APPENDIX - B

Operation and Maintenance Manual, Sewage Treatment System

Hamlet of Cape Dorset

Sept 3, 2009

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Operation and Maintenance Manual, Sewage Treatment System - Hamlet of Cape Dorset

Government of Nunavut, Department of Community and Government Services

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Submitted by

Dillon Consulting Limited

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1 INTRODUCTION

1.1 Purpose

The purpose of this manual is to establish standard operation and maintenance protocol for the management of the sewage treatment system for Hamlet of Cape Dorset. Information presented in this manual has been developed based on the document "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities." This document fulfils Parts B, D, F and H of the Water License 3BM-CAP0810. The Water License is included in **Appendix B** of the Manual.

To assist personnel that operate the sewage lagoon with proper operation and maintenance procedures, the following requirements are further addressed in this O&M manual:

1. Proper operation and maintenance procedures for the sewage treatment system to provide effective treatment and operation of the facility;
2. Monitoring program description;
3. Appropriate methods and procedures for wastewater sampling, and;
4. A spill contingency plan.

1.2 Site Setting

The Hamlet of Cape Dorset is located on Dorset Island, near the southwest tip of Baffin Island at 64° 14' north latitude and 76°32' west longitude. Situated in the Qikiqtaaluk Region of Nunavut, the community is approximately 402 air km southwest of the city of Iqaluit (see **Figure 1** on the following page).

Located in the continuous permafrost zone, Cape Dorset has a climate which consists of short cool summers and long cold winters. Annual snowfall and rainfall are approximately 118 cm and 15 cm, respectively. The typical temperature range for January is between a low of about -29°C and a high of about -23°C whereas in July, the temperatures range between a low of 3°C to a high of about 7°C. Usually, freeze up occurs during the month of November but it may happen as early as October or even September. In some years, early freeze up may thaw again before final freeze up occurs. Spring thaw typically takes place during the month of July, but the time frame can vary as much as freeze up. During spring runoff, the community experiences mild flooding.

The community is situated between two valleys of the Kingnait range of hills. Topography consists of areas of moss surrounded by rock outcrops, bedrock and steep cliffs.

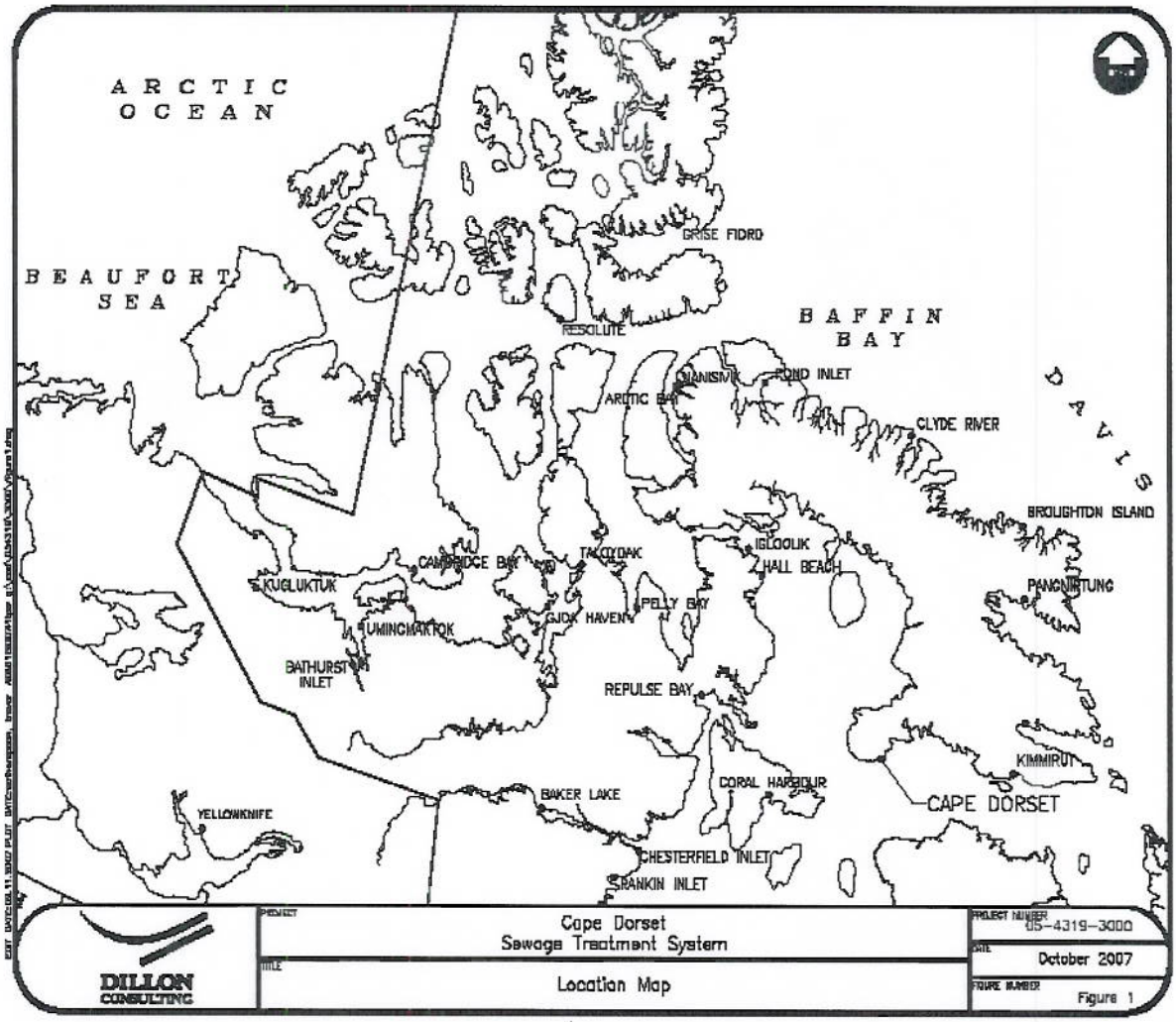


Figure 1: Map of Nunavut

The community uses trucked services for both water delivery and sewage collection. Wastewater is treated using a constructed retention cell treatment system that is located approximately 800 m southwest from the center of the community. **Figure 2** (on page 5) shows the location of the new sewage treatment facility in relation to the community and existing plant.

1.3 Population Projection

Presently, the population of Cape Dorset is approximately 1,236 people (Statistics Canada, 2006). **Table 1** shows the population growth for the Hamlet over the lifetime of the plant projected by Nunavut Bureau of Statistics.

Table 1: Population Projections for Cape Dorset

Year	2000	2006	2011	2016	2021	2026
Population	1,213	1,382	1,536	1,692	1,848	2,002

Source: Nunavut Bureau of Statistics.

A population of 2,002 people was used for the design horizon of the facility.

1.4 Contact List

The Hamlet of Cape Dorset has a Maintenance Management Operation System (MMOS) already in place. Regular maintenance will be conducted as outlined in this manual whereas specific work orders for sewage treatment facility and system will be passed through to the MMOS. A list of the individuals that are responsible for the operation and maintenance of the sewage treatment and waste disposal system are as follows:

Senior Administrative Officer	(867) 897-8943
Municipal Works Foreman	(867) 897-8943

2 BACKGROUND

2.1 General

2.1.1 Sewage Treatment Facility

The facility incorporates a constructed lagoon as the treatment system. Lagoon cell was designed with a 365 day hydraulic retention for storage and treatment. As shown in **Figure 3** on page 6, it has a rectangular shape with approximate dimensions of 170 m and 192 m, distances calculated from inner berms. With an operating liquid level of 3.5 m and 1.0 m freeboard, the lagoon cell has an overall, constructed volume capacity of 96,100 m^3.

Wastewater is stored in the lagoon cell during the entire year. During the spring and summer, natural biological and physical processes will occur, treating the sewage. In early to mid autumn, the sewage effluent is discharged into P Lake (with a capacity of 11,650 m^3), prior to freeze up. Further filtration and treatment will occur as the wastewater flows from P Lake into a small wetland area and down over a cliff and then through a mossy area, approximately 370 m in length, before draining into Telik Inlet.

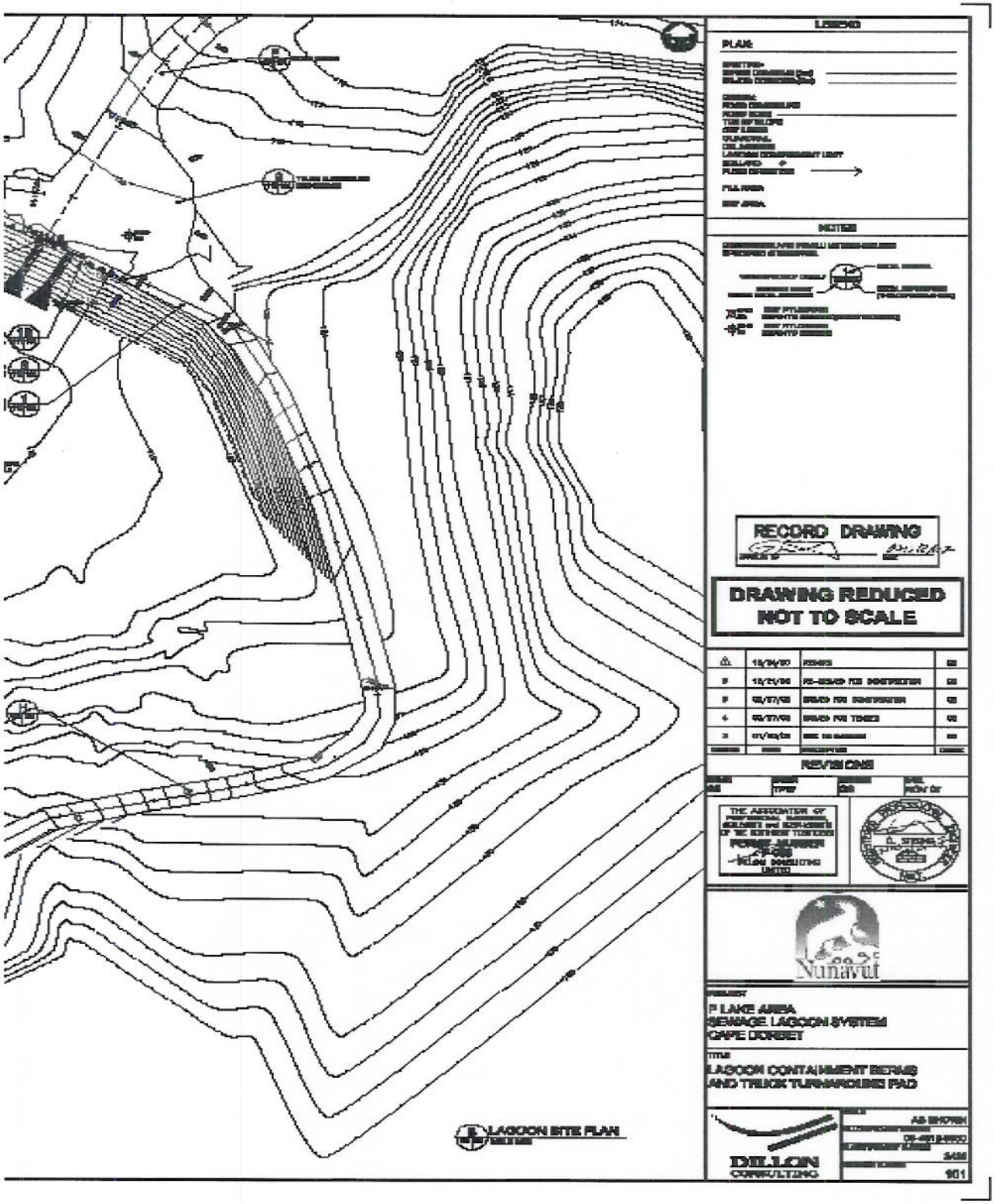
The sewage lagoon can be considered a water retaining structure. The classification of the berms (dams) that comprise the lagoon is considered to have a very low consequence category. In the event of a dam failure there is no expected loss of life, and there are no economic/financial consequences other than to the owner's facilities. This classification is used to determine the operation and maintenance procedures for the berms and structures.

Record drawings of the sewage treatment system can be found in **Appendix A**.

2.1.2 Sewage Collection and Transport

All municipal wastewater of the community is collected and transported to the sewage lagoon by vacuum trucks. The sewage collection service operates 7 days a week. With three trucks operating, about 15 to 20 trips are made to the sewage lagoon per day.

Figure 2: Location of Sewage Treatment Facility


LEGEND
PLAN:
NOTES
RECORD DRAWING
DRAWING REDUCED
NOT TO SCALE
REVISIONS
Nunavut
LAGOON CONTAINMENT BERMS
AND TRUCK TURNAROUND PAD
DILLON
CONSULTING
LAGOON SITE PLAN

oon Cell

2.2 Sewage Production

It is approximated, for smaller communities such as Cape Dorset where water distribution is provided by trucks, that the sewage generation is equal to the water consumption. Therefore, the daily and annual sewage generation rates are approximately equivalent to the water consumption rates. The following equation, proposed by MACA, gives the water consumption rate for small communities on trucked services that have a population less than 2,000 people.

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

Using the estimated population projections shown in **Table 1**, the projected sewage generation rates over the facility lifetime are shown in **Table 2** below. The lagoon was constructed to hold the annual generation rate of 96,100 m^3 of wastewater.

Table 2: Projected Sewage Generation

Year	Population	Sewage Generation Rate (L/capita/day)	Annual Generation (m^3/yr)
2000	1,213	115.11	50,964
2006	1,382	118.61	59,829
2011	1,536	121.80	68,283
2016	1,692	125.02	77,213
2021	1,848	128.26	86,530
2026	2,002	131.44	96,047

Physical, chemical and biological characteristics of sewage are referred to as its composition. It is assumed that raw wastewater has a typical average concentration of 625 mg/L for BOD_5 and 900 mg/L for TSS. For domestic waste, average raw FC concentration is about 2 x 10^9 FCU per 100 mL.

3 SEWAGE DISPOSAL SYSTEM

3.1 Manual Organization

This section of the manual presents the operation and maintenance procedures that are associated with the wastewater treatment facility that designated operators assigned to the system should be aware of concerning the facility and system.

3.2 Equipment

The equipment required to operate the Cape Dorset sewage treatment system consists of three sewage collection trucks with the following capacities:

- 9,092 L (2,000 imp. gal)
- 13,025 L (2,865 imp. gal)
- 13,093 L (2,880 imp. gal)

3.3 Site Personnel

The overall responsibility of the waste disposal site as well as the overseeing of the operation and maintenance personnel is that of the Senior Administrative Officer. Day-to-day operation and maintenance of the facility is the responsibility of the Municipal Works Foreman. In addition, several other employees operate and maintain the sewage trucks on a day-to-day basis.

3.4 Operational Procedures

These procedures must be carried out frequently to ensure efficient operation of the treatment system. Daily operation procedures must/should be carried out frequently to ensure smooth operation of the treatment system.

3.4.1 Basic Operations

1. Municipal wastewater is collected from holding tanks at each residence and commercial building by sewage (vacuum) trucks.
2. Sewage (vacuum) trucks pump the wastewater out of the holding tanks and transport it to the sewage treatment area.
3. Throughout the year, the wastewater is discharged into the lagoon through the offload chute located at the truck pad. The sewage truck backs up to the lagoon (bollards are placed for safety purposes) and the valve is opened. Wastewater is discharged into the lagoon, over the splash pad.
4. The wastewater remains in the lagoon for approximately 12 months. It is naturally treated during the months of June, July, August and September.
5. Decanting occurs once a year, in late September, over a 2 week period. Refer to Section 3.4.2 for the steps to be taken during the decanting stage. The discharged effluent from the lagoon flows into P Lake and further through a small nearby wetland before entering Telik Inlet.

Nunavut Water Board (NWB) requires at least a ten (10) day notification before initiating any decanting of the lagoon.

The effluent discharged from either the 2001 Sewage Disposal Facility at sampling station CAP-4 and/or the Emergency Sewage Disposal Facility at sampling location CAP-5 must meet the following effluent quality standards prior to decant as listed in **Table 3**.

Table 3: Effluent Quality Limits for the 2001 Sewage Disposal Facility and the Emergency Sewage Disposal Facility

Parameter	Units	Maximum Average Concentration
Fecal Coliforms, FC	CFU/100 mL	1×10^4
5 Day Biological Oxygen Demand, BOD_5	mg/L	120
Total Suspended Solids, TSS	mg/L	180
Oil and Grease	-	No visible sheen
pH		6 - 9

Likewise, the effluent discharged from the 2007 Sewage Disposal Facility must meet the discharge limits listed in **Table 4**.

Table 4: Effluent Quality Limits for the 2007 Sewage Disposal Facility

Parameter	Units	Maximum Average Concentration
Fecal Coliforms, FC	CFU/100 mL	1×10^4
5 Day Biological Oxygen Demand, BOD_5	mg/L	80
Total Suspended Solids, TSS	mg/L	100
Oil and Grease	-	No visible sheen
pH		6 - 9

3.4.2 Decanting Procedure

Once the NWB has been notified and all parameters have been met at the discharge location, then the decanting procedure can begin.

The steps involved with decanting the lagoon cell are as follows:

- Open the valve at the discharge pipe.
- Monitor flow rate leaving discharge pipe during decant period.
- Monitor for erosion at the end of the discharge pipe and repair as required.
- Check daily for erosion, blockages and other problems that may occur on the upstream slope of the berm. Apply necessary procedures to fix problem to minimize downtime during decanting.
- If the discharge pipe happens to be blocked or frozen at the time of decanting, then the following options should be used:
  - Try to unblock or thaw pipe using a steamer hose. Once unfrozen, proceed with decanting. If necessary, keep applying heat to the discharge pipe to assist with the flow of material.
  - Decant lagoon using a diesel fired pump or siphon system. If a pump system is used for the decanting, then obtain a pump that will give the required flow rate to discharge the lagoon volume over the two week decant timeframe. In year 20, the required pump flow rate is 5,000 L/min.

3.4.3 Service Disruption Contingency

In the event of any disruption in the service of P-Lake Lagoon, for instance, the road to the lagoon is inaccessible, the Hamlet will use the 2001 Lagoon area as an emergency sewage treatment area until the disruption has been resolved.

The top cell of the existing three cell lagoon system (2001 Lagoon) will be maintained as the emergency sewage treatment area. During times when this cell is active, the community will record the following items;

- The date that the emergency commenced;
- The reason for the emergency;
- The date that the emergency ended;
- The number of trucks discharged to the lagoon; and,
- The volume of the sewage deposited in the lagoon.

Sewage deposited in the emergency lagoon cell will be treated until the discharge criteria are met, and then the treated sewage will be discharged to the receiving environment. It is proposed that this cell be decanted on an annual basis in October.

The Hamlet will notify INAC when the emergency lagoon is in service, and prior to the decant of the emergency lagoon.

The Senior Administrative Officer of the Hamlet of Cape Dorset will be the responsible party for the actions taken under this emergency procedure.

3.4.4 Sampling Procedures and Requirements

A key component to the operations and maintenance of the proposed sewage treatment system is a sampling program. Based on the lagoon's design, the following discharge limits are expected after the treatment stage:

Biochemical Oxygen Demand, BOD_5	45 mg/L
Total Suspended Solids, TSS	45 mg/L
Fecal Coliforms, FC	1.5 x 104 FCU/100 mL

The proposed sampling program will help to monitor the treatment while verifying compliance with regulations. As well, it will model the treatment process which with help to understand the behavior of the lagoon for future development and expansions of the system.

It is important such a sampling program be implemented by the Hamlet as a part of the annual operations for the facility. Local members of the community that operate the system are to be trained on the proper operation and procedure methods used in the sampling program. In addition, quality and safety training will also be included which will ensure that the high quality data will be obtained.

All sampling, sample preservation and analyses will be in accordance with methods described in the current edition of *Standard Methods for the Examination of Water and Wastewater*. In addition, a document has been attached in **Appendix C** of this manual that provides guidelines and procedures to follow when sampling wastewater.

To obtain meaningful results from the analysis, the following five factors are of particular importance:

- Sample collection at designated time and location;
- Correct usage of container/sample bottle for parameter being tested;
- Correct labeling of sample bottles and filling out record/field sheet;
- Correct procedure for field sampling;
- Proper and timely shipment of samples to the laboratory.

It is critical, from a quality perspective, that sample collection be performed from an area of higher concentration to an area of lower concentration of contaminants. Therefore, a sample will be collected at various locations along the system to monitor the effluent quality at various stages of treatment. Descriptions of each sampling location of the sewage treatment system for the Monitoring Program are listed in **Table 5** below and shown in **Figure 4** on page 12.

Table 5: Sampling Station Locations

Monitoring Program Station Number	Description of Monitoring Program Station
CAP-1	Raw Water Supply prior to Treatment
CAP-2	Runoff from Solid Waste Disposal Facilities
CAP-3	Influent of Wastewater to Wastewater Facilities
CAP-4	Effluent Discharge from 2001 Sewage Disposal Facilities
CAP-5	Effluent Discharge from Emergency Sewage Disposal Facilities
CAP-6	Effluent Discharge from 2007 Sewage Disposal Facilities, Final point of Control
CAP-7	Point of Influent of Wastewater to P-Lake
CAP-8	Centre of P-Lake
CAP-9	Location midway between Centre of P-Lake and Effluent discharge of P-Lake
CAP-10	Effluent discharge from P-Lake
CAP-11	Effluent discharge from Wetland area
CAP-12	Wetland Pathway at top of waterfall
CAP-13	Wetland Pathway at midway down waterfall
CAP-14	Wetland Pathway at bottom of cliff, Final Discharge Point
CAP-15	Control Point using small lake located between Lagoon and Tee Lake
CAP-16	Monitoring Well located
CAP-17	Monitoring Well No. 1 located down gradient of Sewage Disposal Facility
CAP-18	Monitoring Well No. 2 located down gradient of Sewage Disposal Facility
CAP-19	Monitoring Well located up gradient of Solid Waste Disposal Facilities
CAP-20	Monitoring Well located down gradient of Solid Waste Disposal Facilities
CAP-21	Thermistor Station
CAP-22	Thermistor Station
CAP-23	Thermistor Station
CAP-24	Thermistor Station

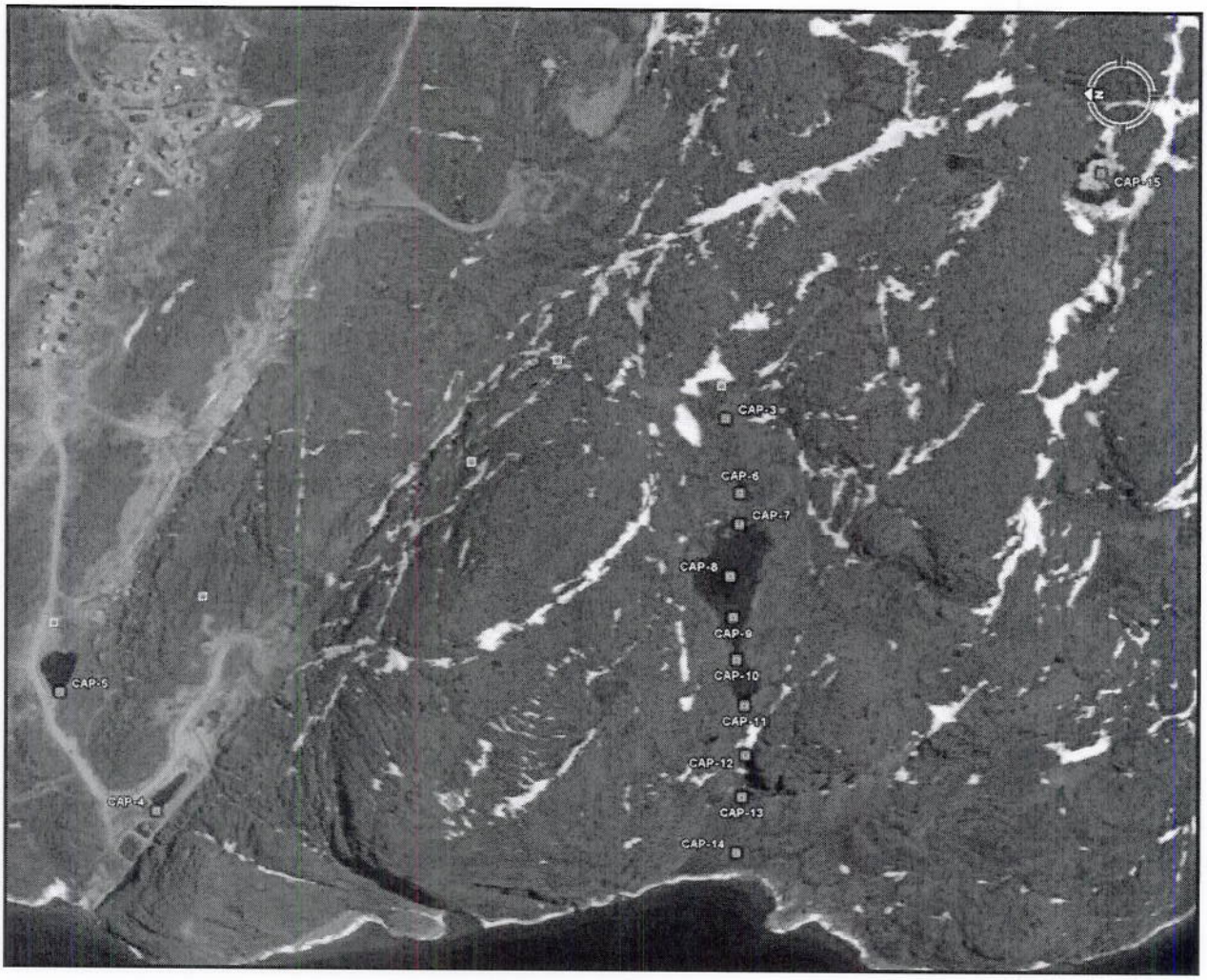


Figure 4: Sampling Locations

By obtaining samples at each of the locations proposed above, effluent treatment rates can be monitored. According to the water license, wastewater samples will be taken from locations CAP-3 to CAP-15 one (1) week prior to the proposed decant date and weekly during the course of lagoon decant. These wastewater samples will undergo the same analysis which will include the following set of parameters as listed on the following page.

Biochemical Oxygen Demand, BOD_5	Carbonaceous Biochemical Oxygen Demand, $CBOD_5$
Total Suspended Solids, TSS	Fecal Coliforms, FC
pH	Conductivity
Oil and Grease (Visual)	Total Organic Carbon, TOC
Total Hardness	Total Alkalinity
Nitrate-Nitrite	Ammonia Nitrogen, NH_3-N
Total Phosphorus, TP	Total Phenols
Magnesium, Mg	Calcium, Ca
Potassium, K	Sodium, Na
Chloride, Cl	Sulphate, SO_4
Total Arsenic, As	Total Aluminum, Al
Total Antimony, Sb	Total Barium, Ba
Total Beryllium, Be	Total Cadmium, Cd
Total Chromium, Cr	Total Cobalt, Co
Total Copper, Cu	Total Iron, Fe
Total Lead, Pb	Total Lithium, Li
Total Manganese, Mn	Total Mercury, Hg
Total Molybdenum, Mo	Total Nickel, Ni
Total Selenium, Se	Total Tin, Sn
Total Strontium, Sr	Total Thallium, Tl
Total Titanium, Ti	Total Uranium, U
Total Vanadium, V	Total Zinc, Zn

The point of compliance for the water license is the discharge from the lagoon cell into P Lake, CAP-6 whereas the compliance point for the Fisheries Act is the discharge into Telik Inlet, CAP-14. **Table 6,** below, lists the test parameters to be analyzed (for the sampling program) based on the receiving water body.

Table 6: Sampling Analysis for Annual Discharge Monitoring

Test Parameter	Receiving Water Body	
	Fresh (P Lake)	Marine (Telik Inlet)
Biological Oxygen Demand, BOD_5	X	X
Total Suspended Solids, TSS	X	X
Fecal Coliforms, FC	X	X
Ammonia-Nitrogen, NH_3 - N	X	X
Total Phosphorus, TP	X	
Heavy Metals	X	X

Sampling of the groundwater monitoring wells (sampling stations CAP-16, CAP-17, CAP-18) at the 2007 Sewage Disposal Facility will be performed once during the summer of each year, prior to the start of the decanting of the lagoon. The following parameters will be analyzed for samples taken from the groundwater monitoring wells:

Biochemical Oxygen Demand, BOD_5	Fecal Coliforms, FC
Total Suspended Solids, TSS	Oil and Grease (Visual)
pH	Conductivity
Total Hardness	Total Alkalinity
Nitrate-Nitrite	Ammonia Nitrogen, NH_3-N
Total Phenols	Calcium, Ca
Magnesium, Mg	Potassium, K
Sodium, Na	Sulphate, SO_4
Total Arsenic, As	Total Cadmium, Cd
Total Chromium, Cr	Total Copper, Cu
Total Iron, Fe	Total Lead, Pb
Total Mercury, Hg	Total Nickel, Ni

Annual sampling and testing for acute lethality to Rainbow Trout, Oncorhynchus Mykiss and Daphnia Magna will be performed for sampling stations CAP-3, CAP-4 and CAP-14, approximately midway through the decant period.

A grab sample will be taken from each of the three sewage trucks during discharge to the lagoon. Samples from the trucks will provide quality of the raw sewage before it enters the lagoon whereas samples along P Lake will obtain quality of the lake prior to decanting. This data will assist with monitoring the water quality of these areas by comparing the results of both raw and treated wastewater samples. These samples will be taken once during the decanting period. The flow rate of effluent discharge during the decanting period is required as well.

Once collected, the samples will be shipped to the laboratory and analyzed using the same test method/procedure. This sampling program will be conducted over several years to collect sufficient data for trend analysis. It is recommended that following the first year of operation the amount of sampling for the monitoring program be adjusted by eliminating those locations that are not considered essential to monitoring the treatment system. Locations such as the lagoon inflow and outlet pathway though the wetland area may be removed if they are deemed stable over time, i.e. there have been no substantial changes in the parameters, specifically along the wetland pathway.

All lab results for the monitoring program will be submitted to the inspector upon completion. Note that any other additional sampling during the year will be at the request of the regulatory agencies.

Hamlet may use either of the two as convenient:

Taiga Laboratories
INAC, 4601-52 Avenue, P.O.Box 1500
Yellowknife,NT X1A 2R3
Ph-(867) 669-2781
Fax-(867)669-2718

OR

Caduceon Environmental Laboratories
Ottawa, Ontario, K1V 7P1
P (613) 526-0123
F (613) 526-1244

3.4.5 Ground Water Monitoring Wells

As part of the operation of the site, there needs to be a ground water monitoring well network installed. The community plans to install these wells at the following locations;

- Upstream of the new lagoon:64013'14.66"N; 76033'56.66" W

3.4.6 Sludge Monitoring Plan

The sludge blanket will be monitored as part of the annual discharge procedure. Approximately 15 years after commissioning, a study will be undertaken to determine the need and frequency for sludge removal and disposal over the lifetime of the lagoon. The design of the lagoon included storage of the sludge blanket for the first 20 years of operation within the lagoon. If the results from the lagoon discharge point, specifically BOD and TSS analyses, become non-compliance, then sludge removal study can be conducted earlier.

Sludge in sewage lagoons should be sampled more often if required. The purpose of the sampling is to ensure that the sludge remains of a quality suitable for land disposal. Sampling shall consist of a sample collected from the center point of a grid no less than 10 m by 10 m. Sufficient samples shall be taken to describe the entire sewage lagoon. Results from the sludge analysis are to be reported upon completion of the test and in the annual report.

Sludge monitoring will be completed after 10 years of operation, and then every 5 years subsequently. Once the sludge blanket is within 0.3 meters of the outlet structure, the hamlet will remove the sludge to a constructed drying bed.

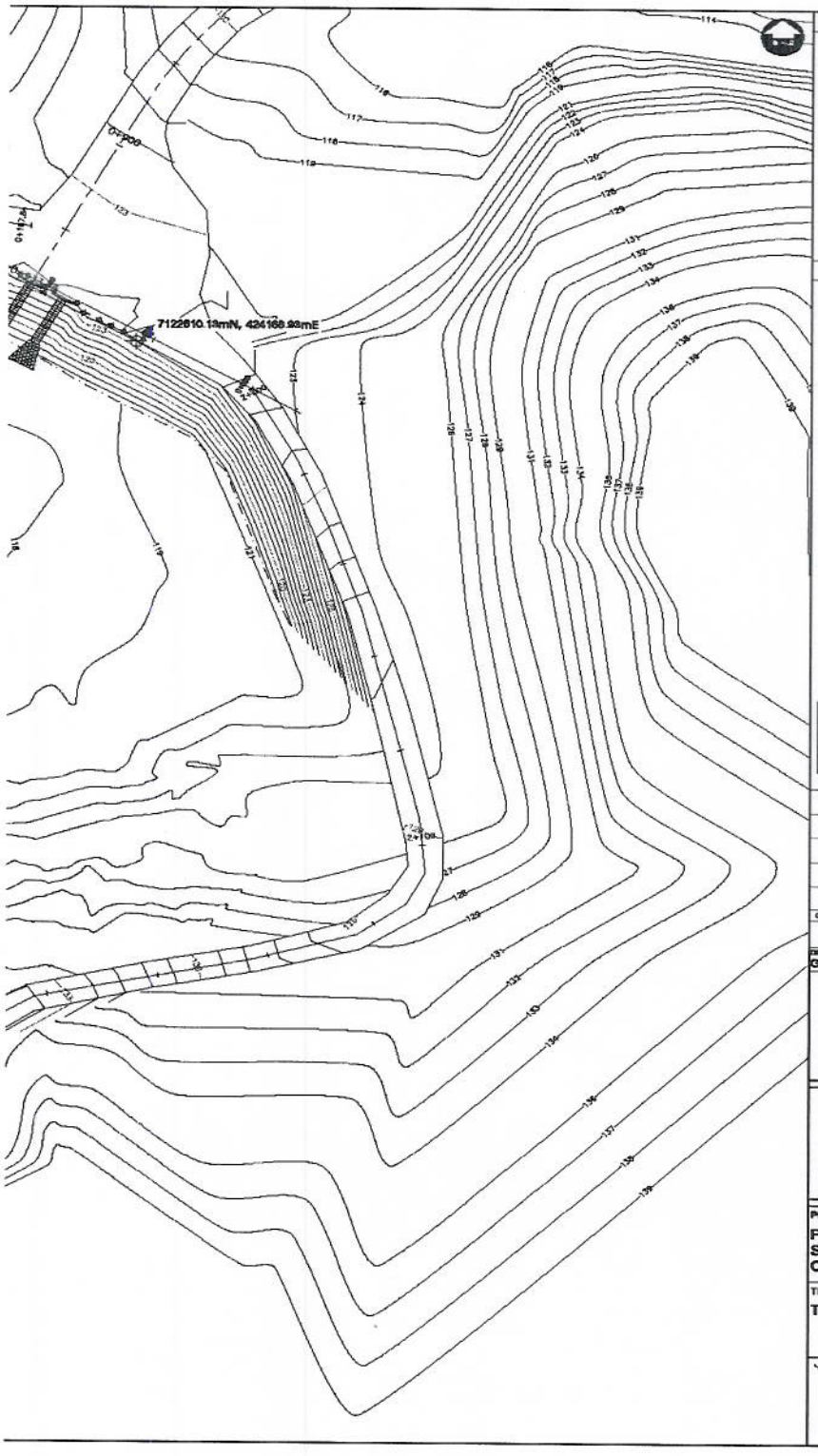
3.4.7 Geothermal Monitoring

During the design stage, a geothermal analysis of the site location was performed. To confirm data that was applied in the model, four thermistors were installed through the lagoon berms into the foundation strata to record ground temperatures and monitor its thermal regime over time. This analysis will further assist with monitoring the freeze-back of berm foundation and confirm agreement of lagoon water temperatures used in the geothermal analysis with those of an operational lagoon.

Thermistors were placed in the four drilled boreholes in the lagoon berms; three thermistors were installed in the crest of the west berm and one installed in the east berm. Refer to **Figure 5** on page 16 for the location of each thermistor. The coordinates of each borehole and the bead depths of each thermistor string are listed in **Table 7** below.

Table 7: Thermistor String Bead Locations

Borehole	BH-1	BH-2	BH-3	BH-4
Coordinates	N 64°13.239' W 76°33.971'	N 64°13.225' W 76°33.965'	N 64°13.203' W 76°33.954'	N 64°13.283' W 76°33.763'
Beads	Depth of Bead in meters (m) of Thermistor			
1st	+1.0	+1.0	+1.0	+1.0
2nd	-1.6	-1.6	-1.6	-1.6
3rd	-4.2	-4.2	-4.2	-4.2
4th	-6.8	-6.8	-6.8	-6.8
5th	-9.4	-9.4	-9.4	-9.4
6th	-11.0	-11.0	-11.0	-11.0
7th	-14.6	-14.6	-14.6	-14.6
8th	-18.8	-18.8	-18.8	-18.8



LEGEND

PLAN:

EXISTING:
MINOR CONTOUR (1m)
MAJOR CONTOUR (5m)

THERMISTER LOCATIONS (STANDARD GPS ACCURACY)

NOTES

UTM COORDINATES ARE IN NAD83, WGS84 ELLIPSOID, UTM ZONE 18.

RECORD DRAWING

DRAWING REDUCED NOT TO SCALE

8	06/01/09	RECORD	GS
7	10/24/07	RECORD	GS
6	12/21/06	RE-ISSUED FOR CONSTRUCTION	GS
5	09/07/06	ISSUED FOR CONSTRUCTION	GS
4	06/07/06	ISSUED FOR TENDER	GS
CHANGE	DATE	DESCRIPTION	CHECK

REVISIONS

DESIGN	DRAWN	CHECKED	DATE
GS	TPW	GS	MAY 09

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
PERMIT NUMBER P 919
DILLON CONSULTING LIMITED

REGISTERED PROFESSIONAL ENGINEER G. STRONG NWT

Nunavut

PROJECT
P LAKE AREA
SEWAGE LAGOON SYSTEM
CAPE DORSET

TITLE
THERMISTER LOCATIONS

DILLON CONSULTING

SCALE	AS SHOWN
DILLON PROJECT NUMBER	06-4819-3000
CLIENT PROJECT NUMBER	3438
DRAWING NUMBER	114

ocations

With the placement of the thermistors, early detection of unknown disturbances in the permafrost ground can be observed. Therefore, it is important to verify that each thermistor is working properly so that it can provide accurate measurements and/or readings. Based on the Geotechnical report, it is recommended that temperature readings be taken at noon on a daily or weekly basis, depending on the time of the year. The following procedures will be performed for the operation and maintenance of the thermistors:

- The thermistors are recoding temperature at every eight hours intervals. Monitoring the operation and collecting data from the field will be done on a four month interval.
- During one year operation of this facility, the data will be analyzed for the purpose of validating assumptions as advised by the Board in item 6 of Part H of the Water License.
- Calibration of the thermistors as specified by the supplier/manufacturer on an as required basis

Refer to thermistor log sheets found in **Appendix D** of this document.

3.4.8 Geotechnical Reviews

A Dam Safety review is to be completed by a qualified geotechnical engineer and will be executed at the following times:

- 3 years after commissioning;
- A frequency of 10 years after the first review.

The review is to include a site inspection and report of the 2007 lagoon based on the following items:

- Dam classification review to verify the original classification is still valid.
- Site inspection of all berms and structures of the lagoon cell.
- Review of the design and construction to verify the systems meets current applicable safety requirements.
- Complete a geothermal assessment of the system based on the recorded thermistor values.
- Safety review to include the operation of all discharge and back up equipment and procedures,
- Maintenance review to verify that all facilities required for safety of the dam and monitoring systems are maintained in satisfactory condition.
- Review of the surveillance and monitoring program and methods to verify that the monitoring program will detect any unsafe conditions in a timely manner.
- Review the level of emergency preparedness to verify that it is appropriate for the facility.
- Review previous report to verify that recommendations have been complied with.

The report generated from the geotechnical review will be submitted as a part of the annual report to the Nunavut Water Board.

3.4.9 Record Keeping and Reporting

Records of all activities and operation should be kept to assist in the planning of annual operations and maintenance as well as the evaluation of the effectiveness of the sewage treatment facility. These records should be kept in the Hamlet Office and be maintained by the facility's supervisor. Sample O&M log sheets for the Cape Dorset Sewage Treatment System are available in **Appendix D** of this document.

Record keeping and reporting requirements are listed in the water license which is attached in **Appendix B** of this document. Based on the record keeping and reporting requirements listed in Part B of the water license, the following information and data should be recorded and be included in the annual report that is submitted to the Board:

- Monthly and annual quantities in cubic meters (m^3) of raw sewage offloaded from sewage trucks for the 2001 Sewage Disposal Facility and Emergency Sewage Disposal Facility;
- Number of days of use for the 2001 Sewage Disposal Facility and Emergency Sewage Disposal Facility;
- Monthly and annual quantities in cubic meters (m^3) of raw sewage offloaded from sewage trucks for the 2007 Sewage Disposal Facility and Emergency Sewage Disposal Facility;
- Annual quantities in cubic meters (m^3) of sewage solids removed from the Sewage Disposal Facilities;
- Number of trips to each of the Sewage Disposal Facilities;
- Start and end date for discharge of lagoon;
- Wastewater analysis results of the sampling stations CAP-6 to CAP-14 of the lagoon treatment system one (1) week prior to decant and weekly during decanting of the lagoon;
- Groundwater analysis results of the monitoring wells CAP-16, CAP-17 and CAP-18 located at the 2007 Sewage Disposal Facility;
- Annual acute lethality results for sampling stations CAP-3, CAP-4 and CAP-14 prior to entry into the ocean;
- Daily and/or weekly temperature measurements of four (4) thermistors located in the lagoon berms;
- Date and description of maintenance activities carried out on the Sewage Disposal Facilities; and
- Date, volume and description of any spills that have occurred.

3.4.10 Health and Safety

Due to the potential health hazards associated with municipal wastewater, it is imperative, for those personnel working in this area, to be familiar with and execute all safety precautions involved with the various work tasks associated with the system.

- Equipment is to be kept clean.
- Wear protective clothing such as gloves and boots at all times.
- Work cloths should not be worn home.
- Hands to be washed frequently; as a minimum before eating and after work.
- Personnel should receive appropriate vaccinations and ensure they are kept up-to-date.

3.5 Maintenance Procedures

In the proceeding sections, maintenance procedures for the different areas of the wastewater treatment infrastructure are discussed and should be carried out to ensure the system runs efficiently.

3.5.1 Sewage Trucks and Holding Tanks

The most important part of the sewage treatment system and process is the collection and transport of the wastewater from the residences and buildings to the lagoon cell. Therefore, it is crucial that the sewage trucks be kept in good repair. Procedures for truck and tank maintenance are as follows:

- Repairs should be completed immediate and take high priority;
- Full tank sewage trucks should not rest for long periods of time, especially during the winter;
- Holding tanks should be kept in good working order and prevented from freezing in the winter.

3.5.2 Access Road and Truck Pad

Basic road maintenance such as those listed below must be performed on a regular basis to ensure that the site is accessible at all times.

- Road and truck pad be graded smooth and reshaped at least twice (2) per year;
- Snow, when necessary during the winter, to be removed to provide unrestricted access to discharge point;
- During snow removal, care is to be taken not to damage berms and surrounding areas;
- Any spilled and/or frozen wastewater should be removed with the snow to appropriate disposal site;
- Discharged point should be monitored for potential erosion problems.

3.5.3 Drainage

The truck pad at the sewage discharge point should be graded such that any wastewater spilled during the offloading procedure will flow into the lagoon cell and sewage treatment system. During the winter months, it is important to monitor the discharge pipe and weirs as there may be problems with flow during periods of extreme low temperatures. Wastewater remaining in the pipe and weir may freeze, causing blockage and/or buildup which can potentially damage or break the structures.

3.6 Operation and Maintenance Summary

Daily, weekly, monthly and yearly activities and procedures that are required by the operator and maintenance personnel are summarized in **Table 8** shown on the following page.

Table 8: Summary of Operation and Maintenance Tasks

Frequency	Description of Task
Daily	▪ Collection, transportation and disposal of wastewater and/or sewage from residential and commercial holding tanks to the truck discharge point at the sewage treatment lagoon. ▪ Immediate cleaning of any spills. ▪ Clearing of snow from access road and truck turn-around pad as required during winter. ▪ Maintaining O&M information records (Refer to sample log sheets located in **Appendix D**).
Weekly	▪ Inspection of berms, dykes and drainage courses. ▪ Monitoring of area surrounding thermistor. ▪ Conduct weekly monitoring program (if required). ▪ Maintaining O&M information records (Refer to sample log sheets located in **Appendix D**).
Monthly	▪ Maintenance of access road and truck pad if required. ▪ Monitoring and recording of thermistor readings for monitoring program. ▪ Confirm location and readability of signs. ▪ Conduct monthly monitoring program (if required). ▪ Maintaining O&M information records (Refer to sample log sheets located in **Appendix D**).
Yearly	▪ Perform annual decanting of lagoon cell in fall. ▪ Conduct geotechnical review of geothermal monitoring program. ▪ Grading and reshaping of access road and truck pad. ▪ Conduct annual monitoring program (if required). ▪ Maintaining O&M information records (Refer to sample log sheets located in **Appendix D**).

4 SPILL CONTINGENCY PLAN

4.1 Community Contact Information

John Ivey
Senior Administrative Officer
Hamlet of Cape Dorset
Cape Dorset, NU
Tel: (867) 897-4943

4.2 Revisions

The following table summarizes the sections of this spill contingency plan, with their revision dates.

Table 9: Summary of Revisions

Section	Revision Date
1: Introduction and Community Details	September 4, 2009
2: Response Organization	September 4, 2009
3: Action Plan	September 4, 2009
4: Resource Inventory	September 4, 2009
5: Training Program	September 4, 2009
Appendices	September 4, 2009

4.3 Distribution List

This plan and most recent revisions will be distributed to:

Bhabesh Roy	Municipal Planning Engineer, C&GS, GN
Tom MacDonald	Project Officer, C&GS, GN
John Ivey	Senior Administrative Officer
Phyllis Beaulieu	Manager of Licensing, Nunavut Water Board

4.4 Purpose and Scope

The purpose of this plan is to outline response actions for potential spills of any size, including a worst case scenario for the Hamlet of Cape Dorset. The plan identifies key response personnel and their roles and responsibilities in the event of a spill, as well as the equipment and other resources available to clean up a spill. It details spill response procedures that will minimize potential health and safety hazards, environmental damage and clean-up efforts. The plan has been prepared to ensure quick access to all the information required in responding to a spill.

4.5 Community Environmental Policy

The Hamlet of Cape Dorset has no formal environmental policy; however, Cape Dorset is committed to operating in an environmentally sensitive manner, and complying with requirements of the Nunavut Water Board.

4.6 Project Description

This spill contingency plan will be used by the Hamlet, for activities associated with Hamlet operations. These include:

- Operation of the sewage disposal site

4.7 Site Description

See Section 1 of this Operation and Maintenance Manual.

Hamlet personnel that are responsible for the sewage treatment and disposal facility should be trained in Workplace Hazardous Materials Information System (WHMIS), Transportation of Dangerous Goods Act and Regulation (TDGA and TDGR) as well as First Aid. In addition, personnel should ensure that proper vaccinations of employees are kept current and that they are familiar with the response plan. It is good practice to obtain copies of a list of procedures and equipment that are to be used for such emergencies in all sewage trucks and the common work area.

In all response cases, personnel should place their own safety as the highest priority. The procedures that should be taken in the likelihood of a potential fire or spill are described in the following sections.

4.8 Fire

A contingency plan should be developed by the Hamlet Fire Department to describe the response and action protocols to be implemented in the case of a fire. Special precautions should be used in the case of waste burning as it can produce harmful, poisonous gases. If an uncontrolled fire occurs, the following procedure should be implemented:

- Immediately evacuate area and go to community's designated meeting place.
- Keep all personnel up-wind from the source.
- Notify the Hamlet Fire Department at (867) 897-8888.

4.9 Spills

A spill contingency plan has been developed by the Hamlet that identifies the procedures to follow when a spill of any hazardous material has occurred. Similar procedures can be used for the case of sewage spills.

Below, in the subsequent sections, the measures that are to be implemented if a spill or uncontrolled release of a substance occurs during the collection and transportation of wastewater are described for the following areas:

- Initial Response
- Containment Procedures
- Spot Spills
- Spills in Proximity to a Waterbody

4.9.1 Initial Response

If a spill occurs, the first person at the scene will:

1. Perform an initial assessment to identity immediate danger.
2. Identify the material spilled and verify the nature of the hazard by corresponding to the Material Safety Data Sheets (MSDS) so to apply appropriate safety procedures.
3. If possible and safe to do so, cut off and/or stop the source of the spill.
4. Control danger to the human life without further assistance, if possible. If, for instance, the spill creates a fire, explosion or other hazard, remove all potential ignition sources.
5. Obtain immediately assistance from others and start to contain and/or clean up the spill.
6. Contact the Municipal Works Foreman to notify them of the spill as they will contact relevant regulators and community residents of the occurrence.
7. Mark off the spill site as to warn the public of the incident and to prevent access.

Once the Municipal Works Foreman has been contacted and have arrived on site, he/she will immediately ensure that:

1. Necessary arrangements for first aid and removal of injured personnel have been made. Where possible, necessary action will be taken to secure the site to protect human safety.
2. If not already done and is safe to do so, take the appropriate action to stop the flow or release of material/substance as well as to contain or prevent the spread of the spilled material if at all possible.
3. Contact the 24 Hour Spill Line at (867) 920-8130 to report spill and obtain additional assistance.
4. Contact the Hamlet's Senior Administrative Officer.
5. If required, notify the Fire Department at (867) 897-8888 and RCMP Detachment at (867) 897-1111.

4.9.2 Containment Procedures

Response personnel will immediately start to contain the spill to ensure that the spill does not spread and contaminant other areas and/or environment. The following actions might also be taken if relevant to the spill situation:

1. If the source of the spill is coming from a leaking fuel truck, then pump fuel into a suitable container or another tank until the tank is dry.
2. Culverts that have been potentially affected by the spill should be blocked off to minimize travel of the substance.
3. Dig a basin or construct a berm to stop and contain the pathway and flow of the spill.
4. Apply absorbent materials to contain and recover small volumes of spilled substance.
5. Spilled substance and/or material are to be collected and transported to an approved waste disposal facility in the appropriate matter.

4.9.3 Spot Spills

Spot spills are those that involve a small volume of substance in a controlled material over a small, contained surface area. For spot spills involving hazardous materials, the following steps may be taken by personnel:

- Immediately take action to clean up spill by implementing proper or suitable handling and containment procedures for the material spilled.
- Report spill to the Municipal Works Foreman and Hamlet's Senior Administrative Officer.
- Determine suitable methods for removal of contaminated soils and restoring site of the spill. Consult environmental and government agencies for assistance.
- Flag and record locations and information of spot spills for future reference and monitoring.
- In the case of a spot sewage spill, place lime over the sewage, collect and transport the material to the solid waste facility for proper disposal.

4.9.4 Spills in Proximity to a Waterbody

If a spill occurs in close proximity to a waterbody, take necessary actions to prevent the spill entering the nearby waterbody. Similar containment procedures discussed above in Section 4.9.2 can be used to assist with the likelihood of spills located near water bodies.

4.10 Existing Preventative Measures

The community is concerned about the environment and the possibility of a spill occurring and takes precautions when working with hazardous materials; however, no formal preventative measures are in place.

4.11 Additional Copies

Several copies of this plan will be kept in the community, in the Hamlet Office.

4.12 Process for Staff Response to Media and Public Inquires

All media enquiries are directed to the SAO, John Ivey.

5 RESPONSE ORGANIZATION

5.1 Response Personnel

The following table lists the personnel who will be involved in the spill response. Contact information is also provided.

Table 10. Response Personnel Contact Information

Name	Contact Information
John Ivey (SAO)	897-8943
Works Foreman at Fire Department	897-8888

5.2 Flowchart of Response Organization and Communication Lines

The following flowchart outlines the chain of communication to be followed, upon discovery of a spill or release by an employee of the community.

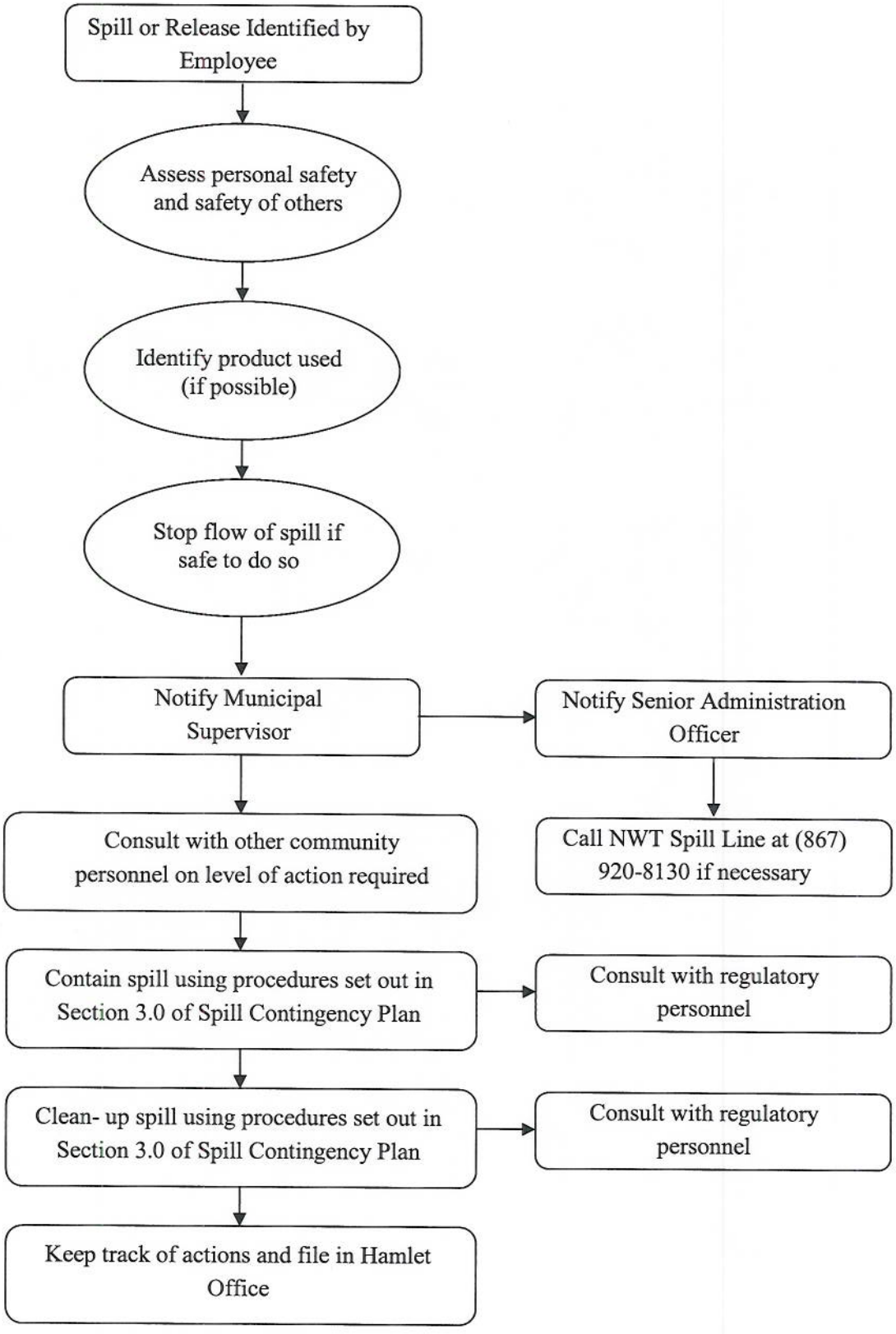


Figure 6: Flowchart of Communication Lines

5.3 Summary of Available Communication Equipment

The following equipment is available in the community for communication purposes:

- Telephone with land line
- Computers with internet connection in Hamlet Office
- Fax machine

6 ACTION PLAN

6.1 Potential Environmental Impacts of Spill

Generally, for the hazardous materials discussed below, environmental impacts are lower during the winter, as snow is a natural sorbent and ice forms a barrier lining for eliminating soil or water contamination. Spills can be more readily recovered when identified and reported.

Gasoline:
Environmental Impacts:

- Harmful to wildlife and aquatic life
- Not readily biodegradable
- Has potential to bioaccumulate in environment
- Volatilizes easily
- Runoff into water bodies must be avoided

Worst Case Scenario: All fuel drums open simultaneously and contents pour onto ground and surrounding environment.

Diesel:
Environmental Impacts:

- Harmful to wildlife and aquatic life
- Not readily biodegradable
- Has potential to bioaccumulate in environment
- Burns slowly (more readily contained than volatile fuels)
- Runoff into water bodies must be avoided

Worst Case Scenario: All fuel drums open simultaneously and contents pour onto ground and surrounding environment.

Waste Oil and Miscellaneous Oils and Grease:

Environmental Impacts:

- Harmful to wildlife and aquatic life
- Not readily biodegradable
- Has potential to bioaccumulate in environment
- Runoff into water bodies must be avoided

Worst Case Scenario: All storage drums open simultaneously and contents pour onto ground and surrounding environment.

Sewage:

Environmental Impacts:

- Human health hazard, and unsightly appearance
- High nutrient concentrations could negatively impact water bodies and runoff into water bodies must be avoided

Worst Case Scenario: Full sewage truck releases all of its contents onto ground and surrounding environment.

6.2 Procedures

6.2.1 Procedures for Initial Actions

The following list of actions should be followed by the first person on the scene:

- Ensure safety of all personnel
- Identify the product spilled
- Assess the hazards and risks to persons in the vicinity of the spill
- If possible, without further assistance, control the danger to human life
- If it is safe to do so, and if possible, stop the spill (i.e. shut off pump, replace cap, tip drum upward, etc.)
- Gather information on the status of the situation, including:
    - Estimated size of spill
    - Estimated migration route
- Contact Municipal Supervisor, as per flowchart in Figure 3.

6.2.2 Spill Reporting Procedures

Spills should be reported immediately to the Municipal Supervisor, who will notify the SAO. Together they will determine if the spill is to be reported to the NWT 24-Hour Spill Line at 867-920-8130.

Copies of the Spill Report form are available in each spill kit and at the back of this manual. The form will be filled out by the Public Works Foreman (or designate), and faxed or emailed to the NWT Spill Line. Contact information is as follows:

Territorial 24-Hour Spill Line
Phone: (867) 920-8130
Fax: (867) 873-6924
Email: spills@gov.nt.ca

6.2.3 Procedures for the Protection of Human Health and Safety

Following a spill, the health and safety of workers as well as the general public is a priority. Actions taken will depend on the type of spill.

- ***In the event of a chemical spill***: Restrict public access to the spill area. Workers involved in the clean-up of the spill should wear personal protective equipment (PPE).
- ***In the event of a flammable or combustible material spill***: Evacuate adjacent buildings and restrict public access to the spill area. Remove sources of ignition if safe to do so (no smoking, flares, sparks or flames in the area). Never walk through or touch the spilled material. De-energize electrical equipment from a remote location if safe to do so. If ignition sources can not be removed safely, evacuate the area immediately and report the spill situation. All equipment used when handling the material must be grounded. Only spark-arresting equipment should be used during clean-up of the spill. PPE should also be worn by workers involved in the clean-up. Refer to the product Material Safety Data Sheet (MSDS) for further instruction.
- ***In the event of a sewage spill***: Restrict public access (including pets and animals) to the spill area.

6.2.4 Procedures for Containing and Controlling Spill

General procedures noted below will be used to contain and control all spills. Specific procedures for spills on land, water, snow and ice follow.

- First anticipate what will be affected by the spill.
- Assess direction and speed of spill, and any factors that could affect these.
- Determine best location for containing spill.

Spills on Land:

Dykes and trenches can be constructed to contain spills on land. Soil surrounding the spill area can be dug out, and piled up, to create a barrier for the spill. A plastic tarp can be placed at the base of the dyke, so that the pooled material can be removed with sorbent materials. Conversely, trenches can be excavated to permafrost, which will provide a natural containment of the spill. Once the material is contained, it can be pumped out, or removed by using sorbent materials. If the spill is moving very slowly, such structures may not be necessary and the material can be removed before migrating away from the spill location.

Spills on Water:

Spills on water are considered the most serious types of spills, as there is often no containment of the spilled material and water quality and aquatic life are negatively impacted. Booms and weirs can be installed to contain the spill. Booms are designed to float, and are made of absorbent material to soak up the spilled fuel. They are deployed from the shore or a boat, to create a circle around the spill. Weirs are installed across a stream, to prevent further migration. Plywood or other materials found onsite can be used. Barriers made of fence or netting can be used as well, with sorbent material placed at the base of the barrier. Once contained, the fuel can be removed by absorbent materials, pumped out or allowed to volatilize.

Spills on Snow:

Snow acts as a natural sorbent for spilled fuel. Impacted snow is easily visible, and can be shoveled into empty drums or barrels for proper disposal. If the spill is migrating down a hill, a snow dyke can be constructed to contain the spill. A plastic tarp can be placed at the base of the dyke, where spilled fuel is expected to pool. The collected fuel and impacted snow ban be removed with absorbent materials, pumped out, or shoveled into barrels for disposal.

Spills on Ice:

Ice is considered impermeable to fuel, so these spills are generally easy to clean up. Small spills can be cleaned up by placing absorbent materials on top of the ice. Impacted snow and slush can then be removed by shovels, and placed in barrels for disposal. For larger spills, dykes of snow and trenches can be constructed to contain the spill. Pooled fuel can then be removed by adsorbent materials or pumped out. Impacted snow and slush can be shoveled into barrels for disposal.

Worst Case Scenarios:

Worst case scenarios include a dyke or trench overflowing and a large spill on water that cannot be contained with materials available in the community. In the first case, a trench or collection pit could be constructed downstream to collect the fuel. In the second case, an emergency response team would need to be called, with appropriate equipment to deal with the spill.

6.2.5 Procedures for Transferring, Storing and Managing Spill Related Wastes

Spills are generally cleaned up starting at the outer limit of the spill, and working towards the point of the spill. Sorbent materials and hand tools such as cans and shovels are used for smaller spills. Larger spills can be contained with the use of a pump and/or heavy equipment.

Spill wastes include used absorbent materials and containers of impacted water and snow. Sorbent materials should be placed in plastic bags for proper disposal. The containers of impacted water and snow should be sealed and stored until disposal at an approved facility can be arranged.

Following a spill, all used materials need to be properly washed and/or replaced.

6.2.6 Procedures for Restoring Affected Areas

Once a spill has been contained, community personnel will consult with regulatory personnel assigned to the file to determine the level of clean-up required. Regulatory personnel may request that a site specific study be conducted, to ensure appropriate clean-up levels are met.

7 RESOURCE INVENTORY

7.1 On-site Resources

It is recommended that the Hamlet of Cape Dorset retain one spill kit in the community, located at the Maintenance Garage. The spill kit should contain the following:

- 30 socks/booms (3" x 4')
- 30 pillows (2L)
- 24 dispersal bags
- 4 pairs gloves
- 2 pairs goggles
- 6 pairs Tyvek coveralls
- 4 shovels
- 2 spill signs
- 2 repair putty
- 1 Emergency Response Guidebook
- 1 Safety and Compliance Directory
- 1 Spill Response Pocket Guide

This response kit is designed to contain and collect up to 56 gallons of spilled oil. Additional volumes will be accommodated with the use of absorbent products that will be maintained in inventory in sufficient quantities.

The following heavy equipment is also available in the community for spill containment:

- Loader
- Dozer

7.2 Off-site Resources

The following resources are available for assistance if needed:

Territorial 24-Hour Spill Line	(867) 920-8130
Indian and Northern Affairs Canada Inspector	(867) 669-2761
GN – Emergency Measures Officer	(888) 624-4043
Cape Dorset Health Centre	(867) 897-8820
RCMP (Cape Dorset)	(867) 897-1111
Environment Canada (Emergency) Yellowknife	(867) 669-4725
GN Environmental Health Office	(867) 975-4817
Health Center	(867) 897-8820
First Air Cargo	1-800-267-1247 or (867) 769-7505

7.3 Training Schedule and Recordkeeping

Training will be conducted on an as-needed basis. Records will be kept in the community office.

8 REFERENCES

[1] Dillon Consulting Limited. "Cape Dorset Sewage Facility Study", produced for Department of Community Government and Transportation, Government of Nunavut, March 2001.

[2] Dillon Consulting Limited. "P Lake Area Sewage Lagoon System", produced for Department of Community and Government Services, Government of Nunavut, January 2006.

[3] Duong, D. and R. Kent. "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solids Waste Disposal Facilities in the Northwest Territories", Produced for MACA, October 1996.

[4] Heinke, G.W. et al. "Guidelines for the Planning, Design, Operation and Maintenance of Wastewater Lagoon Systems in the Northwest Territories, Volume I: Planning and Design", Produced for MACA, November 1988.

[5] Heinke, G.W. et al. "Guidelines for the Planning, Design, Operation and Maintenance of Wastewater Lagoon Systems in the Northwest Territories, Volume II: Operations and Maintenance", Produced for MACA, November 1988.