Defence Construction Canada

Water Use License Application
Shepherd Bay Landfill Monitoring

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This Statement of Qualifications and Limitations is attached to and forms part of the Report.

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1. Post Construction Monitoring Program

1.1 Introduction

The CAM-3 Shepherd Bay DEW Line site is located on the southwest coast of the Boothia Peninsula in Nunavut at 68°48'38" north latitude and 96°26'01" west longitude. The site is approximately 60 km southeast of the community of Taloyoak, and consists of a beach area along the shore of Shepherd Bay and a main station area approximately 10 km inland from the beach.

CAM-3 was downsized in 1989 to a Long Range Radar (LRR) station within the North Warning System after being an auxiliary DEW Line station. The environmental clean-up and demolition of facilities not required for the operation of the LRR site commenced in 2002 and was completed during the summer of 2007. The clean-up included the closure and remediation of five existing landfills, the construction of a landfill for the disposal of non-hazardous waste generated from demolition and site debris collection, and the construction of a Tier II Soil Disposal Facility for disposal of Tier II impacted soils. The landfills at CAM-3 include:

- Beach Landfill;
- Non-Hazardous Waste Landfill;
- Station Landfill;
- Tier II Soil Disposal Facility;
- Northeast Landfill;
- USAF Landfill; and
- NWS Landfill.

1.2 Background

There were two initial site assessments of CAM-3 carried out independently, with the first by UMA Engineering Ltd. (UMA) in association with Hardy BBT Ltd. and Jacques Whitford Group (Jacques) in 1990, and the second by the Environmental Sciences Group (ESG) in 1989 and 1990. In 2000 and 2001, a detailed site investigation was completed to delineate contamination identified in the assessments, and to collect additional geophysical, geotechnical, demolition, and debris information. Input on traditional land use was provided by Nunavut Tunngavik Incorporated (NTI) at that time. The requirements for landfill closure were based on the 2000 and 2001 site investigation data. Finally, additional soil and groundwater sampling was completed as part of landfill baseline monitoring in 2006 and 2007, during site clean-up.

The Department of National Defence (DND), in cooperation with Nunavut Tunngavik Incorporated (NTI), developed a landfill monitoring plan to address post closure monitoring requirements for the landfills at the DEW Line Sites (Appendix B). Defence Construction Canada (DCC) is managing the cleanup and monitoring programs on behalf of DND.

The objective of the landfill monitoring program is to collect sufficient information to assess the performance of the landfills from a geotechnical and environmental perspective. The landfill monitoring plan specifies the requirements for visual inspection, and chemical and thermal monitoring of landfills at the DEW Line sites under DND's jurisdiction.

Table 1 provides the landfill monitoring schedule for the CAM-3 site.

Table 1 – Monitoring Schedule

No. of Years after Construction	Monitoring Event Number	Year
Prior to and during	Baseline	1989/1990, 2000-2007
1	1	2008
2	2	2009
3	3	2010
4	4	2011
5	5	2012
7	6	2014
10	7	2017
15	8	2022
25	9	2032

1.3 Program Components

The post-construction landfill monitoring program consists of four main components to measure the performance of the landfills, depending on the remediation plan for each landfill. These components are visual, soil, groundwater and thermal monitoring. Details on each of the monitoring components are provided below.

1.3.1 Visual Monitoring

The physical condition of each landfill is inspected in accordance with the Visual Inspection Checklist provided in the Environmental Provisions of the NTI-DND Agreement. Documented observations include evidence of settlement, ponding, frost action, erosion, and lateral movement, as well as sloughing of berms, and thermal contraction cracks. Documentation of observations is supported using hand drawn sketches, as applicable. Photographic Records are provided to document the general condition of the landfill and to substantiate all recorded observations.

1.3.2 Soil Monitoring

Background (naturally occurring) conditions refer to native soil geochemistry and represent soil quality from an area not impacted by site activities. Soil sampling to establish general site background conditions was conducted in 2000.

Baseline conditions refer to existing soil chemistry at the landfill area prior to and during remediation. The baseline landfill monitoring program consists of two phases: samples collected as part of the landfill assessment program which determined whether the landfill posed a potential environmental risk, and samples collected during the construction/closure of the landfill. The results of subsequent landfill monitoring events are compared to baseline and background values to evaluate any potential changes in environmental conditions.

As part of the baseline sampling program, soil samples are collected in areas upgradient and downgradient of each landfill. Upgradient samples are targeted to areas near the landfill, but not influenced by migration of contaminants through the landfill. Upgradient samples are meant to be representative of contaminant input conditions to the landfill and serve as the primary basis upon which to compare the downgradient contaminant concentrations.

Downgradient soil samples are collected at surface/shallow depths from designated areas at the toe of each landfill and from areas of preferential drainage. These soil samples are collected and analyzed to document whether there has been migration of contaminants from the landfill area. Although contaminants are primarily transported in water (surface and groundwater), they have a tendency to adsorb to soil particles the water is migrating through. Therefore the soil still retains information regarding the historical input of contaminants.

Analytical results of soil samples collected downgradient of landfills are compared to contaminant concentrations of samples collected upgradient of landfills. Downgradient samples are also compared to overall site background contaminant levels because they help in establishing a more broad level of contaminant concentrations that can be found at the site, particularly where different soil or rock types are present. Contaminant concentrations in downgradient samples that are significantly higher than background or upgradient concentrations, particularly where there have been changes over time; provide evidence of contaminants having migrated to, possibly beyond the soil sampling location. These data, in conjunction with other site-specific information, were used in the assessment of the environmental status of the landfill and the determination of an appropriate remediation solution.

Samples collected during baseline and subsequent landfill monitoring are analyzed for the following parameters:

- Inorganic elements: arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc.
- Mercury.
- PCBs (polychlorinated biphenyls – total Aroclor).
- TPH (Total Petroleum Hydrocarbons) – as represented by the sum of F1 (nC_6 to nC_{10}), F2 (nC_{10} to nC_{16}), and F3 (nC_{16} to nC_{34}), as defined by the CCME Tier I Method – Rev. 5, Analyses of Total Petroleum Hydrocarbons in soil.

The requirement for the analyses of baseline samples is to provide record information on the environmental status of the landfill should potential problems be identified during the monitoring program.

1.3.3 Groundwater Monitoring

During the construction phase, permanent groundwater monitoring wells are installed at all existing landfills classified as a moderate environmental risk (Class B landfills) and at new landfills built to support site remediation. At CAM-3, this includes the existing USAF Landfill (classified as Class B), the Non-Hazardous Waste Landfill (new), and the Tier II Disposal Facility (new). Groundwater monitoring wells were installed hydraulically upgradient and downgradient of the landfills. Surface and shallow depth soil samples are also collected adjacent to monitoring well locations. Analytical data from water samples collected from wells up and downgradient are reviewed in conjunction with soil analytical data to evaluate potential impacts associated with the landfill.

For baseline and for future monitoring events, the following physical measurements are recorded prior to the collections of groundwater samples from a monitoring well:

- Water elevation.
- Total water depth.
- Height of well stick-up.
- Depth to bottom of well.

- Presence of hydrocarbons.
- Hydrocarbon thickness (if appropriate).

Prior to sampling, monitoring wells are purged until groundwater parameters such as pH, temperature and conductivity stabilize. In the event of low recharge volumes, standing water may be sampled and specifically documented. Water samples are not filtered.

Following withdrawal of a water sample, other physical measurements recorded inside:

- Colour, odour.
- pH, conductivity and temperature.

Groundwater samples are analyzed for the following parameters:

- Inorganic elements (total concentrations): arsenic, cadmium, chromium, cobalt, copper, lead, nickel and zinc.
- Mercury.
- PCBs (polychlorinated biphenyls – total Aroclor).
- TPH (Total Petroleum Hydrocarbons) – C_6 to C_{32}.

1.3.4 Thermal Monitoring

For Class B landfills and Tier II Soil Disposal Facilities where a component of the design includes the placement of sufficient fill to promote aggradation of permafrost through the landfill contents, geothermal modeling is conducted to determine the maximum depth of active layer at the landfill, and the amount of fill required on the landfill surface to ensure that the active layer does not penetrate into the landfill contents following freeze-back. Modeling also determines the length of time required for the landfill contents to freeze-back following the placement of additional surface fill. Geothermal modeling considers the following:

- soil type
- soil thermal properties
- presence or absence of insulating cover (vegetation or snow drift)
- measured ground temperatures at the site or at nearby sites
- measured air temperature and climatic data (1957-2000 climate normals data from Environment Canada for Shepherd Bay, Nunavut)
- an estimated 1 in 100 warm year air temperature
- an estimated ten consecutive years of 1 in 100 warm years, and
- an estimate of the effect of global warming (based on estimates of temperature change reported by the Panel on Energy Research and Development for Environment Canada – PERD – in 1998).

At CAM-3, a typical active layer depth based on mean climatic data is 1.5 m for the Tier II Soil Disposal Facility. The predicted active layer depth for a 1 in 100 warm year is 2.0 and for ten consecutive 1 in 100 warm years is 2.1 m. The predicted mean active layer depth for the landfill after 100 years of global warming (using the best estimate approximation method as opposed to more conservative estimates) is 1.9 m. The active layer depth used for the Tier II Soil Disposal Facility design at CAM-3 is the resultant active layer depth from modeling 10 consecutive 1 in 100 warm years, which also accounts for a climate change – a depth of 2.1 m. It is expected to take one year for the landfill contents to freeze back with this

depth of cover fill. These same design parameters were used for the leachate containment design of the USAF Landfill.

During landfill construction, vertical thermistors were installed within the landfill to record ground temperatures. Measured ground temperatures will be compared to the active layer depth and freeze back time modelled during design. It is anticipated that all landfills where freeze back is an integral part of the design will reach thermal equilibrium within approximately five years following closure. If thermal equilibrium is not achieved within five years, it may be necessary to increase the term of the thermal monitoring.

1.4 Frequency

The landfill monitoring program consists of three phases, as described in detail below.

1.4.1 Phase I

Phase I involves monitoring of conditions to confirm that equilibrium is achieved. The frequency of monitoring events during Phase I is dependent on the closure or remediation design at specific landfills. The five-year term was selected on the basis that ground-temperature thermal regimes will require three to five years to reach equilibrium.

An evaluation of all Phase I data is carried out at the end of five years to confirm that thermal and chemical equilibrium is achieved, and that no stability issues are identified. The Phase I monitoring program may be extended, if required, to provide sufficient data to establish equilibrium conditions.

The first year of the Phase I post-construction monitoring is completed by the Environmental Sciences Group (ESG) of the Royal Military College of Canada, who are part of the DEW Line Clean Up Project Team. Subsequent landfill monitoring events are carried out by independent contractors, who successfully win the competitive tender.

1.4.2 Phase II

Phase II monitoring is the verification of equilibrium conditions established in Phase I. The monitoring frequency in Phase II is downgraded from Phase I and will be carried out according to the following schedule: year 7, 10, 15 and 25. Year 25 marks the end of Phase II monitoring.

1.4.3 Phase III

Phase III involves the monitoring for long-term issues such as liner integrity, permafrost stability and significant storm events. At the end of the Phase II program, 25 years after construction, a re-evaluation of the landfill monitoring program will be carried out prior to initiating any Phase III program. The scope of the Phase III monitoring program is not included here, but is anticipated to be based on a 10 year monitoring interval.

1.5 Review and Evaluation Process

An Environmental Working Group (EWG) was established to provide a technical report and to support the DLCU Steering Committee. This working group is comprised of qualified engineering and environmental scientists with expertise in environmental remediation and clean up in northern climates. The EWG has four designated representatives, two from each of the Owner (DND) and the Inuit (through the NTI), respectively.

During the monitoring program, the EWG reviews the results of the monitoring program in accordance with the methodology as described previously. The results of the review and any recommendations regarding changes to the monitoring plan and/or remediation requirements are reported to the DND/NTI Steering Committee.

The requirement for further monitoring after 25 years is evaluated. Monitoring may be terminated if the performance of the landfill was satisfactory over the period of monitoring from an environmental, geotechnical and thermal perspective, as appropriate. The assessment of satisfactory performance is carried out jointly by the NTI and DND.

2. Detailed Landfill Monitoring Requirements

Site figures documenting the monitoring locations at each landfill are provided in Appendix A. Table 2 provides a summary of the general landfill monitoring requirements at the DND DEW Line sites following construction.

Table 2 - General Landfill Monitoring Requirements

Landfill Classification	Visual Inspection	Groundwater Sampling	Soil Sampling	Thermal Monitoring
Existing Landfills, High Potential Environmental Risk (Class A)	Not required, as landfill to be excavated			
Existing Landfills, Moderate Potential Environmental Risk (Class B)	√	√	√	√
Existing Landfill, Low Potential Environmental Risk (Class C)	√		√	
New Landfill, Non-Hazardous Waste Landfill	√	√	√	
New Landfill, DCC Tier II Disposal Facility	√	√	√	√

A summary of these requirements, as related to the specific landfills at CAM-3, is provided in Table 3. The rationale for the monitoring requirements is provided in the landfill-specific sections.

Table 3 – CAM-3 Landfill Monitoring Requirements

Landfill Designation	Visual Inspection	Groundwater Sampling	Soil Sampling	Thermal Monitoring
Beach Landfill	√		√	
Non-Hazardous Waste Landfill	√	√	√	
Station Landfill	√		√	
Tier II Disposal Facility	√	√	√	√
Northeast Landfill	√		√	
USAF Landfill	√	√	√	√
NWS Landfill	√		√	

2.1 Station Landfill

The Station Landfill is located approximately 200 m southeast of the module train along a ridge on the south side of the access road between the station and airstrip. Geophysics identified five lobes of debris, for a combined area of 6,100 m^2. The debris was primarily dumped and covered off the edge of the ridge, with some debris having been placed in separate piles away from the ridge and subsequently covered with fill. No evidence of contaminant migration was detected. Localized Tier II contamination was detected associated with surface debris.

Based on the evaluation of the landfill as a source of contamination, potential pathways and receptors, the Station Landfill was classified as a low potential environmental risk. The remediation of this landfill consisted of regrading with the placement of additional granular fill, and excavation of the Tier II soil. Three of the lobes in close proximity to one another were regraded as one continuous area, while the other two lobes were regraded separately.

The long term monitoring plan consists of visual monitoring and periodic collection of soil samples. Table 4 provides the coordinates of the monitoring stations at the Station Landfill and Table 5 provides the detailed monitoring requirements.

Table 4 – Station Landfill Monitoring Coordinates

	Coordinates		Elevation
Landfill Designation/Monitoring Locations	**North (m)**	**East (m)**	**(masl)**
Station Landfill			
C3-4 (soil)	9840.14	10027.65	
C3-5 (soil)	9789.97	9928.20	
C3-6 (soil)	9762.22	9985.12	
C3-7 (soil)	9758.22	10050.71	
C3-8 (soil)	9711.38	10092.89	

Note: Coordinates are referenced to the site grid and are approximate locations.

Table 5 – Station Landfill Monitoring Requirements

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	N/A
C3-4 to C3-8	Soil	Once per year in 2008-2012; 2014; 2017; 2022; and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

2.2 USAF Landfill

The USAF Landfill is located approximately 2.3 kilometres east and 1.4 kilometres north of the main station area on the southeast side of the Winter Water Lake Road. The landfill consisted largely of buried debris covering an area of 6,570 m^2. The landfill area is elevated approximately 1.0 to 2.5 metres above the surrounding tundra at its downgradient edge, and the mound extends out from a large beach ridge and road area. The landfill was covered with sand and gravel with a small amount of vegetation. Off the edge of the landfill, the terrain changes to a poorly drained tundra consisting of a thick organic mat overlying dense silt or clay. Tier II soil was identified on the landfill surface at several locations (generally associated with debris), and Type A (lubricating oil) contamination was also identified downgradient of the landfill. Some evidence of contaminant migration was detected, however, the data indicated that contaminant migration was due to surface rather subsurface transport.

Based on the evaluation of the landfill as a source of contamination, potential pathways and receptors, the USAF Landfill was classified as a moderate potential environmental risk. Remediation included the excavation of the Type A soil downgradient of the landfill, and the installation of a leachate contaminant system which would effectively encapsulate surficial Tier II soil. A modified leachate containment system was installed at the landfill perimeter during remediation, which addressed the surface contaminant migration potential, but accounted for the existing low-

permeability of the surrounding soil away from the landfill (i.e. clay). The landfill remediation also included the installation of four monitoring wells at the landfill perimeter and four thermistors within the landfill footprint to monitor freeze back conditions.

The long term monitoring plan consists of visual monitoring, periodic collection of soil and groundwater samples and downloading of ground temperature data. Table 6 provides the coordinates of the monitoring stations at the USAF Landfill and Table 7 provides the detailed monitoring requirements.

Table 6 – USAF Landfill Monitoring Coordinates

	Coordinates		Elevation
Landfill Designation/Monitoring Locations	**North (m)**	**East (m)**	**(masl)**
USAF Landfill			
VT-1 (ground temperature)	11447.0	12226.9	48.8
VT-2 (ground temperature)	11412.9	12220.3	46.6
VT-3 (ground temperature)	11416.6	12289.8	46.4
VT-4 (ground temperature)	11422.1	12321.3	45.1
MW-12 (soil and groundwater)	11501.2	12196.3	44.9
MW-13 (soil and groundwater)	11366.9	12268.4	45.4
MW-14 (soil and groundwater)	11367.0	12348.0	42.6
MW-15 (soil and groundwater)	11451.4	12323.4	43.2

Note: Coordinates are referenced to the site grid and are approximate locations.

Table 7 – USAF Landfill Monitoring Requirements

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	N/A
MW-12 to MW-15	Groundwater	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C_6-C_{32})
MW-12 to MW-15	Soil	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel

Location	Sample Type	Frequency	Parameters
			Zinc
			Mercury
VT-1 to VT-4	Thermal	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	Temperature

2.3 NWS Landfill

The NWS Landfill is located immediately adjacent to the northwest edge of the USAF Landfill and contains a limited amount of debris in an area approximately 640 m^2. At the time of investigation, the NWS Landfill area was covered with sand and gravel and was well graded. With the exception of a small amount of subsidence 0.3 metres deep in the geophysical survey, there is little visual evidence that there was a landfill in this area. Wet low-lying ground beyond the landfill comprises the native ground of the area. An erosion channel was noted running through the length of the landfill.

The landfill was classified as a low potential environmental risk, based on its evaluation as a source of contamination, pathways and receptors. The remediation of this landfill consisted of the placement of additional granular fill.

The long term monitoring plan consists of visual monitoring and periodic collection of soil samples. Table 8 provides the coordinates of the monitoring stations at the NWS Landfill and Table 9 provides the detailed monitoring requirements.

Table 8 – NWS Landfill Monitoring Stations

	Coordinates		Elevation
Landfill Designation/Monitoring Locations	**North (m)**	**East (m)**	**(masl)**
NWS Landfill			
C3-19 (soil)	11565.16	12313.12	
C3-20 soil)	11515.39	12360.93	
C3-21 (soil)	11498.15	12332.72	

Note: Coordinates are referenced to the site grid and are approximate locations.

Table 9 – NWS Landfill Monitoring Requirements

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	N/A
C3-19 to C3-21	Soil	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc

			Mercury

2.4 Northeast Landfill

The Northeast Landfill is located approximately 1 kilometre north of the module train. Geophysics identified 12 lobes of debris, for a combined area of 21,800 m^2. The landfill is located along the crest of a former beach ridge, which slopes gently to the east and has a well defined toe to the west; the east portion is relatively flat and the western portion slopes down to a wet low-lying area. Localized Tier I and Tier II contamination, and Type A (lubricating oil) soil contamination was identified at some of the lobes, however, the impacts were all associated with surface debris or staining. No evidence of contaminant migration was identified.

Based on the evaluation of the landfill as a source of contamination, potential pathways and receptors, the Northeast Landfill was classified as a low potential environmental risk. The landfill remediation included the removal of surface debris and localized contaminated areas, along with regrading and the placement of additional granular fill. Several of the lobes in close proximity to one another were regraded as one area.

The long term monitoring plan consists of visual monitoring and periodic collection of soil samples. Table 10 provides the coordinates of the monitoring stations at the Northeast Landfill and Table 11 provides the detailed monitoring requirements.

Table 10 – Northeast Landfill Monitoring Stations

	Coordinates		Elevation
Landfill Designation/Monitoring Locations	**North (m)**	**East (m)**	**(masl)**
NWS Landfill			
C3-9 (soil)	11247.6	10453.9	
C3-10 soil)	11279.8	10545.0	
C3-11 (soil)	11164.5	10538.3	
C3-12 (soil)	11055.4	10418.6	
C3-13 (soil)	10978.6	10340.0	
C3-14 (soil)	11065.7	10322.5	
C3-15 (soil)	11160.7	10331.6	
C3-16 (soil)	11256.1	10315.3	
C3-17 (soil)	11337.9	10375.9	
C3-18 (soil)	11423.6	10404.7	

Note: Coordinates are referenced to the site grid and are approximate locations.

Table 11 – Northeast Landfill Monitoring Requirements

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	N/A
	Soil	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt

			Copper
			Lead
			Nickel
			Zinc
			Mercury

2.5 Beach Landfill

The Beach Landfill is located approximately 100 meters south of the beach POL tanks and 50 metres from the ocean. The landfill is within a flat disturbed area that was difficult to distinguish from the native granular deposits along the beach. Two anomalies were identified during geophysical surveys, covering an estimated area of 1,500 m^2. The landfill was well covered with minimal debris visible at surface. No evidence of contaminant migration was detected. Type A (lubricating oil) hydrocarbon staining was identified within the landfill proximity.

Based on the evaluation of the landfill as a source of contamination, potential pathways and receptors, the Beach Landfill was classified as a low potential environmental risk. The landfill remediation included regrading and the placement of additional granular fill to direct flow around the sides of the landfill and the removal of contaminated soil.

The long term monitoring plan will consist of visual monitoring and periodic collection of soil samples. Table 12 provides the coordinates of the monitoring stations at the Beach Landfill and Table 13 provides the detailed monitoring requirements.

Table 12 – Beach Landfill Monitoring Stations

	Coordinates		Elevation
Landfill Designation/Monitoring Locations	**North (m)**	**East (m)**	**(masl)**
Beach Landfill			
C3-1 (soil)	10976.7	2707.8	
C3-2 (soil)	10997.2	2626.6	
C3-3 (soil)	11019.8	2663.9	

Note: Coordinates are referenced to the site grid and are approximate locations.

Table 13 – Beach Landfill Monitoring Requirements

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	N/A
C3-1 to C3-3	Soil	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

2.6 Non-Hazardous Waste Landfill

The Non-Hazardous Waste Landfill is located south of the existing Northeast Landfill, and to the north of the junction between the main station access road and the road to the beach area. The landfill was constructed for the disposal of non-hazardous wastes and debris generated and collected during site clean-up.

The design of this landfill includes perimeter berms, and the placement of a cover of compacted granular fill over the landfilled material. Three groundwater monitoring wells were installed at the landfill perimeter.

The long term monitoring plan will consist of visual monitoring and periodic collection of soil and groundwater samples. Table 14 provides the coordinates of the monitoring stations at the Non-Hazardous Waste Landfill and Table 15 provides the detailed monitoring requirements.

Table 14 – Non-Hazardous Waste Landfill Monitoring Stations

	Coordinates		Elevation
Landfill Designation/Monitoring Locations	**North (m)**	**East (m)**	**(masl)**
Non-Hazardous Waste Landfill			
MW-1 (soil and groundwater)	10721.1	10338.8	42.2
MW-2 (soil and groundwater)	10773.4	10285.6	39.2
MW-3 (soil and groundwater)	10741.2	10273.6	39.6

Note: Coordinates are referenced to the site grid and are approximate locations.

Table 15 – Non-Hazardous Waste Landfill Monitoring Requirements

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	N/A
MW-1 to MW-3	Groundwater	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C_6-C_{32})
MW-1 to MW-3	Soil	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead

Location	Sample Type	Frequency	Parameters
			Nickel
			Zinc
			Mercury

2.7 Tier II Soil Disposal Facility

A Tier II Soil Disposal Facility has been constructed at CAM-3 for the disposal of Tier II soil excavated during the clean-up. The Facility is located along the south edge of the U-shaped ridge of the site, to the south of the airstrip and to the east of the Station Landfill.

The design of this landfill included a double containment system consisting of a liner system and the construction of saturated, low-permeability berms, followed by the placement of sufficient surface fill to promote freezing of landfill contents and containment berms. The liner was placed along the bottom of the landfill, along the berms, and over the top of the landfill contents and thermistors were installed within the landfill in the berms and the main body of the landfill. Four monitoring wells were installed at the landfill perimeter.

The long term monitoring plan consists of visual monitoring, periodic collection of soil and groundwater samples, and monitoring of subsurface ground temperatures in the berms and in the main body of the disposal facility. Table 16 provides the coordinates of the monitoring stations at the Non-Hazardous Waste Landfill and Table 17 provides the detailed monitoring requirements.

Table 16 – Tier II Soil Disposal Facility Monitoring Stations

	Coordinates		Elevation
Landfill Designation/Monitoring Locations	**North (m)**	**East (m)**	**(masl)**
Tier II Soil Disposal Facility			
VT-5 (ground temperature)	9610.4	10348.5	43.7
VT-6 (ground temperature)	7615.4	10315.6	44.0
VT-7 (ground temperature)	9588.2	10307.0	43.1
VT-8 (ground temperature)	9583.7	10337.5	43.3
MW-4 (soil and groundwater)	9642.0	10333.7	41.8
MW-5 (soil and groundwater)	9563.7	10295.8	37.0
MW-6 (soil and groundwater)	9550.3	10322.7	36.9
MW-7 (soil and groundwater)	9560.2	10366.5	36.9
C3-9 (soil)	11247.58	10453.90	
C3-10 (soil)	11279.77	10545.03	
C3-11 (soil)	11164.51	10538.26	
C3-12 (soil)	11055.42	10418.64	
C3-13 (soil)	10978.59	10339.95	
C3-14 (soil)	11065.72	10322.48	
C3-15 (soil)	11160.72	10331.55	
C3-16 (soil)	11256.05	10315.3	
C3-17 (soil)	11337.86	10375.91	
C3-18 (soil)	11423.59	10404.74	

Note: Coordinates are referenced to the site grid and are approximate locations.

Table 17 – Tier II Soil Disposal Facility Monitoring Requirements

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in 2008,	N/A

Location	Sample Type	Frequency	Parameters
		2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	
MW-4 to MW-7	Groundwater	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C_6-C_{32})
MW-4 to MW-7; C3-9 to C3-18	Soil	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	PCBs
			F1 (C_6-C_{10})
			F2 (C_{10}-C_{16})
			F3 (C_{16}-C_{34})
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury
VT-5 to VT-8	Thermal	Once per year in 2008, 2009, 2010, 2011, 2012, 2014, 2017, 2022, and 2032	Temperature

Appendix A

CAM-3 Landfill Monitoring Site Figures

LEGEND:

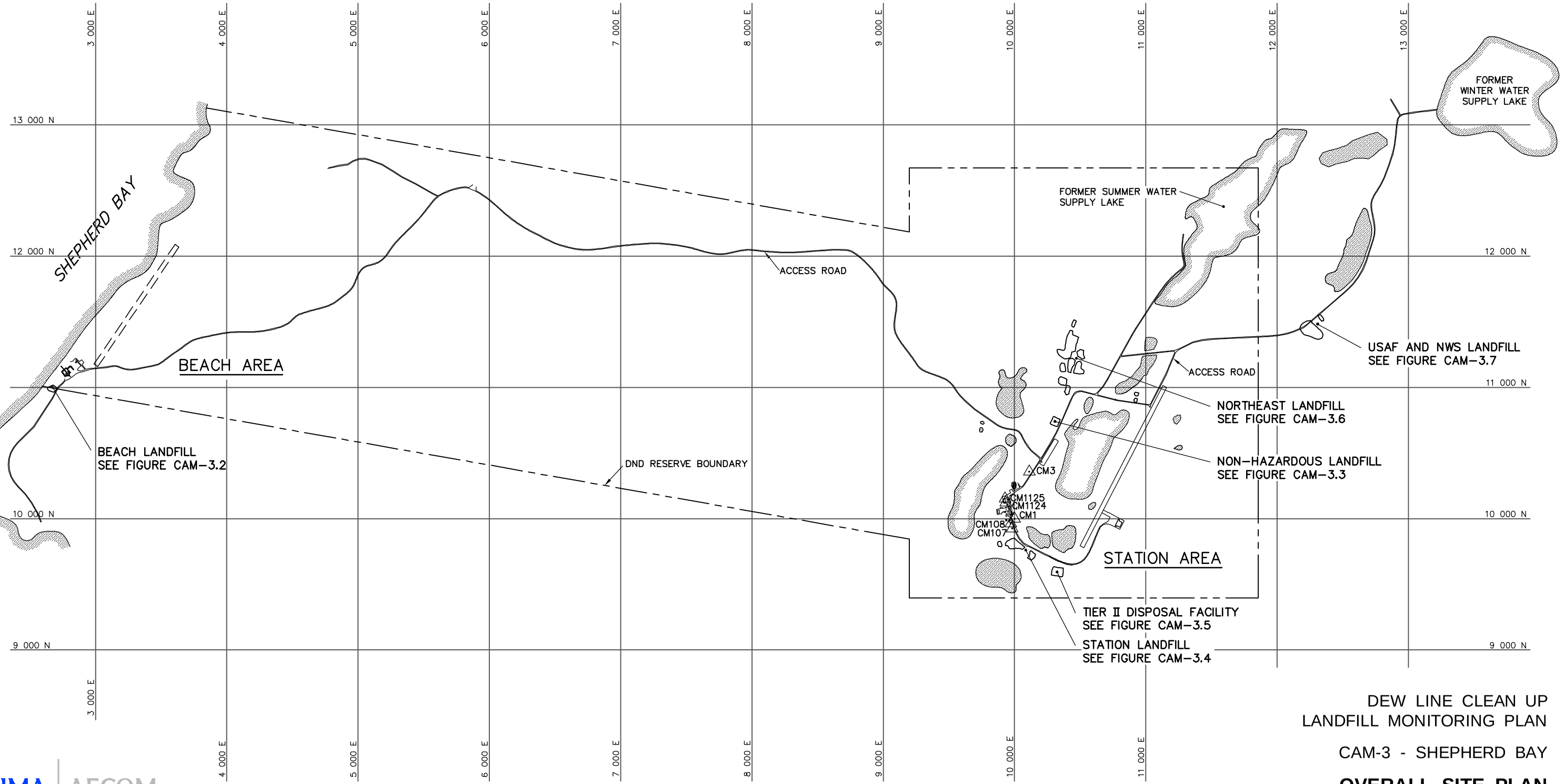
CM1 △ SURVEY CONTROL MONUMENT

SURVEY CONTROL MONUMENTS (LOCAL COORDINATES)				
NO.	COORDINATES		ELEV.	DESCRIPTION
	NORTHING	EASTING		
CM1	10 000.000	10 000.000	41.775	CAM-3 BASELINE
CM3	10 357.750	10 111.994	41.450	GSC MON. 749725
CM107	9 926.007	9 982.062	43.107	DMA MON. 11811
CM108	9 962.344	9 970.897	42.690	DMA RM. 11811
CM1124	10 121.226	9 933.143	43.418	TECSULT
CM1125	10 152.084	9 927.809	43.406	TECSULT

SURVEY CONTROL MONUMENTS (UTM COORDINATES)				
NO.	COORDINATES		ELEV.	DESCRIPTION
	NORTHING	EASTING		
X				
X				

0 300 600 900m

300 150 1:30000



DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

CAM-3 - SHEPHERD BAY

OVERALL SITE PLAN

FIGURE CAM-3.1

UMA | AECOM

DOS NAME: C3-RD01.DWG DMJ - 06/06/21

SHEPHERD BAY

N

95m 96m 97m 98m 99m

49 625 E | 49 650 E | 49 675 E | 49 700 E | 49 725 E

39 800 N | 39 775 N | 39 750 N | 39 725 N

DND RESERVE BOUNDARY

ACCESS ROAD

C3-3 | C3-2 | C3-1

641 | 642 | 643 | 644 | 645 | 646

98m | 99m

49 600 E | 49 625 E | 49 650 E | 49 675 E | 49 700 E | 49 725 E | 49 750 E | 49 775 E

LEGEND:

130→ COORDINATE POINT

■ MONITORING SOIL SAMPLE LOCATION

COORDINATE POINTS			
NO.	COORDINATES		ELEV.
	NORTHING	EASTING	
641	39 773.8	49 696.0	99.9
642	39 747.5	49 676.6	99.7
643	39 755.9	49 644.2	98.6
644	39 764.1	49 633.5	98.0
645	39 771.4	49 632.2	97.8
646	39 791.3	49 669.3	98.9

0 5 10 15m

5 2.5 1:500

UMA | AECOM

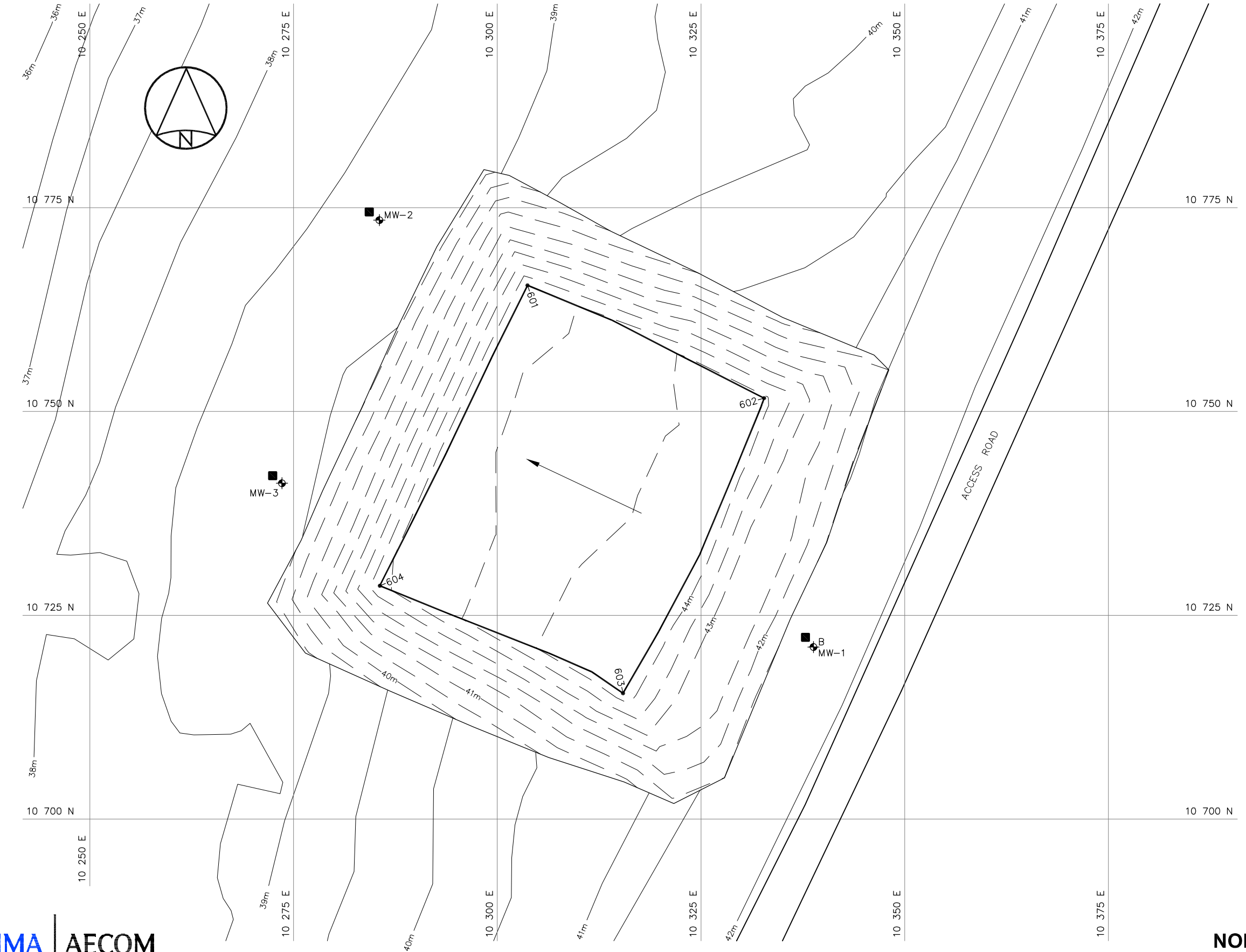
DWG NAME: C3-RD02.DWG DMJ – 06/06/21

DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

CAM-3 - SHEPHERD BAY

BEACH LANDFILL

FIGURE CAM-3.2



LEGEND:

- 130-• COORDINATE POINT
- MONITORING WELL LOCATION
- MONITORING SOIL SAMPLE LOCATION

COORDINATE POINTS			
NO.	COORDINATES		ELEV.
	NORTHING	EASTING	
601	10 765.5	10 303.7	43.4
602	10 751.6	10 332.7	44.1
603	10 715.4	10 315.4	44.3
604	10 728.6	10 285.6	42.9

MONITORING WELLS			
NO.	COORDINATES		GROUND ELEV.
	NORTHING	EASTING	
MW-1	10 721.1	10 338.8	42.2
MW-2	10 773.5	10 285.5	39.2
MW-3	10 741.2	10 273.6	39.6

0 5 10 15m
5 2.5 1:500

UMA | AECOM

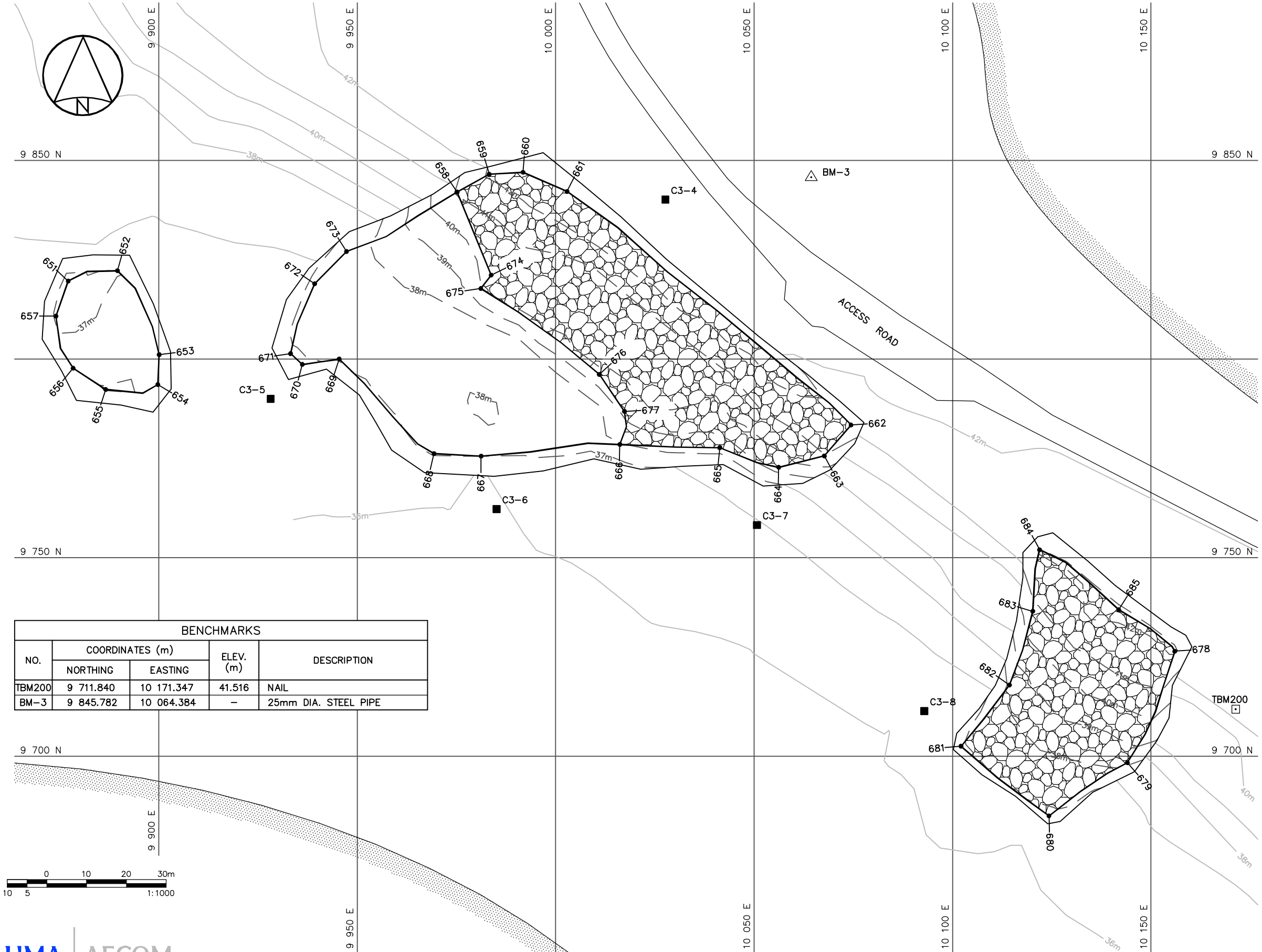
DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

CAM-3 - SHEPHERD BAY

NON-HAZARDOUS WASTE LANDFILL

FIGURE CAM-3.3

DOS NAME: C3-R003.DWG DMJ - 06/06/21



LEGEND:

- CM27△ SURVEY CONTROL MONUMENT
- TBM20⊡ TEMPORARY BENCHMARK
- 130–• COORDINATE POINT
- ■ MONITORING SOIL SAMPLE LOCATION

COORDINATE POINTS STATION AREA LANDFILL		
NO.	NORTHING	EASTING
651	9 819.7	9 877.2
652	9 822.2	9 889.6
653	9 801.1	9 900.1
654	9 793.6	9 899.8
655	9 792.4	9 886.6
656	9 797.7	9 878.5
657	9 810.8	9 874.1

COORDINATE POINTS STATION AREA LANDFILL		
NO.	NORTHING	EASTING
658	9 842.1	9 975.2
659	9 846.6	9 983.3
660	9 847.0	9 991.8
661	9 842.2	10 002.9
662	9 783.4	10 074.4
663	9 775.6	10 067.7
664	9 772.7	10 056.2
665	9 777.7	10 041.4
666	9 778.5	10 016.2
667	9 775.5	9 981.2
668	9 776.2	9 969.4
669	9 800.0	9 945.5
670	9 798.6	9 936.2
671	9 801.4	9 933.2
672	9 819.0	9 939.3
673	9 827.1	9 947.3
674	9 821.2	9 983.8
675	9 817.8	9 981.1
676	9 796.1	10 011.0
677	9 786.8	10 017.4

COORDINATE POINTS STATION AREA LANDFILL		
NO.	NORTHING	EASTING
678	9 726.5	10 156.0
679	9 698.4	10 144.0
680	9 685.0	10 124.3
681	9 702.5	10 102.1
682	9 718.0	10 114.3
683	9 736.5	10 120.2
684	9 752.0	10 121.9
685	9 736.9	10 141.9

BENCHMARKS				
NO.	COORDINATES (m)		ELEV. (m)	DESCRIPTION
	NORTHING	EASTING		
TBM200	9 711.840	10 171.347	41.516	NAIL
BM-3	9 845.782	10 064.384	–	25mm DIA. STEEL PIPE

UMA | AECOM

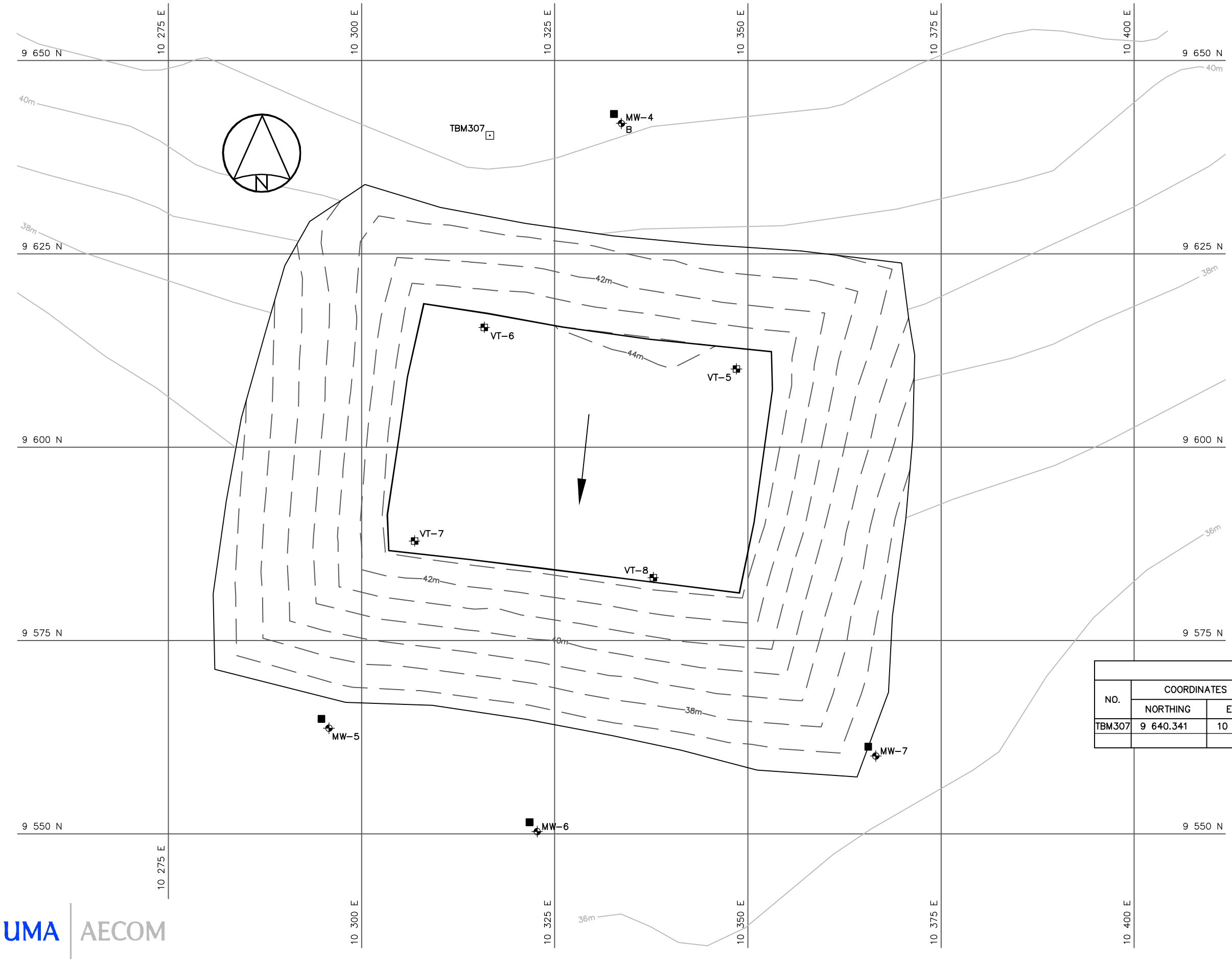
DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

CAM-3 - SHEPHERD BAY

STATION LANDFILL

FIGURE CAM-3.4

DOS NAME: C3-R004.DWG DMJ – 06/06/21



LEGEND:

- TBM20 ⊡ TEMPORARY BENCHMARK
- 130 • COORDINATE POINT
- ⌖ MONITORING WELL LOCATION
- VT ⌖ VERTICAL THERMISTOR
- ■ MONITORING SOIL SAMPLE LOCATION

MONITORING WELLS			
NO.	COORDINATES		GROUND ELEV.
	NORTHING	EASTING	
MW-4	9 641.9	10 333.6	41.9
MW-5	9 563.7	10 295.8	37.0
MW-6	9 550.3	10 322.7	36.9
MW-7	9 560.1	10 366.6	36.9

THERMISTORS			
NO.	COORDINATES		GROUND ELEV.
	NORTHING	EASTING	
VT-5	9 610.1	10 348.5	44.2
VT-6	9 615.5	10 315.9	44.0
VT-7	9 587.9	10 306.9	43.3
VT-8	9 583.1	10 337.8	43.4

BENCHMARKS				
NO.	COORDINATES (m)		ELEV. (m)	DESCRIPTION
	NORTHING	EASTING		
TBM307	9 640.341	10 316.602	41.308	NAIL

0 5 10 15m
5 2.5 1:500

UMA | AECOM

DWG NAME: C3-RD04.DWG DMJ - 06/06/21

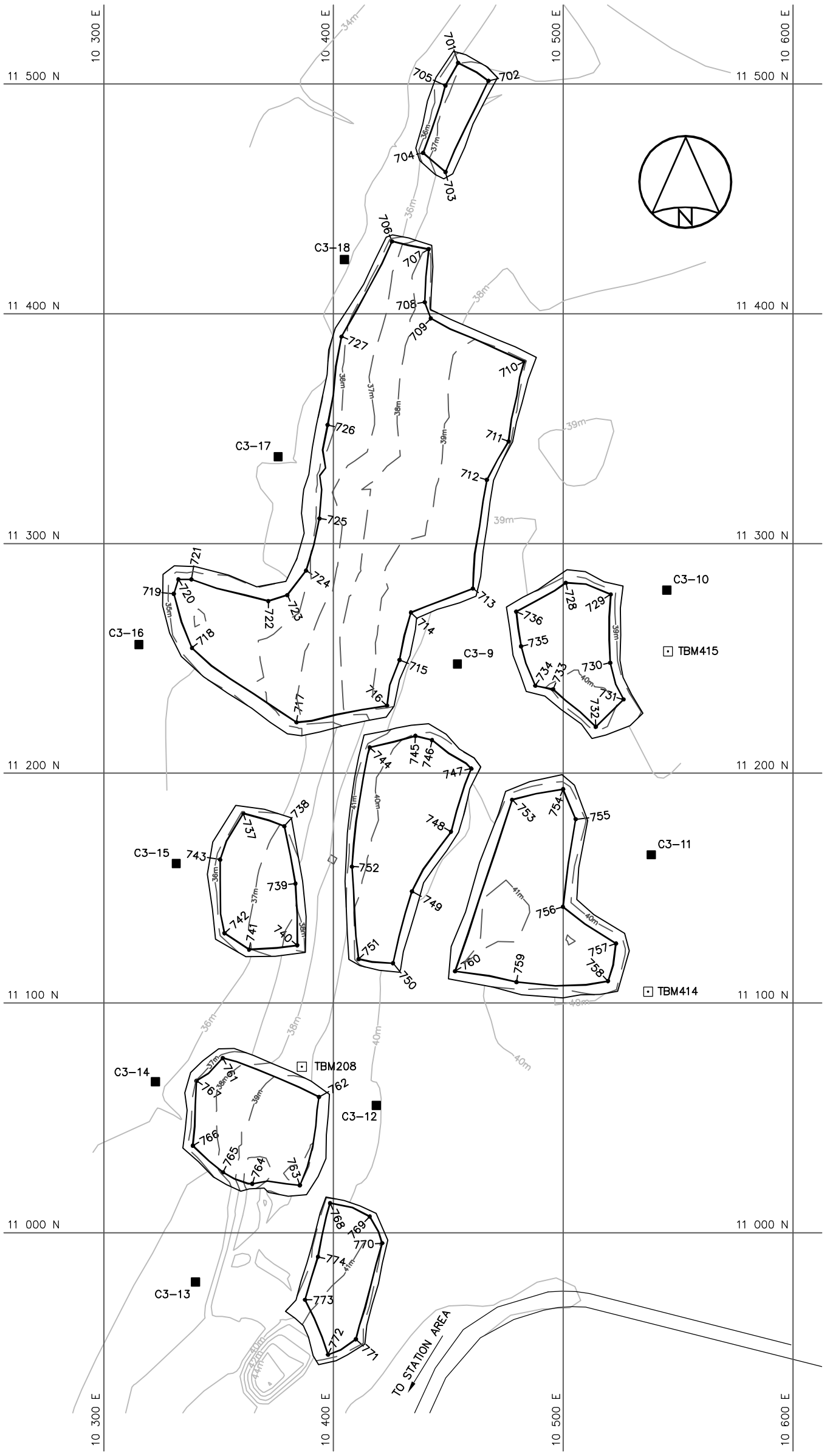
DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

CAM-3 - SHEPHERD BAY

TIER II DISPOSAL FACILITY

FIGURE CAM-3.5

COORDINATE POINTS NORTHEAST LANDFILL		
NO.	NORTHING	EASTING
701	11 509.2	10 454.2
702	11 501.4	10 467.4
703	11 461.8	10 448.7
704	11 470.1	10 439.0
705	11 499.4	10 448.7
706	11 431.6	10 425.4
707	11 428.2	10 441.4
708	11 405.0	10 439.7
709	11 398.0	10 442.3
710	11 379.3	10 483.0
711	11 344.4	10 476.2
712	11 327.8	10 466.7
713	11 280.4	10 460.6
714	11 270.0	10 433.7
715	11 249.3	10 428.7
716	11 229.4	10 423.3
717	11 222.2	10 383.9
718	11 254.5	10 338.4
719	11 278.2	10 330.5
720	11 284.4	10 332.5
721	11 284.4	10 338.1
722	11 275.0	10 371.6
723	11 277.6	10 379.9
724	11 288.2	10 388.0
725	11 310.9	10 393.9
726	11 351.6	10 397.4
727	11 390.1	10 403.5
728	11 283.0	10 501.1
729	11 277.9	10 520.7
730	11 248.1	10 520.4
731	11 232.2	10 526.2
732	11 220.2	10 514.1
733	11 236.6	10 495.5
734	11 238.1	10 487.8
735	11 255.3	10 481.6
736	11 270.4	10 479.5
737	11 182.6	10 360.7
738	11 177.0	10 378.6
739	11 152.0	10 383.4
740	11 125.1	10 384.2
741	11 123.3	10 363.3
742	11 130.4	10 352.6
743	11 162.4	10 350.7
744	11 211.3	10 415.7
745	11 216.3	10 435.6
746	11 214.4	10 442.8
747	11 202.1	10 460.0
748	11 174.5	10 451.1
749	11 148.6	10 434.1
750	11 117.3	10 425.9
751	11 119.1	10 410.9
752	11 159.4	10 408.0
753	11 188.5	10 477.7
754	11 193.1	10 499.9
755	11 180.0	10 505.4
756	11 141.9	10 499.8
757	11 125.9	10 522.9
758	11 109.5	10 519.5
759	11 109.2	10 479.6
760	11 113.8	10 452.9
761	11 076.0	10 351.8
762	11 059.1	10 393.7
763	11 020.6	10 385.4
764	11 021.3	10 364.7
765	11 026.3	10 351.9
766	11 037.9	10 338.8
767	11 066.1	10 340.4
768	11 012.9	10 398.5
769	11 007.1	10 415.8
770	10 995.5	10 421.2
771	10 953.6	10 409.7
772	10 946.9	10 397.6
773	10 970.8	10 387.6
774	10 989.5	10 393.2



TEMPORARY BENCHMARKS				
NO.	COORDINATES (m)		ELEV. (m)	DESCRIPTION
	NORTHING	EASTING		
208	11 072.305	10 386.113	38.911	NAIL
414	11 104.981	10 536.900	40.119	2x2 WOODEN HUB
415	11 253.052	10 545.538	39.061	2x2 WOODEN HUB

LEGEND:

TBM20 ⊡ TEMPORARY BENCHMARK

130 ● COORDINATE POINT

■ MONITORING SOIL SAMPLE LOCATION

0 20 40 60m

20 10 1:2000

DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

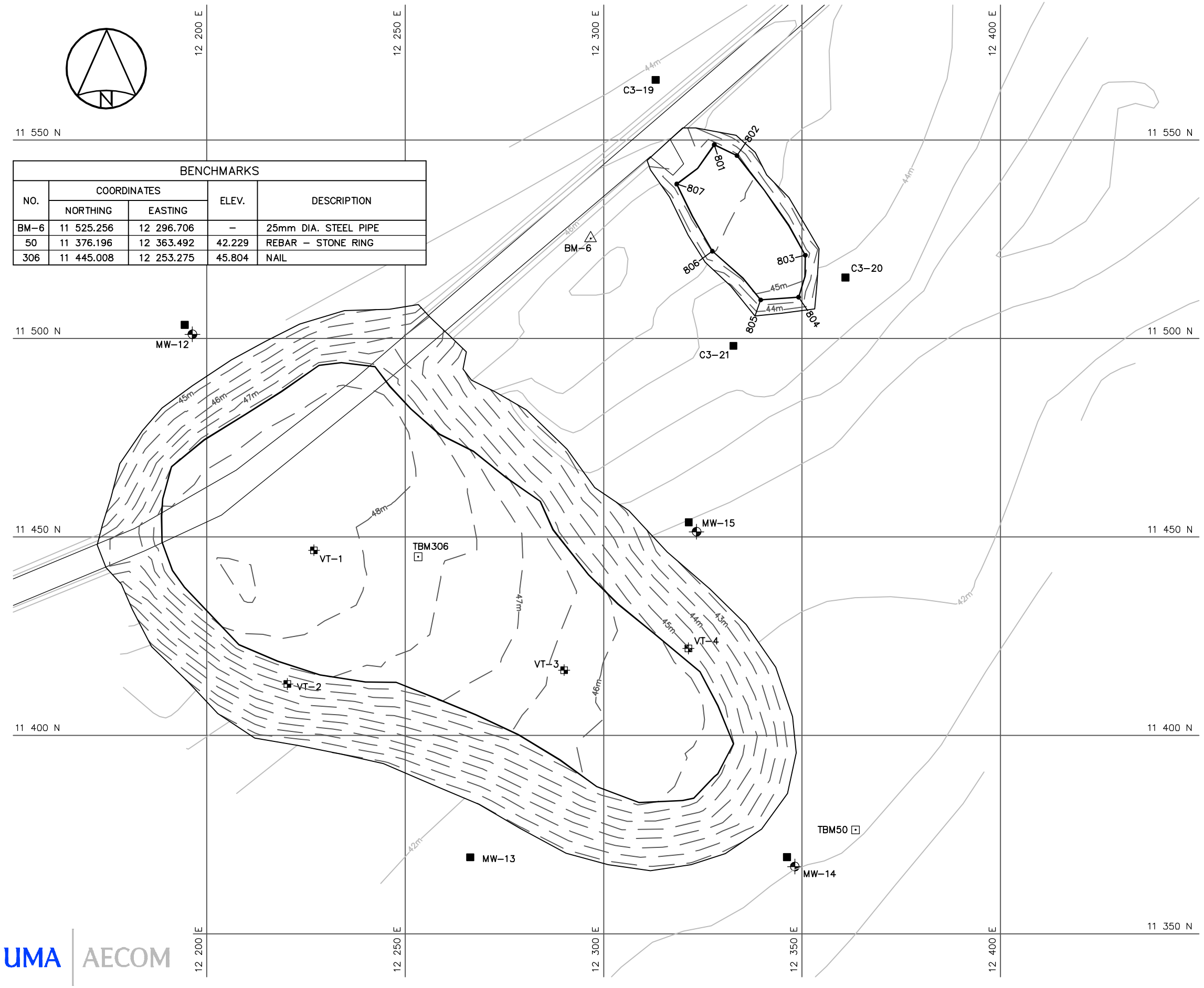
CAM-3 - SHEPHERD BAY

NORTHEAST LANDFILL

FIGURE CAM-3.6

UMA | AECOM

DOS NAME: C3-RD04.DWG DMJ – 06/06/21



BENCHMARKS				
NO.	COORDINATES		ELEV.	DESCRIPTION
	NORTHING	EASTING		
BM–6	11 525.256	12 296.706	–	25mm DIA. STEEL PIPE
50	11 376.196	12 363.492	42.229	REBAR – STONE RING
306	11 445.008	12 253.275	45.804	NAIL

LEGEND:

- CM27 △ SURVEY CONTROL MONUMENT
- TBM20 ⊡ TEMPORARY BENCHMARK
- 130 → COORDINATE POINT
- ⌖ MONITORING WELL LOCATION
- VT ✚ VERTICAL THERMISTOR
- ■ MONITORING SOIL SAMPLE LOCATION

COORDINATE POINTS NWS LANDFILL		
NO.	NORTHING	EASTING
801	11 548.8	12 327.9
802	11 546.1	12 333.6
803	11 521.0	12 350.8
804	11 510.4	12 349.2
805	11 509.7	12 339.6
806	11 522.0	12 327.4
807	11 538.9	12 318.4

MONITORING WELLS			
NO.	COORDINATES		GROUND ELEV.
	NORTHING	EASTING	
MW–12	11 501.1	12 196.4	44.9
MW–13	11 366.9	12 268.4	42.4
MW–14	11 367.0	12 348.2	42.2
MW–15	11 451.3	12 323.4	43.0

THERMISTORS			
NO.	COORDINATES		GROUND ELEV.
	NORTHING	EASTING	
VT–1	11 446.1	12 227.0	48.3
VT–2	11 413.0	12 220.3	46.7
VT–3	11 416.4	12 290.0	46.4
VT–4	11 421.9	12 321.4	45.1

0 10 20 30m
10 5 1:1000

UMA | AECOM

DGN NAME: C3-R004.DWG DMJ – 06/06/21

DEW LINE CLEAN UP
LANDFILL MONITORING PLAN

CAM-3 - SHEPHERD BAY

USAF AND NWS LANDFILLS

FIGURE CAM-3.7

Appendix B

Cooperation Agreement

AGREEMENT

BETWEEN

NUNAVUT TUNNGAVIK INCORPORATED

AND

HER MAJESTY IN THE RIGHT OF CANADA

AS REPRESENTED BY

THE MINISTER OF NATIONAL DEFENCE

FOR THE CLEAN-UP AND RESTORATION OF

DISTANT EARLY WARNING SITES

WITHIN THE NUNAVUT SETTLEMENT AREA

(Environmental Provisions)

Arthur C. Eggleton
Minister of National Defence

Dated 1 Sep 98

James Eetoolok
1st Vice President
Nunavut Tunngavik Incorporated

Dated 1 Sep 98

AGIKATIGEGUTAOYOK

UGUNAGA

NUNAVUT TUNNGAVITKUN TIMIKUTIGIYANIN

UVALO

KOENMIN IHUMAKHUTIVLOGIN KANATAMI

GIVGAKTOKTIGIVLOGO UNA

MINISTAOYOK AGUYAKTULIKIYINI

HALUMAKHIVALEATILOGIN IHOAKHAKHUGILO

TULAEGUYUN IGLUKAKVEN

UGUNANI NUNAVUTMI NUNATAKNIKMI NUNAOYUN

(AVATILIKINIGUN PIVIKHAKAKVEOYUN)

ARTHUR C. EGGLETON
MINISTAOYOK AGUYAKTILIKIYINI

KANATAOM GAVAMAENI

UVLOANI _____

JAMES EETOOLOOK
HIVULIK TUKLEATA
IKHIVAOTALEOM
NUNAVUT TUNNGAVITKUN
TIMIKUTIGIYANI
UVLOANI _____

AGIKATIGEGUTAOYOK

UGUNAGA

NUNAVUT TUNNGAVITKUN TIMIKUTIGIYANIN

UVALO

KOENMIN IHUMAKHUTIVLOGIN KANATAMI

GIVGAKTOKTIGIVLOGO UNA

MINISTAOYOK AGUYAKTULIKIYINI

HALUMAKHIVALEATILOGIN IHOAKHAKHUGILO

TULAEGUYUN IGLUKAKVEN

UGUNANI NUNAVUTMI NUNATAKNIKMI NUNAOYUN

(AVATILIKINIGUN PIVIKHAKAKVEOYUN)

ARTHUR C. EGGLETON
MINISTAOYOK AGUYAKTILIKIYINI

KANATAOM GAVAMAENI

UVLOANI _____

JAMES EETOOLOOK
HIVULIK TUKLEATA
IKHIVAOTALEOM
NUNAVUT TUNNGAVITKUN
TIMIKUTIGIYANI
UVLOANI _____

ᐊᖏᕈᑦ
ᓄᓇᕘᒥ ᑐᓐᖓᕕᒃᑯᑦ
ᐊᒻᒪ
ᑯᐃᓐ ᑭᒡᒐᖅᑐᖅᑎᖏᓐᓄᑦ ᑲᓇᑕᒥ
ᑭᒡᒐᖅᑐᖅᑎᒥᔭᐅᓪᓗᓂ
ᑲᓇᑕᐅᑉ ᐅᓇ.ᑖᖅᑐᒃᓴᓕᕆᔾᑯᖏᑦᑕ ᒥᓂᔅᑕᖓᑦ

ᓄᓇᕘᒥ ᑎᐅᓚᐃᖅᑲᖅᕖᑦ ᓴᓗᒻᒪᖅᓴᖅᑕᐅᓂᕆᔮᖅᑕᖏᓐᓄᑦ
ᐊᒻᒪᓗ ᓄᓇᐅᑉ ᖄᖓ ᐋᖅᑭᒃᓱᖅᑕᐅᓂᕆᔮᖅᑕᖏᓐᓂᓗ
ᓄᓇᕘᖅᑖᕕᐅᔫᑉ ᐃᓗᐊᓂ

(ᐊᑭᑎᓕᕆᓂᖅᑯᑦ ᒪᓕᒐᑦ)

ᐋᖅᑐᖅ ᔩ. ᐃᒡᒍᓕᑕ
ᒥᓂᔅᑕ ᑲᓇᑕᐅᑉ ᐅᓇᑖᖅᑐᒃᓴᓕᕆᔨᖏᓐᓄᑦ

ᔭᐃᒥᓯ ᐃᑯᓗᒃ
ᐊᖓᔪᖅᑳᑉ ᓯᕗᓪᓕᖅ ᑐᓪᓕᐊ
ᓄᓇᕘᒥ ᑐᓐᖓᕕᒃᑯᓐᓄᑦ

ᐅᓪᓗᒥ

ᐅᓪᓗᒥ

PREAMBLE

WHEREAS the Government of Canada (Canada) has modernized the air defences of Canada through a joint USA/Canada project referred to as the North American Air Defence Modernization Project (NAADM);

AND WHEREAS NAADM includes the decommissioning of some of the Distant Early Warning (DEW Line) radar sites and the conversion of others to North Warning System (NWS) radar sites;

AND WHEREAS fifteen DEW Line sites are located on Department of National Defence (DND) reserves within the Nunavut Settlement Area (NSA);

AND WHEREAS DND wishes to undertake an environmental clean-up of the DEW Line sites, facilities and associated areas;

AND WHEREAS the Inuit and the Federal Government have an interest in all activities that occur within the NSA, including, but not limited to, protecting the ecosystem integrity and the existing and future well-being of the residents and communities of the NSA and increasing the participation of Inuit and Inuit Firms in business and employment opportunities in the NSA;

AND WHEREAS DND and NTI are voluntarily entering into this Agreement to establish a framework for the decommissioning, remediation and restoration of the DEW Line sites in the NSA;

NOW THEREFORE, in consideration of the premises and mutual covenants contained herein, the Parties agree as follows:

1.0 DEFINITIONS

Debris means hazardous and non-hazardous materials of non-natural origin existing on the surface, or visible and partially embedded within one metre of the surface or within two metres of the surface of any water body at low tide and any structures scheduled for demolition

DEW Line sites means the Distant Early Warning Sites listed in paragraph 3.1 below;

DCL means Defence Construction (1951) Limited the designated contracting agent for contracting for the Department of National Defence for the Dew Line Clean-up;

DND means the Crown in the right of Canada represented by the Minister of National Defence or his delegate

Engineered Landfill means a landfill professionally designed to permanently isolate the contents of the landfill from contact with the environment.

Hazardous materials or substances means all materials or substances designated as hazardous under territorial or federal legislation at the time of the clean-up of a particular landfill.

Inuit has the same meaning as in the NLCA;

Inuit Owned Lands has the same meaning as in the NLCA;

Landfill means any area where a concentration of non-hazardous and/or hazardous substances or materials or Debris have been buried;

Minister of National Defence means the Minister of National Defence or his designate

Nunavut Settlement Area has the same meaning as in the NLCA;

Rules means the *Rules and Procedures for the Management of Inuit Owned Lands* adopted by NTI, as amended from time to time,;

Parties means NTI and DND;

Regional Inuit Associations (RIA) means the Qikiqtani Inuit Association, the Kivalliq Inuit Association and the Kitikmeot Inuit Association;

Relevant RIA means the RIA in the region in which a DEW Line site is located;

Work means all the materials, equipment, goods, services, labour, matters and things done or furnished or required to be done or furnished to perform any DEW Line site decommissioning, remediation or restoration activity.

2.0 OBJECTIVES

2.1 The objectives of this Agreement are to establish a broad environmental framework for participation of the Inuit in the clean-up of the DEW Line Sites in the NSA and to achieve cost effective and an environmentally sound DEW Line clean-up as described herein.

2.2 DND and NTI will enter into a corollary agreement with respect to economic benefits for the Inuit and Inuit firms including provisions for training (this agreement may or may not involve regional negotiations).

3.0 GENERAL

3.1 **Scope.** This Agreement relates to the decommissioning, remediation, restoration and related activities of the following DEW Line sites:

PIN 2 - Cape Young
PIN 3 - Lady Franklin Point
PIN 4 - Byron Bay
CAM M - Cambridge Bay
CAM 1 - Jenny Lind Island
CAM 2 - Gladman Point
CAM 3 - Shepherd Bay
CAM 4 - Pelly Bay
CAM 5 - Mackar Inlet
FOX M - Hall Beach
FOX 2 - Longstaff Bluff
FOX 3 - Dewar Lakes
FOX 4 - Cape Hooper*
FOX 5 - Broughton Island
DYE M - Cape Dyer

* Prior to the signing of this Agreement the clean-up of Cape Hooper (FOX 4) had already begun under a separate set of understandings. Therefore only the post clean-up provisions of this Agreement will apply to this site

3.2 **Precedent.** This Agreement is not to be construed as a precedent for any other activities of DND, Canada or any third party. Nothing in this Agreement shall be interpreted or used to define the rights of the Parties, Canada or any third party in relation to any matter under the NLCA or to interpret any Article of the NLCA except for the purpose of this Agreement.;

3.3 **Urgency.** The Parties mutually agree to recognize the urgency of the matters dealt with in this Agreement and to perform all required actions as expeditiously as possible.

3.4 **Nunavut Land Claims Agreement.** The Parties recognize and acknowledge their respective obligations to comply with the NLCA in connection with all Work.

3.5 **Inuit Owned Lands.** All use of and access to Inuit Owned lands by DND, Contractors and subcontractors for the purposes of the Work is subject to the NLCA and the Rules, to the extent that the Rules are not inconsistent with the NCLA.

3.6 **Clean-up Schedule.** The commencement and completion of the Work will take place in accordance with the attached Appendix A. The Parties will use their best efforts to adhere to Appendix A.

4.0 Steering Committee

4.1 There shall, during the duration of this Agreement, be a Steering Committee to monitor progress, develop recommendations and suggest alternative solutions for achieving the commitments set forth in this Agreement by:

(a) reviewing progress in achieving the commitments set out in this Agreement;

(b) ensuring that any perceived deficiencies with respect to the Work or to commitments under this Agreement discussed and, where agreed, are expeditiously acted upon;

(c) considering other items of mutual concern, as appropriate;

(d) requesting the Environmental Working Group (EWG), established in accordance with section 7 of this Agreement, to undertake additional study and formulate recommendations to the Steering Committee.

4.2 The Steering Committee shall consist of four members, two to be named by DND and two to be named by NTI. It shall meet at least twice a year and at the request of any Party at mutually agreed upon times and locations. In order to place an item in the agenda, a Party shall provide that item to the other Party not less than ten working days before each scheduled meeting. The Steering Committee shall operate on the basis of unanimous agreement.

4.3 Recommendations agreed to by a majority of the members of the EWG will be incorporated into the site specific plan referred to in section 23 of this Agreement or into the post-clean-up methodology as the case may be. Where either DND or NTI disagree with the EWG recommendations, it will raise the issue at the Steering Committee for discussion in accordance with clause 4.4. If the Environmental Working Group is deadlocked (ie 2-2) on any issue, including scoring of the risk assessment matrix and landfill remediation, the Steering Committee will discuss the situation and attempt, in good faith, to arrive at a consensus. The Parties pursuant to clause 4.5 may, where appropriate, seek independent advice.

4.4 Should unanimous agreement not be reached at the Steering Committee the following approach will be used:

(a) Prior to Clean-up Commencing - the clean-up will not commence until the issue is resolved to the satisfaction of both Parties.

(b) Clean-up has commenced - the clean-up will continue in accordance with the site specific clean-up plan. If the issue is not included in the site specific plan then DND will proceed based on the advice provided by its consultants. DND and NTI will continue to attempt to arrive at a consensus.

In either event, both Parties continue to have the option of involving the provisions of section 5 of this Agreement if unanimous agreement cannot be reached. If unanimous agreement is reached at a later date or there is an arbitration decision which differs from the actions taken by DND, the new decision will be implemented.

4.5 The Steering Committee shall, with the agreement of the members, acting reasonably, invite representatives of Government departments, Inuit organizations, non-governmental organizations, Contractors, Subcontractors and others to provide advice or information as required. If requested by the other Party, DND and NTI agree to provide each other with all relevant scientific and technical information, with the exception of:

- advice to Ministers or Inuit Boards of Directors
- negotiating strategies
- commercially confidential third Party information
- personal information

4.6 The Parties each shall be responsible for their respective costs associated with participating in Steering Committee meetings.

5.0 ARBITRATION

5.1 If DND and NTI disagree on any question of fact or mixed question of law and fact related to the interpretation, implementation or operation of this Agreement, with the exception of any matter within the jurisdiction of the Arbitration Board under the NLCA, either party may by written demand refer the dispute to arbitration in accordance with the following provisions.

5.2 An arbitration Panel consisting of a single arbitrator who both Parties agree is qualified to arbitrate the question in dispute will render a decision on the dispute. If DND and NTI cannot agree on a single arbitrator then a decision will be render by an Arbitration Panel consisting of three similarly qualified arbitrators, one of whom shall be chosen by NTI, one by DND and the third by the two so chosen, which third arbitrator shall be the chairperson. If within fifteen days of having received a written demand, or such extended time as the parties agree, a party fails to either agree to a single arbitrator or to appoint an arbitrator, or if the two arbitrators appointed by the parties do not agree upon the third arbitrator, then upon written application by either party such third arbitrator shall be appointed by the superior court having jurisdiction in the NSA.

5.3 The arbitration proceedings shall be held within thirty days following the appointment of the Arbitration Panel in a location agreed upon by the Parties or, if the Parties are unable to agree, as determined by the arbitration panel. The timing for the panel hearing may be extended by mutual consent of the Parties, not unreasonably being withheld.

5.4 The arbitration panel shall have jurisdiction to determine all questions of fact, questions of mixed law and fact and to make an award, including interim relief, payment of interest, and costs. If an arbitration panel makes no decision as to costs, each party shall bear its own costs and an equal share of the other costs of the arbitration, including the remuneration and expenses of the arbitration panel.

5.5 The Arbitration Panel shall render a decision, in writing, within thirty days of the completion of the arbitration hearing and state the reasons on which it is based. The decision is final and binding and is not subject to appeal. Pursuant to section 17(3)(b) of the *Federal Court Act*, the Parties agree that the Federal Court Trial Division shall have jurisdiction to review the decision of an arbitration panel on any grounds set out in section 18.1(4) of the *Federal Court Act.*

5.6 Where a party to an arbitration fails to comply with any of the terms of the decision of the arbitration panel, any party to the arbitration may file in the office of the Registrar of the superior court having jurisdiction in the NSA, a copy of the decision in the prescribed form, whereupon the decision shall be entered in the same way as a judgement or order of that court, and is enforceable as such.

5.7 The territorial *Arbitration Act* shall apply in any arbitration under this Agreement to the extent that it is not inconsistent with this Agreement, unless otherwise agreed by the parties.

5.8 The arbitration panel may, on application, allow any to participate in an arbitration as an intervenor, if in the arbitration panel's opinion the interest of that person may be directly affected by the arbitration, and on such terms as the arbitration panel in its discretion may order.

5.9 Unless the parties otherwise agree, the proceedings and Board's decision shall be made public.

6.0 Environmental Risk Assessment Matrix

6.1 All landfills will be scored by the EWG in accordance with the Environmental Risk Assessment Matrix as set out in Appendix B of this Agreement. The construction of this matrix takes into account two conservative assumptions:

- The contents of the landfills are unknown and all potential contaminants (ie substances typically used at DEW Line sites) may be present in the landfill
- If a contaminant comes into contact with receptors, it could have an adverse impact on those receptors regardless of the exposure duration or concentration

6.2 Landfills scoring 105 points or more are classified as potentially high environmental risk (Class A) and will be excavated. Landfills with a score of 100-104 points will be considered on a case by case basis to determine whether they should be excavated or considered as Class B landfills.

6.3 Landfills with a score in the range 75 to 99 points are classified as moderate environmental risk (Class B). An engineered leachate containment system will be provided for these landfills to mitigate against potential environmental risks. The landfill engineers under contract to DCL will take into consideration any suggestion of the EWG regarding the design of the leachate containment facility. In specific cases where an engineered leachate containment system cannot be constructed, the EWG will recommend whether complete excavation or partial excavation with a leachate containment system is required.

6.4 Landfills with scores of 75 or less are classified as low environmental risk (Class C). The remediation approach for these landfills will be the placement of an engineered cover following collecting, sorting, and appropriate disposal of debris where it may impact on the integrity of the landfill. Hazardous debris will be removed and disposed of in accordance with federal regulations. Generally, the final thickness of cover material will be approximately 0.75 metres, but may vary depending on site specific conditions.

6.5 Scores that fall within plus or minus five points of 75 points will be considered on a case by case basis.

6.6 The scoring of Category C: Receptors of the matrix will take into account local/traditional knowledge in accordance with the procedures set out in Section 8 of this Agreement. The primary focus for the collection of local/traditional knowledge will be on the local community and an Inuit representative who is familiar with the DEW site under assessment.

6.7 The scoring of the landfills will take place before the clean-up at that DEW site commences and the site specific clean-up plan is finalized.

7.0 Environmental Working Group

7.1 An Environmental Working Group (EWG) will be established. The EWG will consist of four members, two chosen by each of the Parties. The members will be qualified engineers and/or scientists with expertise in environmental remediation and clean-up in northern climates.

7.2 The EWG will, for each of the landfills prior to the clean-up of that site, be responsible for the scoring of the risk assessment matrix, interpreting the results and recommending a remediation solution in accordance with this Agreement. If a majority of the members of the EWG are in agreement with the EWG recommendations then DND will include these recommendations in its site specific plans which are referred to in section 23 of this Agreement. If the EWG is deadlocked then the issue will be referred to the Steering Committee as per section 4.3 of this Agreement.

7.3 During the monitoring period, the EWG will also examine the results of the monitoring program in accordance with the methodology set out in section 20 of this Agreement and report to the Steering Committee on the results of their investigation. Should changes to the monitoring plan and/or additional remediation be required, the EWG will make recommendations to the Steering Committee on what action should be taken as per section 4.3 of this Agreement.

7.4 The EWG will go on-site during the pre-cleanup delineation phase of the project to assemble information required, including local/traditional knowledge as per section 8 of this Agreement, to score the risk assessment matrix. DND will contribute $10,000 per site to NTI to defray the cost incurred by its EWG members and a community representative selected by the relevant RIA (NTI Representative). DND will also provide the NTI representative transportation

costs whenever the NTI representatives are travelling to a site or to a community with the DND representatives on a DND charter. DND will also provide meals and accommodation for the NTI representative while at the site.

7.5 The EWG will also act as a resource to the Steering Committee and will upon request from the Steering Committee investigate certain matters and produce reports or studies for consideration by the Steering Committee. Both Parties agree to cover the costs of their members of the EWG to undertake such work.

8.0 Local/Traditional Knowledge

8.1 Traditional and local knowledge for use in the scoring of the risk assessment matrix will be collected during the Pre-Cleanup Delineation phase of the DEW Line clean-up project.

8.2 An Inuit representative familiar with the DEW site and traditional use of the area around the site will be chosen by the relevant Regional Inuit Association to be on site during the pre-construction delineation phase of a site clean-up. The Inuit representative will work closely with the EWG to identify Inuit use of the area, wildlife patterns, and past events and occurrences that may have impacted on landfills (i.e. dumping, hazardous waste storage, natural occurrences) in order to assist in the scoring of the matrix.

8.3 DND and NTI will attempt to establish a community DEW Line Clean-up Committee which would facilitate the flow of local knowledge to the EWG prior to, and during, the site visit.

8.4 The EWG will visit the local community (ies) most affected by the DEW site. The EWG will conduct one-on-one interviews with a number of residents and will also meet with the Hamlet Administration Officer and/or the Hamlet Mayor, the local Hunters and Trappers Association, and relevant community organizations to obtain information concerning the traditional use of the area by the community. The Community Land and Resource Committee (CLARC) will be consulted if Inuit Owned Land is affected in any way.

8.5 In anticipation of these community consultations, DND, in consultation with NTI will prepare an information package in English and the relevant Inuit language for

use in the community consultations. The package will include maps of the site and the surrounding area along with sample questions (see Appendix D) that would facilitate discussion.

8.6 DND will provide NTI with at least six months notice regarding the site visit in a given season. Six weeks notice will be provided regarding the dates for the community visit. DND will attempt to arrange the timing for the community consultation to avoid harvest time when members of the community might be on the land. NTI in conjunction with the EWG will arrange the interviews with the various community associations and individuals.

8.7 The EWG will document all information collected during the community consultations. This information will be provided to DND, NTI, the relevant RIA and the host community.

8.8 All information collected from the interviews will be considered during the matrix scoring and will be given equal consideration with conventional scientific knowledge collected during the site visits.

8.9 Prior to the actual clean-up, DND will conduct a community information session to inform the residents of the scope of the Work and other relevant facts. In the case of CAM 4, there will be a community information session during the summer of 1998 at the option of the RIA. For Fox 5, in addition to this community information session, the EWG will be consulting the community of Broughton Island on FOX-5 as part of its work on scoring landfill evaluation matrices, during the summer of 1998 and DND will provide a limited public information session at that time.

9.0 CEPA Soils

9.1 Soils at concentrations exceeding federal regulations (referred to herein as "CEPA" soils) will be removed from the site and disposed of in a licenced facility in accordance with those federal regulations.

10.0 Tier II Soils

10.1 Tier II soils are defined in Appendix E of this Agreement.

10.2 Tier II soils will be excavated and placed in an engineered, lined, containment facility (Tier II Disposal Facility). After excavation, the area will be backfilled with sufficient clean fill to provide an effective layer over any remaining Tier I soils and to meet the requirement of clause 22 of this Agreement . A schematic of a Tier II Disposal facility is presented in Appendix K. Tier II soils may also be placed in a similarly engineered cell of a larger landfill. The location of the Tier II Disposal Facility will be selected in order to minimize potential environmental impact in a cost-effective manner. In some cases Tier II soils may be transported from one DEW site to another depending on soil volumes and project economics.

10.3 Confirmatory testing will be conducted in accordance with the methodology outlined in section 13 of this Agreement.

11.0 Tier I Soils

11.1 Tier I Soils are defined in Appendix E of this Agreement.

11.2 Tier I soils will be excavated to a depth of to 30 cm if the soil is located on a flat or gently sloping area such as a gravel pad unless delineation testing indicates a lessor depth of contamination. In such a case, a suitable safety margin will be excavated. Where Tier I soils are located on slopes greater than 3:1 (horizontal:vertical), the contaminated soils will be excavated to a depth of up to 60 cm. After excavation, the area will be backfilled with sufficient clean fill to provide an effective layer over any remaining Tier I soils and to meet the requirement of clause 22 of this Agreement .

11.3 Tier I soils will be placed in a professionally engineered landfill where they may be used as intermediate fill.

11.4 During the pre clean-up delineation phase prior to going to tender for the clean-up, testing to determine the presence or absence of Tier II contaminated soil below the Tier I soils will be conducted.

12.0 Hydrocarbon Soils

12.1 Hydrocarbon contamination will be based initially on the measurement of Total

will investigate areas of concern identified by NTI and/or its representatives who will be on-site during the delineation work. Risk assessment consideration will be given to soils that act as sources of contaminants to nearby aquatic environments even if the contaminants are below the relevant DCC criteria. The method of delineation will follow the grid as set out in Appendix F of this Agreement.

13.2 Confirmatory testing of contaminated areas, other than Tier I soils, will be conducted after contaminated soils have been excavated. Confirmatory testing will be conducted in accordance with the protocol outlined in Appendix F of this Agreement.

13.3 Should there be evidence to suggest that some contaminated areas were missed during the pre clean-up delineation work, these areas will be investigated in accordance with the pre clean-up delineation methodology.

13.4 During the confirmatory testing phase, NTI may assign a qualified observer to the site.

13.5 Appropriate quality assurance measures acceptable to the EWG will be taken to ensure the accuracy of all analytical work in the field or in laboratories.

14.0 Debris

14.1 Debris will be collected and sorted into hazardous and non-hazardous components. Hazardous debris will be disposed of in accordance with Federal regulations. Non-hazardous debris will be buried in a professionally engineered landfill, provided there is a suitable location and sufficient gravel is available. Appendix C contains additional details concerning the destination of collected debris.

14.2 All debris which is attributable to the operation of any DEW site and is within two metres of the surface at low tide or within two metres of the surface of an inland water body will be removed by DND.

15.0 Off Site Contamination and Debris

15.1 Where there is reasonable evidence of additional off site contamination or debris

Petroleum Hydrocarbons (TPH) where the TPH value is greater than or equal to 2500 ppm. Should the soils contain Tier I or Tier II contamination, they will be treated in accordance with the relevant sections of this Agreement. These hydrocarbon areas will be identified on site as part of the pre-construction delineation testing.

12.2 Each contaminated area will be evaluated qualitatively by the EWG using the checklist outlined in Appendix J of this Agreement.

12.3 Where remediation is required, one of the following options will be used:

- aerating the hydrocarbon contaminated soil in place to reduce hydrocarbon contaminant concentrations
- use of hydrocarbon contaminated soil as intermediate fill within an engineered landfill
- landfilling in a Tier II Disposal facility
- bioremediation using a landfarming or bio-pile processes
- soil washing
- other equivalent technologies recommended by the EWG

12.4 Based on site specific conditions, the EWG will recommend the most appropriate of the remediation options outlined in clause 12.3 in accordance with section 4.3 of this Agreement. The appropriateness of the options will take into consideration the environmental sensitivity of the area. Factors which will be considered in the selection of the method are:

- type of contaminant (ie fuel or lubricating oil)
- total volume of hydrocarbon contaminated soils on site (mobilization costs, ability to treat the soil)
- concentration of hydrocarbons within the soil (effectiveness of treatment process)
- type of soil

13.0 Pre Clean-up Delineation and Confirmatory Soil Testing

13.1 A comprehensive pre clean-up delineation program will be designed to ensure that all contaminated soil and contaminated building material will be identified . DND

which, subject to clause 15.2, is attributable to the operation of a nearby DEW site, DND will undertake testing to determine the extent of the contamination in consultation with NTI and remediate the site in accordance with the relevant sections of this Agreement.

15.2 Should the evidence clearly demonstrate that other individuals or organizations have contributed significantly to the contamination or debris, then NTI and DND will endeavour to obtain the third Party (ies) agreement to contribute its pro-rated share of the investigation and clean-up costs before the investigation and clean-up commences. If the third party does not agree to pay their share of the costs, DND has the option, where practical, to clean up its share of the contamination, or in the alternative, waiting until there is third party agreement regarding payment of the investigation and clean-up costs. The investigation and clean-up will be in accordance with the clean-up protocol outlined in this Agreement.

15.3 NTI will endeavour to identify areas of concern prior to the delineation phase of the clean-up.

16.0 PCBs in Paint

16.1 PCBs in paint will be treated in accordance with applicable federal regulations. Changes to these regulations will be dealt with in accordance with section 25.1 of this Agreement.

17.0 Materials Containing Lead-based Paints

17.1 Materials containing lead-based paints will be placed in a professionally engineered landfill. Should regulations or guidelines be issued which direct otherwise, the implementation of this change will be dealt with in accordance section 25.1 of this Agreement.

18.0 Barrels

18.1 The testing and disposal of POL tank sludge, waste oil, petroleum products, antifreezing agents, solvents and barrels will be handled in accordance with the criteria as set out in Appendix G.

19.0 Borrow Material

19.1 DND will attempt to minimize new excavation of borrow materials required for the clean-up activities. Where possible, existing sources of borrow material will be used. All borrow areas will be regraded to match the surrounding topography.

20.0 Monitoring Program

20.1 The monitoring program will identify an actual or potential landfill failure. Remedial action will be undertaken if leachate is present at levels greater than the site specific baseline concentrations at the time of the landfill completion. Action taken as result of the monitoring program will ensure the integrity of the landfills and thereby the health of the Inuit is protected on a continuing basis.

20.2 Following the completion of the clean-up for a site, DND will commence a monitoring program in accordance with Appendix H of this Agreement.

20.3 The monitoring program will have three phases. The objective of each phase are identified in Appendix H.

20.4 Monitoring results will be communicated to both Parties in the form of a comprehensive report.

21.0 Research Proposals

21.1 NTI, on behalf of communities, may raise at the Steering Committee, items, including the need for hydrographic mapping, which could involve the requirement for research and investigation. These proposals will be discussed and evaluated at the Steering Committee. If the Steering Committee decides that the proposals are consistent with the objective of the clean-up which is to protect the environment from contaminants entering the food chain or involve direct DEW site related impacts which could cause significant economic impact, DND will fund the agreed upon research activities.

21.2 Where the proposals are broader in nature and not solely restricted to DND DEW

site activities, DND will support NTI in seeking funding under other Government programs and/or initiatives and may contribute funding to the approved proposals.

21.3 Involvement of the Inuit in the research activities including training and technology transfer will be dealt with in an agreement dealing with economic provisions.

22.0 Site Restoration

22.1 All sites will be regraded to the extent possible to conform to the natural contours. The regrading will pay particular attention to hydrocarbon stained areas and wherever feasible these areas will be regraded so as to improve the aesthetics of the stained area.

23.0 Site Specific Clean-up Plan

23.1 DND will provide NTI with a site specific clean-up plan six months in advance of the clean-up of a particular site. NTI will review the plan to satisfy itself that the plan is in accordance with the requirements as set out in this Agreement. Any items of concern to NTI will be referred to the Steering Committee for resolution in accordance with section 4.3 of the Agreement prior to the issuance of any requests for bids by DCL. DCL, as the representative of the project proponent (DND), will be responsible for preparing all necessary submissions to obtain regulatory approval to proceed with the clean-up activity.

24.0 Liability and Indemnification

24.1 DND acknowledges and agrees that it has continuing responsibility and liability for the integrity of all landfills remaining on site. DND agrees that should there be evidence of potential or actual failure of a landfill, it will investigate the situation pursuant to the monitoring provisions of this Agreement.

24.2 Should there be evidence of contamination at the DEW Line site which exceeds the protocol as set out in this Agreement at the time of the signing of this Agreement and which cannot be attributed to a third Party then DND will undertake the clean-up.

24.3 DND agrees that nothing in this Agreement shall relieve the Crown or its agents either at present or in the future from complying with all applicable federal laws of general application. Changes to territorial law will be referred to the EWG which will make recommendations to the Steering Committee concerning the relevance of these changes to the clean-up.

24.4 DND agrees that it will be a condition of any sale or transfer of any of the lands comprising the DEW Line sites that the purchaser must assume DND's obligations under this Agreement with respect to the lands sold or transferred. It will also be a further condition of any such sale or transfer that the purchaser or transferee shall provide security for the performance of the assumed obligation and shall provide and maintain a letter of credit, surety bond, or other security in a form and amount mutually agreeable to the Parties.

25.0 Amendments

25.1 Should existing federal regulations or guidelines be amended, the EWG will examine the implementation of these changes or amendments taking account the special characteriztics of the Arctic environment and make appropriate recommendations to the Steering Committee in accordance with section 4.3 of this Agreement.

25.2 The Protocol for confirmatory testing may be reviewed and adjusted on a site by site basis provided that a majority of the EWG are in agreement with the changes. Permanent or major changes will require the prior approval of the Steering Committee.

25.3 In the event that either Party wishes to amend the schedule as set out in Appendix A, it will provide the other Party with thirty (30) months written notice. If unforeseen event(s) or a decision by a regulatory body occurs which has a material impact on this schedule, the Parties will review these events and attempt to arrive at a mutually acceptable alternative.

25.4 Both Parties agree to review changes in technology and research studies which may have a bearing on this Agreement and discuss the need for changes resulting from these developments. The Steering Committee may task the EWG to investigate a particular technology pursuant to clause 4.1 (d) of this Agreement.

Recommendations of the EWG will be implemented in accordance with section 4.3.

25.5 If either Party wishes to make other changes to this Agreement, it will provide, in writing, six months notice of proposed changes. Any agreed upon amendments will be executed and attached as an appendix to this Agreement.

25.6 DND and NTI agree to consider amendments in an expeditious manner, particularly where the proposed amendments directly affects the conduct of a clean-up in progress or one which is scheduled to commence in the near term.

26.0 EWG Reports

26.1 All reports of the EWG will be available to provide additional information and guidance in the implementation of this Agreement. In the event of any conflicts or differences in interpretation of the EWG reports and this Agreement, this Agreement will prevail.

27.0 Notices

27.1 Where any Party is obliged or entitled to give any notice, request, approval, demand, consent, direction or other communication (ie Notice) to the other Party, such party shall first communicate the substance thereof personally or by telephone. However, such Notice shall not be sufficiently given until sent in writing to the addressees at the address below. Any Notice may be personally delivered or sent by registered mail or telefacimile and will be effective upon receipt by the addressee.

27.2 Notices to DND will be sent to:

Director General Environment
National Defence Headquarters
101 Colonel By Drive
Ottawa, Ontario
K1A 0K2

27.3 Notices to NTI will be sent to:

1st Vice President
Nunavut Tunngavik Incorporated
Box 1041
Cambridge Bay
Northwest Territories
X0E 0C0

28.0 **Termination of the Agreement**

28.1 This Agreement will terminate on the later of December 31st, 2008 or when the clean-up work as set out in this Agreement for the sites listed in Appendix A is completed or on such a date agreed to by the Parties in accordance with clause 25.3 of this Agreement.

28.2 Notwithstanding clause 28.1 of this Agreement, monitoring and any necessary remediation in accordance with section 20 of this Agreement will continue for twenty five (25) years after the termination of this Agreement.

28.3 At the end of twenty five years of monitoring following the termination of this Agreement, DND and NTI will negotiate a new agreement to specify the terms of any further monitoring (if required).

Annexes to the Agreement

Appendix A

Clean-up Schedule

Site*		Start Date	Completion Date
CAM M	Cambridge Bay	1998	1999
FOX 5**	Broughton Island	2001	2003
CAM 4**	Pelly Bay	2001	2003
FOX M/CAM 5	Hall Beach/Maclar Inlet	2002	2006
CAM 3	Shepard Bay	2002	2003
DYE M	Cape Dyer	2003	2006
CAM 2	Gladman Point	2003	2004
FOX 2/FOX 3	Longstaff Bluff/Dewar Lakes	2004	2008
CAM 1	Jenny Lind Island	2004	2005
PIN 4	Byron Bay	2005	2006
PIN 3	Lady Franklin Point	2006	2007
PIN 2	Cape Young	2007	2008

* Dates for the Baffin Sites are tentative pending resolution of economic and business issues

** The starting dates for CAM 4 and Fox 5 and the subsequent starting dates could be moved up pending the timing of the PCBs in paint decision by Environment Canada

Appendix B

Environmental Risk Assessment Matrix

Introduction

The matrix has been based on the CCME National Classification System for Contaminated Sites, and adapted to address the particular concerns of the Arctic environment. The matrix is divided into three categories of equal weight: contaminated source, pathways, and receptors. The interaction of these three elements results in environmental risk. Each category is assigned 50 points, which are distributed among several factors. Each of these factors has been made as specific as possible in order to reduce the subjectivity of the matrix to a minimum. In addition, each of the three main categories is assigned a highly subjective "special considerations" factor according to the method described in the CCME Classification System. As it is unlikely that any classification system could address all possible factors, a special considerations factor allows the user to increase or decrease the score "to emphasize important concerns about a site and should be used as an **exception rather than as a rule**" (CCME 1992, p.6-7).

The purpose of the matrix is to evaluate the environmental risk posed by landfills in their current condition and location. It is not suitable for determining the risk posed by a landfill post-closure, as most of the elements in the matrix would not change by the application of a remedial solution. It should also be recognized that monitoring is an integral part of the closure.

The next sections provide guidance to the EWG on the methodology and items to be considered when scoring the matrix. This section is followed by the actual matrix which is to be used in the scoring.

A. Contaminant Source

Five factors were considered under Contaminant Source to describe specific landfills, as follows:

- A.1 Landfill Extent
- A.2 Estimated Depth of Landfill
- A.3 Presence of Leachate
- A.4 Presence of Surface Contaminated Soil
- A.5 Presence of Surface Debris

A.1 Landfill Extent

Landfill areas will be based on the results of geotechnical/geophysical site surveys and visual observations. Those landfills with an area greater than 10,000 square metres will score 10 and those smaller landfills will be scored in proportion to their size relative to 10,000 square metres.

A.2 Estimated Depth

The estimated depth of a landfill is determined by visual inspection of surrounding topographic features. The average depth of the active layer will be used as a qualifier for the description of landfill depth, as this is generally the maximum depth of investigation. The depth of the active layer may range from one to two meters at these sites, depending on material type; therefore an average depth of 1.5 meters was used in the rating. Landfills with estimated depths of greater than 1.5 meters will score 5 and those with estimated depths of less than 1.5 meters will score less.

A.3 Presence of Leachate

Leachate provides evidence of contamination within landfill. Leachate can be defined as the presence of contaminants in water emanating from the landfill, but concentrations may be so low as to be difficult to detect. The presence of leachate can be better determined by the presence of contaminated soil at the toe of the landfill, indicating

chronic low levels of contaminants leaching from the landfill. All types of contaminants in leachate (PCBs, (Polychlorinated Biphenyls) TPH (Total Petroleum Hydrocarbons) or inorganics) are considered to be of equal concern, as indicators of contamination within the landfill.

In the scoring, leachate is considered to be either present or not; no interpolation of the score is used in this category.

A.4 Surface contaminated soil

Within each landfill, there is potentially a source of contamination. The presence of surface contaminated soil, like the presence of leachate, is an indication that the landfill contains contamination. The volume of contaminated soil is not taken into consideration; this provides a conservative approach in that a small amount of contaminated soil can trigger a high score. The presence of Tier II soils will trigger the highest score (15). Based on the hypothesis that each landfill potentially contains contaminants, 5 points are given to this subsection, even if no surface contaminated soils were identified.

A.5 Presence of surface debris

At some landfills surface debris is very extensive, while at others there is almost no debris. Scoring needs to be quantitative; therefore the percentage of the surface area of the landfill that is covered with debris is used as the basis for scoring. A landfill that has surface debris covering more than 50% of its surface receives a full score.

B. Pathways

The primary transport mechanisms for contaminants from the DEW Line landfills are considered to be:

- aerial transport of fine particles; and
- water transport, both as surface water run-off or subsurface water flow.

B.1 Aerial Transport of Contaminants

All contaminants can be transported as particles; windblown debris is not considered in this category, as debris pickup is inherent in any cleanup. Surface contamination or surface expressions of leachate imply the potential for aerial transport. This factor is given a low weight because the quantity of contaminated soil on the surface of a landfill is generally low relative to the quantity of contaminated soil at the site as a whole. In addition, it is anticipated that relative to the effect of water movement, aerial transport contributes less to the transport of contaminants away from a landfill.

B.2 Water Movement

Water movement includes the movement of surface water and subsurface water within the active layer. "Groundwater" is not addressed as an issue separate from surface water as the movement of water within the active layer is subject to the same driving forces as surface water. The intent of this sub-category is to examine factors that affect migration away from the landfill – slope, runoff, extent and type of cover on the landfill, annual precipitation and distance to surface water. Among these factors, topography, runoff potential and proximity to surface water are given the highest weight.

B.2.1 Topography

The degree of the slope on which the landfill is located is one of the major factors contributing to transport of contaminants; the scoring is carried out on a sliding scale. In cases where there are different slopes across the landfill, a weighted average is used.

B.2.2 Cover Material – Depth

The extent to which potential contaminants are available to transport is also dependent on the depth and type of cover material. The potential for leachate generation and correspondingly, leachate migration, is related to the infiltration of water into the landfill. Cover over the landfill helps mitigate infiltration of water into the landfill contents. As the thickness of the landfill cover increases, the likelihood that potential contaminants will be released from the landfill decreases. If the active layer is contained in the cover material above the debris, then the potential for surface water infiltration into the landfill is small; this circumstance is assigned the lowest score.

B.2.3 Cover Material – Type

The erosion potential of a landfill is partly based on the type of cover material. Erosion can eventually lead to the exposure of the landfill contents. Some cover materials are more susceptible to erosion than others; well graded gravels are the least susceptible, and silty materials are the most susceptible. In cases where there is no cover, this factor is assigned the highest score. Where the cover materials consist of a combination of soil types, the scoring should reflect the more conservative or higher score.

B.2.4 Surface Water/Run-Off Potential

This factor aims to describe the destructive potential of water action on the landfill, which could take the form of waves; streams, rivers or lakes; or seasonal drainage. Where there is significant seasonal drainage, the run-off potential is high. "Significant seasonal drainage" is defined as run-off that has the potential to transport large quantities and concentrations of contaminants to surface water courses over a short period of time (CCME 1992, p.23). Significant seasonal drainage also includes consideration of major snow drifting on a landfill.

B.2.5 Precipitation

The amount of precipitation received, either as rain or snow fall, affects the amount of surface water infiltration or run-off. The majority of the DEW Line sites receive less than 500 mm of precipitation annually, with the exception of Cape Dyer. Typically, the amount of precipitation at any site is relatively low; therefore it is unlikely that any single precipitation event would cause significant runoff. This factor is therefore given a relatively low weight.

B.2.6 Distance to Downgradient Perennial Surface Water/Seasonal Drainage Channel

The distance to surface water will affect the probability of contaminants reaching the watercourse. This factor can include streams, seasonal or perennial, running directly through the landfill, or streams and lakes downgradient from the landfill, but it is intended to exclude small ponds with no outflow. On very steep slopes this distance should consider the horizontal distance to the water body rather than the vertical drop. The impact of drainage with respect to contaminant exposure is not considered in this category (it is considered under Receptors); this factor determines whether there is a drainage pathway from the landfill.

C. Receptors

This section addresses the potential for impact on receptors, specifically, aquatic and terrestrial habitats, as well as human exposure. Impact on humans is the primary consideration; however, it should be recognized that impact on humans is implicit in the scoring of factors addressing ecosystem impact. The scoring within each category is to be based on recorded data, as well as local knowledge of the land use in the area, and therefore requires local input.

C.1 Potential Impact on Receiving Freshwater/Marine Habitat

The water body should be selected based on the potential effects on the receiving habitat. In the selection of the receiving water body to be used in the landfill evaluation matrix, consideration must be given to the regional drainage patterns. For example, where the drainage from a landfill is overland (i.e. there is no direct connection between the landfill and the downgradient water body), water bodies beyond 2 kilometers should not be used in the evaluation. This is based on the premise that natural attenuation of any potential contamination will occur with overland flow. Where a direct connection between a landfill and a downgradient water body exists, via a stream or interconnected ponds, the two-kilometre limit should not be used.

C.1.1 Proximity to Receiving Freshwater/Marine Habitat

"Receiving habitat" is considered to be the most potentially impacted significant body of water near the toe of the landfill. The water body may support freshwater or marine life and/or may be used by avifauna and/or terrestrial mammals as a water source. It is not necessarily the seasonal drainage course or perennial water body closest to the landfill toe: This section's objective is to select a habitat which support receptors rather than identify the closest body of water. It is assumed that only habitat downgradient from the landfill is to be considered (given that aerial transport of contaminants to habitat upgradient from the landfill will be addressed by the remediation of contaminated soil).

C.1.2 Estimated Habitat Usage – Freshwater/Marine

This section is scored based on the frequency of usage within the selected receiving water body: the level of biodiversity and the occurrence of calving/spawning should be considered in scoring. It is recognized that freshwater and/or marine wildlife is potentially more at risk compared with terrestrial wildlife or avifauna, which should only be exposed through water ingestion. Thus, when terrestrial wildlife or avifauna is the primary receptor, the score for this factor should fall into the moderate or low category based on the potential frequency of usage. Otherwise, when the selected water body sustains freshwater and/or marine wildlife, the level of biodiversity should be used to evaluate the score. It should be noted that the most conservative approach - in the selection of the receiving water body - must be used when scores from section C.1.1 and C.1.2 are combined. Finally, "Biologically sensitive" areas such as bird sanctuaries and/or endangered, threatened or vulnerable populations should be considered as "special considerations".

C.2 Potential Impact on Receiving Terrestrial Habitat

C.2.1 Extent of Vegetation

Typically the area in which to consider vegetation would include an area 300 m downgradient from the toe of the landfill. The area within this distance is expected to be most susceptible to uptake of contaminants if they are leaching from the landfill, but a larger or smaller area could be considered if site specific conditions warrant it.

C.2.2 Estimated Habitat Usage – Terrestrial/Avifauna

The same criteria as for usage of aquatic habitat are to be applied.

C.3 Potential Human Exposure Through Land Use

C.3.1 Presence/Occupation

This factor addresses strictly dermal exposure and inhalation; consumption of food and water from the area is dealt with in subsequent factors. The risk of dermal exposure or inhalation is much lower when soil is frozen; therefore winter occupation of the site is assigned a low risk. "Summer" in this factor is intended to include the spring, summer and fall periods when the ground is not frozen. Within this factor, the scoring takes into account the likelihood and the duration of contact. In such way, proximity to a community is considered (high likelihood of contact), although proximity to a community does not necessarily trigger a high score if visits are infrequent (low duration of contact).

The likelihood of contact considers proximity to community or to a camp, as well as proximity to "travel routes". The duration of contact considers full time residences (i.e. permanent community for high, summer camp for moderate, winter camp or travel routes as low). Scores may be interpolated between the allocated points, according to the table below.

Table 1-1: Scoring Guide for Section C.3.1

	High Likelihood of Contact	Moderate Likelihood of Contact	Low Likelihood of Contact
High Duration of Contact	8	6	4
Moderate Duration of Contact	6	4	2
Low Duration of Contact	4	2	1

For large DEW Line sites, different parts of the site need to be considered individually, as some areas of the site could be quite far (more than a few kilometres) from the landfill under consideration.

C.3.2 Proximity to Drinking Water Source

Regardless of whether the source is seasonal or perennial, an established community or a summer camp water source located downgradient of the landfill is to be considered in this factor.

C.3.3 Food Consumption

Sedentary organisms are more susceptible to local inputs as their exposure is large if they are downgradient from the landfill. These organisms can include bottom-dwellers such as sculpins, mussels, sea urchins etc., as well as terrestrial vegetation, which can be used for medicinal purposes. This kind of contamination "is quite localized when considered on a broad regional scale" (DIAND 1997, pg. 5). Migratory marine animals may have body burdens of contaminants; these are not directly attributable to local contaminant sources, as the vast majority of organochlorines, for instance, arrive in the Arctic via long range transport.

Caribou living in the general area of DEW Line sites do not have elevated levels of contaminants, since they feed over a very wide area. The Canadian Arctic Contaminant Assessment Report (DIAND, 1997) describes these results in more detail.

It is recognized, however, that sources such as DEW Line sites do contribute contaminants to the Arctic ecosystem. For the purpose of scoring the matrix, therefore, a high consumption of animals from the area surrounding the DEW Line sites has the potential to pose a higher risk than a low consumption, **although in general the risk remains low.**

This factor is divided into two sub-sections, and the score is the sum of the score for each of the two sub-sections.

1.3 Special Considerations

As indicated in the introduction to the matrix (section 1.1), each of the three main categories includes a "*special considerations*" factor. The proposed value of the special considerations factor is a maximum of ten percent of the overall score for each category. It is intended that no circumstance will allow a user to assign a special considerations score that will cause the score for that category to exceed the maximum allotted. To avoid undue bias, it is also suggested that the user should complete the entire evaluation form and score a site before addressing special considerations in the total score.

The Environmental Working Group (EWG) based the landfill risk evaluation matrix on the CCME model which defines three categories: contaminant source, pathways and receptors. Within those three categories, the EWG tried to address all of the possible factors contributing to risk. Recognizing that even a thorough matrix could never address all possible risk factors, special considerations were included to address specific risk factors, which are not general to all of the DEW Line sites.

As noted in the CCME document, the special considerations factor is not intended to be applied on a regular basis, as it addresses very site-specific risk factors. In fact, if the special consideration factor was being consistently applied in the scoring of landfills, it would indicate that the matrix itself was incomplete. Special considerations should be site-specific characteristics that can be documented.

Three examples of how special considerations could be applied are provided to clarify the use of such a classification:

Example 1. Wildlife on site

At Byron Bay, the caribou belong to the Peary herd, an endangered species. It may be that "special considerations" points would be assigned to the Receptors category when endangered, threatened and/or vulnerable species (COSEWIC, 1997) are known to visit the DEW Line landfill.

Example 2. Drinking water

The risk associated with landfill impact on a drinking water source is addressed in section C.3.2. In that section, the distance from a landfill to a known drinking water source, permanent or seasonal, is used as an indicator of the risk that the contaminants in the landfill could have an impact on the drinking water source. If a landfill is close to a drinking water source, then section C.3.2 would be assigned the maximum score (8 points). In the case of Pelly Bay, however, where the landfills are far from the drinking water source and therefore receive a relatively low score in section C.3.2, "special considerations" points may be added to address concerns that the landfills are located in the watershed for the community drinking water supply.

Example 3. Proximity to a community

In the landfill risk evaluation matrix, human exposure to a landfill is measured in the following way: people can spend time at the landfill (potential dermal exposure), they can drink water from an area near the landfill (potential ingestion), they could live very close to landfills (potential exposure through aerial transport) or they could eat animals that feed near the landfill (potential ingestion). These three considerations form section C.3 of the risk evaluation matrix. If a landfill is located near a community, there is a greater likelihood that people will spend time at the landfill than there is for landfills far from a community. It is not necessarily the case, however, that landfills near communities receive frequent visits; therefore, instead of creating a special section addressing proximity to a community, the risk of human exposure (section C.3.1) is more accurately evaluated by measuring time spent at a landfill. In these cases, however, "special considerations" points may be added to the Receptors category to address a community's specific concerns.

PROPOSED ENVIRONMENTAL RISK EVALUATION MATRIX FOR LANDFILLS IN THE NUNAVUT REGION			
A.	CONTAMINANT SOURCE		Maximum Score
A.1	LANDFILL EXTENT		
	>10 000 m2	10	
	For areas less than 10,000 = Area of Landfill X 10 / 10 000	2-9	
	Minimum Score	1	10
A.2	ESTIMATED DEPTH OF LANDFILL		
	greater than 1.5 m	5	
	less than 1.5 m	2-4	5
A.3	PRESENCE OF LEACHATE		
	Evidence of Leachate	10	
	No Evidence of Leachate	0	10
A.4	PRESENCE OF SURFACE CONTAMINATED SOIL		
	> DCC Tier II Stains	15	
	> DCC Tier I < DCC Tier II. Stains	10	
	Contaminated suspected, no surface contamination noted	5	15
A.5	PRESENCE OF SURFACE DEBRIS AT LANDFILL		
	>50% of surface area	10	
	<50% of surface area, pro-rated	1-9	
	No debris observed	0	10
	SPECIAL CONSIDERATIONS		
		+/- 5	
	TOTAL SCORE - CONTAMINANT SOURCE		*50*

PROPOSED ENVIRONMENTAL RISK EVALUATION MATRIX FOR LANDFILLS IN THE NUNAVUT REGION			
B.	**PATHWAY/TRANSPORT MECHANISMS**		**Maximum Score**
B.1	AERIAL TRANSPORT OF CONTAMINANTS		
	All Landfills Scored as 2 If Surface Soil Contamination (A.4) or leachate (A.3) has been identified		2
B.2	WATER MOVEMENT		
B.2.1	TOPOGRAPHY		
	Steeply Slope (>40 % Grade)	12	
	Sloping (10% to 40% Grade)	4-11	
	Subdued to 10% Slope	2-3	
	Flat (< 3%)	1	12
B.2.2	COVER MATERIALS -DEPTH		
	No to little existing cover	4	
	Greater than 50% exposed/surface debris	3	
	Occasional exposed/surface debris	2	
	Existing cover, minimal debris.	1	
	Cover thickness > average active layer thickness	0	4
B.2.3	COVER MATERIAL - TYPE		
	No cover	5	
	Silty/Sandy Material	4	
	Sandy/Gravel Material	3	
	Gravel Material	1-2	5
B.2.4	SURFACE WATER/RUN-OFF POTENTIAL		
	Very High - evidence of erosion, continuing run-off, or wave action	12	
	High - evidence of erosion, seasonal, widespread, storm waves	10	
	Moderate - % area affected by erosion	3-9	
	Low - no evidence of erosion, slight slopes	1-2	12
B.2.5	PRECIPITATION		
	> 500 mm annual precipitation	5	
	< 500 mm annual precipitation (pro-rated)	1-4	5
B.2.6	DISTANCE TO DOWNGRADIENT PERENNIAL SURFACE/L SEASONAL DRAINAGE CHANNEL		
	0 to 100 m	10	
	100 to 300 m	7-9	
	300 to 1 km	2-6	
	greater than 1 km	1	10
	SPECIAL CONSIDERATIONS		
		+/- 5	
	TOTAL SCORE - PATHWAYS		***50***

PROPOSED ENVIRONMENTAL RISK EVALUATION MATRIX
FOR LANDFILLS IN THE NUNAVUT REGION

C.	RECEPTORS				Maximum Score
C.1	POTENTIAL IMPACT ON RECEIVING FRESHWATER/MARINE HABITAT				
C.1.1	PROXIMITY TO RECEIVING FRESHWATER/MARINE HABITAT				
	0 to 100 m			6	
	100 to 300 m			4-5	
	300 to 1 km			2-3	
	greater than 1 km			1	6
C.1.2	ESTIMATED HABITAT USAGE - FRESHWATER/MARINE				
	High: High Biodiversity/ High Occurrence/Calving or Spawning Area			5-6	
	Moderate: Moderate Biodiversity, Migratory			3-4	
	Low: Low biodiversity: rare sightings			1-2	6
C.2	POTENTIAL IMPACT ON RECEIVING TERRESTRIAL HABITAT				
C.2.1	Extent of Vegetation				
	Extensive vegetation growth, (80 to 100 % ground cover)			6	
	Moderate vegetation growth (40 to 80% ground cover)			4-5	
	Low vegetation growth (20 to 40% ground cover)			2-3	
	Sparse vegetation (<20% ground cover)			1	6
C.2.2	ESTIMATED HABITAT USAGE - TERRESTRIAL/AVIFAUNA				
	High: High Biodiversity/ High Occurrence/Calving, Denning or Nesting Area			5-6	
	Moderate: Moderate Biodiversity, Migratory			3-4	
	Low: Low biodiversity: rare sightings			1-2	6
C.3	POTENTIAL HUMAN EXPOSURE THROUGH LAND USE				
C.3.1	Presence/Occupation	*likehood of contact*			
	Duration of contact	high	moderate	low	
	High - Numerous visits, summer camp	6	6	4	
	Moderate - occasional summer camp	6	4	2	8
	Low - Infrequent visits or winter camp	4	2	1	
C.3.2	Proximity to Drinking Water Source				
	0 to 100 m			8	
	100 to 300 m			5-7	
	300 to 1 km			2-4	
	greater than 1 km			1	8
C.3.3	Food Consumption				
	High quantity of sedentary organisms - marine & plant life			8	
	Moderate quantity of sedentary organisms - marine & plant life			6	
	Low quantity of sedentary organisms - marine & plant life			4	
	No consumption			0	8
	High quantity of migratory organisms			2	
	Moderate quantity of migratory organisms			1	
	Low quantity of migratory organisms			0.5	
	No consumption			0	2
	SPECIAL CONSIDERATIONS				
				+/-5	
	TOTAL SCORE - RECEPTORS				***50***
	TOTAL SCORE				150

Appendix C
Disposal Requirements For Items Potentially Found At Dew Line Sites

Hazardous materials (as defined by federal or territorial legislation) will not be landfilled at the DEW sites.

The following table includes items that could be found at DEW sites and provides the treatment of these items as part of the clean-up.

Item	Disposal
Waste oil	Treat as per the DLCU Barrel Protocol/GNWT criteria
PCB-containing equipment (e.g. transformers/capacitors)	Treat as per federal regulations
Asbestos	Bag and bury according to GNWT regulations
Sewage-liquid	Treat as per wastewater discharge criteria
Sewage-solid	Treat as soil
Lead and PCB based paints	Treat as per federal regulations
Radioactive tubes	Not suitable for landfill
Scrap metal	Bury in engineered landfill on site
Radar components	Bury in engineered landfill on site
Fuel barrels	Treat as per the DLCU Barrel Protocol/GNWT criteria
Lime	Not suitable for landfill
Antifreeze	Treat as per the DLCU Barrel Protocol/GNWT criteria
Wood	Bury in engineered landfill on site
AVGAS (aviation fuel)	Treat as per the DLCU Barrel Protocol/GNWT criteria
Sulfamic acid	Not suitable for landfill.
Cathode-ray tubes and screens	Bury in engineered landfill on site
Filtron tubes	Not suitable for landfill
Oscillators	Bury in engineered landfill on site
Meters	Not suitable for landfill if PCB- or mercury-containing
Copper wire	Bury in engineered landfill on site
Transmission fluid	Treat as per the DLCU Barrel Protocol/GNWT criteria
1,1,1-trichloroethane	Not suitable for landfill
PBX telephone equipment	Bury in engineered landfill on site
Mercury vapour rectifier tubes	Not suitable for landfill
Paint thinners	Treat as per the DLCU Barrel Protocol/GNWT criteria
Batteries	Not suitable for landfill
Chlorinated hydrocarbons	Treat as per the DLCU Barrel Protocol/GNWT criteria
Corrosion inhibitors	Not suitable for landfill
Lye	Not suitable for landfill
Corrosives	Not suitable for landfill

Item	Disposal
Plastic	Bury in engineered landfill on site
Solvent	Treat as per DLCU Barrel Protocol/GNWT criteria
Dynamite	Not suitable for landfill
RF Interference filters	Bury in engineered landfill on site
Generators	Clean and bury in engineered landfill on site
Scopes	Bury in engineered landfill on site
Vehicles	Clean and bury in engineered landfill
Rubber fuel bladders	Clean and bury in engineered landfill on site
Creosote-treated poles	Bag and bury in engineered landfill on site
Compressed gas cylinders	Vent, puncture and bury in engineered landfill on site
Refrigeration equipment	Recover freon and bury in engineered landfill on site
Paper	Bury in engineered landfill on site

Appendix D

Sample Questions For Community Consultations

Habitat Considerations

- Are there fish/birds/clams in the pond/lake/bay immediately down hill of the landfill?
- Are there many different types of fish/birds/clams in the pond/lake/bay? What species have you observed in that water body?
- Does spawning or nesting occur in the pond/lake/bay?
- Do the animals in the pond/lake/bay stay all year round or are they migratory?
- Have you observed any land animals such as caribou, fox or bear at the DEW Line site? How many? Was the wildlife feeding/calving/nesting/burrowing on site or near a landfill?

Exposure Considerations

- Does the community fish in the pond/lake/bay down hill of the landfill? Where does the community fish?
- Does the community collect clams/sculpins/urchins from the lake/bay?
- Does the community hunt seal, walrus or whales from the bay?
- Does the community pick berries or use the vegetation down gradient of the landfill?
- Does the community hunt at the DEW Line site? What do they hunt?
- How often do the community residents visit the site? Do you camp there seasonally? Where is the camp located?
- Where is drinking water taken from on-site?

Special Considerations

- Is the community aware of this landfill? Are there any special considerations?

Appendix E

Tier I and Tier II
DEW Line Clean-up Criteria

Substance	Units	DCC Tier I	DCC Tier II*
Arsenic	ppm	-	30
Cadmium	ppm	-	5.0
Chromium	ppm	-	250
Cobalt	ppm	-	50
Copper	ppm	-	100
Lead	ppm	200**	500
Mercury	ppm	-	2.0
Nickel	ppm	-	100
Zinc	ppm	-	500
PCB's	ppm	1.0***	5.0

* concentrations exceeding this limits are classified as Tier II Soils except where the concentrations exceed federal regulations (referred to herein as "CEPA" soils)

** concentrations between 200 and 500 ppm are classified as Tier I Soils

*** concentrations between 1.0 and 5.0 ppm are classified as Tier I Soils

Appendix F

Confirmatory Testing Protocol

Confirmatory Testing Grid Sizes

Size of area	Grid size	# Perimeter samples analyzed	# Interior grid samples analyzed
<100 m^2	3x3 m	all	all
>100 m^2, <2500 m^2	6x6 m	50%	40%
>2500 m^2	12x12 m	50%	40%

Where the excavation has an irregular shape, samples from the perimeter of the excavated area are to be collected following the shape of the excavation, rather than the grid if the grid points do not fall on the edge of the excavation.

Samples at the grid intersections will be point samples (as opposed to composite samples from each cell on the grid),to ensure simplicity of sampling and clarity of the result.

Appendix G

Barrel Contents Criteria and Disposal

Introduction

In order to determine the correct disposal method for barrels and their contents, the contents must first be identified. All barrel contents will be sampled and analyzed. Analytical data obtained for the samples collected from barrels located at the site will be compared to the criteria included in Table 1, below. Barrel contents are identified as organic or aqueous and the concentrations of glycols, alcohols, PCBs, chlorine, cadmium, chromium and lead are determined. Uncontaminated aqueous phases can be disposed of on the land; uncontaminated organic phases can be incinerated; contaminated aqueous material should be scrubbed free of organic material; and contaminated organic material should be disposed of as hazardous material.

Table 1: Barrel Protocol Criteria and Disposal Summary

Phase	% glycols or alcohols	PCB	Cl	Cd	Cr	Pb	Disposal
Organic	-	<2	<1000	<2	<10	<100	Incineration
Organic	-	>2	>1000	>2	>10	>100	Ship south
Aqueous	>2 %	>2	>1000	>2	>10	>100	Ship south
Aqueous	>2 %	<2	<1000	<2	<10	<100	Incineration
Aqueous	<2%						Scrub and discard

A. Inspection

1. All barrels are to be inspected to address the following items which shall be recorded and used as a guide prior to opening barrels.

2. Symbols, words, or other marks on the barrel that identify its contents, and/or that its contents are hazardous: e.g. radioactive, explosive, corrosive, toxic, flammable.
3. Symbols, words, or other marks on the barrel that indicate that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume containers.
4. Signs of deterioration or damage such as corrosion, rust, or leaks at seams, rims, and V grooves.
5. Spillage or discoloration on the top and sides of the barrel.
6. Signs that the barrel is under pressure such as bulging and swelling.

B. Sampling

1. Barrels shall not be transported until it has been determined that they are not under pressure, do not leak, and are sufficiently sound for transport.
2. Barrels to be sampled should be set in an upright position, provided that this does not cause them to leak and that it is physically possible.
3. Barrels should only be opened using heavy equipment, according to accepted procedures and under qualified supervision.
4. Once open, barrels will be sampled by personnel wearing proper personal protective gear. Samples of the contents of all barrels shall be extracted using a drum thief.
5. In instances where there are a large number of barrels with obviously similar contents, these can be grouped together and 30 to 40% of the barrels in the group sampled. Barrels containing less than 50 mm of liquid may be combined with compatible material prior to sampling; samples inferred to contain only water on a visual examination shall be tested prior to this consolidation. Barrel contents, which consist of black oil, shall not be consolidated.
6. All barrels shall be clearly numbered using spray paint or other suitable marker. The number on this label should be the only sample coding provided to the laboratory.
7. The barrel locations and barrel sample descriptions should be recorded.
8. Samples should be kept at ambient temperatures and shipped by guaranteed freight to laboratories where they should be kept cold pending analysis.

C. Testing

1. Liquid samples shall be inspected and classified as either containing water or organic materials. Samples thought to contain water shall be analyzed to confirm that they are indeed water, and contain less than 2% glycols or alcohols.
2. The contents of barrels containing organic materials, including aqueous samples which contain more than 2% glycols or alcohols, shall be tested for PCBs, total

chlorine, cadmium, chromium and lead, in addition to identification of the major components e.g. fuel oil, lubricating oil.

3. Contents of barrels which contain two or more phases shall have all phases analyzed; the organic phases as described above and the aqueous phase to ascertain whether it contains less than 2% organic substances. In addition, the aqueous phase shall be tested for any components found in the organic phases above the criteria described below.

D. Disposal of Barrel Contents

1. Barrels containing only rust and sediment shall be treated as empty barrels.
2. Barrel contents comprising water only (less than 2% glycols or alcohols) shall be transferred to an open vessel such as a utility tub or half-barrel and any organic material removed by agitation with a pillow or segment of oil absorbent material. The water may then be discarded on to the ground that is a minimum of 30 meters distance from natural drainage courses. Used oil absorbent material shall be treated as described in below (D.5.).
3. Barrel contents which are composed of water with glycols and/or alcohols or organic phases, and which contain less than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium, and 100 ppm lead, may be disposed of by incineration. Alternatively these contents may be disposed of off-site at a licensed disposal facility. The solid residual material resulting from incineration shall be subjected to a leachate extraction test. Material found to be not leachate toxic shall be disposed of as DCC Tier II contaminated soil. Leachate toxic material shall be treated as hazardous waste and disposed of off-site at a licensed disposal facility.
4. Barrel contents, which contain greater than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium or 100 ppm lead shall be disposed of off-site at a licensed disposal facility. Contents may be combined with compatible materials for shipping purposes. Flash points may be required to be determined if they cannot be inferred from the product identification.
5. Used oil absorbent material should be treated as hazardous waste and disposed of off-site at a licensed disposal facility. If it is shown to be uncontaminated with PCBs (< 2 ppm), chlorine (< 1000 ppm), cadmium (< 2 ppm), chromium (< 10 ppm) and lead (< 100 ppm), it may be incinerated on-site.

E. Disposal of Barrels

1. Empty barrels may be crushed or shredded and landfilled on-site as non-hazardous waste after they have been cleaned in an appropriate manner. The barrels shall be

crushed in such a manner so as to reduce their volume by a minimum of 75%. Shredded barrels may be disposed of off-site as recycled metals.

Appendix H

Post Construction Landfill Monitoring Regime

1.0 Types of Landfills

There are four types of landfills that require monitoring:

- New landfills for non-hazardous materials and Tier I soil;
- Landfills to be closed by the addition of granular fill and regraded;
- Landfills to be closed with leachate containment; and
- Tier II soil disposal facilities.

2.0 Monitoring

New landfills are to be constructed for the disposal of non-hazardous demolition wastes, site debris and Tier I soil. These landfills, constructed according to specifications, are considered to pose low potential environmental risks as the contents and placement of the materials in the landfill are known. The monitoring of these landfills will be limited to a visual inspection program to evaluate the stability of the landfill.

Existing landfills that are to be regraded will be monitored for leachate periodically by the collection of soil and/or water samples from test pits at the toe of the landfill, in addition to visual inspection.

For existing landfills that have been classified as moderate potential environmental risk, and proposed Tier II soil disposal areas, the design in both cases is to incorporate a leachate containment system, consisting of synthetic liners (geocomposite clay liners, and/or geomembrane liners) and promotion of permafrost aggradation through the landfill contents. The monitoring program for these landfills will include thermal monitoring of the ground temperatures in and around the landfill, collection and analysis of soil samples, collection and analysis of water from wells around the landfill, and visual inspection.

3.0 Description of Monitoring Components

3.1 Visual Inspection

The physical integrity of the landfill will be inspected and reported using photographs (from the air as well as ground level) and hand drawn sketches. Documented observations should include:

- Signs of damage from settlement, ponding, frost action, erosion, and lateral movement.
- Sloughing of berms, thermal contraction cracks etc.

3.2 Soil and Water Sampling

Soil and water samples, representing background as well as baseline conditions, will be collected. Results of analyses of samples from landfills will be compared to these baseline and background samples as this is indicative of changing environmental conditions at the site.

In general, one monitoring well will be placed upgradient and three will be placed downgradient. This allows the assessment of hydraulic gradient and evaluation of potential impacts. Soil samples will be collected from the toe of the landfill, and will generally be taken from the same locations as the wells. Soil samples at the toe of the landfill reflect chronic input from water and are a very important indicator of leachate.

Soil and water samples will be tested for:

- PCBs (polychlorinated biphenyls);
- TPH (total petroleum hydrocarbons),; and;
- Inorganic elements: arsenic, cadmium, chromium, cobalt, copper, lead, nickel and zinc.

If the landfill is close to a drinking water source and has the potential to have an impact on it, the water samples will be analyzed for the following parameters in addition to the compounds and elements listed above:

- inorganic elements by ICP scan;

- major ions, hardness, and total dissolved solids,; and;
- pH and conductivity.;

The intent of the additional analyses is to provide added information to evaluate the potential impacts related to the landfill, and not necessarily to provide an assessment of the potability of the water source. In this latter case, the results of the analyses of these drinking water samples will be compared to the most current version of Canadian and/or Territorial standards for drinking water for the parameters analysed, in addition to comparison with background and baseline data.

3.3 Thermal Monitoring

As indicated previously, one component of the leachate containment system incorporates aggradation of the permafrost through the landfill contents such that the active layer does not penetrate the waste materials. Geothermal analyses were carried out to predict the length of time for freezeback of the landfill; long-term and short-term thermal regime in the ground; and the depth of the active layer in the cover material. The analyses have shown that it takes several years for the landfill temperatures to equilibrate and stabilize.

A thermal monitoring system provides measurement of sub-surface ground temperatures, which allows comparison to and verification of the predicted ground temperatures. The thermal monitoring system consists of installation of thermistor strings, with "thermistor beads" at select intervals to provide ground temperature profiles at various locations within the landfill. The thermistor strings are attached to automated data-loggers which allow for remote data collection. In general, a minimum of three thermistors will be placed; the actual number will be evaluated on a landfill-specific basis. Thermistor installation will be in accordance with standard engineering practice.

Checklists for the collection of monitoring data are presented in Appendix I.

4.0 Monitoring Frequency

Generally, the post-construction monitoring program would have three phases, each with a different objective.

4.1 Phase I: Monitoring of conditions to confirm that equilibrium is achieved.

During Phase I, sites where leachate containment and/or Tier II soil facilities have been constructed, monitoring will take place on an annual basis, for an estimated period of five years following construction. The five-year term was selected on the basis that ground-temperature thermal regimes at these specific landfills would require three to five years to reach equilibrium.

At other locations, where existing landfills have been regraded and new landfills have been constructed, Phase I monitoring will be carried out on in the first, third and fifth years following construction.

An evaluation of the Phase I data will be carried out at the end of five years to confirm that thermal and chemical equilibrium had been achieved, and that no stability issues have been identified. The Phase I monitoring program may be extended, if required.

4.2 Phase II: Verification of equilibrium conditions established during Phase I.

The monitoring frequency in Phase II be downgraded from Phase I, and be carried out according to the following schedule: year 7, year 10, year 15 and year 25. Year 25 would mark the end of Phase II monitoring.

4.3 Phase III: Monitoring for long term issues such as liner integrity, permafrost stability, and significant storm events.

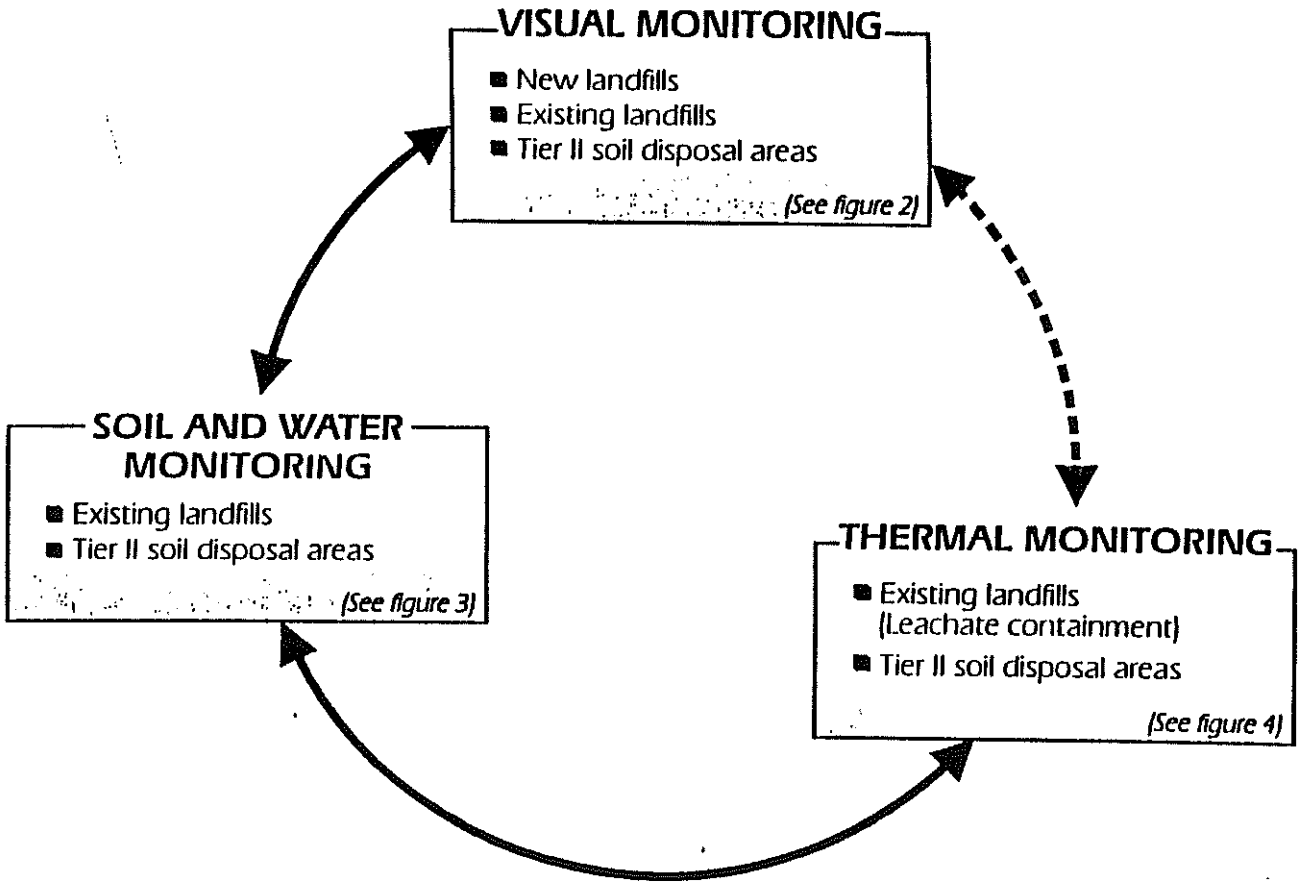
At the end of Phase II, 25 years after implementation of the remedial actions for a given landfill, a major re-evaluation of the monitoring program will be carried out prior to initiating Phase III. It is difficult to predict beyond 25 years how world events and improvements in technology may impact on monitoring requirements. Based on current technology and knowledge, a Phase III program should be implemented at 10 year intervals. The duration of the Phase III program will be estimated at the outset of the program and be subject to re-evaluation as new technologies are developed and new information becomes available.

5.0 Interpreting Monitoring Results

Monitoring results (thermal, chemical and visual) have to be interpreted in concert with one another. An increase in chemical concentrations, for instance, from one year to the next does not necessarily trigger action if there are no other signs of landfill instability. Stability problems would have to be established by a geotechnical engineer with northern experience. Action will be taken based on trends in chemical data rather than isolated results.

Normally, the first step to be taken when a potential problem is identified is to intensify the monitoring program. If a problem has been confirmed, then remedial action will be undertaken.

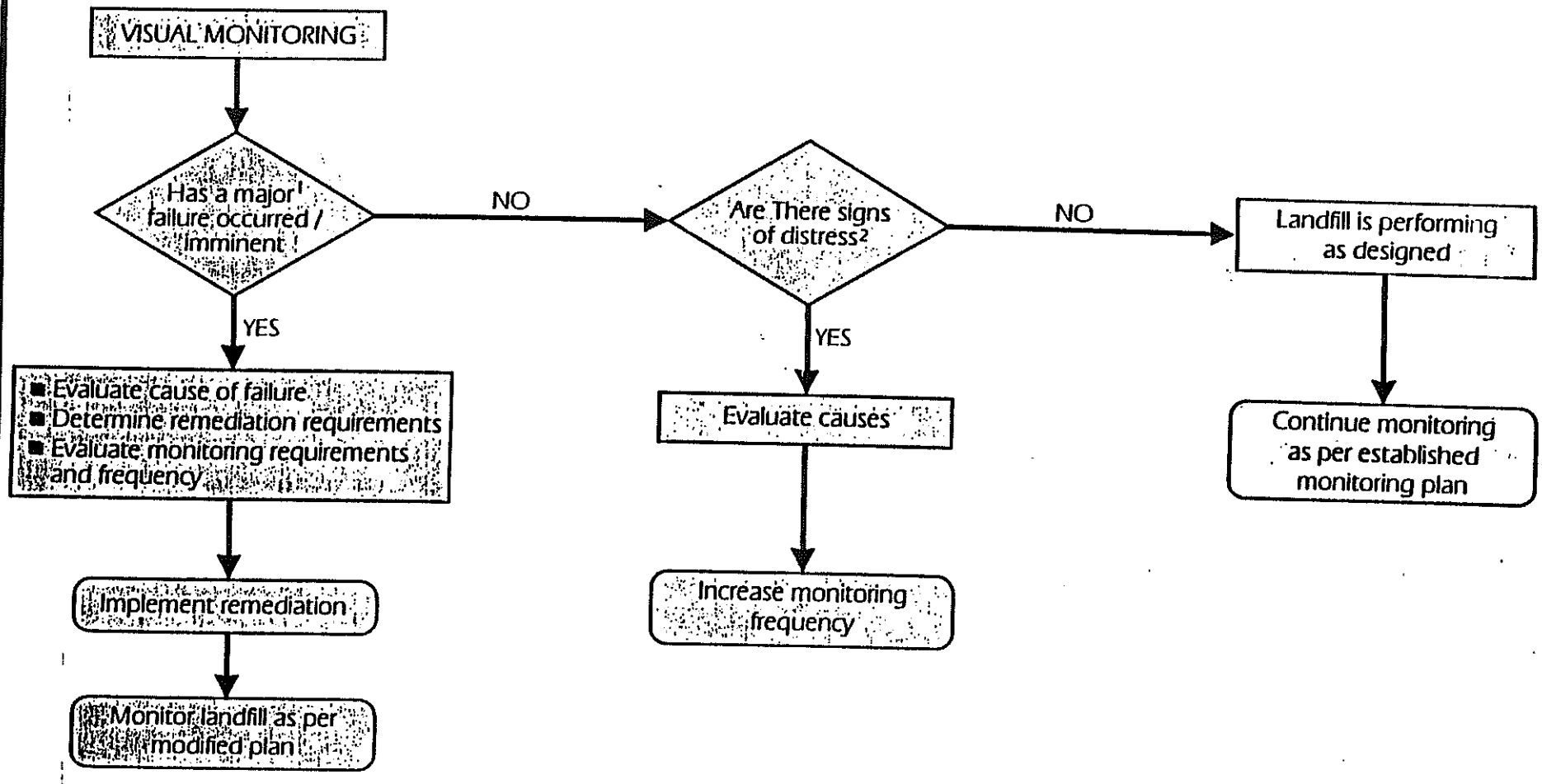
The flowcharts in Figures 1 to 4 illustrates the decision-making process to be applied to monitoring data. The following section outlines actions to be taken if the monitoring program indicates a deficiency in a landfill.



DEW Line Clean-Up
Environmental Working Group
LANDFILL MONITORING PROGRAM

SUMMARY FLOW CHART

Figure



Notes:

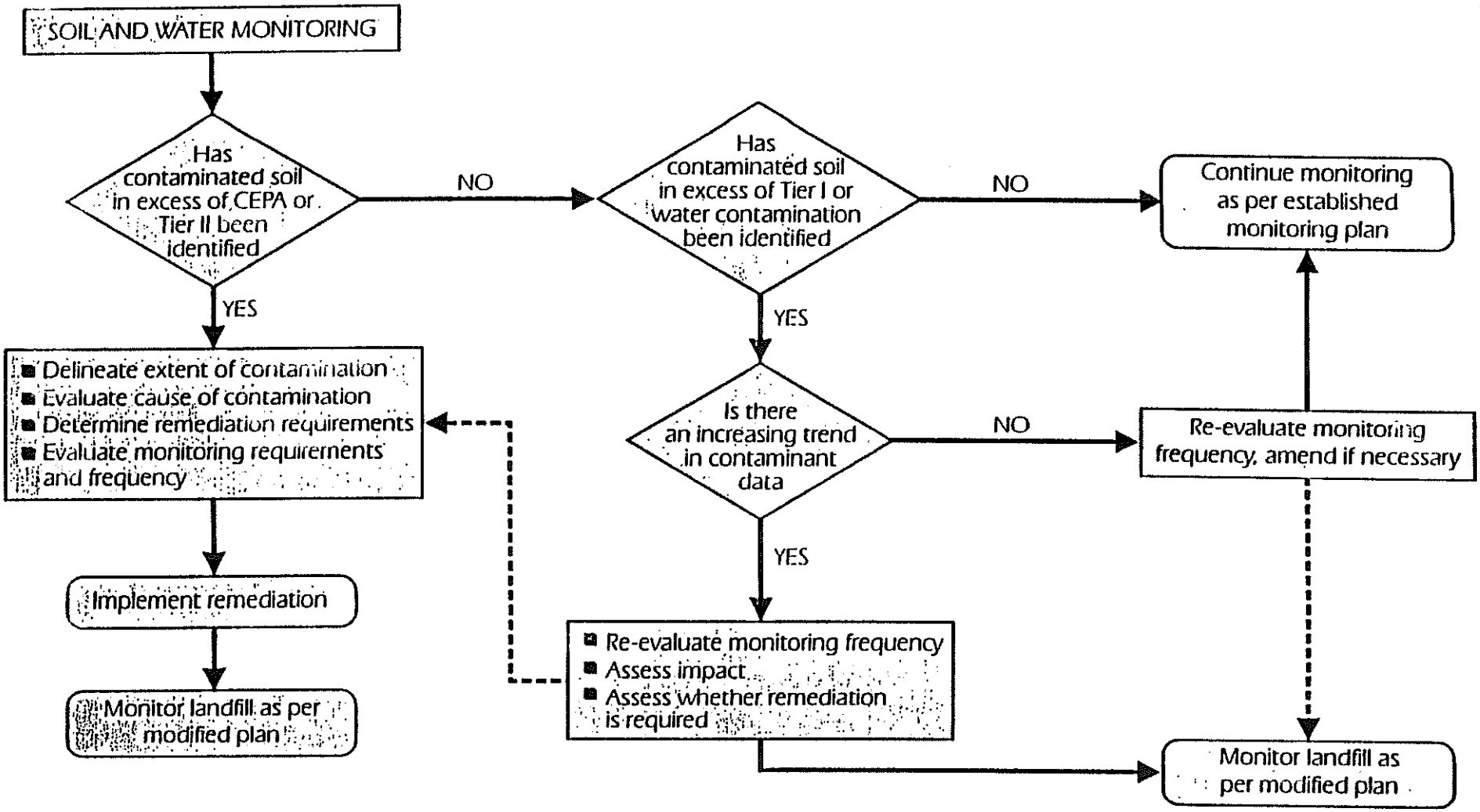
1 Major Failure: significant exposed debris (>25% of surface area) due to erosion, settlement, frost action; berm failure (slope stability)

2 Signs of Distress: Voids due to settlement, ponding on surface, and\or tension cracks, and/or erosion.

DEW Line Clean-Up
Environmental Working Group
LANDFILL MONITORING PROGRAM

VISUAL MONITORING FLOW CHART

Figure



Note:
Water contamination to be evaluated relative to baseline and background concentrations.

DEW Line Clean-Up
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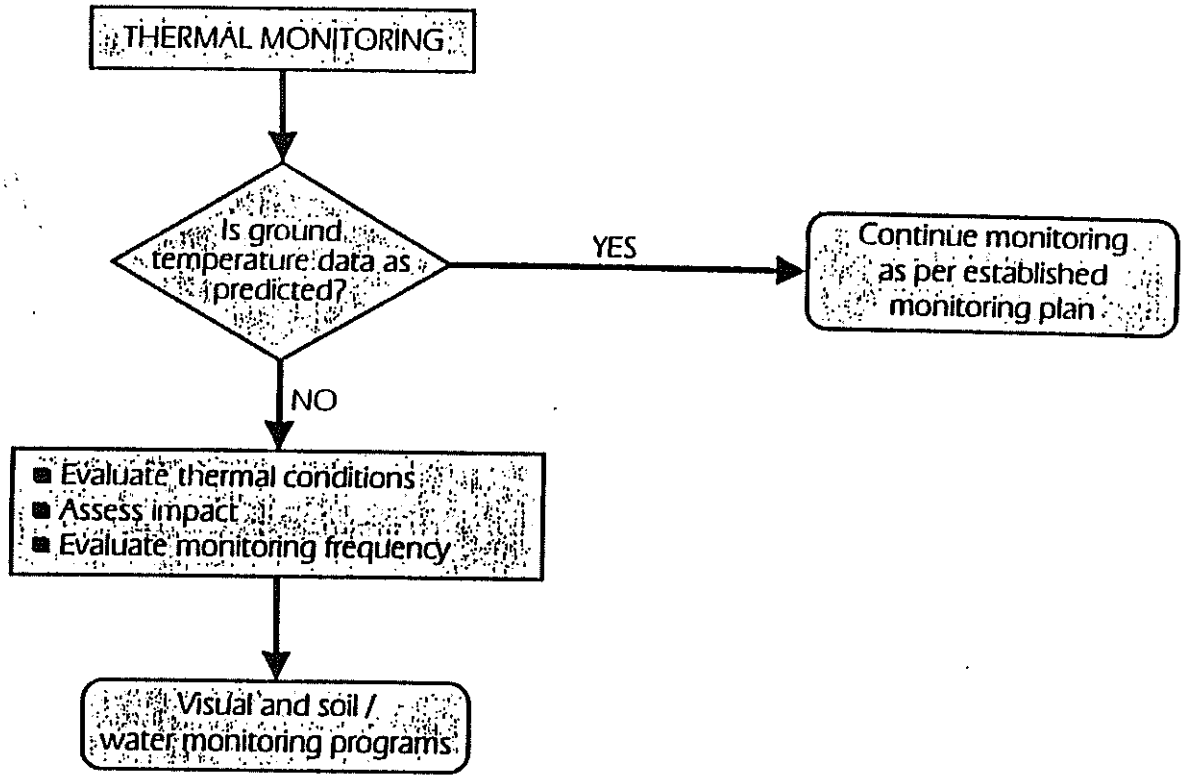
LANDFILL MONITORING PROGRAM

SOIL AND WATER MONITORING FLOW CHAR

Figure



DEW Line Clean-Up
Environmental Working Group
LANDFILL MONITORING PROGRAM

THERMAL MONITORING FLOW CHART

Figure

6.0 Impact of Monitoring Results

The possible results and the associated potential mitigation requirements for the landfill monitoring components are described in the following subsections. For all instances, the mitigation requirements are dependent on the severity of the deficiency, and will be assessed by a professional geotechnical engineer with northern engineering design and construction experience. In addition, the assessment and implementation of resulting remediation requirements will be carried out in a staged approach to ensure that the proposed solutions address the specific requirements in a logical and cost effective manner.

6.1 Visual Inspection

If the results of the visual inspection program indicate evidence of significant settlement, ponding, or frost jacking, it may be necessary to implement one or more of the following mitigative measures:

- increase the frequency of the visual monitoring program
- place erosion protection material such as riprap, vegetation mats, etc.
- recompact existing debris material and existing granular material
- place additional granular fill
- regrade, as required, to promote positive drainage away from the deficient landfill area.

It should be noted that settlement of the landfill surface may not necessarily result in failure of the landfill. Settlement (typically differential settlement) that results in ponding and infiltration of surface water could lead to erosion and frost jacking problems.

If the visual monitoring program results indicate evidence of sloughing of landfill perimeter berms and thermal contraction cracks, it may be necessary to implement one or more of the following mitigative measures:

- flatten granular berm slopes
- compact existing granular slopes
- place and compact additional granular fill material

6.2 Soil and Groundwater Monitoring

The results of the soil and groundwater monitoring program will be compared against baseline data established prior to the initial landfill development or remediation program. Results of the analysis of soil and groundwater samples that show decreasing trends of contamination at the perimeter of landfills typically indicate that the implemented landfill remediation has been effective. Conversely, if the results indicate increasing levels of contamination, then it may be necessary to implement one or all of the following:

- Increase the frequency of the monitoring program.
- Carry out a review and evaluation of the nature and extent of the contamination, including the incorporation of the results of the visual monitoring program. The major objective of this evaluation will be to determine the cause of the contaminant migration problem, and in particular to determine if it is the result of ineffective design, material (e.g. liner) failure, improper compaction, selection and use of inadequate granular material, poor grading, etc. This evaluation may require intrusive investigation into and around the landfill.
- Depending on the results of the above, it may be necessary to remove and replace liner material, reconstruct containment berms, etc.
- Assess the requirement to excavate and dispose of the contaminated soil; this would include the delineation of the vertical and areal extent of the contamination.
- Excavate and dispose of contaminated soil and/or excavate all or part(s) of the landfill, as required.

The requirement for the specific scope and extent of remediation, as outlined above, will also incorporate an risk evaluation of the potential impacts of the contamination based on the principles defined in the Landfill Risk Evaluation Matrix. The need for the risk evaluation is predicated on the understanding that not all affected sites pose the same risk to the environment, and consequently remediation requirements will vary.

6.3 Thermal Monitoring

The results of the thermal monitoring program will be compared against the parameters for freezeback that were incorporated into the geothermal design of the landfills. It is important that the overall assessment of these results consider the results of both the visual and soil/groundwater monitoring programs. If the thermal monitoring results indicate ground temperatures that are significantly higher (greater than 2° C) than

predicted during the geothermal analyses carried out as part of the design, then it may be necessary to implement one or more of the following:

- Increase the frequency of the recording and assessment of results from the thermal monitors.
- Establish, based on the results of the soil and groundwater monitoring programs, if groundwater and/or soil contaminant levels beyond the perimeter of the landfill have increased. Incorporate the results of a risk assessment. Assess the impacts, as outlined above, to determine the appropriate remediation requirements.
- If it established that a slower than expected freezeback period has resulted in the migration of contamination beyond the landfill and depending on the results of the above risk assessment, then it may be necessary to implement one or more of the following:

    - determine if the rate of the freezeback progress is continuing, or if freezeback within the landfill has terminated; is at steady-state;
    - excavate and dispose of contaminated soil and/or excavate all or part of the landfill, as required;
    - place additional granular cover material or other insulating material (styrofoam insulation, vegetation) over the landfill to provide an increased insulation barrier over the landfill;
    - reconstruct and/or re-saturate the perimeter berms of the landfill.

Appendix I

Landfill Monitoring Checklist

DEW LINE CLEANUP
LANDFILL MONITORING CHECKLIST

MONITORING PROGRAM

LANDFILL TYPE	Visual	Soil and Water	Thermal
New Landfill (Non-Hazardous Wastes)	X		
Landfill requiring Regrading	X	X	
Landfill requiring Leachate Containment	X	X	X
Tier II Soil Disposal Facilities	X	X	X

SITE: _____

LANDFILL DESIGNATION: _____

LANDFILL TYPE: _____

DATE: _____

MONITORING EVENT NO.: _____

NAME: _____

WEATHER CONDITIONS: _____

VISUAL INSPECTION CHECKLIST

Carry out a visual inspection of the landfill surface, berms, toe of berms and identify potential areas of distress as follows:

1. Settlement:
   a) Is there differential settlement occurring on the surface?
      i) low areas or depressions;
      ii) voids forming

   b) What is the extent of settlement?
      i) percent of surface area affected;
      ii) localized areas or continuous;
      iii) how deep;

   c) Where is the settlement occurring?
      i) near berms, center of facility, etc.

   d) Explain?
      i) evidence of significant surface infiltration,
      ii) water ponding on surface
      iii) snow drifting

32. Erosion
   a) Is there erosion occurring on the surface or berms of the landfill?
      i) preferred drainage channels;
      ii) sloughing of material;

   b) What is the extent of erosion?
      i) percent of surface area affected;
      ii) localized areas or continuous;

   c) Where is the erosion occurring?
      i) along the toe, on the surface, through the berms;

   d) Explain?
      i) evidence of significant surface water run-off ;
      ii) poor material type;

34. Frost Action

a) Is there frost action/damage to the landfill?
   i) exposure of debris due to uplift;
   ii) tension cracking along berms;
   iii) sorting of granular fill;

b) What is the extent of frost action?
   i) percent of surface area affected;
   ii) localized areas or continuous;

c) Where is the cracking, frost heaving occurring?
   i) along the toe, on the surface, through the berms;

d) Explain?
   i) poor material gradation;
   ii) poor compaction;
   iii) high water content, silt content in cover material;

45. Condition of Other Monitoring Instruments:

56. Provide detailed sketch and photographic record of landfill.

PRELIMINARY STABILITY ASSESSMENT

SOIL AND GROUNDWATER MONITORING FIELD CHECKLIST

1. Soil Samples:

Sample No:	
Field Measurements: VOC	
Soil Description:	
Analyses Requested	

2. Water Samples

Sample No: Well No.:	
Field Measurements :	pH Conductivity Temperature
Well Processing	Water level
	Purged well or standing water sampled
	Recovery Rates
Analyses Requested	

Comments:

Additional surface water samples: where, why, describe areas of stressed vegetation

THERMAL MONITORING CHECKLIST

Thermistor Number:
Location:

1. Download data
2. Replace battery pack
3. Check condition of connections and instrumentation
4. Save data to hard-drive and disk,.
5. Relock cap

Appendix J

Hydrocarbon Contamination Checklist

General

Date:

Name of Assessor:

Site Name:

Hydrocarbon Spill/Stain Location:

Hydrocarbon Source

What type of hydrocarbon is present in this stain? Consider the following:

Toxicity (Lubrication Oil, Diesel, Gasoline/Avgas)
Fluidity
Solubility
Volatility

What is the concentration of total petroleum hydrocarbons in parts per million (ppm)? Is it above 2500 ppm?

What is the approximate volume of contaminated soil in cubic metres?

Pathways

1. Is the contaminated soil in a stable location or on a slope?

2. What is the estimated organic matter in the contaminated soil? (ie. <0.1%, <5%, >5%)

3. What is the estimated grain size of the contaminated soil? Consider the following:

   Coarse (D_{50} > 75 micron)
   Fine (D_{50} < 75 micron)

4. What is the distance from the contaminated soil to a marine or freshwater environment?

5. What is the annual precipitation of the site?

6. What is the mean summer temperature?

Potential Impacts on Receptors

1. What is the distance to the nearest down gradient marine or freshwater habitat?

2. Is this a potential or known drinking water source for terrestrial animals or humans?

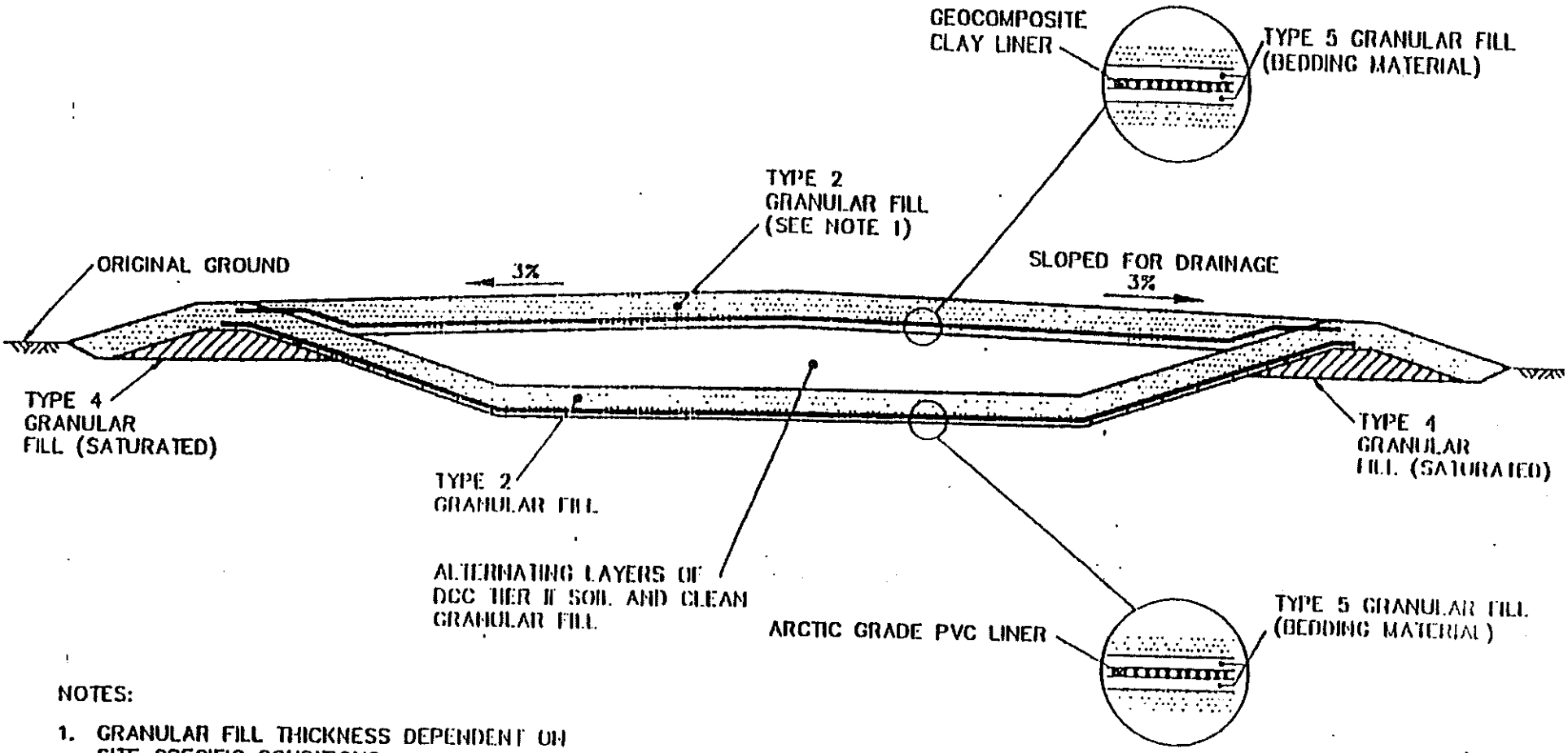
3. What is the down gradient habitat usage? Consider the following:

   Grazing, nesting, denning, spawning, calving
   High, medium, or low number of sitings.
   High, medium or low biodiversity.

4. Is this area visited frequently by humans for hunting, fishing, gathering or camping purposes? What is consumed and from where is it obtained?

Appendix K

Tier II Disposal Facility



NOTES:

1. GRANULAR FILL THICKNESS DEPENDENT ON SITE SPECIFIC CONDITIONS.
2. GRANULAR FILL GRADATIONS ARE SITE SPECIFIC.

UMA

TIER II DISPOSAL FACILITY

TYPICAL CROSS SECTION