AGNICO EAGLE

MEADOWBANK DIVISION

Whale Tail Pit – Expansion Project
Landfarm Design and Management Plan

April 2019

VERSION 1_NWB

EXECUTIVE SUMMARY

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is proposing an expansion to the Whale Tail Pit and Haul Road Project, a Meadowbank satellite deposit located on the Amaruq property. As an expansion to the Approved Project (Nunavut Impact Review Board (NIRB) Project Certificate No. 008 and Nunavut Water Board (NWB) Type A Water License 2AM-WTP1826) Agnico Eagle is proposing to expand and extend the Whale Tail Pit operations to include a larger Whale Tail open pit, development of the IVR open pit, and underground operations while continuing to operate and process ore at the Meadowbank Mine.

This document presents the Landfarm Design and Management Plan for the Project. It describes the design features and operational procedures for the landfarm to be constructed at the Project for the storage and treatment of petroleum hydrocarbon contaminated soils.

On-site storage and remediation has been established as the preferred method for treatment of light petroleum hydrocarbon contaminated soil that may be generated on the proposed mine site. The landfarm is designed to receive soils, rock, snow, and ice contaminated with light hydrocarbons such as diesel and gasoline, and also antifreeze.

The landfarm is proposed to be located just east of the Fuel Storage Facility and in close proximity with the IVR Attenuation Pond. The central location of the landfarm was chosen to minimize the footprint of the site and the transport distance of contaminated material from potential spill locations. The proposed landfarm was designed assuming that 1,000 m³ per year of PHC soils will need to be managed during the construction, and operation phases of the Project and 350 m^3 of material per year during closure. Water accumulating in the landfarm will not be discharged directly to the receiving environment. It will be collected and directed to the IVR attenuation pond. The landfarm will have an impervious liner and no impacts on shallow groundwater are anticipated.

Soils contaminated with light end petroleum hydrocarbons will require an estimated four (4) full summer seasons for complete remediation. When remediated, the soils will be removed from the facility and can be used for construction purpose or stacked in the Waste Rock Storage Facility.

A report of landfarm activities will be prepared annually by the Environment Department, indicating the volume of material added to the facility, amount of material removed and disposal or re-use location, all analysis results, volume and type of nutrient addition, visual inspection results, and volume of contact water pumped.

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DOCUMENT CONTROL

Version	Date	Section	Page	Revision
1_NIRB	October 2018			Landfarm Design and Management Plan as Supporting Document submitted to Nunavut Impact Review Board for review and approval as part of Whale Tail Pit – Expansion Project.
1_NWB	April 2019			Landfarm Design and Management Plan as Supporting Document submitted to Nunavut Water Board for review and approval as part of Whale Tail Pit – Expansion Project. Addition of Engineered drawings to address GN IR#17. Addition of water management details to address GN IR#17. Addition of sludge sampling prior to enrichment to address GN IR#20. Addition of PAH sampling prior to removal from landfarm to address GN IR#21.

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

ACRONYMS

Agnico Eagle	Agnico Eagle Mines Limited
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
GN	Government of Nunavut
LDMP	Landfarm Design and Management Plan
NIRB	Nunavut Impact Review Board
NPAG	Non-Potentially Acid Generating
NWB	Nunavut Water Board
PAG	Potentially Acid Generating
PAH	Polycyclic Aromatic Hydrocarbon
PHC	Petroleum Hydrocarbon
PID	Photoionization Detector
RMMS	Responsible Mining Management System
TSF	Tailings Storage Facility
WRSF	Waste Rock Storage Facility

SECTION 1. INTRODUCTION

1.1 Project Overview

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is proposing an expansion to the Whale Tail Pit and Haul Road Project, a Meadowbank satellite deposit located on the Amaruq property. As an expansion to the Approved Project (Nunavut Impact Review Board (NIRB) Project Certificate No. 008 and Nunavut Water Board (NWB) Type A Water License 2AM-WTP1826) Agnico Eagle is proposing to expand and extend the Whale Tail Pit operations to include a larger Whale Tail open pit, development of the IVR open pit, and underground operations while continuing to operate and process ore at the Meadowbank Mine.

Agnico Eagle is permitted to operate the Whale Tail Pit until 2024. Agnico Eagle is proposing to expand the project operations until 2026, for a total of eight years of operations. The Whale Tail Pit project, as approved under Project Certificate No.008 and Water Licence 2AM-WTP1826 does not include the use of a landfarm at the Whale Tail project site to manage waste but rather includes use of the landfarm located at the Meadowbank Mine. In order to optimize contaminated soil management and reduce potential contamination, Agnico Eagle is proposing to build a landfarm at the Project site.

The Landfarm Design and Management Plan (LDMP), which is a component of the Responsible Mining Management System (RMMS), focuses on minimizing the waste footprint on-site, and maximizing remediation potential through implementation of bioremediation experience and research carried out at the Agnico Eagle's Meadowbank Mine and Meliadine Gold Project sites. Onsite storage and remediation has been established as the preferred method for treatment of petroleum hydrocarbon (PHC) contaminated soil that may be generated at the Project site. Specifically, remediation through landfarming has been identified as the primary treatment option and, as such, is the focus of this Plan.

The objectives of this plan are to:

- provide an overview of the proposed contaminated soil management at the Project;
- describe the location and design criteria of the landfarm;
- define acceptable types of contaminated soils to be placed in the landfarm and conditions for removal of treated soil;
- define operating procedures and monitoring requirements; and
- describe contingency options for alternate treatment/storage of PHC soil.

1.2 Related Documents

Spill prevention is the first stage in contaminated soil management at the Project. Documents containing information related to this Plan include:

- Spill Contingency Plan, and
- Risk Management and Emergency Response Plan.

There is also a related information as part of the Oil Pollution Emergency Plan, which is specific to spills at Agnico Eagle's Baker Lake Oil Handling Facility located in Baker Lake.

SECTION 2. LANDFARM DESIGN

2.1 Background

In the event of a spill, on-site storage and remediation is the most practical and efficient method in handling contaminated soil, particularly in an isolated location such as the Project. Any PHC contaminated soils generated during the construction, operation, and closure phases will be adequately managed. Soils contaminated with light PHCs, such as diesel, will be treated on-site in a landfarm. This method involves spreading, mechanical mixing, and placing the contaminated soil in windrows within a containment area and promoting conditions favorable for the volatilization and aerobic microbial degradation of hydrocarbons.

Materials contaminated with heavy hydrocarbons (e.g. grease), will need to be segregated, packaged, and shipped south for treatment and/or disposal.

A landfarm options analysis prepared for Agnico Eagle by Golder (2007) identified factors relevant to landfarming in the north. This include environmental factors and physical properties of the soil that affect microbial growth and rates of biodegradation, including temperature, pH, soil moisture, nutrient content, salinity, and soil particle size.

Although rates of biodegradation decline with temperature, landfarming is still a feasible technique in Arctic climates as demonstrated by the Meadowbank landfarm. Degradation in the north is typically restricted because microbial activity stops between 0 to -5 degrees Celsius (°C) restricting biodegradation to the months of June to September[1]. Nevertheless, degradation was reported at 90% over two summers on Resolution Island (Paudyn et al. 2008).

2.2 Location

The overall site plan and the proposed location of the landfarm is shown on Figure 1. This location was chosen due to its close proximity with the Fuel Storage Facility and potential synergies, and its proximity with potential spills locations. It is also located away from any receiving environment waterbody.

[1] Even though bioremediation ceases below -5°C, volatilization of the PHCs does continue but at a much slower rate.

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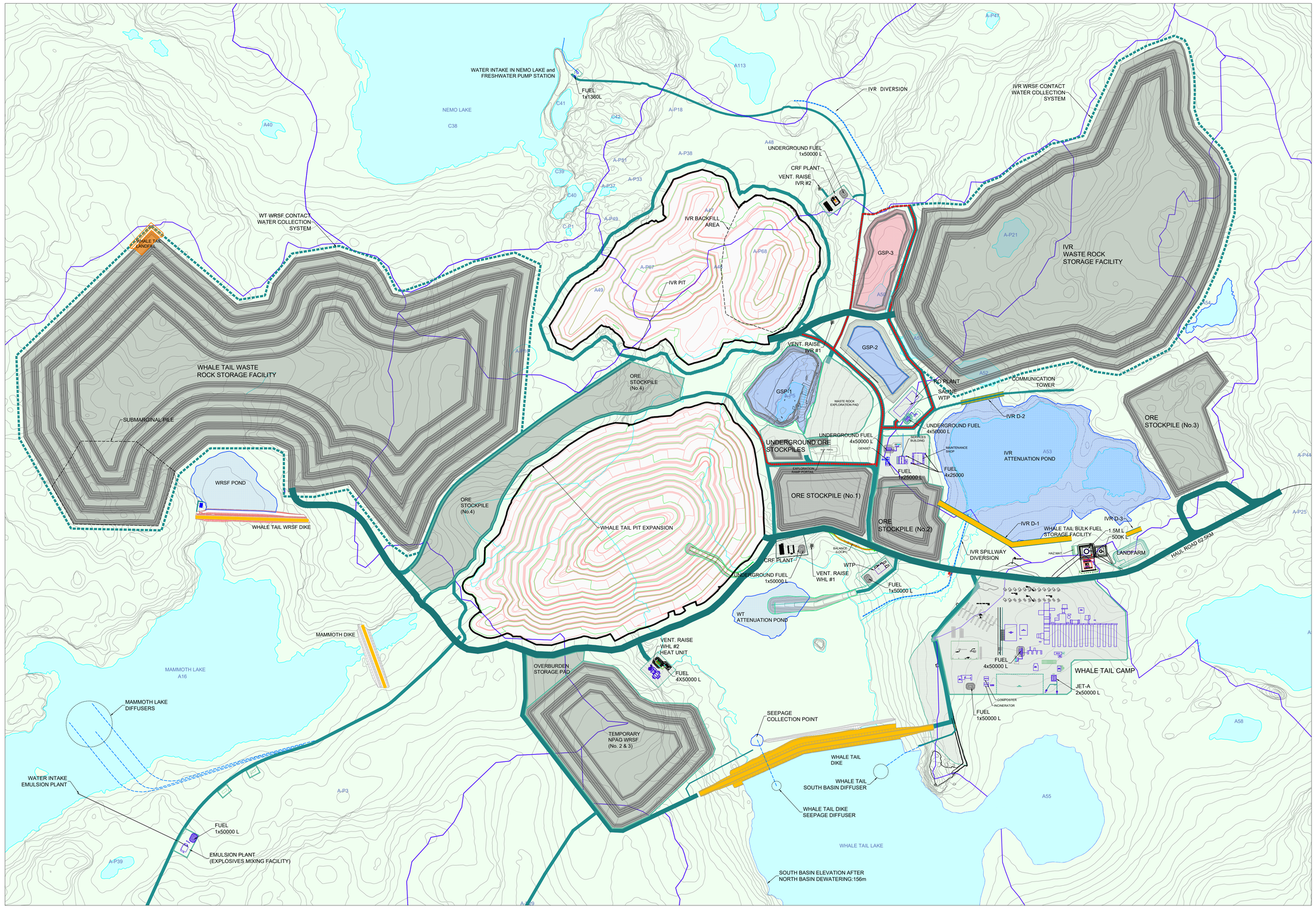

PLAN CLÉ
KEY PLAN

ISSUED FOR PERMITTING
DATE : 2019-05-06

NOTES GÉNÉRALES / GENERAL NOTES

LEGEND

- WATERSHED
- ATTENUATION POND
- WATER PIPE
- LAKE WATER
- OPEN PIT
- HAUL ROAD, LARGE WIDE
- HAUL ROAD, SINGLE LANE
- SERVICE ROAD
- ROAD, SALT PROTECTION
- ROCK PILE
- WATER POND
- PAD
- BUILDING

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT

REVISIONS

AMARUQ PROJECT

TITRE / TITLE

AGNICO EAGLE – MEADOWBANK DIVISION
AMARUQ MINE PROJECT
005 – SITE PREPARATION
210 GENERAL ARRANGEMENT
AMARUQ MINE SITE ARRANGEMENT
PERMITTING

DESSINÉ PAR DRAWN BY	J. CRETE	DATE 2019-05-02
VÉRIFIÉ PAR CHECKED BY	J.MOSQUERA	2019-05-02
APPROUVÉ PAR APPROVED BY		
ÉCHELLE SCALE	1:6000	DATE 2019-05-02

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2.3 Design

The landfarm will be designed to receive soils, rock, snow, and ice contaminated with light hydrocarbons such as diesel and gasoline, and also antifreeze. A conceptual design for the landfarm is presented in Appendix A. The design volume of the landfarm was based on allowances for the materials being treated at the Project.

2.3.1 Soil Volume Requirements

At the Meadowbank mining operation, it was estimated during the design phase of the landfarm that the volume of PHC soils would be between 300 and 350 m³ per year. Similar assumptions were made at the Meliadine site during the design phase, but experience showed that the volume of soil entering the landfarm yearly is higher than expected when large spills occur. Therefore, the proposed landfarm at Whale Tail was designed assuming that 1,000 m³ per year of PHC soils will need to be managed during the construction, and operation phases of the Project. During closure, 350 m^3 of material per year is expected to enter the landfarm. Similar to the Meadowbank and Meliadine designs, it was assumed that a yearly volume of 500 m³ of contaminated ice and snow would require management and the landfarm was designed to account for this volume. Based on observations at Meadowbank and Meliadine, this assumption is conservative.

Based on experience, it is estimated that soils contaminated with light end PHCs will require four (4) full summer seasons for complete remediation. Ethylene glycol or antifreeze is expected to largely biodegrade within one (1) year (Dobson 2000). When remediated, the soils will be removed from the landfarm and used on-site, or placed in the Waste Rock Storage Facility (WRSF).

2.3.2 Design Specifications

The design criteria for the landfarm are outlined in Table 1.

Table 1 Landfarm Design Criteria

Design Criteria	Value
Potential volume of PHC per year during construction and operation	1000 m³
Potential volume of PHC per year during closure	350 m³
Potential volume of contaminated snow/ice per year	500 m³
Remediation time	4 years
Estimated snowmelt water equivalent in spring freshet for a 1 in 100 wet precipitation year	171 mm
Thickness of PHC in containment facility	1.5 m
Facility Structure	
Facility base thickness	2.0 m
Side Slopes of Berm	3(H):1(V)
Berm Crest Width (m)	4
Berm Height (m)	Approximately 2

To prevent movement of contaminants from the landfarm facility into groundwater and the surrounding environment, it will have an impervious liner.

Table 2 shows the growth and stabilization of the volume of PHC considering remediation over four (4) years and the maximum volume of contaminated material that is anticipated to be stored over a period of 22 years.

The size of the landfarm was based on the design criteria (Table 1), the estimated volume of material (Table 2), and the requirement to turn over the surface of the piles during the summer months. The designed footprint of the landfarm will be 12,000 m^2. Contaminated material will be piled 1.5 m so that the material is below the crest height of the perimeter berm. The maximum accumulated quantity of contaminated material in the landfarm at any one time is expected to be 5,500 m^3.

Table 2. Volume of Petroleum Hydrocarbon Contaminated Material in the Landfarm

Mine Year	Estimated PHC Produced (m^3)	Accumulated PHC in Landfarm for Remediation (m^3)	Treated PHC Removed from Landfarm (m^3)	Hydrocarbon Contaminated Snow or Ice to Landfarm (m^3)	Maximum Accumulated PHC in Landfarm (m^3)
-1	1000	1000		500	1500
1	1000	2000		500	2500
2	1000	3000		500	3500
3	1000	4000		500	4500
4	1000	5000	1000	500	5500
5	1000	5000	1000	500	4850
6	350	4350	1000	500	4200
7	350	3700	1000	500	3550
8	350	3050	1000	500	2900
9	350	2400	1000	500	2250
10	350	1750	350	500	2250
11	350	1750	350	500	2250
12	350	1750	350	500	2250
13	350	1750	350	500	2250
14	350	1750	350	500	2250
15	350	1750	350	500	2250
16	350	1750	350	500	2250
17	0	1400	350	500	1900
18	0	1050	350	500	1550
19	0	700	350	500	1200
20	0	350	350	0	350
21	0	0	350	0	0

The liner will be protected from travel over top by aggregates added above and below the liner. Based on the conceptual design, freeze thaw cycles are not expected to affect the performance of the liner as contaminated soil only will be put in the landfarm.

SECTION 3. LANDFARM OPERATION AND MAINTENANCE

Agnico Eagle will be responsible for managing and implementing the landfarm operation plan.

3.1 Acceptable Materials

3.1.1 Contaminants

The landfarm facility will only treat and/or store light PHC contaminated soils that have been generated through mine-related activities at the Project. Material from other sites will not be accepted without approval from the NWB, Crown-Indigenous Relation and Northern Affairs Canada (CIRNAC) Water Resources Officers and the Kivalliq Inuit Association.

The following products may be treated in the landfarm if used onsite and spilled on soil:

- diesel fuel;
- gasoline;
- aviation fuel (Jet A);
- hydraulic oil;
- other light oil (e.g. engine oil, lubricating oil); and
- Ethyl Glycol (antifreeze).

In the event that the contaminant source is unknown, soil samples will be analyzed for PHCs and Polycyclic Aromatic Hydrocarbons (PAH) and possibly additional contaminants prior to placement in the landfarm. These additional parameters could include total metals, oil and grease, and volatile organic compounds. Analysis for additional compounds will be determined by the Environment Department on a case-by-case basis. Concentrations of contaminants will be compared to the site background values (for metals) and/or criteria in the Government of Nunavut (GN) *Guidelines for Contaminated Site Remediation* (GN, 2009). If this analysis indicates soil contamination above background or GN guidelines with any substances not approved for landfarming (i.e. non-PHC contaminants), the spill material will not be placed in the landfarm. This is to ensure PHC contaminated soils are not contaminated with other products.

Spills of > 100 L of non-PHC material (e.g. solvents, glycol) will be placed in drums and stored in the site Hazmat area for shipment south to approved facilities during barge season. Spills of non-PHC material < 100 L will be placed in the Meadowbank Tailings Storage Facility (TSF) or placed in drums and stored in the site Hazmat area for shipment south to approved facilities during barge season .

3.1.2 Grain Size

Bioremediation of very coarse-grained larger soil material is inhibited as it does not readily retain moisture. However, volatilization will occur more rapidly (SAIC 2006). It has been noted that this

material likely contains lower concentrations of contaminants due to a lower volume: surface area ratio, and can typically be screened out prior to landfarming (SAIC 2006). As a result, soils and rock material with grain size less than 2.5 centimetres (cm) will be separated from larger-grained material, where possible. This will occur at the spill location or in the landfarm using a screen sieve, should it prove necessary. The two soil fractions will be handled separately in the landfarm.

3.2 Contaminated Soil Additions

Soil contaminated with the above-described petroleum hydrocarbon materials will be excavated and transported to the landfarm facility in dump trucks or in roll-off containers. Care will be exercised to ensure that the entire spill is excavated (verified by olfactory and visual assessment, or sampling if necessary) and that none of the contaminated material is lost during transport. All material collected (coarse and fine) from spill locations will be deposited at the landfarm to be remediated.

3.3 Contaminated Snow

For spills < 100 L, PHC-contaminated snow will be placed in a designated area of the landfarm and treated as contact water after snowmelt.

For spills > 100 L, PHC-contaminated snow will be excavated and stored in labeled drums. After snow melt, the contaminated water will be pumped through the site's oil-water separator (carbon filter) to remove PHC residue. The treated water will be sampled per Part F, Item 7 of the Water License 2AM-WTP1826, and discharged to the tundra if water quality meets Water Licence criteria. If criteria are not met, water will be treated as hazardous material and shipped south. Also, after snowmelt, visible product will be cleaned up with absorbent pads or booms.

3.4 Remediation

Remediation of fine-grained PHC-contaminated soil in landfarms occurs naturally through volatilization and aerobic microbial degradation. Soil aeration and nutrient amendment are recognized as methods of improving rates of remediation. While it is recognized that pH, salinity, moisture content, and microbial population density also contribute to rates of degradation, these factors will not be explicitly investigated or managed unless remediation rates are too slow to allow meeting targets set for closure.

3.4.1 Absorbent Materials

Coarse-grained soils are not readily bio-remediated, but concentrations of PHC contaminants may still be reduced through volatilization. Oil absorbent pads will be used to help remove visible product from coarse-grained material. Used absorbent materials will be incinerated.

3.4.2 Aeration

To promote aerobic conditions throughout the windrows, soil will be mixed mechanically with earth-moving equipment. This turnover of soil piles will occur at least once per year, during the summer

months. The presence of coarse material also helps creating gaps within the piles which will increase aeration and help degradation of PHC.

3.4.3 Soil Moisture

Prior to turning, site personnel will ensure that soil is not so dry as to generate significant dust, nor overly saturated. If soil is too dry, non-contaminated water from within the landfarm containment area will be used as a moisture source and sprayed on the piles. If no accumulated water is available, water from a freshwater supply will be used. If the windrows are saturated, aeration will be delayed until the moisture content is reduced.

3.4.4 Nutrient Amendment

The use of sewage sludge as a nutrient amendment does not only provides the benefit of nutrients, but also adds organic matter to help retain moisture and microorganisms. Furthermore, the use of sewage sludge produced on-site helps to reduce the waste footprint of the mine by re-directing this material from disposal facilities and avoids needing to import a chemical fertilizer. Sewage sludge will be placed in the landfarm on an as needed basis. The excess will be stored in the WRSF. To ensure unwanted parameters are absent from the sludge used as enrichment, samples will be collected prior to sludge enrichment and analysed for presence of metals.

3.5 Removal of Soil from the Landfarm

3.5.1 GN Remediation Guidelines

Prior to removal of the finer grained soil from the landfarm, soil samples will be analyzed to ensure they meet GN guidelines, as described below.

The GN remediation criteria are characterized for agricultural/wildlife, residential/parkland, commercial, and industrial land uses. At the Project, remediation to agricultural/wildlife criteria is targeted; however, if these criteria cannot be met, industrial criteria will be followed.

The GN remediation criteria for coarse-grained soils will be applied. Table 3 presents the applicable Tier 1 criteria for coarse-grained soil, assuming agricultural/wildlife or industrial land uses and Table 4 presents remediation criteria for PAHs contaminants in soil as presented in the Environmental Guideline for Contaminated Site Remediation.

Table 3 - Summary of relevant GN Tier 1 Soil Remediation Criteria for Surface Soil

	Land Use Criteria (mg/kg)	
	Agricultural/Wildlife	**Industrial**
Benzene	0.03	0.03
Toluene	0.37	0.37
Ethylbenzene	0.082	0.082
Xylene	11	11

PHC Fraction 1	30	320
PHC Fraction 2	150	260
PHC Fraction 3	300	1,700
PHC Fraction 4	2,800	3,300

Table 4 - Summary of relevant remediation criteria for PAHs

	Land Use Criteria (mg/kg soil)	
	Agricultural/Wildlife	**Industrial**
Benzo-a-pyrene	0.1	0.7
Naphthalene	0.1	22

Source: Government of Nunavut Environmental Guideline for Contaminated Site Remediation Table A4-1 (Canadian Soil Quality Guidelines)

3.5.2 Sampling and Analysis

Landfarm windrows will be sampled annually at the end of the summer season to determine if remediation objectives have been met. Representative composite samples will be taken of each windrow to estimate remaining PHC and PAH concentrations. For each 10 m of windrow length, one composite sample will be collected, each consisting of three surface sub-samples and three sub-samples at 1 m depth. Sub-samples will be taken approximately 3.3 m apart, and will be taken from both sides of the windrow.

Degradation rates are assessed regularly to estimate the total remediation time required for PHC-contaminated soil under these conditions. If remediation to GN guidelines is feasible within the timeframe, landfarm operations will continue, with aeration and nutrient amendments as described above. If rates of total petroleum hydrocarbons degradation are not sufficient through this method, alternate options could be further investigated (see Section 4).

3.5.3 Soil Removal

Coarse-grained material will be assessed after segregation from mechanical screening has been started, by Environment Department technicians for PHC product and odors. A photoionization detector (PID) monitor may be employed to assist in petroleum-hydrocarbon based vapor detection. When PHC vapors are no longer detected, the material will be removed and sent to the WRSF to be disposed of as potentially acid generating (PAG) material. This material will be capped with non-potentially acid generating (NPAG) material at closure, allowing freeze-back and permanent encapsulation to occur (Agnico Eagle 2018).

When sample analysis of fine-grained material at the end of a season indicates that concentrations of contaminants are below GN guidelines, a soil pile or the appropriate section of a pile will be deemed acceptable for removal from the facility. Interim monitoring may be conducted through measurements of head-space with a portable instrument (e.g. flame ionization detector), but samples will be confirmed by an accredited laboratory prior to soil removal.

Soil remediated to agricultural/wildland criteria will be appropriately delineated by Environment Department staff, and stockpiled outside the landfarm for use in site works or reclamation activities. Soil remediated to industrial-use criteria will be removed from the landfarm and placed in the WRSF as PAG material.

3.6 Water Management

Since the landfarm facility will be uncovered to facilitate natural weathering, water accumulating inside the bermed area may come into contact with contaminated material.

3.6.1 Snow Management

Non contaminated snow will be removed as much as possible during winter to minimize the quantity of spring melt water inside the berm. Care will be taken to ensure contaminated snow/soil is not disturbed by leaving a base layer of snow (no less than 10 cm) in place. Following snowmelt any contaminated product left from winter spill clean-up operations will be padded up. The base soil in these areas will be excavated and added to existing remediation windrows as soon as possible after snow melt to minimize migration into the facility substrate.

3.6.2 Water Management

The landfarm will have an impermeable liner to prevent water from reaching the receiving environment. The landfarm floor will be sloped to allow accumulation of water in the southeast corner. In the event of water accumulation or seepage, the ponded water will be analyzed for Water License 2AM-WTP1826 Schedule 1 Table 1 Group 4 monitoring parameters prior to discharge to the adjacent IVR Attenuation Pond. Alternatively, ponded water will be sprayed on the windrows to increase moisture content, as required. Water accumulating in the landfarm will not be discharged to the receiving environment.

Visual inspections by the Environment Department will be conducted for seepage of contact water coming through the perimeter berm, or the accumulation of water within the containment berm. This will be conducted on a weekly basis starting after freshet and continuing until October when water is likely to be present.

3.7 Landfarm Closure and Reclamation

After removal of all remediated soil and prior to closure and reclamation of the landfarm, the berm and base will be sampled on a 10 m grid to determine if these soils are free from PHC contamination. Results of this analysis will be compared to GN criteria set out in Table 3. No excavation will be necessary if agricultural/industrial criteria are met. If industrial criteria are used, the landfarm will be covered with 2 m of waste rock or other material used for reclamation. The surrounding berm will be breached to avoid water accumulation on the landfarm.