Operations and Maintenance Plan

Cambridge Bay Soil and Water Treatment Facility

June 2018

Summary

This Plan outlines how Nunavut Excavating will operate and maintain the soil and water treatment facility (SWTF) in Cambridge Bay, Nunavut. The facility will include one bermed and lined area for soils contaminated with petroleum hydrocarbons, a lined water and snow retention/storage area and a lined and bermed hazardous waste storage area. Soil is treated by a mechanized process combined with the application of amendments to the soil to facilitate microbial activity to break down the pollutants. Once treated, soil will be reused as alternate daily cover at the Hamlet's Landfill or re-purposed as permitted. Water will be treated using an onsite water treatment plant and once treated will be used to increase moisture at the soil treatment facility or discharged as per Government of Nunavut requirements. The waste storage area will be used to temporarily store waste that requires containerization and/or shipment to an authorized location.

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1. Purpose & Scope

The purpose and scope of this Plan is to outline the methodology for operating and maintaining the SWTF. The location and design drawing of the facility can be found in Appendix B.

Nunavut Excavating manages operations responsibly and will comply with all licenses, permits and applicable territorial and federal laws and regulations related to Facility operations and maintenance. The following table lists regulations and guidelines applied to and referenced for Facility operations.

Table 1. Relevant waste management regulations and guidelines

Jurisdictional Authority	Regulation or Guideline
Government of Nunavut (GN), Department of Environment (DoE)	*Environmental Guideline for the General Management of Hazardous Waste (2010)*
Government of Nunavut (GN), Department of Environment (DoE)	*Environmental Guideline for Site Remediation (2002)*
Government of Nunavut (GN), Department of Environment (DoE)	*Environmental Guideline for Contaminated Site Remediation (2003)*
Environment Canada (EC)	*Federal Guidelines for Landfarming Petroleum Hydrocarbon Contaminated Soils (SAIC 2006)*
Transport Canada (TC)	*Transportation of Dangerous Goods Regulations (2012)*

a) Project Description

The purpose of this project is to construct and operate a permanent SWTF in Cambridge Bay, Nunavut. Following bioremediation, treated soil meeting landfill criteria is reused as Alternative Daily Cover (ADC) at the town landfill or re-purposed. Soil not meeting reuse criteria is transported off site for disposal at a suitable facility. Water will be treated using an onsite water treatment plant and once treated will be analyzed and discharged as per territorial regulations.

The Facility includes: one engineered cell consisting of three sub-cells: one cell 50 m x 40 m, for receipt, storage and treatment of petroleum hydrocarbon-contaminated soil; one cell designed for storage of up to 170 m^3 of petroleum hydrocarbon-contaminated snow and water; one cell 19m x 14m designed for storage of hazardous waste awaiting shipment; one small package treatment plant to treat petroleum hydrocarbon-contaminated water; one or two above ground storage tank(s) (AST) for treated water storage; one small shed for storage of supplies, documentation and health and safety equipment.

The SWTF is intended to be constructed commencing in summer of 2018. The facility is anticipated to be operated for a term of five (5) years at which time its use to the community will be re-evaluated.

2. Environmental Management

The Facility will be located within the hamlet limits on an existing lease adjacent to the hamlet of Cambridge Bay sewage lagoon. Land disturbance as a result of the construction and operation of the Facility will be minimal and not greatly alter existing site condition. Based on facility design, operating principles and monitoring plan the environmental impacts associated with this facility will be minimized.

3. Soil and Water Treatment Facility

The Facility is designed to treat petroleum hydrocarbons. Materials received at the site for treatment include petroleum hydrocarbon-contaminated soil and/or water and snow, from off-site sources including residential, commercial and industrial properties where a hydrocarbon spill or leak has occurred. Prior to receipt on-site, contaminated soil will be profiled which may include sampling and field testing to determine suitability for treatment. Soil meeting acceptance criteria is deposited into an engineered cell, operated as a Soil Treatment pad. Water will be treated then tested to ensure it passes required criteria for discharge.

Once the bioremediation process has been given adequate time, soil is sampled and tested to confirm it meets discharge/beneficial reuse criteria (as presented in Appendix A). Soil meeting reuse criteria is hauled as cover material at the Hamlet's landfill or re-purposed as permitted.

a) Facility Design

The facility has been designed to receive up to 3,000 m^3 (a drawing of the Facility Plan and Section is provided in Appendix B). The cell is 50 m by 40 m, surrounded by a soil berm approximately 1.5 m tall with 2:1 side slopes measured from existing grade. The base of the cell is graded to a 1.0% slope on the long axis, away from the entrance ramps to control and direct interior drainage towards the water storage cell.

At least 0.2 m of soil fill <8mm in diameter, debris, and organics (protective fill) covers the base of the cell and the sides of the berm to protect the overlaying geomembrane against punctures. A Solmax 460ST 60 mm single textured high density polyethylene (HDPE) liner (or equivalent) covers the cell floor, overlaps the crest of each berm, and is anchored into the side of the perimeter berms. A 16 oz non- woven geotextile overlays the geomembrane as a precaution against punctures, and is anchored into the perimeter berms. Approximately 500 mm of fill free from debris and organics overlays the geotextile on the base of the cell, for torsion protection from turning vehicles. At least 300 mm of fill overlays the interior side slopes of the berms.

b) Soil Management

All soil transported to site requires a waste profile including analytical testing and suitable movement documents prior to receipt on-site. An example of a typical waste profile form is included in Appendix E. If this information is absent or incomplete, or materials do not meet the acceptance criteria listed in Appendix A, soil is not received into the Facility and will remain the responsibility of the generator. In some cases, such as spills and emergency response, soil may be accepted into the facility and samples collected after receipt. DoE representatives will be notified in this situation.

Once quality and quantity of soil are approved for receipt at site, soil is end-dumped into a designated area of the cell, and placed in biopiles in a fashion to facilitate segregation and ease of access for equipment or technical staff to complete required sampling and treatment campaigns. Soil is managed in biopiles with an average height of up to 3.0 m using a hydraulic excavator or dozer. Once placed, each biopile is labelled with a unique identifier affixed to a stake driven into the pile. Each waste shipment is managed and treated separately. Efforts are made to avoid comingling of wastes and dilution of contaminated soils with cleaner soils.

Typically, three tilling events occur each year over the summer season. Tilling may occur using a track hoe equipped with an Allu bucket. This is a mechanical process which uses specialized equipment designed specifically to shred and aerate soils and/or organic matter. Materials are quickly churned and aerated. Thorough mixing, blending and aeration are accomplished while all unwanted debris is removed manually. The final waste soil matrix is a finely processed material suitable for beneficial reuse.

Tilling does not occur when the ambient air temperature is below 5^{o}C. The mean expected residency of soil undergoing bioremediation in the Soil Treatment facility is one year however soils with recalcitrant contaminants may require longer treatment times.

There may be times throughout operations wherein it may be necessary to add amendments to the soil to promote effective and efficient breakdown of hydrocarbon constituents. Typical amendments include fertilizer to stimulate natural microflora activity, water to adjust moisture content, and lime to modify pH. In more extreme circumstances other soil conditioners such as surfactants can liberate hydrocarbon from soil particle adsorption to promote bioavailability, or peroxides to promote oxidation of chemical constituents. In the event that any of these are required, MSDS will be provided, located in a small storage shed on site and be accessible to all workers. Any amendments will be procured for immediate use; no long term storage on site is expected. Over the short term, amendments will be stored within appropriate containment in the locked shed on site.

All soil amendment application, will be conducted by Nunavut personnel experienced in waste facility management and operation.

c) Sampling

To assess the progress of remediation, a photoionization detector (PID) may be used or grab samples collected and tracer tests carried out during the first or second treatment campaign. Once it is determined that a remediation end point has likely been reached, formal soil sampling occurs to determine compliance with reuse criteria. Following the sampling protocol outlined below, along with avoiding comingling of soils between biopiles, efforts are made to ensure that confirmatory sampling is unbiased and representative, and contaminated soils are not diluted with cleaner soils.

Sampling involves establishing sample points in each biopile: one representative sample is collected for the volume of remediated soil specified in Table A2; this is consistent with confirmatory sampling for soil removal from landfarms in Yukon Territory (Environment Yukon 2011) and confirmatory sampling of *ex situ* stockpiles in BC (BC Ministry of Environment 2009; Appendix A). Each representative sample collected is composed of five sub-samples. Each sub-sample is collected from one of five areas or 'cells' within each, wherein each of the five cells is equivalent to 20% of the soil volume specified in Table A2. Multiple specimens from within the cell can be collected for each sub-sample, reducing the "nugget effect" that can arise when small sample volumes are collected from a stock pile; this is consistent with BC's Technical Guidance on Contaminated Sites for Site Characterization and Confirmation Testing (BC Ministry of Environment 2009). Samples will be collected by trained personnel using either handheld implements such as a hand auger or shovel or with the assistance of mechanical equipment such as an excavator.

Quality Assurance/Quality Control (QA/QC)

All samples are collected in laboratory prepared containers, stored in temperature-controlled coolers, transported and submitted to a Canadian Association for Laboratory Accreditation (CALA) accredited laboratory for analysis of contaminants of concern. NE follows appropriate chain of custody control mechanisms during transportation of samples to the laboratory.

Samples are collected and submitted for QA/QC purposes including collection of: 10% blind duplicates; 1 field blank per day; 1 travel blank per shipment. For each sample collection personnel use new latex or Nitrile gloves for collecting each sample and augers and shovels are washed to avoid potential cross contamination. At the time of sampling, on-site activities and observations are documented including field testing results, soil pile stability or suspected leachate issues.

Upon receipt, the laboratory conducts internal QA/QC sampling. If results from either field or lab QA/QC analysis are considered significantly different, re-sampling will occur.

d) Reuse and Disposal

Once remediated soil has been analysed, it is classified as either meeting reuse criteria, or requiring off- site disposal. Soil suitable for industrial reuse has analytical results meeting the criteria outlined in Appendix A. Material meeting re-use criteria will be used as cover material at the Hamlet's landfill or re- purposed as permitted.

Soil is removed from the cell using an excavator and dump truck and is hauled to the landfill working face. All materials removed from site will be accompanied by appropriate movement documents.
Volumes and soil sampling results will be provided to GN Department of Environment in annual reports.

e) Maintenance

Weekly site inspections during snow-free months include a visual inspection for erosion, subsidence, exposure of liner, leakage, wildlife disturbance and security breach. During winter months, inspections occur monthly. The Soil Treatment facility liner is inspected annually, after soil turning and soil removal. Any tears detected during visual inspection will be repaired and documented immediately. Inspections are conducted by trained personnel. Inspection logs are maintained on site will be provided upon request. An example of the inspection form can be found in Appendix D.

f) Water/Snow Retention and Storage Pond

The water storage area will be 19m x 14m lined pond located in the corner of the treatment pad. The pad will be sloped to allow for rainfall to drain from soil into the retention pond as shown on the design drawing in Appendix C. The capacity of the retention pond is anticipated to be 170m^3.

An above ground storage tank (AST) or a vacuum truck will be used onsite in the event that water levels are anticipated to increase beyond the storage capacity of the pond. Regularly scheduled site inspections during snow free months will monitor the water levels, exposure of liner, and retention pond volumes. Inspection logs will be maintained onsite at all times.

As water levels increase in the retention pond, samples will be collected and analyzed for the parameters listed on Table A5 in Appendix A. If the samples do not pass the criteria, the water from the storage pond will be treated using an onsite water treatment plant and transferred to a storage tank onsite. Once results are received and pass the criteria set forth by the Government of Nunavut (DOE), the water will be discharged to surface. Analytical results and notification will be reported to the DOE prior to the planned discharge. In the event that water does not meet discharge criteria it will be transported to an authorized disposal location.

g) Hazardous Waste Storage Area

A portion of the bermed and lined soil treatment pad will be used for the storage of hazardous waste containers (drums, bags etc.) that are awaiting transportation to authorized facilities. These types of waste could include fuels, oils, solvents and glycols which require consolidation, containerization and temporary storage onsite while awaiting shipment to authorized facilities. This storage location will be connected to the water storage pond allowing any contact water to be contained.

4. Documentation and Reporting

If required, an annual report will be submitted to GN Department of Environment (DOE) in accordance with the terms and conditions of the license approval and permits assigned to the Facility. In conjunction with annual reporting, this Plan is to be reviewed annually and updated as needed to maintain compliance. Analytical test results, as required under the anticipated water license, are submitted to DOE. A copy of all licenses and permits will be maintained on site.

5. Safety and Emergency Response Plans

The operations at the facility will involve the use of heavy equipment to process the soil stored for treatment and for the movement of soil into and out of the treatment pad. The soils handled at site have varying levels of petroleum hydrocarbon contamination.

All operations will be performed in conjunction with Nunavut Excavating Health and Safety Programs and applicable regulations and standards. All personnel on site are required to wear basic personal protective equipment: hard hat, high visibility vest or striping, safety footwear. Other PPE requirements are specific to the tasks undertaken by the employees on site. Refer to the Nunavut Excavating Health and Safety Manual (which will be available on site).

Emergency Contact Information for the Cambridge Bay Soil Treatment Facility:

Police	867-9-1111
Fire	867-983-2222
Ambulance	867-983-2531
Nunavut Excavating	867-975-3320
Hamlet of Cambridge Bay	867-983-4650
Department of Environment	867-975-7700

a) Fire and Prevention Control

The purpose of this plan in to provide information to Nunavut Excavating employees and contractors in the event that a fire occurs at or near the facility. Specifically, the plan establishes who is responsible for various aspects of the fire control procedure.

DO NOT PANIC, the greatest danger lies not in fighting the fire, but in the panic that arises from a fire. Spend a few minutes getting a grip of the situation. Go through the steps of notifying the appropriate authorities and follow the basic steps in the fire control plan.

1. Notify any other nearby employees
2. Notify the site manger immediately. Follow his instructions.
3. Notify the fire department. Tell them the location and type of fire and whether it looks like it will spread out of the immediate area.
4. Notify surrounding property owners, particularly if it appears that the fire could spread beyond the facility.
5. When the fire department arrives, follow their instructions.
6. Do not fight the fire alone.
7. Do not place yourself or others in danger while fighting the fire.

b) Spill Response Plan

For the purpose of this plan, a spill is the accidental or purposeful discharge of a liquid waste (listed herein) or contaminated soil in a location or manner that will allow it being washed, carried, or flow into a natural or man-made watercourse that could potentially result in groundwater or surface water contamination now or in the future.

Most potential spill sources will only be present during normal facility working hours. As a result, adequate personnel and equipment is available to respond to any spill-related emergency. With equipment at the facility, it is possible to respond immediately to the site of any spill for necessary spill containment and cleanup. The immediate requirement will be to construct temporary earth berms around the spill area to control and allow implement cleanup measures as directed by the Site Manager and the Hazardous Materials Response Team (if applicable).

The facility is operated in conjunction with Nunavut Excavating’s spill contingency plan (NE 2018) along with NE’s Waste Management Plan (NE 2018). The Spill Contingency Plan addresses spills of:

1. Fuel and oils from Landfill equipment
2. Soils contaminated with petroleum hydrocarbons
3. Liquids from the storage pond

6. Training

Personnel managing waste are certified in Workplace Hazardous Material Information System (WHMIS) and Transportation of Dangerous Goods (TDG). Any waste shipment requiring a Federal Movement Document (FMD) will need to have FMD filled out by an individual holding a valid certificate in TDG. Personnel responsible for operation and maintenance of the SWTF receive training.

Appendices

Appendix A

Table A1. Material Acceptance Criteria

Parameter	Facility Acceptance Criteria
BTEX F1-F4	mg/kg
Benzene	NA
Toluene	NA
Ethylbenzene	NA
Xylene	NA
F1	12500
F2	10000
F3	5000
F4	7500
Total Metals	mg/kg
Antimony	20
Arsenic	12
Barium	2000
Beryllium	8
Boron	NA
Cadmium	22
Chromium (total)	87
Cobalt	30
Copper	91
Lead	600

Parameter	Facility Acceptance Criteria
Mercury	50
Molybdenum	40
Nickel	89
Selenium	2.9
Silver	40
Thallium	1
Tin	300
Uranium	300
Vanadium	130
Zinc	360

Table A2 Pre-Acceptance and Re-Use Sampling

Soil Volume (m^3)	Sample Quantity
1 – 50	1
51 – 500	2
501 – 1,000	3
1,001 – 2,000	4
2,001 – 4,000	5
Water Volume (m^3)	**Sample Quantity**
1 – 50	1
51 – 275	2

Table A3 Re-Use criteria for CCME Metals (Industrial)

Parameter	Units	CCME Industrial Guidelines for Metals in Soil (mg/kg)
Antimony	mg/kg	40
Arsenic	mg/kg	12
Barium	mg/kg	2000
Beryllium	mg/kg	8
Boron	mg/kg	N/A
Cadmium	mg/kg	22
Chromium (total)	mg/kg	87
Chromium, hexavalent (Cr(VI))	mg/kg	1.4
Cobalt	mg/kg	300
Copper	mg/kg	91
Lead	mg/kg	600
Mercury	mg/kg	50
Molybdenum	mg/kg	40
Nickel	mg/kg	89
Selenium	mg/kg	2.9
Silver	mg/kg	40
Thallium	mg/kg	1
Tin	mg/kg	300
Uranium	mg/kg	300
Vanadium	mg/kg	130
Zinc	mg/kg	360

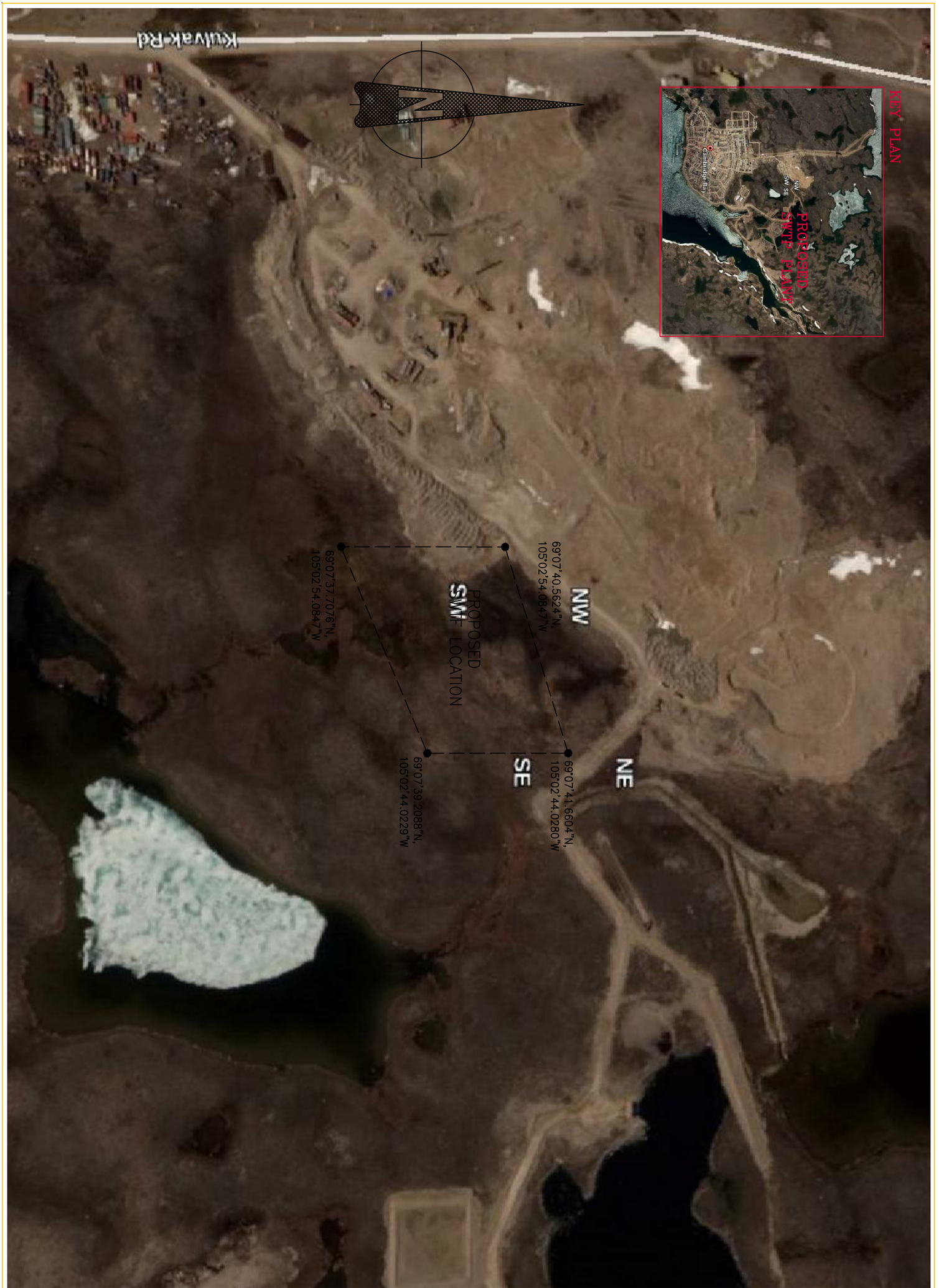
Table A4 Re-Use criteria for Petroleum Hydrocarbon CCME (Industrial)

PHC Reuse Criteria	ADC Fine-Grained Soil (mg/kg)	ADC Coarse-Grained Soil (mg/kg)
Benzene	0.0068	0.030
Toluene	0.08	0.37
Ethylbenzene	0.018	0.82
Xylenes	2.4	11
PHC (F1)	320	320
PHC (F2)	260	260
PHC (F3)	2500	1700
PHC (F4)	6600	3300

Source: 2014 Environmental Guideline for the Management of Contaminated Sites, Department of Environment, GN

Table A5 Discharge Criteria for Water as per Government of Nunavut (Department of Environment)

Parameter	Maximum Concentration of any grab sample (mg/L)
Total Extractable Hydrocarbons (TEH)*	15 and no visible sheen
Total Lead	0.05[1]
Benzene	0.37[2]
Toluene	0.002[3]
Ethylbenzene	0.09[3]



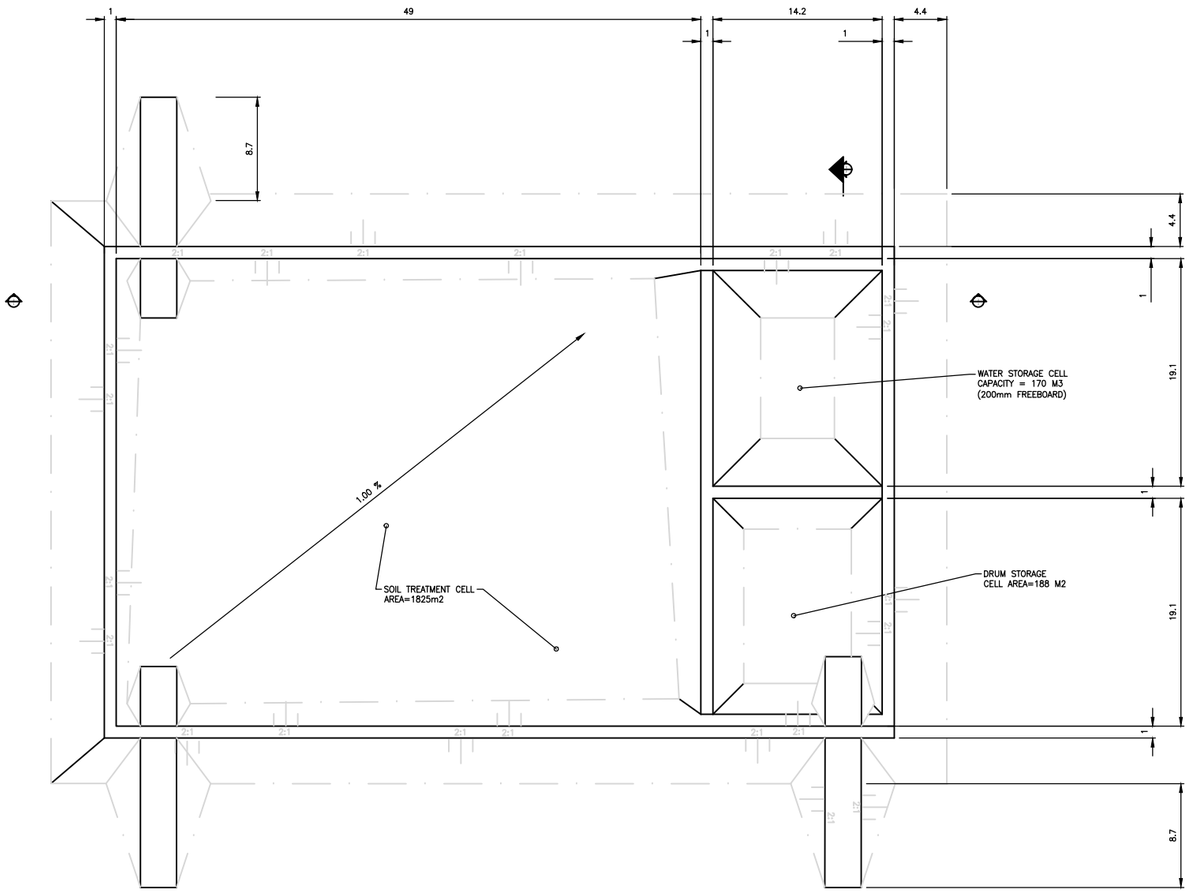
SITE PLAN

SOIL TREATMENT FACILITY
SITE PLAN
CAMBRIDGE BAY, NUNAVUT

NUNAVUT EXCAVATING

CAMBRIDGE BAY, NUNAVUT

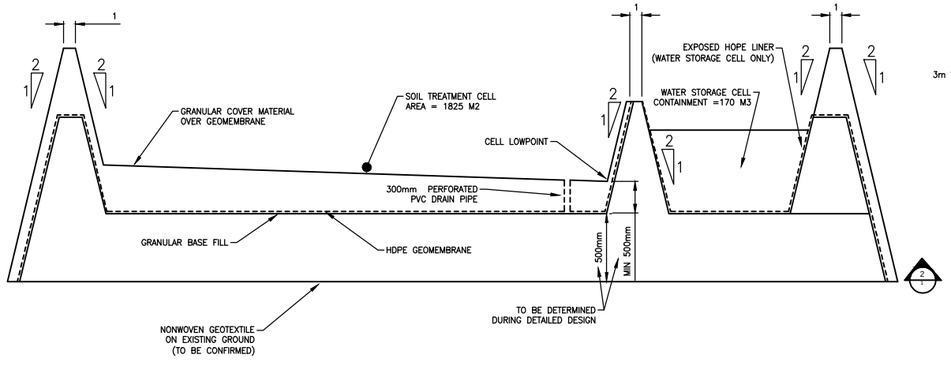
DRW'N BY:	D.B.
DATE:	JUNE 2018
SCALE: N.T.S	DWG NO.



PLAN

NOTES:

1. FIGURE IS IN SUPPORT OF NUNAVUT EXCAVATION'S APPLICATION FOR A DEVELOPMENT PLAN FOR A SOIL TREATMENT FACILITY IN CAMBRIDGE BAY, NU.
2. FIGURES PRESENT GENERAL LAYOUTS AND CONCEPTUAL DESIGNS. FINAL DESIGNS AND CONSTRUCTION WILL DEPEND ON FIELD CONDITIONS AND LOCALLY AVAILABLE CONSTRUCTION MATERIALS.
3. SCALES AND DIMENSIONS ARE APPROXIMATE.
4. EXISTING GRADE IS ASSUMED TO BE FLAT AND LEVEL. ACTUAL CONFIGURATION WILL MAKE USE OF ADVANTAGEOUS NATURAL SLOPE ORIENTATIONS.
5. BERM HEIGHT MAY BE INCREASED TO ACCOMMODATE FIELD CONDITIONS.
6. GEOMEMBRANE INSTALLATION QUALITY CONTROL AND QUALITY ASSURANCE SHALL BE CONDUCTED THROUGHOUT INSTALLATION ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
7. BERMS AND BASE SHALL BE COMPACTED TO 98% STANDARD PROCTOR DENSITY IN LIFTS UP TO 300 MILLIMETERS.
8. PERMAFROST INSULATION LAYER AND GRADING FILL IS TO BE GRADED AND PROOF ROLLED WITH SMOOTH DRUM ROLLER OR SMOOTH PLATE PRIOR TO PLACEMENT OF GEOTEXTILE AND GEOMEMBRANE.
9. BERM SLOPES TO BE CONFIRMED DURING DETAILED DESIGN.
10. MINIMUM DEPTH OF BASE FILL ABOVE EXITING GROUND TO BE CONFIRMED DURING DETAILED DESIGN.



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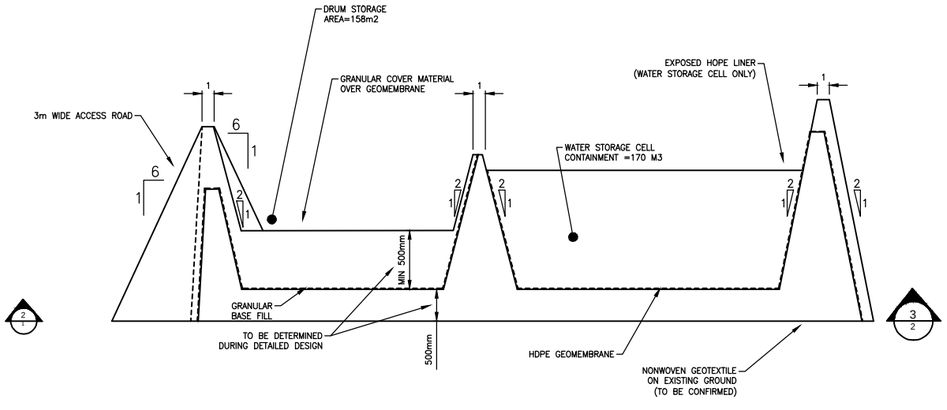

SECTION

SITE PLAN AND SECTION

DRW'N BY: D.B.

DATE: JUNE 2018

SCALE: N.T.S

DWG NO.

NUNAVUT EXCAVATING

CAMBRIDGE BAY, NUNAVUT

SOIL TREATMENT FACILITY
CONCEPTUAL DESIGN
CAMBRIDGE BAY, NUNAVUT