

# **Gjoa Haven, NU Sewage Lagoon – Abandonment and Reclamation Plan**

*FINAL*

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Abandonment and Reclamation Plan

Hamlet of Gjoa Haven, NU

11-5029

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*Submitted by*

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## TABLE OF CONTENTS

		<b><u>Page No.</u></b>
1	INTRODUCTION .....	1
2	SITE DESCRIPTION .....	1
	2.1 Location .....	1
	2.2 Sewage Treatment Facility .....	2
	2.3 Current Contents of the Existing Lagoon .....	4
3	CLOSURE .....	5
	3.1 Sewage Treatment and Disposal from Existing Lagoon.....	5
	3.2 Sludge Removal and Disposal .....	5
	3.3 Infrastructure Removal .....	6
	3.4 Monitoring Program .....	6
	3.4.1 Effluent .....	6
	3.4.2 Sludge .....	7
	3.5 Signage.....	8
	3.6 Implementation Schedule.....	8
	3.7 Registration.....	8
	3.8 Future Land Use.....	9
4	POST CLOSURE .....	10
	4.1 Inspections .....	10
	4.2 Monitoring .....	10
	4.3 Regulatory Requirements.....	11
5	REFERENCES .....	12

## LIST OF TABLES

Table 1: Quality Standards for Effluent Discharged to Wetlands.....	6
Table 2: Lagoon Decommissioning Implementation Schedule .....	8

## LIST OF FIGURES

Figure 1: Gjoa Haven Sewage Lagoon Site Location.....	1
Figure 2: Site Plan of Existing Sewage Lagoon and New Sewage Lagoon.....	2

## LIST OF PHOTOGRAPHS

Photo 1: Existing Sewage Treatment Lagoon.....	3
Photo 2: Un-Engineered Wetlands where Effluent is Discharged.....	4
Photo 3: Sewage Treatment Pipe Outflow on Existing Lagoon .....	4

## **1 INTRODUCTION**

A new sewage lagoon has been constructed for the Hamlet of Gjoa Haven and is slated to be commissioned for use in November 2013. The purpose of this Abandonment and Reclamation (A&R) Plan is to assist with the closure of the former Gjoa Haven sewage lagoon and help with the monitoring of the site after its closure. This A&R Plan has been completed with guidance from the *Abandonment and Restoration of Sewage Lagoons in Nunavut* (FSC, 2005).

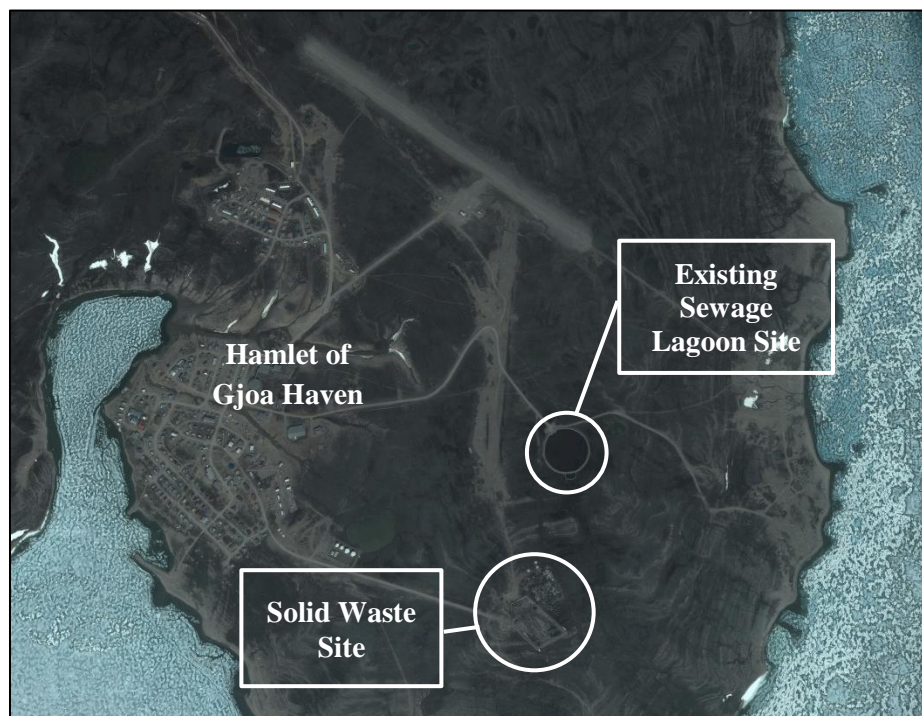
## **2 SITE DESCRIPTION**

### **2.1 Location**

The Hamlet of Gjoa Haven is located at 68°37' N latitude and 95°50' W longitude (according to Google Earth Pro, 2007), on the southern tip of King William Island, Kitikmeot Region, Nunavut. Topography consists mostly of sands and gravels with a continuous permafrost zone. Low lying vegetation such as mosses and lichens are predominant with hardy grasses found in some areas. Year round access to the Hamlet is limited to air travel, however, during the summer months freight may be brought in by sealift.

The former sewage lagoon is located 1.5 km from the community and has an approximate volume of 22,700 m<sup>3</sup> of sewage. Sewage is collected from the community by a sewage truck and discharged into the single-cell sewage lagoon. It is a circular shaped lagoon with a truck turnaround pad and decant structure.

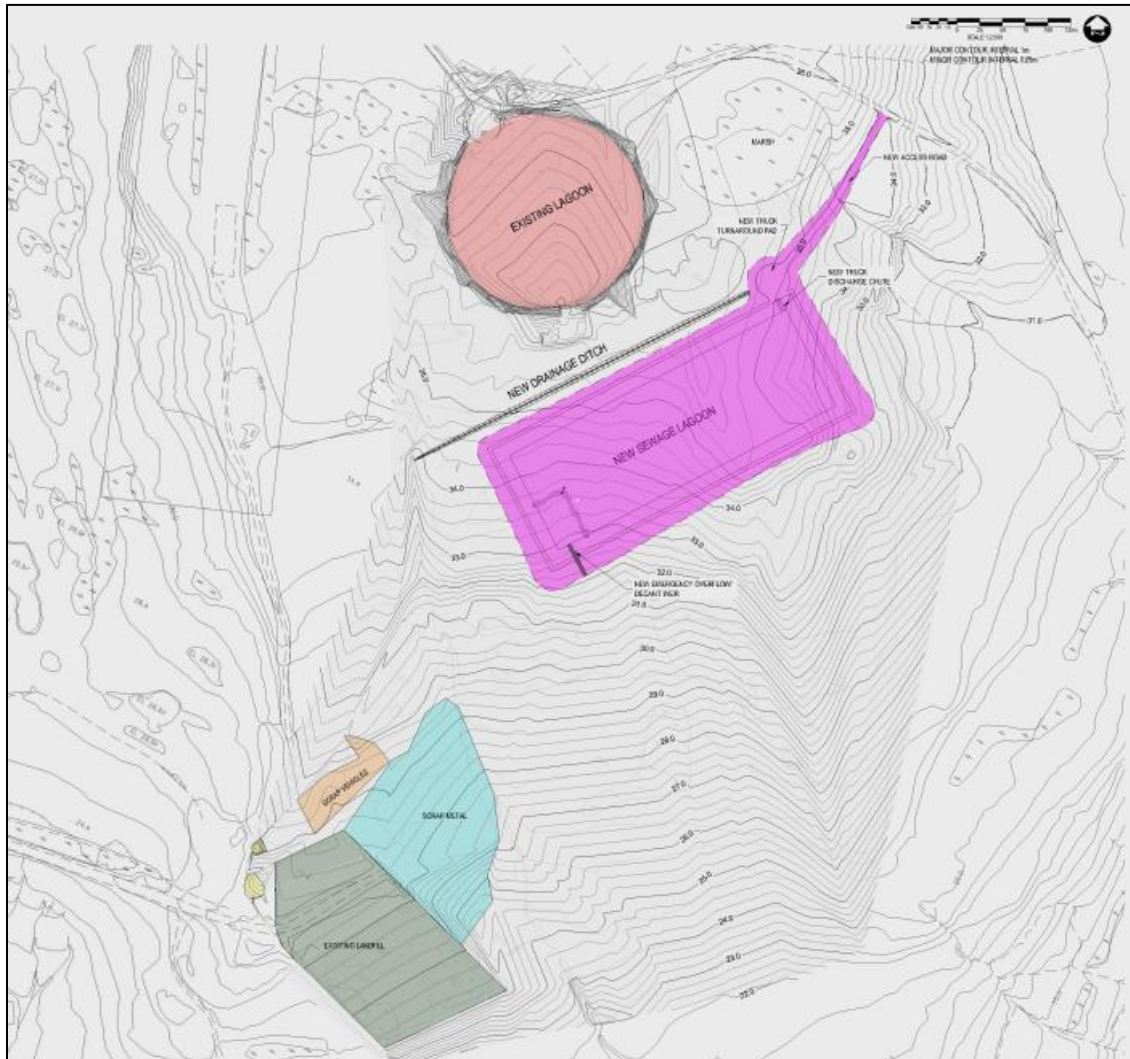
**Figure 1** shows the location of the existing site in relation to the community.



**Figure 1: Gjoa Haven Sewage Lagoon Site Location**

*Image from Google Earth Pro registered to Dillon Consulting Limited*

The hamlet plans to discontinue use of this site in the fall of 2013 once the new sewage lagoon has been commissioned. The new sewage lagoon has been constructed adjacent to the former sewage treatment site. The figure below shows the location of the new sewage lagoon in relation to the existing lagoon.



**Figure 2: Site Plan of Existing Sewage Lagoon and New Sewage Lagoon**

## **2.2 Sewage Treatment Facility**

Recently the sewage lagoon in Gjoa Haven has experienced a number of problems relating to the stability of the berm wall surrounding the lagoon. The first report of berm instability was in July 2004 when it was noted that raw sewage was being discharged from the lagoon each time a sewage truck disposed of its cargo. In September 2005, the berm walls were reinforced and built back up in order to stop the flow of the raw sewage from the lagoon. However, an inspection in September 2006 revealed that a section of the berm wall had collapsed and a continuous stream of raw sewage was being discharged into the surrounding wetland area. A smaller secondary containment berm was constructed in 2008 to hold

effluent that had leaked out of the lagoon. However, a section of the secondary containment berm has subsequently failed and effluent is seeping from the secondary cell into the surrounding environment.

Due to the collapse in the berm wall, sewage now flows from the lagoon along a 1.2 km path through a natural wetland. Discharge from the wetland percolates into the sandy soil matrix before it reaches the ocean edge eliminating a direct discharge route from the wetland into the ocean. A decant pipe was placed within the berm wall to allow for drainage of the effluent into the surrounding wetland. The lagoon relies on seepage through the berm wall as opposed to an annual decant event.

The following photos were taken during a site visit in July of 2011. Photo 1 shows the existing sewage treatment lagoon. Photo 2 shows the 1.2 km path through the un-engineered wetland to the eventual discharge into the ocean and Photo 3 shows the outflow pipe for the existing sewage treatment lagoon.



**Photo 1: Existing Sewage Treatment Lagoon**





**Photo 2: Un-Engineered Wetlands where Effluent is Discharged**



**Photo 3: Sewage Treatment Pipe Outflow on Existing Lagoon**

### **2.3 Current Contents of the Existing Lagoon**

The existing lagoon has an estimated capacity of 22,700 m<sup>3</sup>. The current volume of sewage in the existing lagoon is unknown due to continuous seepage of effluent from the lagoon.

### 3 CLOSURE

The existing sewage lagoon will be closed in an environmentally responsible manner in order to mitigate health and safety risks to the community residents.

#### 3.1 Sewage Treatment and Disposal from Existing Lagoon

Sewage effluent still remaining in the lagoon will be left in the lagoon until spring 2014. Leaving effluent in the lagoon will expose effluent to freeze-thaw processes that will allow for some physical treatment such as settling of solids to occur. Once the effluent thaws in the spring and is exposed to warmer temperatures, biological activity in the lagoon will increase and further treatment of effluent should occur. Discharge of effluent from the lagoon into the wetland area should occur around mid-August. Prior to discharge the effluent will be sampled and the results submitted to the Nunavut Water Board. Sampling will be in compliance with the Water Licence, Part D, 2.

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

<i>Parameter</i>	<i>Maximum Concentration of any Grab</i>
<i>Faecal Coliforms</i>	<i>1 x 10<sup>4</sup> CFU/dl</i>
<i>BOD<sub>5</sub></i>	<i>80 mg/L</i>
<i>Total Suspended Solids</i>	<i>100 mg/L</i>
<i>Oil and grease</i>	<i>No visible sheen</i>
<i>PH</i>	<i>Between 6 and 9</i>

Discharge will occur at a controlled rate so as not to overwhelm vegetation within the wetland. The wetland will be able to provide better polishing through greater nutrient uptake and removal from the effluent.

#### 3.2 Sludge Removal and Disposal

In order to decommission the existing sewage lagoon, sludge must be removed from the bottom of the lagoon and treated to an acceptable standard. The standard to which sludge will be treated is dependent upon the end use of the sludge. Due to the scarcity of cover material available in the community and the relatively lower quality treatment requirements, it is recommended that sludge removed from the lagoon, once treated, be used as cover material at the solid waste site.

The treatment method recommended for the lagoon sludge is freeze-thaw conditioning. This method involves placing sludge on a sand layer within a drying bed and allowing it to freeze over the winter. As the sludge thaws in the spring, water contained within the sludge drains through the sand layer and is collected via a collection pipe. Collected water is discharged to the operating lagoon for further treatment. The sludge is then tested to determine if it meets the required guidelines for its intended use. If it does not meet the guidelines, the sludge can remain in the drying beds for another freeze-thaw cycle.

The sludge should be removed from the existing lagoon and placed in the drying beds once all remaining effluent has been decanted. The drying beds can be constructed at the current site to minimize transportation costs of sludge from the lagoon to the drying beds. Currently, there is minimal data available on the amount of sludge in the bottom of the existing lagoon. Prior to construction of the drying beds, sludge depth measurements will have to be taken in order to determine the amount of sludge to be treated.

Once the sludge has reached acceptable quality levels, it can be moved to the solid waste site where it can be used as intermediate cover material. As well, storing sludge at the solid waste site will reduce public and environmental health hazards. The drying beds can then be used for treatment of sludge from the new lagoon as it builds up. If the new lagoon is de-sludged on a regular basis (approximately every 3 – 5 years), a number of benefits will occur. These benefits may include more efficient treatment of sewage effluent in the lagoon, less sludge to treat at one time, less drying bed space required and a consistent source of cover material for the solid waste site.

### **3.3 Infrastructure Removal**

When the sludge has been removed from the lagoon, the lagoon can be decommissioned and deconstructed. Infrastructure removal at the site will be limited to removal of the existing lagoon berms and discharge pipe. Material from the berms can be used to cover over the lagoon and grade the site. In order to promote soil stability, the area should be seeded with natural vegetation. Depending on the nature of the soil, topsoil or soil amendments may be required in order to support vegetative growth.

There are no buildings at the site of the former sewage lagoon. The pipe outflow will be removed from the site and disposed of in the solid waste facility. Signs for the newly constructed site will be erected. Existing signs must be taken down and replaced with signs to notify the public that the site is closed. Any old signs, fencing and available gates will be removed and disposed of in the solid waste facility.

### **3.4 Monitoring Program**

#### **3.4.1 Effluent**

Effluent from both the existing and new lagoon sites discharged to the surrounding wetland must meet the requirements of the Nunavut Water Board. As per the requirements of the hamlet's expired water licence, all effluent discharged must meet the following effluent quality standards:

**Table 1: Quality Standards for Effluent Discharged to Wetlands**

<b>Parameter</b>	<b>Maximum Average Concentration</b>
BOD <sub>5</sub>	80 mg/L
Total Suspended Solids	100 mg/L
Fecal Coliforms	1x10 <sup>4</sup> CFU/dl
Oil and Grease	No visible sheen
pH	Between 6 and 9



Effluent from the existing lagoon will be discharged starting in the summer of 2014 and continue through to the fall of 2014. Testing will begin prior to discharge of lagoon effluent and continue monthly until all effluent has been discharged from the lagoon. During this time, effluent from the community will be discharged into the new lagoon for treatment and storage. Effluent from the new lagoon may need to be discharged over the summer and fall as well. Both the new and former sewage lagoons share the same wetland area, therefore it will be very important to discharge both lagoons at a slow steady rate for the duration of the summer and fall. Further testing of the wetlands will conform to those standards specified in the Operations and Maintenance Manual for the new sewage lagoon.

### **3.4.2 Sludge**

Sludge monitoring will include visual inspections of the sludge drying beds, visual inspections of effluent collection basins and sample analysis of the de-watered sludge. Sludge beds should be inspected regularly to check for leakages of effluent or sludge from the beds and to assess when sludge is undergoing freeze-thaw conditioning. Effluent collection basins should be inspected regularly once the sludge begins to thaw. Collection basins should be pumped out as required and effluent discharged to the sewage lagoon.

Sampling of de-watered sludge should only be necessary after the first freeze-thaw conditioning cycle has been completed. If the results of the sampling meet the requirements specified by the NWB, sludge can be removed from the drying beds and used in the landfill as cover material. According to the report titled *Abandonment and Restoration of Sewage Lagoons in Nunavut* (FSC, 2005), sludge must meet the following criteria prior to land disposal:

1. Sludge must be considered stabilized by having a ratio of volatile suspended solids (VSS) to total suspended solids (TSS) of less than 0.6.
2. Must have less than 100mg/L of the following substances:
  - Ammonia sulphide
  - Benzidine
  - Benzyl chloride
  - Diethylamine
  - Ethylamine
  - Ethylenediamine
  - Maleic anhydride
  - Methylamine
  - Potassium Permanganate
  - Quinoline
  - Strychnine
  - Tetrachloroethanes

3. Must have less than 0.001mg/L of the following substances:

- Hexachloro-dibenzo-p-dioxins
- Pentachloro-dibenzo-p-dioxins
- Dichlorobenzodioxin tetrachloro-dibenzo-p-dioxins
- Hexachloro-dibenzofurans pentachloro-dibenzofurans
- Tetrachloro-dibenzofurans

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 NWB. All analysis should be completed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) certified laboratory.

### **3.5 Signage**

Signage will be posted at the site location indicating the closure of the decommissioned sewage treatment facility. New signs are also required to indicate the location of the new facility where the sewage will now be received.

### **3.6 Implementation Schedule**

The proposed schedule for the decommissioning of the existing sewage treatment facility is shown in Table 2 below.

**Table 2: Lagoon Decommissioning Implementation Schedule**

<b>Item</b>	<b>Proposed Completion Date</b>
Commissioning of new sewage treatment facility	November 2013
Decommissioning of existing sewage treatment facility – gradual discharge of effluent	Summer/Fall 2014
Construction of sludge drying beds and removal of sludge from decommissioned lagoon to drying beds	Summer/Fall 2014
Leveling of berms and lagoon cell and placement of topsoil and seed	Summer/Fall 2014
Full decommissioning of the site complete	Fall 2014
Sampling of sludge	Summer 2015
Relocation of sludge to solid waste facility*	Summer 2015

\*Depending on the sampling results an additional freeze-thaw cycle may be required.

### **3.7 Registration**

Upon closure of the facilities, the site will be identified and registered as a former Sewage Treatment Facility on the subsequent land title documents associated with the property.

### **3.8 Future Land Use**

The sewage lagoon site is located in the same area as the solid waste site and the new sewage lagoon site. Once closed, the land area of the former sewage disposal site will continue to be part of the wastewater disposal site. However, the former sewage lagoon site will be monitored to ensure the growth of vegetation. Cover material will be allowed to settle and be re-graded as necessary. All cave-ins will be filled to prevent pooling. Because the area will continue to accommodate the solid waste site and the new sewage lagoon, there are no future plans for the land utilized by the former sewage lagoon.

A final survey of the site should be performed to map out the exact area of the facility. The mapping will show areas of the site facilities, potential contamination, disturbed areas and monitoring locations.

## **4 POST CLOSURE**

Following closure of the site, periodic inspection and monitoring will be required to ensure that there are no intentionally harmful impacts to the environment. To prevent or mitigate potential environmental impacts generated from the sewage treatment facility site, testing and reporting for parameters of concern will be required until the regulatory bodies deem the site has reached a point where no long term environmental impacts will likely occur.

### **4.1 Inspections**

Inspection of the sludge drying beds is necessary to ensure there are no leaks in the system. This is required periodically over the summer months while the sludge is drying. This inspection can be completed by hamlet staff. If hamlet staff identify any leaks or other problems with the system, they must immediately contact the NWB.

A report detailing the findings of each inspection and sample analysis results will be prepared and sent to the NWB on an annual basis. The report will include the following items:

- Timeframe of inspections;
- Frequency of inspections;
- Items inspected including drainage issues, erosion control problems, vegetative growth, etc.;
- Measures taken to correct site issues or problems;
- Regulatory compliance requirements such as SNP monitoring locations and test parameters; and,
- Results of inspections.

The NWB will provide direction as to what items will be inspected, what time of year and frequency of inspections.

### **4.2 Monitoring**

The sampling programs for both the effluent and sludge are described in Section 3.3. According to FSC (2005), following closure of the site, monitoring will continue until either of the following conditions are met:

- It can be demonstrated that the site is no longer releasing contaminants; or
- It can be demonstrated that the site has reached an equilibrium state in which contaminant release poses no unacceptable risk to the environment.

Once it is believed that either of the above conditions has been satisfied, a report providing justification to discontinue the monitoring program should be submitted to the NWB for review. The monitoring program cannot be discontinued until approval to do so has been provided by the regulatory authorities.

### **4.3 Regulatory Requirements**

The Abandonment and reclamation plan has been completed in accordance with the hamlet's former water licence issued by the NWB. Changes to the licence may result in changes to the Abandonment and Reclamation plan. The *Abandonment and Restoration of Sewage Lagoons in Nunavut* (FSC, 2005) was used as an additional guideline.

## **5 REFERENCES**

1. FSC Architects & Engineers (2005). *Abandonment and Restoration of Sewage Lagoons in Nunavut, Final Review Report*. Yellowknife, NT.



