory**  
4601-52nd Ave., Box 1500, Yellowknife, NT. X1A 2R3  
Tel: (867)-669-2788 Fax: (867)-669-2718

**Taiga Batch No.:**  
**130622**

## **- FINAL REPORT -**

**Prepared For:** Hamlet of Gjoa Haven

**Address:** P.O. Box 200  
Gjoa Haven, NU  
X0B 1J0

**Attn:** Jacob Keanik

**Facsimile:** (867) 360-6309

**Final report has been reviewed and approved by:**

**Angelique Ruzindana**  
**Quality Assurance Officer**

### **NOTES:**

- Test methods and data are validated by the laboratory's Quality Assurance Program. Taiga Environmental Laboratory is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) as a testing laboratory for specific tests registered with CALA.
- Routine methods are based on recognized procedures from sources such as
  - Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF;
  - Environment Canada
  - USEPA
- Samples shall be kept for thirty (30) days after the final report is issued. All microbiological samples shall be disposed of immediately upon completion of analysis to minimize biohazardous risks to laboratory personnel. Please contact the laboratory if you have any special requirements.
- Final results are based on the specific tests at the time of analysis and do not represent the conditions during sampling.

**ReportDate:** Friday, August 16, 2013

**Print Date:** Friday, August 16, 2013



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Tel: (867)-669-2788 Fax: (867)-669-2718

**Taiga Batch No.:**  
**130622**

**- CERTIFICATE OF ANALYSIS -**

**Client Sample ID:** GJOA-02

**Taiga Sample ID:** 001

**Client Project:** GJOA-02,GJOA-04

**Sample Type:** Water

**Received Date:** 07-Aug-13

**Sampling Date:** 06-Aug-13

**Sampling Time:** 10:30

**Location:** Gjoa Haven, NU

**Report Status:** Final

Test Parameter	Result	Detection Limit	Units	Analysis Date	Analytical Method *	Qualifer
<b><u>Inorganics - Physicals</u></b>						
Alkalinity, Total (as CaCO <sub>3</sub> )	430	0.4	mg/L	07-Aug-13	SM2320:B	
Conductivity, Specific (@ 25°C)	2830	0.4	µS/cm	07-Aug-13	SM2510:B	
pH	7.43		pH units	07-Aug-13	SM4500-H:B	
Solids, Total Suspended	130	3	mg/L	08-Aug-13	SM2540:D	
<b><u>Inorganics - Nutrients</u></b>						
Ammonia as Nitrogen	18.1	0.005	mg/L	14-Aug-13	SM4500-NH <sub>3</sub> :	
Biochemical Oxygen Demand	>41.88	2	mg/L	07-Aug-13	SM5210:B	62
Organic Carbon, Total	142	0.5	mg/L	08-Aug-13	SM5310:B	
<b><u>Major Ions</u></b>						
Calcium	381	0.1	mg/L	07-Aug-13	SM4110:B	
Chloride	198	0.7	mg/L	07-Aug-13	SM4110:B	
Hardness	1240	0.7	mg/L	07-Aug-13	SM2340:B	
Magnesium	71.0	0.1	mg/L	07-Aug-13	SM4110:B	
Nitrate as Nitrogen	0.35	0.01	mg/L	07-Aug-13	SM4110:B	

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**Taiga Batch No.:**  
**130622**

**- CERTIFICATE OF ANALYSIS -**

**Client Sample ID: GJOA-02**

**Taiga Sample ID: 001**

Nitrite as Nitrogen	< 0.01	0.01	mg/L	07-Aug-13	SM4110:B
Potassium	60.3	0.1	mg/L	07-Aug-13	SM4110:B
Sodium	202	0.1	mg/L	07-Aug-13	SM4110:B
Sulphate	1030	1	mg/L	07-Aug-13	SM4110:B

**Microbiology**

Coliforms, Fecal (other)	40	10	CFU/100mL	07-Aug-13	SM9222:D
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**Organics**

Oil and Grease, visible	Non-visible			14-Aug-13	Visual Exam
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**Trace Metals, Total**

Aluminum	111	0.6	µg/L	11-Aug-13	EPA200.8
Arsenic	9.0	0.2	µg/L	11-Aug-13	EPA200.8
Cadmium	1.31	0.05	µg/L	11-Aug-13	EPA200.8
Chromium	4.4	0.1	µg/L	11-Aug-13	EPA200.8
Cobalt	3.4	0.1	µg/L	11-Aug-13	EPA200.8
Copper	130	0.2	µg/L	11-Aug-13	EPA200.8
Iron	20500	5	µg/L	11-Aug-13	EPA200.8
Lead	37.5	0.1	µg/L	11-Aug-13	EPA200.8
Manganese	897	0.1	µg/L	11-Aug-13	EPA200.8
Mercury	0.14	0.01	µg/L	11-Aug-13	EPA200.8
Nickel	22.3	0.1	µg/L	11-Aug-13	EPA200.8
Zinc	1270	0.4	µg/L	11-Aug-13	EPA200.8

**ReportDate:** Friday, August 16, 2013

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**Print Date:** Friday, August 16, 2013



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**Taiga Batch No.:**  
**130622**

## **- CERTIFICATE OF ANALYSIS -**

**Client Sample ID:** **GJOA-04**

**Taiga Sample ID:** **002**

**Client Project:** GJOA-02,GJOA-04

**Sample Type:** Water

**Received Date:** 07-Aug-13

**Sampling Date:** 06-Aug-13

**Sampling Time:** 10:30

**Location:** Gjoa Haven, NU

**Report Status:** Final

Test Parameter	Result	Detection Limit	Units	Analysis Date	Analytical Method *	Qualifer
<b><u>Inorganics - Physicals</u></b>						
Alkalinity, Total (as CaCO <sub>3</sub> )	322	0.4	mg/L	07-Aug-13	SM2320:B	
Conductivity, Specific (@ 25°C)	1130	0.4	µS/cm	07-Aug-13	SM2510:B	
pH	7.74		pH units	07-Aug-13	SM4500-H:B	
Solids, Total Suspended	16	3	mg/L	08-Aug-13	SM2540:D	
<b><u>Inorganics - Nutrients</u></b>						
Ammonia as Nitrogen	21.2	0.005	mg/L	14-Aug-13	SM4500-NH <sub>3</sub> :	
Biochemical Oxygen Demand	7	2	mg/L	07-Aug-13	SM5210:B	
Organic Carbon, Total	38.7	0.5	mg/L	08-Aug-13	SM5310:B	
<b><u>Major Ions</u></b>						
Calcium	49.5	0.1	mg/L	07-Aug-13	SM4110:B	
Chloride	156	0.7	mg/L	07-Aug-13	SM4110:B	
Hardness	254	0.7	mg/L	07-Aug-13	SM2340:B	
Magnesium	31.8	0.1	mg/L	07-Aug-13	SM4110:B	
Nitrate as Nitrogen	1.76	0.01	mg/L	07-Aug-13	SM4110:B	
Nitrite as Nitrogen	0.32	0.01	mg/L	07-Aug-13	SM4110:B	

**ReportDate:** Friday, August 16, 2013

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Taiga Batch No.:  
**130622**

## - CERTIFICATE OF ANALYSIS -

Client Sample ID: **GJOA-04**

Taiga Sample ID: **002**

Potassium	21.2	0.1	mg/L	07-Aug-13	SM4110:B
Sodium	128	0.1	mg/L	07-Aug-13	SM4110:B
Sulphate	10	1	mg/L	07-Aug-13	SM4110:B

### Microbiology

Coliforms, Fecal (other)	16	1	CFU/100mL	07-Aug-13	SM9222:D
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### Organics

Oil and Grease, visible	Non-visible	14-Aug-13	Visual Exam
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### Trace Metals, Total

Aluminum	22.0	0.6	µg/L	11-Aug-13	EPA200.8
Arsenic	9.3	0.2	µg/L	11-Aug-13	EPA200.8
Cadmium	0.32	0.05	µg/L	11-Aug-13	EPA200.8
Chromium	0.9	0.1	µg/L	11-Aug-13	EPA200.8
Cobalt	2.2	0.1	µg/L	11-Aug-13	EPA200.8
Copper	4.3	0.2	µg/L	11-Aug-13	EPA200.8
Iron	1970	5	µg/L	11-Aug-13	EPA200.8
Lead	1.0	0.1	µg/L	11-Aug-13	EPA200.8
Manganese	121	0.1	µg/L	11-Aug-13	EPA200.8
Mercury	0.02	0.01	µg/L	11-Aug-13	EPA200.8
Nickel	7.8	0.1	µg/L	11-Aug-13	EPA200.8
Zinc	7.1	0.4	µg/L	11-Aug-13	EPA200.8

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Tel: (867)-669-2788 Fax: (867)-669-2718

Taiga Batch No.:

**130622**

### - CERTIFICATE OF ANALYSIS -

---

Client Sample ID: **GJOA-04**

Taiga Sample ID: **002**

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### - DATA QUALIFIERS -

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#### Data Qualifier Descriptions:

**62**      *Residual DO was less than 1 mg/L. Unable to repeat analysis at lower dilution. Holding time exceeded.*

**\* Taiga analytical methods are based on the following standard analytical methods**

SM - Standard Methods for the Examination of Water and Wastewater

EPA - United States Environmental Protection Agency

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