Public Works and Government Services Canada

Northern Contaminated Sites Program

Remedial Action Plan
FOX-E, Durban Island
Intermediate DEW Line Site

Prepared by:

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Project Number:

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Date:

March, 2011

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March 29, 2011

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Dear Ms. Cotta:

Project No: **60158564**

Regarding: Remedial Action Plan, FOX-E Durban Island DEW Line Site

AECOM is pleased to submit the final Remedial Action Plan for the FOX-E, Durban Island DEW Line Site. We thank you for the opportunity to complete this work on behalf of Public Works and Government Services Canada.

Should you have any questions or require additional information, please do not hesitate to contact the undersigned at (780) 486-7000.

Sincerely,
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Executive Summary

FOX-E, Durban Island is located off the east coast of Baffin Island in Nunavut (67°05' N, 62°07' W). The nearest community is Qikiqtarjuaq, approximately 95 km to the southwest and the nearest air charter base is located in Iqaluit, located approximately 475 km to the southwest.

AECOM completed a Phase III Environmental Site Assessment (ESA) at FOX-E in the summer of 2010. The objective of this assessment was to collect all data necessary to develop a detailed clean-up design. The results of this assessment were used to develop the following Remedial Action Plan according to the Abandoned Military Site Remediation Protocol, the Canadian Environmental Protection Act, the Transportation of Dangerous Goods Act and Regulations and the Nunavut/NWT Guideline for the General Management of Hazardous Waste (1998).

The FOX-E site areas are connected via gravel roads with a steep switchback road connecting the Upper and Lower sites. Some sections of the road are reported to be in poor to very poor condition and will require major upgrading during construction to allow for heavy equipment use. Some areas are currently accessible only via poorly developed trails, which will require upgrading and access to the Dump A area is limited to helicopter and foot travel. There is no airstrip located on Durban Island. There is barge access to the site along the coast of the Davis Strait and a suitable beach landing area is present. Barge landing is not expected to be a concern.

An archaeological investigation has been completed for FOX-E by Golder Associates and the final "Archaeological Impact Assessment Report" is appended to this Remedial Action Plan for the identification of heritage features needing protection or avoidance during site remedial activities.

The investigation and delineation of contaminated soil at FOX-E was completed for the contaminants of concern listed in the protocol. This protocol specifies clean-up criteria for inorganic elements, petroleum hydrocarbons, and Polychlorinated Biphenyls.

Nine existing buried debris areas were investigated during the 2010 site investigation. The total surface area of buried debris areas is approximately 956 m^2. Based on the location and condition of the buried debris areas and contaminant migration assessment results, each buried debris area was classified as Class A, B or C according to the protocol. The remedial requirements for each buried debris area were initially assessed according to the recommended remedial method specified in the protocol for the various waste disposal area classifications. In addition, for development of remedial recommendations, site specific information for each buried debris area was considered, such as proximity to surface water bodies, presence and sensitivity of down-gradient receptors (terrestrial and aquatic), and long term geotechnical stability potential. Based on these evaluations, all nine existing buried debris areas were classified as Class C with a recommended remedial action of regarding with granular fill material.

Based on the surface debris assessment, demolition inventory and sampling, and barrel inventory and sampling, the crushed volume of hazardous waste identified at FOX-E is 130 m^3. The estimated crushed volume of non-hazardous waste is 2,420 m^3.

Based on the volume of non-hazardous waste, the quantities and types of granular materials identified during the 2010 investigation and the identification of several suitable sites for new landfill development, the option exists to dispose of non-hazardous waste within an engineered Non-Hazardous Waste Landfill on-site or off-site at a southern location. The preferred location for construction of an on-site facility is at Potential Landfill Area 2, located at the Upper Site. To allow for work efficiencies and cost savings, AECOM recommends that a "Combined Contract", including a consolidated non-hazardous waste landfill at Durban Island, be implemented for remediation of FOX-E and Padloping Island.

The following volumes of contaminated soil were identified at FOX-E:

- Tier I soil: 23 m^3;
- Tier II soil: 18 m^3;
- Tier I/Type A soil: 11 m^3; and
- Type B soil: 378 m^3.

Tier I and Tier I/Type A soil can be disposed of within a non-hazardous waste landfill. Considering the small volume of Tier II soils identified on-site, construction of an on-site Secure Soil Disposal Facility (SSDF) is not cost effective and it is recommended that Tier II soil be disposed of off-site at a southern disposal facility. The recommended remedial option for treatment of Type B soil is aeration or landfarming. The recommended location for a treatment or landfarming area for Type B Soils is at Potential Landfill Area 1 located at the Upper Site.

Based on the above remedial recommendations, it is estimated that the clean-up at FOX-E will require one full summer construction season and a partial season the same year as contractor mobilization. Contractor mobilization would likely be completed by sealift with barge support during the late summer/fall of the year before the main construction season and the contractor could initiate the work, weather permitting. The bulk of the construction activities would be completed during the main construction season with contractor demobilization in the fall. The number one priority for the contractor, in terms of main work elements, will be to complete the treatment area or landfarm and transport and spread the Type B Soils requiring treatment in the landfarm during the mobilization year to allow for treatment of PHC-impacted soils to commence as soon as possible and to facilitate achieving the remedial endpoint criteria by the end of the main construction season. This can only occur, though, after upgrading of the access to the Upper Site area. Following construction of the landfarm, the construction activity focus should switch to construction of the Non-Hazardous Waste Landfill. Hazardous waste segregation from demolition components is also recommended for completion as early as possible while facility construction is occurring to allow building demolition to proceed once the Non-Hazardous Waste Landfill is completed. Because of some unknowns related to barrel contents, the number of barrels on-site and the limited access to Dump A, barrel consolidation is recommended to be completed as much as possible during the mobilization year to allow for collection of samples and analysis.

In addition to a “Combined Contract” design scenario, Public Works and Government Services Canada and Indian and Northern Affairs Canada have expressed interest in a “Walkaway Solution” for the FOX-E site, which would apply remedial design solutions that would eliminate requirements for long term monitoring. For the FOX-E site, the major difference between a “Walkaway Solution” and a “Conventional Remediation” design solution is that all waste and untreated contaminated soil would require disposal off-site at a southern disposal facility as opposed to providing an on-site facility which would require long term monitoring. Cost impacts associated with these design scenarios have been provided under separate cover.

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1. Introduction

AECOM was retained by Public Works and Government Services Canada (PWGSC), on behalf of Indian and Northern Affairs Canada (INAC), Nunavut Regional Office Contaminated Sites Program, to complete a Phase III Environmental Site Assessment (ESA) and a Remedial Action Plan (RAP) with Class C Cost Estimate for the FOX-E, Durban Island former Intermediate DEW Line site.

The scope of work for the Phase III ESA included the assessment of:

- Contaminated soil areas;
- Surface water and sediment quality;
- Building materials and demolition requirements, including identification of hazardous materials;
- Existing waste disposal areas (aided by the completion of a geophysical survey of the area);
- Barrel contents;
- Areas of surface debris;
- Any other potentially hazardous materials on-site other than barrels or demolition items;
- The sources and volume of non-hazardous waste materials;
- Site access roads, barge landing areas, and airstrip;
- Borrow sources for use during clean-up activities; and
- Traditional knowledge regarding past and present land use of the site from the elders of the nearby communities.

The results of the Phase III ESA have been reported previously (AECOM 2010a). The findings of the Phase III ESA report form the basis of the RAP report.

This report discusses remedial options for site issues identified during the Phase III ESA and provides recommendations for the preferred options. Where different remedial options have been evaluated, a cost estimate comparing the options has been prepared. This report has been structured as follows:

- Section 2.0 outlines the background information that forms the basis of the remedial option evaluations and recommendations;
- Section 3.0 discusses remedial options for site Waste Disposal Areas;
- Section 4.0 identifies remedial requirements for hazardous waste elements at the site;
- Section 5.0 summarizes the sources of non-hazardous waste at the site and provides recommendations for disposal;
- Section 6.0 summarizes the findings of the contaminated soil investigation, and assesses remedial options for the various types of contaminated soil;
- Section 7.0 discusses issues related to the implementation of the recommended remedial options; and,
- Finally, Section 8.0 discusses implications of alternate design scenarios including a “Combined Contract” with nearby Padloping Island remediation site and a “Walkaway Solution”. Cost estimates for the different design scenarios are provided under separate cover in (AECOM 2011).

Figures are presented in Appendix A.

2. Background

2.1 Site Location and History

FOX-E, Durban Island was constructed as an Intermediate DEW Line site in 1957 by the Department of National Defence (DND). The station was abandoned as part of the DEW Line system in 1963, and in 1965 responsibility for the land was assumed by INAC. The site is located at 67°05' N, 62°07' W, on the eastern side of Durban Island, 2.3 km off the east coast of Baffin Island and the site is situated on the shores of Davis Strait. FOX-E is about 60 km northwest of the DYE-M, Cape Dyer DEW Line Site, 24 km southwest of the Padloping Island site, and 95 km southeast of the closest community, Qikiqtarjuaq which is located on Broughton Island. The nearest air charter base is located at Iqaluit, which is approximately 475 km southwest of the site. The site does not have an airstrip; however, and is only accessible by helicopter or by sea. Limited helicopter services are available from Iqaluit and a provision should be allowed for mobilizing a helicopter from the south such as Labrador, which was the experience during the 2010 site investigation.

The site has been divided into two main areas; the Upper Site and Lower Site. The Upper Site consists of the Station Area situated on a high plateau and an area southwest of the Station Area, while the Lower Site consists of the Beach Landing Area situated on the shore of the Davis Strait and the Old Construction Camp area situated along the access road that connects the Station Area and the Beach Landing Area.

There are two Crown Land parcels on Durban Island totalling approximately 120 hectares. There is one at the Upper Site area which encompasses the abandoned facilities at the Station Area and the other at the Lower Site area which encompasses the Old Construction Camp and beach fuel storage tanks. The remains of a 6.6 km long gravel road that connects the two parcels is situated on Inuit Owned Land (IOL) and is reported to generally be in poor to fair condition, and requiring major repairs at some sections in order to support construction operations. A 'U' shaped helicopter pad is located at the Upper Site which is the only infrastructure on-site for aircraft, as there is no airstrip on Durban Island. An overall plan showing the site infrastructure and access roads is shown on Figure 1.0.

Typical of Intermediate DEW Line sites, the FOX-E Station Area consisted of a Module Train, Warehouse, Garage, Inuit Huts, two Petroleum, Oil, and Lubricants (POL) storage tanks and pumphouse, and a felled Doppler antenna. Less typical of these sites, a large water reservoir tank and pumphouse is included in the Station Area infrastructure as there is no fresh water source at the Upper Site and there are no nearby freshwater lakes in vicinity of the Site. Personnel historically obtained freshwater from the runoff collector stream, which runs beside the Old Construction Camp toward the Beach Landing Area, terminating at the ocean. In addition to the main site, a beach POL storage facility is located at the Beach Area and consists of two 75,700 litre POL tanks and ancillary piping from the tanks to the shoreline.

2.2 Remedial Protocols and Criteria

The remedial recommendations provided herein are based primarily on the latest version of the INAC Abandoned Military Site Remediation Protocol (AMSRP) (INAC 2009), which provides assessment and remedial guidelines for Waste Disposal Areas (WDA's) including dump sites, landfill and debris areas, disposal of barrel contents, development of borrow sources and landfills and clean-up criteria for contaminated soil. There are no criteria for the classification of hazardous waste at federal sites, except for materials regulated under the Canadian Environmental Protection Act (CEPA), including the Inter-provincial Movement of Hazardous Waste Regulations. The classification and remedial recommendations for materials not covered under CEPA has been based on the Transportation of Dangerous Goods (TDG) Regulations and the Nunavut/NWT Guideline for the General Management of Hazardous Waste (1998), under the territorial Environmental Protection Act (R.S.N.W.T 1998 c.E-7). More detailed information related to remedial guidelines or requirements under the sources noted above is provided in the issue-specific sections below.

2.3 Site Specific Remedial Considerations

The following sections provide site specific considerations that have been applied in the development of this remedial action plan.

2.3.1 Off-Site Access

The FOX-E site is located along an ocean coast line. Barges have historically landed at the Beach Landing Area. The terrain at the beach is generally flat and comprised of well-drained, coarse-grained beach deposits and larger cobbles closer to the shore line. It is not expected that the use of heavy equipment for moving materials at the beach landing area will pose a problem. The depth of water in the near shore environment was assessed from air photo review and there was no evidence of shallow water extending great lengths from the shoreline. Tidal prediction rates for August and September were available from the Hamlet of Qikiqtarjuaq and the DYE-M, Cape Dyer DEW Line Site. This information was collected from the Department of Fisheries and Oceans (DFO) website. For these two sites during August and September, tidal fluctuations are in the order of approximately 1.1 m at Qikiqtarjuaq and 2.4 m at DYE-M. It can be expected that FOX-E, which is situated approximately in between these two sites will see similar tidal fluctuations.

AECOM has obtained nautical charts published by the Canadian Hydrographic Service. These nautical charts indicate that show suitable ocean depth information for access corridors to and between Durban and Padloping Island.

There are currently no nearby mining operations, and therefore, no potential for independent development of an ice road that would be of use for contractor mobilization. Because of the distance from any communities, combined with the availability of barge access, it is possible, but considered unlikely, that overland mobilization (i.e. cat train) would be considered a viable option for contractor mobilization. It has therefore been assumed for the preparation of this RAP and its associated cost estimate, that primary access to the site for mobilization and demobilization of contractor equipment and supplies for remediation will be via sealift with barge support.

There is no airstrip on Durban Island and it is expected that construction shift changes, grocery runs, and material resupply will be performed via helicopter. A helipad and windsock is located southwest of the Station Area at the Upper Site. For the purposes of this RAP, it has therefore been assumed that aircraft access to the site will not be an issue, though limited to a helicopter, and the primary mobilization of the contractor's equipment will be via sealift with barge support. All landings for both aircraft and barge at the site will be at the discretion of the pilot or operator.

The site assessment and provision of a RAP for the nearby Padloping Island Site is being undertaken concurrently with the FOX-E, Durban Island site. Other INAC/Department of National Defence (DND) projects have realized cost savings by having concurrent operations and consolidated waste disposal facilities for two sites as opposed to one. The PIN-D and PIN-E remediation contracts were combined into one contract with a consolidated NHW facility at PIN-D. Additionally, the PIN-B and PIN-2 contracts were awarded to the same contractor and operated concurrently with successful sharing of resources.

If the Padloping and Durban Island projects were combined into one contract, then it is expected that the work activities could be done concurrently and the contractor could shuttle workers between the two sites using a helicopter or boat.

2.3.2 On-Site Access

The most challenging aspects of the FOX-E clean-up are expected to be the on-site access to the Upper Site using the steep gravel switchback road and the extremely difficult access to the Dump A area.

There is one gravel road onsite that is approximately 6.6 km long and connects the Upper and Lower Sites. The majority of the road is situated on Inuit Owned Lands (IOL). The road was surveyed and its condition assessed during the site investigation and a summary of the road conditions is provided in Table 1. For ease of reference, the road has been divided into four sections, Sections 1 through 4, as shown on Figure 1.0. Sections 1 and 3 are generally in good condition and will require only minor upgrading to support heavy equipment traffic during construction operations. Sections 2 and 4 however, are reported to be in poor condition with frequent erosion channels, gullies, sinkholes, washouts and collapsed culverts and will require major repairs to support construction operations.

Road Section 2 is reported to be in very poor condition and is considered to be un-passable with construction equipment in its current state. In localized areas of this section of road, rock falls, slides, and bedrock outcrops limit the passable road width to as little as 1.5 m, especially along the upper portion of the road which tends to be narrower. The road width will require widening to facilitate one-way traffic. Long loads are expected during construction to mobilize a camp to the Upper Site. Blasting and scaling may be required to widen the road at the switchbacks or other areas where widening the road to the outside is not feasible to allow a proper turning radius around the switchbacks for the long loads.

Portions of road Section 2 may be prone to rock falls and slides (either rock or surficial soils) and would need to be monitored during construction, especially after rainfall events since this section of road passes through an area of significant runoff from the Station plateau area. Safety nets, etc. may be required if sections of the road exhibit frequent rock falls. Mitigation measures may also be required if slides are deemed to be a hazard. It is recommended that a road hazard assessment be completed on this section of road during the contractor's mobilization and mitigation measures provided as part of the contractor's health and safety plan.

A large washout requires repair and two timber bridges require either repair or removal and replacement with large diameter culverts backfilled with suitable granular material. A proper ditch along the inside of the road and additional culverts may be required to protect the road from runoff, especially where major erosion features are present.

Road Section 4 is in poor to fair condition and includes major erosion features such as erosion gullies, channels, loss of road topping and one major washout. The erosion features are a result of a large amount of surface runoff originating from the nearby plateaus that tend to concentrate through the valley upslope of the road, creating an outwash plain. Soft road conditions are present in localized areas due to the amount of water that passes through this area. Construction of drainage ditches, swales and additional culverts may be required to facilitate movement of construction equipment and portions of the road may need to be widened if two-way traffic is required. Localized areas of the road are level with the surrounding terrain and the road grade may require raising in low lying areas where drainage improvements are not viable or where there is a potential for overtopping creating washout conditions.

Dump A is situated off the crest of a large slope originating at the Station Area plateau. This area is currently not connected to the rest of the site with an access road and will require access during clean-up operations. To transport the debris from Dump A to the Upper Site for processing and disposal, various access options have been considered. The first access option considered is the construction of a trail from the Beach Landing Area to the base of Dump A that will follow the base of the ridge and the shore line. Based on air photos and discussion with personnel involved in the 2010 site investigation, there is steep topographic relief from the plateau to the water's edge with loose cobbles and boulders, creating unsuitable terrain for building a trail to connect the Beach Landing Area and the Dump A site. Additionally, a trail route around the island from the Beach Landfill Area would have to cross at least two areas with significant drainage channels. As a result, the construction of a trail from the Beach Landing Area to Dump A is not considered to be feasible.

The second access option considered is landing a barge at the beach below Dump A and mobilizing equipment to build a road up the slope of Dump A to access the debris. There is however, no beach landing identified along this portion of the coast and, additionally, a sheer cliff is present between the base of Dump A and the coast that precludes access at this area. As a result, using equipment mobilized via barge to the Dump A area is not considered to be feasible without further investigation.

Due to the extreme topographic constraints, the methodology for removing the debris from Dump A is expected to be a significant challenge. It is considered to be an extreme hazard to traverse the slopes even by foot at the upper portions where the majority of the debris is located. Access to the area is limited to helicopter and ground personnel on foot. It is recommended that unpainted wood debris be consolidated into piles on the slope and burned in place. To access and remove the wood debris hanging on the sheer cliff at the top of the Dump A, a crane positioned on the plateau at the edge of the cliff may be required. In addition to the wood debris, there are approximately 3,010 barrels scattered over the surface of Dump A. At this time, the only known solution for the removal of these barrels is to use a helicopter to sling the barrels to the Upper Site where empty barrels can be crushed and placed in the NHWL and barrels containing liquid contents can be analyzed and processed accordingly. Preferably, the crushing of the barrels could occur on the slope, which would drastically reduce the number of sling loads required by the helicopter. The clean-up of Dump A will be extremely labour intensive and pose significant hazards that will require mitigation by the contractor during construction. Additional remedial solutions and access to the area should be considered at the time of the bidder's tour.

Table 1. Summary of Access Road at Durban Island

Road Section	Condition	Passable Equipment	Steep and High Side Slopes	Erosion and Drainage Features	Road Surface
1 – Station to the crest of the plateau slope	good	Heavy equipment	-	No discernable road ditches, one collapsed culvert	-
2 – Crest of plateau slope to toe of the slope	Very poor to poor	Un-passable, only passable with a quad	Side slopes of 1H:1V and 1H:2V with heights between 3 m and 30 m. Sections of road may be exposed to rock falls and potentially unstable slopes	Erosion gullies, channels, sink holes, washouts, collapsed culverts, poor drainage	Long sections of exposed bedrock, boulders, and cobbles. Evidence of rock falls and slides on to the road. Evidence of slump blocks on steep side slopes.
3 – Toe of the plateau slope to the end of the old construction camp.	Fair to good	Heavy equipment	Side slopes of 3H:1V with heights between 1m and 15m for the first half of this section	Minor erosion features, fair drainage, except in the vicinity of the old construction camp where there is poor drainage and ponding water.	Fairly rough in sections. Soft road conditions in the vicinity of the old construction camp.
4 – Old construction camp to beach landing area.	Poor to Fair	Pick-up truck	-	Erosion gullies, channels, washouts, very poor drainage, collapsed culverts	Fairly rough and soft road condition in sections.

2.3.3 Environmental Considerations

Information regarding traditional knowledge and land use of the site was obtained during the site investigation through conversations with the bear monitors, Johnny Kooneeliusie and Loasie Audlakiak from Qikiqtarjuaq. To their knowledge, there has been no traditional land usage on Durban Island since closure of the FOX-E Station in the early 1960's other than perhaps transient visits by hunters and trappers. Neither hunting nor fishing are significant land use activities in this area since there are more attractive hunting and fishing areas closer to the nearby communities. To their knowledge there are no known residents of Qikiqtarjuaq that worked at the Station when it was operating.

Wildlife typically found in this region includes polar bears, seals, whales, arctic fox, arctic hare, caribou, ermine, lemming, ptarmigan, snowy owl, raven, snow bunting, osprey, shorebirds, seabirds, and waterfowl. Evidence of large numbers of Canada geese were noted during the ESG 2009 geochemistry study. During the 2010 site investigation, several polar bears and ptarmigans were noted.

Vegetation in the Davis Highlands Tundra ecoregion is characterized by a discontinuous cover of mosses, lichens, and cold-hardy vascular plants such as sedge (Carex sp.) and cotton grass (Eriophorum sp.). As noted in the 1994 ESG report, on the plateau where the main station buildings are located, the vegetation is very sparse and comprised of mostly lichens and mosses with some isolated tufts of willow (Salix sp.) and rush (Lazula sp.) plants. In the flatter, low lying areas (beach, Old Construction Camp and Dump A); the vegetation is fairly lush with willows, sedges, grasses, rushes, and flowering herbs. A detailed list of the vegetation types found at Durban Island can be found in the 1994 ESG report.

2.3.4 Geology/Geomorphology/Hydrology

The surficial geology of Durban Island mainly consists of bedrock outcrops and colluvial blocks and rubble derived from local bedrock with sand and gravel, and glacial erratics and till mixed in by freeze-thaw action. The main work areas at the Upper and Lower sites of FOX-E are located in areas of bedrock "blockfields" with fine sand and gravel and occasional glacial deposits of till and erratics. The main access road connecting the work areas travels through areas of exposed bedrock.

The bedrock at Durban Island is comprised of Precambrian metamorphosed sedimentary rocks (metagreywacke, metasiltstone, metapelite), migmatite of sedimentary origin, and minor igneous intrusive rocks (granitoid) of the Hoare Bay Group. The Beach and Construction Camp areas at the Lower Site are situated on this formation.

The plateaus at higher elevations of central Durban Island terminate on one or more sides by steep cliffs and contain the erosional remnants of basaltic volcanic rocks of the Cape Dyer Formation, which overlie the Precambrian rocks. The Station Area at the Upper Site is located on bedrock of this formation.

In the northeast corner of Durban Island, about 2 km northeast of the main station site, there are semi consolidated beds of sedimentary rocks (sandstone, shale, and conglomerate) of the Cape Searle and Quqaluit Formations overlying the Precambrian rocks.

A background geochemical assessment was undertaken in 2009 for FOX-E and reported in ESG 2010. The goal of the background geochemical assessment at FOX-E was to establish what the natural levels of inorganic contaminants are in the surrounding environment. The report concluded that naturally occurring elevated background levels of arsenic, chromium, cobalt, copper and nickel were discovered in the soil at the FOX-E site and therefore require Site Specific Criteria (SSC). Further discussion on implementation of this study to the criteria included in the INAC AMSRP is provided in Section 6.2.

Based on air photo interpretation and observations during the 2010 site investigation, regional overland drainage originates from the Upper Site and disperses radically and over the cliff edges within localized drainage channels. In the area of the access road that connects the Upper and Lower sites the relief is more gradual and drainage seems to follow a series of draws. The access road switchbacks and crosses a seasonal drainage channel twice and it is expected that in periods of intense rainfall and spring snow melt, high velocity stream flow will occur within this channel. Two timber bridges, in poor condition, currently cross this channel and should be replaced with large diameter culverts and backfilled with suitable granular material. At the Lower Site, surface runoff in some areas occurs as sheet flow and consequently has eroded much of the fine material from the road surface.

None of the soil types identified on-site are particularly prone to erosion, nevertheless; there are numerous washouts, erosion channels and gullies along the access road and repairs, in combination with ongoing maintenance, will be required during construction. Areas near the coast may be subject to future erosion by wave action in the event of sea level rise with global warming. Any borrow development in the vicinity of the beach or area may require drainage control to prevent sediment loading to the coastal area. Areas identified for new development (borrow and potential new landfill construction) at the Upper Site area are not considered at risk of any significant erosion due to a relatively small catchment area above and gentle slopes.

2.3.5 Archaeological Features

Golder Associates have completed an archaeological investigation for FOX-E. The report “Archaeological Impact Assessment of the FOX-E Intermediate DEW Line Site, Durban Island, Nunavut” is provided in Appendix F and the findings are summarized below:

- MgBs 2: considered to be of limited significance with no signs of remains; and
- MgBs 4: stone feature considered to be of moderate significance and should be avoided during construction. Located on a beach ridge overlooking the beach landing area and POL tanks.

2.3.6 Community Consultation

A community meeting was held in Qikiqtarjuaq, Nunavut on February 21, 2011 and included a presentation from Stephen Hooey from INAC regarding the proposed remediation programs at the Padloping Island and FOX-E, Durban Island sites. Taylor Eshpeter from AECOM also attended to provide support and answer technical questions on the remedial options presented. The presentation was held in the town hall gymnasium and attracted approximately 40 community members. The presentation communicated the intent of the cleanup as outlined in the draft version of the RAP while adding additional information on the “Combined Contract” and “Walkaway Solution” design scenarios. The community showed interest in the project, especially for the prospect of employment. Following the presentation, the floor was open to questions or concerns by the community. There were no concerns raised by the community regarding the remedial options presented for the two sites. One elder, though, was keen to share his knowledge of the area, especially for the Padloping site, where he lived for years while the site was in operation. Notes from his conversation are summarized below.

In general, the elder was concerned that there might still be dynamite onsite at Padloping and Durban Island and that there were camps with possible grave sites on an island adjacent to Durban Island that should not be disturbed.

The following items represent the discussions held with Markosie Audlakiak at the community meeting, most of which is regarding the Padloping Island site which he was more familiar with:

- When the military was searching for the location of Durban Island, Markosie was a boy and was involved.
- Near Durban Island there were some camping areas across from the island that were used in the 1800’s.
- On Durban Island there were three groups of camps, one on the right side of the island, one on the left side of the island and a main camp.

- Stephen H. – Where did they get their water from at Padloping?
- Markosie A. – There was a lake and they trucked the water. My father was a water truck driver.
- Stephen H. – Was it hard to maintain the access road at Durban Island?
- Markosie A. – They used dynamite and there was a river crossing. There is a landing area for helicopters up top. There might be a dump on either side of the landing area.
- Markosie A. – At Padloping Island across from the main site on a point there might be a grave site and a camp site from the 1800's. I visited the graveyard last year and the sites were all damaged except one.
- Stephen H. – How were the graves marked?
- Markosie A. – They must be very old. Without coffins. Bones are visible.
- Stephen H. – How many graves are there at this location?
- Markosie A. – The exact number is unknown.
- Stephen H. – What is the name of this area where the graves are located?
- Markosie A. – Amittuarjugusiq.
- Stephen H. – Is this area well known?
- Markosie A. – Yes, it is well known, but the campers are deceased. I traveled there by canoe.
- Stephen H. – Are there other artifacts in the area?
- Markosie A. – In 1955 when they closed Padloping Island they traveled by dog sled to Qikiqtarjuaq. There are very few people remaining who lived at Padloping Island. I know all the people who had lived there are here in this areas. If you have any questions, please call.

To act on this knowledge, an allowance should be included for explosive experts in the Potential Additional Work (PAW) of the final tender documents. Additionally, there should be no reason that equipment or personnel will be on adjacent islands during construction, therefore disturbing historical camps or graves on these adjacent Islands is highly unlikely.

2.3.7 Site Assessment Information

Data from the following reports form the basis of this RAP:

- AECOM, November 2010, Phase III Environmental Site Assessment Report, FOX-E Durban Island Intermediate DEW Line Site, prepared for Public Works and Government Services Canada;
- ESG, 1994 - Environmental Study of Abandoned DEW Line Sites: Six Intermediate Sites in the Eastern Arctic prepared for Department of National Defence.
- ESG, 2010 - Background Geochemical Assessment of FOX-E Durban Island, Nunavut.

3. Waste Disposal Areas

3.1 Waste Disposal Remedial Protocol

The assessment of Waste Disposal Areas (WDA's) at FOX-E, Durban Island was completed with the goal of classifying the WDA's according to the three categories specified under the INAC Abandoned Military Site Remediation Protocol (AMSRP):

- ***Class A - High Risk:*** WDA's located in an unstable, high erosion location. Remediation will involve relocation of the WDA contents to an engineered landfill.
- ***Class B - Moderate Risk:*** WDA's in a suitable, stable location, but there is evidence of contaminant migration. Remedial solutions include the installation of an engineered containment system, or relocation, whichever is deemed more cost effective.
- ***Class C - Low Risk:*** WDA's in a suitable, stable location, and there is no evidence of contaminant migration. In such cases, the buried debris may be left in place with the placement of additional granular cover, as required.

WDA assessments involved the collection of soil samples up and down-gradient of the buried debris areas, at surface and depth. Contaminant concentrations obtained from down-gradient samples were compared to those from up-gradient samples and also to average levels of contaminants from all of the buried debris area assessment samples. Where down-gradient samples were consistently higher than up-gradient (by at least two times the concentration of average or up-gradient samples), and elevated concentrations were present over a significant proportion of the total sample locations (i.e. more than one isolated event), the WDA was evaluated to have evidence of contaminant migration. The potential for surface soil contamination was also assessed by noting any staining or the presence of types of debris that might act as contaminant sources (such as battery debris). In areas where contamination was suspected, surface and shallow depth soil samples were collected to assess and delineate the extent of contamination.

WDA's less than 1,000 m^2 in size are typically referred to as Buried Debris Areas and are typically not investigated to the same detail as Dump Sites or Existing Landfills, which are greater than 1,000 m^2. It is unlikely that leachate containment will be cost effective when compared to excavation for Buried Debris Areas. If contaminants are present, the AMSRP recommends that the Buried Debris Areas be excavated to their full extent. If there is no contaminated soil present within Buried Debris Areas, then the AMSRP recommends that the debris should be cut off and removed within the Upper 0.5 m of the ground surface and the ground surface should be regraded to match surrounding topography.

The following sections describe specifics related to the three recommended requirements for each of the three classes of WDA's. For all WDA's, it is recommended that any surface debris or surface contaminated soil be removed prior to initiating the buried debris remediation requirements outlined above.

3.1.1 Excavation/Relocation (Class A)

All WDA's have the potential to contain buried hazardous waste materials and contaminated soil, in addition to the expected non-hazardous waste debris. For this reason, where the recommended remedial action is excavation and relocation of buried debris contents, the contents of the WDA will require segregation during excavation to allow classification of the various waste streams. Debris should be separated from soil, with segregation of hazardous and non-hazardous waste. Soil should be sampled to identify any contaminant levels. Contaminated soil identified during sampling should be disposed of according to the requirements outlined in the INAC AMSRP.

Through work on the DND DEW Line sites, AECOM has developed and maintained a database recording the breakdown in dump excavation components. This database is currently comprised of dump excavation information from 15 sites. From this database, the average excavation volume breakdown is as follows:

- Tier I soil: 15%
- Tier II soil: 20%
- Non-hazardous debris: 15%
- Hazardous debris: 2%
- Clean fill: 48%

For excavation of WDA's at DEW Line sites under the jurisdiction of the Department of National Defence (DND), AECOM has typically applied these standard percentages during the design stage. However, where site-specific information suggests a higher or lower level of contaminated soil (based on the results of environmental sampling), a higher level of hazardous debris component (based on exposed debris observations), or different concentration of debris (i.e. higher or lower debris content based on extent of cover or a weak and/or spotty geophysical anomaly), the percentages have been modified accordingly.

Based on observations from other intermediate DEW Line sites under INAC's jurisdiction and on observations from historical air photo review completed at DND DEW Line sites, it was common during the early stages of site operation that debris disposal at WDA's did not, generally, involve the placement of cover over debris upon disposal. WDA's in these circumstances were typically comprised almost entirely of debris and oftentimes had contaminated soil associated with them as a result of the type of debris disposed, but there was little-to-no surface cover. At the DND sites however, where the sites were in operation over a longer period of time, landfilling operations gradually evolved such that debris began to be covered with granular fill with the common implementation of excavation of existing ground, stockpiling of excavated granular material and placement of debris, with subsequent debris backfilling with the stockpiled granular material. The DND WDA's typically have reasonably good surface cover overlying debris, with the majority of debris exposure restricted to along the toe, where backfilling was not so thorough. Observations from FOX-E, suggest that a "trench and cover" debris disposal methodology was implemented during operations in some areas, while in other areas, debris disposal was piled at surface or pushed over the edge of a ridge and scattered down the face of the slope. For this reason, the same design principles applied at DND DEW Line sites, regarding buried debris excavation component breakdown, have been applied for the evaluation of WDA buried debris excavation quantities at FOX-E.

However, a review of the site and area specific quantity breakdowns from the DND dump excavation database was undertaken to further determine the appropriateness for applying these average concentrations to the WDA's at FOX-E. It was noted, during this review, that the component breakdown from excavations, particularly related to contaminated soil quantities, could be fairly well correlated with the amount of contaminated soil identified at the WDA surface or down-gradient, and/or with the strength of evidence regarding contaminant migration. The results could also be well correlated with the other factors such as the strength of the geophysical anomaly (which is indicative of the density of debris within the WDA. This suggests that the average component concentrations noted above should be more strictly used as a starting point for evaluation, with ultimate component breakdown derived from much more consideration of dump-specific information (where that information is available from the site investigations).

The results of the geophysical surveys at FOX-E WDA's (in terms of anomaly strength) suggest that a lower concentration of debris is present in these WDA's compared to typical DND site landfills, which is consistent with their operation over a much shorter timeframe. However, a definitive comparison could not be completed because the geophysical method used at FOX-E was slightly different than that which has been used at DND sites. Contaminated soil was rarely identified at the FOX-E WDA's and contaminant levels observed down-gradient were never at significantly high concentrations. These observations suggest that a lower level of contaminated soil should be expected from within WDA's. The standard component breakdown for the WDA's at the FOX-E site has therefore been assumed as the following:

- Tier I soil: 10%
- Tier II soil: 10 to 12%
- Non-hazardous debris: 20%
- Hazardous debris: 1%
- Clean fill: 57 to 59%

The volume of non-hazardous debris has been assumed to be the same as the average breakdown from DND sites because of the inability to compare the geophysical survey results directly. This is felt to be a conservative measure. The percentages of Tier II and Tier I soils, and hazardous debris has been decreased, with a corresponding increase in the volume of clean fill. And as noted above, these standard percentages have been further modified where warranted by WDA-specific information.

WDA's classified as Class A should be excavated to the limits of debris. Where contaminated soil has been detected in the excavated contents, it is also recommended that confirmatory testing of the excavation base be completed to ensure no contaminated soil remains. The excavation area should be backfilled and graded to conform to surrounding terrain, and provide positive drainage.

Of the nine buried debris areas identified at FOX-E, none were classified as Class A according to the INAC Abandoned Military Site Remediation Protocol. As a result, there is no buried debris excavation required at this site.

3.1.2 Leachate Containment (Class B)

The typical design used for leachate containment at existing DEW Line WDA's involves the excavation of a trench just beyond the limits of the buried debris. The trench extends into either ice rich permafrost or saturated ground, which at FOX-E is generally encountered at 0.8 m below ground surface. A geosynthetic liner system is placed extending from the base of the trench over the WDA. The trench is then backfilled with low-permeability (Type 4) granular fill which may also extend upslope of the trench. Well graded sand and gravel (Type 2 granular fill) is placed and compacted over the surface to a thickness that will promote permafrost aggradation through the key trench and into the landfill contents. The primary long-term containment system is the saturated granular fill. Once the material freezes, it becomes a low-permeable containment barrier. The geosynthetic liner provides essential short-term containment until permafrost aggrades into the landfill and continues to provide longer-term containment following freeze back.

Geothermal modelling completed for the remedial design at the nearby DYE-M Cape Dyer site, where terrain and vegetative cover is similar, specified a design thickness of 3.9 m of Type 2 fill at the Upper Site and 3.2 m of Type 2 fill at the Lower Site for freezeback of contents. Geothermal modelling considered 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 from 30 years, an estimated 1 in 100 warm year air temperatures and an estimate of the effect of global warming. The effect of global warming was estimated using the most recently published data summarizing global warming rate estimates for Arctic environments (ACIA 2005). The design cover thickness specified for DYE-M has been used for consideration of remedial options at FOX-E.

This remedial option has initiated the need for significant post clean-up monitoring with the installation of thermistors within the WDA to confirm that contents are frozen. To confirm that no further contamination migration is occurring, groundwater monitoring wells are installed up and down-gradient for the collection of groundwater samples and soil samples are collected adjacent to the monitoring wells. This monitoring has typically been done on a yearly basis for the first five years following site clean-up (which is the estimated time required to achieve thermal equilibrium), and then upon a reduced frequency after 5 years.

Of the nine buried debris areas identified at FOX-E, none were classified as Class B according to the INAC Abandoned Military Site Remediation Protocol. As a result, there is no requirement for the installation of a leachate containment system at this site.

3.1.3 Regrading (Class C)

For WDA's located in a geotechnically stable location, with no evidence of contaminant migration, the recommended remedial action is regrading with the placement of additional granular cover. It is typically recommended that the extent of regrading be extended slightly beyond the extent of the identified limits of debris (a 2 m offset has been used historically). The granular fill cover placed over the WDA's should be well-graded (Type 2), erosion resistant, and well-compacted to limit infiltration of water. Where there is the potential for erosion from surface drainage, it is typical to strategically place armouring material (Type 1 granular fill). The placement of fill should be configured in such a way so as not to promote ponding of water and graded to conform to surrounding terrain. Typically, a fill thickness of 0.75 m has been used, but for smaller areas, with no appreciable topographic expression, a thinner fill thickness of 0.5 m has been applied.

There is potential at FOX-E to implement a "Walkaway Solution" that will remediate the site with consideration for eliminating the requirement for long term monitoring. In the event that the "Walkaway Solution" is implemented, the remedial recommendation for the Class C buried debris areas will not change. This is due to the fact that the combined surface area of the nine Buried Debris Areas is less than 1,000 m^2 and therefore they do not require long term monitoring.

The following sections provide a summary of the Buried Derbis Areas identified at FOX-E, Durban Island along with recommendations for remediation.

3.2 Buried Debris Areas

3.2.1 Lobe 1

Lobe 1 is located at the Upper Site Station Area approximately 75 m northwest of the garage as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 122 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, wood and clothing. The terrain in the area of Lobe 1 is generally flat with a 5 to 6% slope to the northwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the gentle slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 1 scored as a low potential environmental risk or Class C Buried Debris Area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial recommendation is for the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

3.2.2 Lobe 2

Lobe 2 is located at the Upper Site Station Area, approximately 60 m north of the garage and 30 m east of Lobe 1 as shown in Figure 2.0. The estimated areal extent and depth of the buried debris are 74 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, wood, painted wood, and glass. The terrain in the area of Lobe 2 is generally flat with a 5 to 6% slope to the northwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 2 scored as a low potential environmental risk or Class C Buried Debris Area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial recommendation is for the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

3.2.3 Lobe 3

Lobe 3 is located at the Upper Site Station Area approximately 50 m northwest of the garage and 30 m east of Lobe 2 as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 101 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal and crushed barrels. The terrain in the area of Lobe 3 is generally flat with a 5 to 6% slope to the northwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 3 scored as a low potential environmental risk or Class C Buried Debris Area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors and its small size. As a result, the remedial recommendation is for the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris and excavation of the Type B hydrocarbon plume that extends over the eastern corner of this buried debris lobe. The source of the Type B hydrocarbon plume is not expected to be from the Buried Debris Area.

3.2.4 Lobe 4

Lobe 4 is located at the Upper Site Station Area approximately 80 m north of the warehouse and 40 m northeast of Lobe 3 as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 145 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, wood and crushed barrels. The terrain in the area of Lobe 4 is generally flat with a 1 to 2% slope to the northwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 4 scored as a low potential environmental risk or Class C Buried Debris Area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial recommendation is for the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

3.2.5 Lobe 5

Lobe 5 is located at the Upper Site Station Area approximately 90 m southeast of the garage as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 120 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, wood and a fire extinguisher. The terrain in the area of Lobe 5 is generally flat with a 1 to 2% slope to the southwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 5 scored as a low potential environmental risk or Class C Buried Debris Area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial recommendation is for the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

3.2.6 Lobe 6

Lobe 6 is located at the Upper Site Station Area approximately 115 m southeast of the garage and 30 m south of Lobe 5 as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 50 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, painted wood, and a tarp. The terrain in the area of Lobe 6 is generally flat with a 1 to 2% slope to the southwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 6 scored as a low potential environmental risk or Class C Buried Debris Area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial recommendation is for the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

3.2.7 Lobe 7

Lobe 7 is located at the Upper Site Station Area approximately 15 m southeast of the Inuit huts and situated between the huts and the edge of the cliff as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 95 m^2 and 1.0 m, respectively. Based on visual observations and samples collected up-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. A down-gradient sample was not feasible since the southeast limit of the buried debris area is approximately 4m from the crest of the cliff. Minimal surface debris was noted at the surface of the lobe and consisted mainly of metal and wood. The terrain in the area of Lobe 7 is generally flat with a 5 to 6% slope to the southwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 7 scored as a low potential environmental risk or Class C Buried Debris Area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial recommendation is for the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

3.2.8 Lobe 8

Lobe 8 is located at the Upper Site Area, southwest of the Station Area and is approximately 35 m north of the access road as shown in Figure 3.0. The estimated areal extent and depth of the buried debris are 117 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. A down-gradient sample was not feasible since the southeast limit of the buried debris area is approximately 4 m from the crest of the cliff. No surface debris was present over the limits of the buried debris area. The terrain in the area of Lobe 8 is gently sloping with a 5 to 6% slope to the northwest. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 8 scored as a low potential environmental risk or Class C Buried Debris Area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial recommendation is for the placement of additional granular cover to a thickness of 0.75 m.

3.2.9 Lobe 9

Lobe 9 is located at the Lower Site Area Old Construction Camp within Dump C and approximately 50 m west of the access road as shown on Figure 4.0. The estimated areal extent and depth of the buried debris are 132 m^2 and 1.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of wood pieces. The terrain in the area of Lobe 9 is generally sloping with an 8 to 10% slope to the southeast. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 9 scored as a low potential environmental risk or Class C Buried Debris Area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial recommendation is for the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

4. Hazardous Waste Remediation

4.1 Protocols and Regulatory Requirements

The AMSRP defines hazardous waste materials as any materials, which are designated as "hazardous" under Nunavut Territorial or Federal legislation; or as "dangerous goods" under the Transportation of Dangerous Goods Act (TDGA) and regulations.

As part of the assessment of FOX-E Durban Island, an inventory of hazardous waste materials was compiled and supplemented with sampling during the 2010 site investigation. Various hazardous waste materials were identified during the survey and included: demolition and site debris consisting of asbestos and PCB/lead amended painted materials, batteries, barrel contents, electrical components, and miscellaneous chemicals.

The storage, treatment, and destruction of PCB materials with concentrations of greater than 50 mg/kg are regulated under the Chlorobiphenyls Regulations, which are governed by the Canadian Environmental Protection Act (CEPA). The regulations have been amended recently and Part 1 Section 1(2) of SOR/2008-273, that came into effect on September 17, 2008, states, "*For the purposes of these Regulations, if a solid or a liquid containing PCBs is composed of several matrices, the concentration of PCBs is based on the mass of the matrix in which the PCBs are located*." This means that for classification of waste painted with PCB amended paint, the mass of the substrate cannot be factored in with the mass of the paint to determine a total PCB concentration for the painted item as a whole, as has been done previously. For the purpose of the Phase III ESA, AECOM has assessed the classification of painted materials at FOX-E using the original and amended regulations and provided calculations using the "Substrate Consideration" and "No Substrate Consideration" methodologies.

Based on communications between Environment Canada and INAC, substrate calculations, as outlined in the protocol, can be completed based on an agreed upon Compliance Promotion Guideline that is to be published for the PCB Regulation. Therefore, the hazardous material volumes estimated in the "Substrate Consideration" methodology within the Phase III ESA have been used for the purposes of this RAP. The estimated volume for hazardous waste materials generated from demolition activities is provided in Appendix C.

Previously, where materials were not regulated under CEPA, classification of hazardous waste defaulted to the federal TDG Act and Regulation under Guideline for the General Management of Hazardous Waste. At FOX-E, materials classified under these regulations tend to be associated with painted materials where PCB concentrations were not in excess of CEPA concentrations, but where lead concentrations may be in excess of the leachate criterion stipulated under the TDG regulations, which have been amended (Amendment 6 - SOR/2008-34) so there is no longer a classification of materials with toxic leachate. Regulation regarding movement of these materials now falls to Environment Canada (EC) under the following two regulations: Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (1999, 2005 amendment), and Interprovincial Movement of Hazardous Waste and Hazardous Recyclable Material Regulations (1999, 2002 amendment). Both EC documents specify a criterion for lead leachate at 5 mg/L, which was the same criterion previously specified under the TDGA.

Projects that will result in the disturbance of Asbestos-Containing Materials (ACMs), including vermiculite, must satisfy the regulatory requirements under the Canada Labour Code - Part II and the Nunavut Environment Protection Act. In addition, the Canadian Occupational Safety and Health Regulations, Part X - Hazardous Substances would be applicable to ACM's. The Environmental Guideline for Waste Asbestos (GN 2002) defines ACM's as any type of material with greater than 1% asbestos by weight.

Treated or creosote-impregnated waste materials (e.g. poles, timbers, etc.) are only considered "toxic", as defined under Section 11 of CEPA, if the waste creosote or its component compounds **enter** or are likely to enter the environment in a concentration or quantities or under conditions that could lead to **exposure** of humans or other biota at levels that could cause adverse effects. At DEW Line sites, these components have been determined to be non-hazardous as the components leach at a very slow rate and as such, do not present a threat to the environment if properly contained.

4.2 Surface Debris Component

A surface debris inventory was completed by dividing the site into sections, with coverage of the areas completed on foot or by ATV. The limits of debris were identified using hand-held GPS by collecting waypoints at each transect where no further debris was visible, or in areas where debris was more sporadic, by collecting waypoints at debris locations. The GPS waypoints were downloaded onto the site plan drawing and the debris area perimeters were drawn by connecting the debris limit waypoints, or by grouping individual debris locations accordingly. The areas of surface debris created by these debris limits or groupings were assigned a numerical label and in some cases alphabetical. Along transects, debris types were noted and volumes were tracked, with a total volume and description of all types of debris recorded for each debris area.

The survey identified approximately 10 m^3 crushed volume of hazardous site debris consisting primarily of asbestos containing materials and battery debris. Of this volume, approximately half was identified at Dump A where access is limited to helicopter. A summary of hazardous waste components identified from the surface debris inventory is provided in Table 1 of Appendix C. Specifics related to barrel contents are discussed below.

4.3 Barrel Component

The classification of barrel contents and remedial requirements is based on the Barrel Protocol outlined in the INAC AMSRP. This protocol provides specifics related to when hydrocarbon-containing barrels may be safely incinerated on-site, may be safely discharged (in the case of aqueous contents) and where contents require off-site disposal. The specifics of the protocol are provided in Appendix E.

The assessment of barrels was completed at the same time as the inventory of surface debris; contents were identified as either aqueous or hydrocarbon-containing and their classification and sample number (if applicable) was noted on the barrel with a paint marker. A representative number of samples were collected from the main barrel stockpiles, as well as other barrels at the site, that were identified as having non-aqueous contents.

The 2010 inventory of barrels at FOX-E indicates there are approximately 6,910 barrels at the site with the majority of the barrels located at Dump A (3,010) and Dump D (2,830). Approximately 528 barrels were inspected for contents and of these barrels 60 barrels were identified to have liquid contents. It should be noted that the majority of barrels at Dumps A, D, and E were not inspected due to safety concerns which included steep terrain and loose boulders at Dump A and precariously piled barrels at Dumps D and E.

In total, 6 liquid samples were collected from barrels located at the Station Area and analyzed for the parameters outlined in the AMSRP. A summary of the analytical results for the samples collected from the barrels is provided in Appendix D.

The 2010 investigation inspected all barrel areas that were safely accessible and identified those with contents. Because the majority of the barrels within Dumps A, D, and E were not inspected, only a rough estimate can be provided for the total volume of liquids expected to be on-site. Based on knowledge from previous sites and by projecting the information from the barrels inspected, it is estimated that 8,000 litres of liquids are potentially present in the barrels at the FOX-E site.

The results of the limited sampling and testing for parameters outlined in the Barrel Protocol indicate that aqueous barrel contents are suitable for discharge and hydrocarbon barrel contents can be incinerated. The volume of barrel contents that will require off-site disposal because of incineration criteria exceedences is unknown, but an estimated volume of 500 L has been projected.

4.4 Demolition Component

The demolition investigation included an inventory of all site buildings and other facilities that would require dismantling for disposal. The investigation noted their construction and any anticipated special disposal requirements with the collection of samples for applicable analysis to confirm disposal requirements. Samples were collected from painted substrate to identify whether the materials were PCB-containing in excess of CEPA regulations. Asbestos containing materials were identified and it was noted, in particular, where asbestos was covered with paint containing PCBs. Based on paint analytical data and observations related to asbestos content, the hazardous and non-hazardous component of the demolition materials was determined.

The results from the paint analysis found seven of the twelve samples to contain a PCB level above the Canadian Environmental Protection Act (CEPA) criteria and 1 of the 12 samples to contain leachable lead concentrations above the TDG regulations. Five of these samples above the CEPA criteria were collected from the interior components of the module train kitchen. One sample from the interior of the water reservoir building, collected from the wall of the tank was above the CEPA criteria. Analytical results from these samples were used to estimate the volume of hazardous materials requiring off-site transport and southern disposal. The POL tanks will require off-site disposal due to leachable lead concentrations above the TDG regulations.

In areas of PCB-oil storage or in the vicinity of transformers, it is common that the concrete floor may be contaminated with PCBs. A concrete floor sample was collected from the generator room in the module train. This sample contained PCBs in excess of the 50 mg/kg criteria and will require off-side disposal as hazardous waste. PCB impacts in concrete are often limited by depth and hazardous concrete volumes can be minimized by grinding and collecting the upper surface (10 mm) of the slab for disposal as hazardous waste and providing confirmatory testing of the remaining slab. If the confirmatory testing shows PCB concentrations less than 50 ppm, then the remaining slab can be removed and disposed of in the NHW Landfill. Prior to grinding, any loose or chipping PCB paint or oil stained concrete surface should be removed, containerized and disposed of as hazardous waste. The analytical data for these samples is provided in Table 3 of Appendix C.

Two asbestos samples were collected at FOX-E during the 2010 site investigation. One was collected from the insulation in the exterior wall of the garage and the other from piping insulation from the interior of the water reservoir building. The results from the garage indicated that no asbestos was detected, while results from the piping insulation sample contained 40% asbestos. Based on experience from other DEW Line sites, it is typical for asbestos-containing materials, particularly pipe wrap insulation, to be painted with PCB-amended paint. These specific instances were noted during the 2010 demolition inventory, as this material will require disposal as PCB waste, but must be segregated during packaging for off-site disposal to allow for proper handling at the PCB-waste disposal facility. The total estimated volume of asbestos containing pipe wrap painted with PCB-amended paint is 15 m^3.

While potential PCB-containing electrical equipment, including transformers, capacitors and fluorescent light ballasts are commonly present on DEW Line sites, it was clear during the 2010 investigation that a dedicated removal of these materials had been completed at an earlier date. At the module train in particular, it was noted that a sweep of each room had been completed, with removal of PCB-containing equipment, and subsequent notation on doorways or walls that PCBs had been removed. No PCB-containing electrical equipment was identified during the 2010 investigation.

There is the potential for mercury-containing switches and thermostats at DEW Line sites, but none were identified at FOX-E in 2010.

A summary of hazardous materials identified during demolition inventory is provided in Table 2 of Appendix C. The total crushed volume identified is 103 m^3 and includes asbestos, PCB-amended painted materials and PCB-amended paint over asbestos.

4.5 Estimated Buried Debris Excavation Component

All nine buried debris areas indentified at FOX-E were evaluated to be Class C and therefore do not require excavation. The remedial recommendation for the nine buried debris areas is regrading with granular fill. In the event that a "Walkaway" solution is implemented, the remedial recommendation for these Buried Debris Areas will not change as the plan area of each of these Buried Debris Area is less than 1,000 m^2 and, as such, there is no requirement for future monitoring, based on the AMSRP. Additionally, there is no buried debris associated with Dumps A through E as these are comprised entirely of concentrated surface debris.

4.6 Remedial Requirements

Generally, all hazardous materials identified at the site will be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act (TDGA) (TC 2001) and Regulations and the CEPA Inter-provincial Movement of Hazardous Waste Regulations (SOR/2002-301), to a licensed hazardous waste disposal facility.

Particulars are described below:

- Asbestos: Asbestos waste will be collected, double bagged and disposed of in an engineered NHW landfill, in accordance with the appropriate legislation;
- Petroleum Products: Petroleum products, such as gasoline or diesel, which do not contain other hazardous products according to the Barrel Protocol (chlorine, PCB, heavy metals, etc.) will be incinerated on-site under appropriate emissions controls. Heavier petroleum products such as lubricating oil will be disposed of off-site or mixed with lighter petroleum products and incinerated on-site under appropriate emissions controls;
- Compressed Gas Cylinders: Compressed gas cylinders with known contents will be vented. Once empty, the metal cylinder will be disposed of in an engineered NHW landfill;
- Creosote Treated Timbers: Timbers will be wrapped and secured in polyethylene sheets and disposed of in an engineered NHW landfill;
- PCB Paint on Building Components: PCB paint and PCB painted components, which are regulated under CEPA, will be collected and transported off-site, in accordance with the Transportation of Dangerous Goods Act and CEPA, to a licensed PCB disposal facility; and
- Lead-Based Paint on Building Components: Lead-based painted components which are classified as hazardous material will be collected and transported off-site, in accordance with the CEPA Inter-provincial Movement of Hazardous Waste Regulations, to a licensed hazardous waste disposal facility.

5. Non-Hazardous Waste Remediation

5.1 Surface Debris Component

The method for completion of the surface debris inventory is described above. Based on the 2010 ESA inventory, the majority of surface debris was identified as non-hazardous, including barrel contents. The estimated crushed volume of surface debris, including crushed barrels is 2,075 m^3. A summary of surface debris areas and volumes is provided in Table C1 of Appendix C. It should be noted that a large percentage of this volume will be generated from Dump A with extremely difficult access to the debris.

5.2 Demolition Component

The method employed for demolition inventory and characterization of waste is described above. The results of this investigation and calculations related to ultimate classification of PCB waste indicate that the volume of non-hazardous waste materials from demolition is approximately 345 m^3, crushed. A summary of demolition quantities is provided in Table 2 of Appendix C.

5.3 Estimated Buried Debris Excavation Component

All nine buried debris areas indentified at FOX-E were evaluated to be Class C and therefore do not require excavation. The remedial recommendation for the nine buried debris areas is regrading with granular fill. In the event that a "Walkaway Solution" is implemented, the remedial recommendation for these Buried Debris Areas will not change as the plan area of each of these Buried Debris Areas is less than 1,000 m^2 and, as such, there is no requirement for future monitoring, based on the AMSRP. Additionally, there is no buried debris associated with Dumps A through E as these are comprised entirely of concentrated surface debris.

5.4 Remedial Recommendations

The total volume of non-hazardous waste material from demolition (345 m^3), surface debris (695 m^3), and barrels (1,380 m^3) identified at FOX-E during the 2010 Phase III ESA is approximately 2,420 m^3. According to the INAC AMSRP, the assessment of the need for construction of an on-site NHW Landfill should consider primarily the availability of suitable locations to build such a facility at the site. Additional considerations include the availability of appropriate granular borrow materials, the volume of non-hazardous waste identified for disposal, and the long term monitoring requirements associated with an on-site Non-Hazardous Waste Landfill. At FOX-E, Durban Island, three locations were identified during the Phase III ESA site investigation that were deemed suitable for construction of a new facility, all of which are located at the Upper Site. Sufficient granular borrow material has been identified within close proximity to the proposed new landfill locations and there would be no requirement to haul granular material up the access road during construction. Finally, based on information from other DEW Line intermediate sites, the volume of demolition and surface debris at this site does suggest that construction of an on-site facility for disposal is warranted. Considerations for alternate disposal options for non-hazardous waste are discussed below and in Section 8.0.

AECOM has provided recommendations in Section 8.2 to proceed with a "Combined Contract" for the Padloping and Durban Island sites and consideration should be given to a consolidated NHW Landfill at the Durban Island site, since suitable landfill sites and availability of Type 2 borrow material are very limited at Padloping Island. For a "Combined Contract" design scenario, it is recommended that a consolidated NHW Landfill be constructed at the FOX-E, Durban Island Site for the disposal of waste from the Padloping and Durban Island sites. This will require material to be hauled up the Durban Island access road from the Beach Landing Area to the Upper Site. There is no suitable location at the Lower Site of FOX-E to construct a Non-Hazardous Waste Landfill and it is expected that most of the available granular material identified at the Lower Site will be required to upgrade and maintain the access road to support construction activities.

6. Contaminated Soil Remediation

6.1 Remedial Criteria and Clean-up Protocols

The investigation and delineation of contaminated soil at FOX-E Durban Island was completed for the contaminants of concern identified under the INAC AMSRP including: arsenic, cadmium, cobalt, copper, lead, nickel, zinc, and PCBs. The INAC AMSRP identifies two levels of contamination - Tier I soil which is considered an environmental risk only when located at surface, and Tier II soil which is considered an environmental risk at any depth of impact.

Delineation of Petroleum Hydrocarbon (PHC) impacts was completed using the parameters defined in the INAC AMSRP. Total Petroleum Hydrocarbon (TPH) soil analyses are typically completed using a methane extraction method, and measure concentrations of carbon chain sizes between C_6 and C_{34}. Type A hydrocarbons are defined as impacts comprised of 70% or more of the heavier fractions (F3 and F4), which corresponds to impacts derived from lubricating (lube) oil or grease spills. Type B hydrocarbons are defined as those impacts comprised primarily of lighter end components (F1-F3), derived from fuel spills. The INAC AMSRP process specifies different numerical clean-up criteria based on the type of hydrocarbon impacts (Type A versus Type B), proximity to significant water bodies, and depth of impacts.

Table 2 below provides a summary of contaminated soil remedial criteria and volumes identified during the Phase III ESA using parameters defined in the INAC AMSRP. A more detailed summary of contaminated soil volumes is provided in Table B-1 in Appendix B. It should be noted that these volumes do not include any area specific contingencies and are derived directly from the delineated areas and depths.

Table 2. Summary of Contaminated Soil Remedial Criteria and Quantities

Contaminated Designation	Description	Soil Volume (m^3)
Tier I Contaminated Soil	Soils containing concentrations of any or all contaminants listed as follows: • Lead ..... 200 to 499 ppm • PCBs ..... 1 to <5 ppm	23
Tier II Contaminated Soil	Soils containing concentrations equal to or greater than any or all contaminants listed as follows: • Arsenic ..... 31 ppm* • Cadmium ..... 5 ppm • Chromium ..... 343 ppm* • Cobalt ..... 91 ppm* • Copper ..... 159 ppm* • Lead ..... 500 ppm • Mercury ..... 2 ppm • Nickel ..... 1,632 ppm* • Zinc ..... 500 ppm • PCBs ..... >5 ppm;<50 ppm *Site Specific Criteria	18
TPH Type A Soils F3 and F4 fractions	Soils contaminated with hydrocarbons consisting primarily of oil and grease at concentrations equal to or greater than: • TPH, Sum of F3 and F4 fractions 20,000 ppm	11 (co-contaminated with Tier I levels)
TPH Type B Soils F1-F3 fractions	Soils contaminated with hydrocarbons consisting primarily of fuel oil, and/or diesel, and/or gasoline, with concentrations equal to or greater than the following concentrations : • Station Area and Beach POL Area: Surface soils to 0.5 m depth ..... 2,500 ppm (TPH, sum of F1 through F3 fractions) • Subsurface soils below 0.5 m in depth ..... 5,000 ppm (TPH, sum of F1 through F3 fractions)	378 (note: The Beach POL Area is greater than 30 m from the shore)

The specified remedial requirements under the INAC AMSRP are as follows:

- ***Tier I soil:*** cap in place with a minimum of 0.3 m of granular fill, or dispose in an engineered NHW Landfill.
- ***Tier II soil:*** dispose in SSDF or transport off-site for disposal in engineered territorial or provincial disposal facility;
- ***Type A Soils:*** scarify and leave in place if under criteria, or dispose in an engineered NHW Landfill; and
- ***Type B Soils:*** excavate and treat ex-situ through aeration or landfarming, treat in-situ with landfarming, or dispose of in SSDF, if available. Note that disposal in the SSDF is only considered appropriate if concentrations are sufficiently low that there are no concerns for inhibiting freezing of contents and/or with free-product development, which could compromise the liner integrity at the facility.

6.2 Background Geochemical Assessment

The Background Geochemical Assessment was conducted in 2009 (ESG 2010) and concluded that naturally occurring elevated background levels of arsenic, chromium, cobalt, copper and nickel were discovered in the soil at the FOX-E site.

The assessment established new recommended Tier II contaminated levels for the elements that are naturally occurring on site and are as follows As – increased from 30 to 31 ppm, Cr – increased from 250 to 343 ppm, Co – increased from 50 to 91 ppm, Cu – increased from 100 to 159 ppm, and Ni – increased from 100 to 1,632 ppm. Without an apparent natural cause, elements above the revised criteria are considered anthropogenic and require remediation.

6.3 Tier I and Type A Soil

A small volume of Tier I soil was identified at the Module Train at the Station Area along with a small volume of co-contaminated Tier I/Type A PHC soil at the Garage. The total estimated volume of Tier I and co-contaminated Tier I/Type A soil is 34 m^3. It is recommended that the Tier I and Tier I/Type A PHC soil be disposed of in an engineered NHW Landfill.

A detailed breakdown showing area-specific volumes of Tier I and Tier I/Type A soil is provided in Appendix B.

6.4 Type B Soil

PHC impacted soil (Type B), requiring remedial action, were identified during the site investigation and include impacted areas at or near the Station POL Tanks, Module Train, Warehouse, Garage, Lobe 3 and Beach POL Tanks. The total volume of PHC Type B soil identified for remediation is 378 m^3. A summary of contaminated soil volumes by area is presented in Table B-1 of Appendix B.

Remedial options applicable to the treatment of hydrocarbon impacted soil include:

- In-situ biological treatment or chemical oxidation;
- Ex-situ, on-site aeration (using an excavator with standard or “Allu” type bucket; and
- Ex-situ, on-site aeration and biological treatment (landfarming);
- Ex-situ, off-site treatment and/or disposal in a Licensed Disposal Facility.

In-situ treatment of the hydrocarbon impacted soil at the Beach POL is not considered an option due to its close proximity to the shoreline.

Advantages and disadvantages of each treatment option are described in Table B. Based on the applicability of the various treatment options at the Durban Island site, the recommended remedial option is on-site, ex-situ aeration (using a standard or “Allu” type bucket) or on-site, ex-situ aeration and biological treatment, i.e. landfarming.

Recent monitoring results from landfarm operations at another former DEW Line site (FOX-C Ekalugad Fjord) have indicated that treated soil criteria are achievable through on-site biological treatment methods; however, more highly contaminated soils may take extended periods of treatment to meet the criteria. Based on the volume of impacted soil and moderate hydrocarbon concentrations observed during the 2010 investigation, it is anticipated that landfarming may be completed within a 1 year period provided site conditions are monitored and optimized where possible (i.e., moisture conditioning, nutrient amendment). It may be more appropriate to apply more intense aeration methods for the relatively small volume of soils requiring treatment at Durban Island in order to allow this activity to be completed within the expected short overall construction period for this project.

Soils contaminated with Type B fractions should be excavated and treated by ex-situ aeration or aeration with biological treatment methods in an on-site treatment or landfarm facility. Soils concentrations should be reduced to meet the criteria described in the AMSRP.

Table 3. Summary of Remedial Options - Hydrocarbon Contaminated Soil

Remedial Option	Description/Requirements	Applicability	Advantages	Disadvantages/Limitations	Implementation
In-situ Biological Treatment / Chemical Oxidation	• Application of ozone, peroxide or permanganate through instrumentation within the impacted area.	• Amendable to light and medium end hydrocarbons (F1, F2, F3 fractions).	• Under optimal conditions can reduce concentrations below criteria. • Minimize excavation and disturbance of existing vegetation.	• Monitoring required. • Difficult to confirm that target concentrations are met throughout the contaminated area. • Not applicable to metal contaminated soil.	• Not appropriate for hydrocarbon areas located in close proximity to water bodies (Beach POL).
On-Site, Ex-situ Aeration by Allu Bucket	• Hydrocarbon contaminated soils are excavated and placed within a contained treatment area. • Soils are frequently turned for aeration.	• Hydrocarbon contaminated soils, including F1, F2, and F3 fractions.	• Contaminant concentrations reduced. • No environmental risks associated with potential spills during off-site transport. • Generally good for more intense treatment of small soil volumes.	• More effective on lighter end hydrocarbons. • May be difficult to aerate soils with excessive moisture, fine-grained soils and rock using the Allu system. • Impermeable membrane/low permeable soils required for containment.	• Adequate location and granular materials identified for construction of treatment area. • Geosynthetic liner required for perimeter containment.
On-Site, Ex-situ treatment by Landfarming / Bioremediation	• Hydrocarbon contaminated soils are excavated and placed within bermed treatment area. • Soils are periodically turned and nutrients added to optimize treatment conditions.	• Hydrocarbon contaminated soils, including F1, F2 and F3 fractions.	• Contaminant concentrations reduced. • No environmental risks associated with potential spills during off-site transport.	• More effective on lighter end hydrocarbons. • Generally requires 1-2 treatment seasons for contaminant reduction to criteria. • Restricts use of the site during treatment operations. • Impermeable membrane/low permeable soils required for containment.	• Adequate location and granular materials identified for construction of treatment area. • Geosynthetic liner required for perimeter containment if permeable soils are used.
Off-Site Treatment and Disposal	• Contaminated soils are transported off-site for treatment or disposal.	• All contaminated soil types.	• Contaminated soils removed from site eliminating risk of exposure.	• Considerable costs associated with off-site transport. • Project costs are very sensitive to contaminated soil volumes. • Potential environmental risks during transport.	• Shipment and disposal off-site is technically appropriate, but at considerable costs.

6.5 Tier II Soil

The 2010 site investigation identified a small volume of Tier II levels of cadmium at the Garage to a depth of 0.3 m in depth and a small volume of Tier II levels of arsenic and copper at the Inuit House to a depth of 0.3 m in depth. The total volume of Tier II soil identified for remediation is 19 m^3 from delineated contaminated areas. It should be noted that none of the buried debris areas at FOX-E are identified for excavation and as a result it is not expected that the estimated Tier II soil volume will change substantially. Samples beneath the module train have not been collected, however, and there is a slight chance that additional Tier II soils will require excavation and disposal from this area. The footprint of the module train is approximately 227 m^2. A summary of contaminated soil by area is presented in Table B-1 of Appendix B.

The INAC AMSRP indicates that all soils with metal and/or PCB concentrations exceeding the DEW Line Clean Up (DLCU) Tier II Criteria (but not regulated by CEPA) will be disposed of according to the following options:

- On-site disposal within a secure soil disposal facility (SSDF) consisting of double containment within permafrost encapsulation and a geosynthetic liner system in the base and cover of the facility; or
- Off-site disposal at a licensed southern disposal facility.

The decision criterion to determine if a Secure Soil Disposal Facility (SSDF) is required at a DEW Line Site is outlined in Table 5.3 of the INAC AMSRP. The FOX-E site is not landlocked and there is no Tier II soil volume from buried debris excavations that require disposal which for other sites generally accounts for a large unknown volume of Tier II soils. The estimated Tier II soil volume requiring excavation and disposal is 19 m^3, which is less than the decision criteria volume of 300 to 500 m^3 and the risk of overrun is considered to be very low because there is no buried debris excavation required at this site. Based on criteria outlined in Table 5.3, off-site disposal is considered the preferred remedial option for disposal of Tier II soil from the FOX-E site. Because of the possibility of Tier II soils beneath the module train, it is recommended that a 200% contingency on the known volume be carried in terms of volume for off-site disposal to ensure that there are sufficient containers on-site for soil containerization during remediation, so as not to delay project completion.

6.6 Summary

Remedial options have been evaluated for the contaminated soils identified in the 2010 site investigation. Based on the estimated volumes of contaminated soils and technical considerations, for locating and developing suitable disposal and/or treatment facilities, it is recommended that at Durban Island all Tier I and Type A PHC soils be disposed of in an engineered NHW landfill, all PHC Type B soils be treated on-site, while Tier II and hazardous soils will need to be containerized and disposed of off-site. Based on the applicability of the various disposal and treatment options, the following recommendations are made:

- Soils contaminated with Tier I levels of PCBs and inorganic elements should be excavated and placed in an engineered NHW Landfill. The total volume of Tier I soil and co-contaminated Tier I/Type A PHC soil is estimated at 34 m^3. These soils may be utilized as intermediate fill during placement of non-hazardous waste within and on-site landfill.
- Soils contaminated with Tier II levels of PCB and/or inorganic elements should be excavated, containerized, and shipped off-site for disposal. The total volume of Tier II soil is estimated at 19 m^3.
- Soils contaminated with light end PHC's (Type B soils) should be excavated and treated ex-situ by aeration supplemented with biological methods in an on-site treatment or landfarm facility. TPH concentrations in soils should be reduced, when required, to meet the INAC AMSRP. The total volume of hydrocarbon impacted soil requiring treatment is 378 m^3.

7. Implementation

7.1 Schedule

It is expected, based on the assumption of barge access, that the contractor would mobilize to the site in late July or early August and initiate the construction with critical work items and then complete the remediation activities in one full construction season in the year following mobilization. Assuming the first year extends to mid September, which is typical for other sites in the area such as DYE-M, Cape Dyer, this would allow for approximately 4 to 6 weeks of construction during the mobilization year. During this time, it would be reasonable to assume that the contractor could perform major upgrades to the access road, set-up their camp, investigate recommended borrow sources, and build the treatment area or landfarm to allow placement of the Type B soils requiring treatment. It is also recommended that during the mobilization season, the contractor remove any birds' nest (used by rough-legged hawks or other species) on any of the DEW Line facilities to prevent nesting on the module train early during the main construction season, which would restrict timing of building demolition. It is understood, however, from past DEW Line experience, that when the existing structure still remains, that rough-legged hawks will rebuild the nest. It should be made clear to the contractor that structures which hold nests with young shall not be demolished until the young birds have left the nest.

Based on the recommended remedial actions outlined above, construction activities will require at least one full season of clean-up activity and a productive mobilization year which will include upgrading the access road, constructing a landfarm at the Upper Site and consolidating debris at Dump A. Specifics related to timing and prioritization of contractor activities is described in the following sections.

Refer to Section 8.2 for additional discussion on alternate design scenarios. If the Padloping and Durban Island projects were combined into one contract, then it is expected that the work activities could be done concurrently. Since there is more work and more variety of work activities at Durban Island, it is anticipated that the contractor would set up his primary operations, including the provision of a construction camp, at the Durban Island Site and shuttle workers to and from the Padloping Island Site with a helicopter or boat. For a "Combined Contract" solution, the site waste would also be consolidated at the Durban Island site.

7.2 Waste Disposal Areas Remediation

Table C summarizes the recommended remedial requirements for Waste Disposal Areas at FOX-E. All nine areas were classified as low risk potential environmental risk and the recommended remedial action is for regrading by placing additional granular material as cover over these areas. This work is not dependent on other work items and can likely commence anytime.

Table 4. Summary of Recommended Remedial Requirements for Waste Disposal Areas

Buried Debris Area	Size (m^2)	Estimated Depth (m)	Estimated Volume (m^3)	Environmental and Geotechnical Investigation	Dump Classification	Recommended Remediation Based on Engineering Considerations
Lobe 1	122	0.5	61	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • No erosion noted. • Sparse vegetation cover. • Minimal surface debris noted.	Class C	Regrade, based on lack of contamination and the stability of this buried debris area.
Lobe 2	74	0.5	37	• No evidence of contaminant migration. • No potential for surface	Class C	Regrade, based on lack of contamination and the stability of this buried debris area.

Buried Debris Area	Size (m^2)	Estimated Depth (m)	Estimated Volume (m^3)	Environmental and Geotechnical Investigation	Dump Classification	Recommended Remediation Based on Engineering Considerations
				contaminated soil identified. • Sparse vegetation cover. • No erosion noted. • Minimal surface debris noted.		
Lobe 3	101	0.5	51	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • Sparse vegetation cover. • No erosion noted. • Minimal surface debris noted.	Class C	Regrade, based on lack of contamination and the stability of this buried debris area.
Lobe 4	145	0.5	73	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • Sparse vegetation cover. • No erosion noted. • Minimal surface debris noted.	Class C	Regrade, based on lack of contamination and the stability of this buried debris area.
Lobe 5	120	0.5	60	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • Sparse vegetation cover. • No erosion noted. • Minimal surface debris noted.	Class C	Regrade, based on lack of contamination and the stability of this buried debris area.
Lobe 6	50	0.5	25	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • Sparse vegetation cover. • No erosion noted. • Minimal surface debris noted.	Class C	Regrade, based on lack of contamination and the stability of this buried debris area.
Lobe 7	95	1.0	95	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • Sparse vegetation cover. • No erosion noted. • Minimal surface debris noted.	Class C	Regrade, based on lack of contamination and the stability of this buried debris area.
Lobe 8	117	0.5	59	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • Sparse vegetation cover. • No erosion noted. • No surface debris present.	Class C	Regrade, based on lack of contamination and the stability of this buried debris area.
Lobe 9	132	1.5	198	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • Moderate vegetation cover. • No erosion noted. • Minimal surface debris noted.	Class C	Regrade, based on lack of contamination and the stability of this buried debris area.

7.3 Demolition

The demolition inventory for FOX-E identified approximately 103 m^3 of hazardous and 345 m^3 of non-hazardous demolition debris. These crushed volumes are based on segregation of hazardous and non-hazardous building components during demolition and do not include bulking factors that may be attributed to off-site packaging volumes or with on-site disposal volumes.

Hazardous building materials and related components, including Asbestos-Containing Materials (ACMs), PCB wastes and leachable lead wastes will be removed prior to demolition of the structures. ACMs generally include mechanical insulation on pipes and chimneys, transite board and fire asbestos core doors. ACM's that are painted are to be treated as PCB wastes and containerized separately for off-site disposal. Non-painted ACM,s will be double bagged and disposed of in a localized area of the NHW Landfill. Vermiculite insulation contained within the inter-module wall cavities is not considered asbestos-containing (<1% asbestos); however, due to its friable nature should be removed in a manner consistent with a moderate risk (Type 2) abatement. Type 2 asbestos removal specifies parameters for removal of minor friable asbestos, including loose asbestos, on top of false ceilings and within piping or ducting.

Other hazardous materials, including batteries and potential glycol containing liquids within the building heating systems, will be containerized for off-site disposal or recycling in accordance to TDGA requirements. While no PCB-containing equipment or mercury switches were noted during the 2010 site investigation, if these materials are identified during clean-up, they will also require containerizing for off-site disposal.

Select painted components in the module train, garage, warehouse and water reservoir building are considered PCB wastes and are regulated under the Canadian Environmental Protection Act (CEPA) and the painted POL tanks exceed criteria for leachable lead and are considered to be hazardous waste. Loose and flaking paint is to be removed from all painted surfaces and collected for off-site disposal as hazardous waste. Similarly, paint on concrete floors in the small water storage room in the module train contains PCBs in excess of 50 mg/kg and is to be removed and treated as PCB waste. Consistent with CEPA and the AMSRP, PCB amended painted material will be containerized in accordance with the TDGA and Regulations and removed from site. These materials will be transported to a licensed facility for PCB destruction and disposal.

Non-hazardous waste from demolition items mainly includes unpainted wood and metal construction materials and concrete from foundations following surface paint removal. Painted structural materials with PCB paint concentrations less than 50 mg/kg, following substrate calculations, can be disposed of in an on-site landfill following removal of any loose or flaking paint. If cutting torches will be used to dismantle structural steel components, paint must be removed from the surface in the locations to be cut. All cuttings and shaving created during these operations must be contained and collected for disposal as hazardous waste.

Building foundations at FOX-E consist of timber piles and sills (module train), elevated concrete slab on concrete piles (warehouse) and concrete slab on grade (garage, water reservoir building and POL tanks). Timber piles, sills and the elevated concrete pad can be disposed of in a NHW Landfill whereas the concrete slabs on grade can remain in place once all paint has been removed from the surface of the slab. The preferred remediation option from the technical perspective is to place additional fill material and regrade around the foundations to match existing topography.

It is recommended that the segregation and containerization of hazardous waste components be commenced early during the main construction season. This will facilitate the completion of full demolition, which can commence upon completion of construction of the NHW Landfill berms or when a suitable staging area for off-site transport has been identified.

7.4 Surface Debris

Twenty surface debris areas were identified during the 2010 Phase III ESA. The identified limits of these areas cover approximately 740,000 m^2. The crushed volume of hazardous materials identified is 10 m^3, while the crushed volume of non-hazardous waste is 2,075 m^3, including crushed barrels. Both of these volumes represent crushed volume estimates. These volumes also include barrels and their contents, based on results of barrel inventory and sampling. A detailed breakdown of surface debris areas and debris volumes is provided in Table C1 of Appendix C. The limits of surface debris areas are shown on the Figures. Non-hazardous waste can be disposed of in an engineered NHW Landfill. Hazardous waste must be packaged in accordance with TDGA regulations for shipping to an off-site licensed hazardous waste disposal facility.

In addition to the identified surface debris areas, it is typically noted in clean-up specifications that all debris within 50 m of existing pads and roadways is picked up. The surface debris investigation generally covered off all of the areas near roadways and the existing perimeters were drawn to include debris identified in this vicinity. The volume of debris to be collected from within 50 m of a roadway was estimated, during the site investigation, to be 20 m^3 crushed volume.

Collection of surface debris can proceed upon completion of a suitable starter berm for the NHW Landfill or when a suitable staging area for off-site transport has been identified. This can likely begin early during the main construction season. It is expected that surface debris collection at Dump A will commence prior to the construction of the NHW Landfill, though, since this area will require substantial work to consolidate the debris into piles in preparation for transport to the NHW Landfill or temporary staging area via helicopter. Consolidation of debris at the Dump A will be limited to a labour crew due to steep slopes and loose boulders making it inaccessible by heavy equipment. This work could commence in the fall of the mobilization season and will likely continue for the majority of the main construction season. To access the debris on the sheer cliff of Dump A, it is assumed for this report and the Class C cost estimate that a crane will be used which will be situated at the crest of the cliff. Mobilization of a the crane to the Upper Site will proceed following access road upgrades, which are expected to occur during the mobilization season.

7.5 Barrel Remediation

The 2010 inventory of barrels at FOX-E indicates there are approximately 6,910 barrels on-site, including marker barrels. Of these, 528 barrels were inspected and 60 of these inspected barrels were identified to have aqueous contents. The majority of the barrels are stockpiled within Dump D at the Old Construction Camp area or scattered within Dump A on the slopes below the Station Area.

The results of the Phase III ESA indicate that the majority of barrels inspected are empty and will require no sampling or processing during clean-up. Due to safety concerns, however, most of the barrels within Dump A and D were not inspected. Of the six samples taken from barrels at the Station Area, only one had exceedences for lead and will require off-site disposal. Based on the results of this sampling, barrels at the Station Area with aqueous contents can be discharged, while those with hydrocarbon contents can be incinerated. Because most of the scattered barrels on-site could not be assessed due to safety concerns, all barrels within Dumps A and D with contents should be consolidated and sampled to confirm disposal requirements.

It is expected that there will be barrel contents with hydrocarbon concentrations exceeding the barrel criteria. These barrels will require consolidation and packaging according to TDGA regulations for off-site disposal. The total estimated volume of barrel contents is 8,000 L and the total estimated volume of barrel contents requiring off-site disposal is 500 L.

Because of the need to classify some barrels that could not be properly assessed during the ESA due to safety concerns and the complicated logistics with the clean-up of Dump A, it is recommended that collection of barrels, with consolidation of like products, be completed early during the main construction season to allow for sampling of contents in a timely manner, with incineration or additional consolidation for off-site transport completed during the remainder of the season.

7.6 Proposed New Containment Facilities

7.6.1 Non-Hazardous Waste Landfill (NHWL)

The total crushed volume of non-hazardous waste at FOX-E is approximately 2,420 m^3 and the total crushed volume of non-hazardous waste at Padloping Island is 1,860 m^3, which corresponds to a NHW Landfill airspace requirement of approximately 4,280 m^3. The estimated footprint for a NHW Landfill to accommodate this volume is approximately 60 x 60 m, to the toe of the outside berm. The two areas identified for the construction of the Durban Island NHW Landfill are Potential Landfill Areas 2 and 3. Because Potential Landfill Area 3 is situated on Inuit Owned Lands, the preferred location is Potential Landfill Area 2. The total available surface area at Potential Landfill Area 2 is 20,000 m^2. It is preferable to locate the landfill as close as possible to the existing road to minimize transport costs and the need for access road development.

In terms of contractor priorities for construction of new facilities during clean-up, construction of the NHW Landfill is considered the second priority, behind the landfarm treatment facility (see below). It is expected that construction of the facility can be completed during the main construction season with disposal of waste also commencing this same season.

7.6.2 Landfarm Treatment Area

The total volume of Type B soil identified for remediation is approximately 378 m^3, which will require an area of approximately 3,000 m^2 for the construction of a landfarm treatment area. Potential Landfill Area 1 is the preferred location for a landfarm and is the only site considering that Potential Landfill Area 3 is situated on Inuit Owned Lands and Potential Landfill Area 2 is the preferred location for a NHW Landfill. This site is located at the Upper Site and is in close proximity to the station area where the majority of the Type B hydrocarbon soils are situated and provides a surface area of approximately 24,000 m^2. Potential Landfill Area 2 is considered suitable for the construction of a landfarm treatment area. Following the treatment of the Type B hydrocarbon soils to below criteria, the closure plan for the landfarm treatment area should include reshaping the berms to blend with the surrounding terrain. The treated soils should not be covered with granular material which will allow further aeratiopn of the soils over time.

The construction of the landfarm treatment area is a priority following the upgrading of the main access road, as the treatment of soil could potentially delay the contractor's demobilization from site. Considering the small volume of Type B soils and the short project duration, it is recommended to provide mechanical aeration with a "standard" or "Allu" type bucket for treatment or spread the soils within a landfarm to a depth of 0.3 m instead of 0.4 m in an effort to accelerate the remediation process and reduce risk of the soils not meeting criteria at the end of the main construction season. Preliminary sizing of the landfarm treatment area and associated granular volumes for the construction of the landfarm treatment area were based on the 0.3 m lift thickness of Type B soils.

7.7 Contaminated Soil Excavation

- Tier I soil: Excavation of this soil may commence as soon as the NHW Landfill is constructed or when a suitable storage area is identified as a staging area for off-site transport.
- Type A soil: Excavation of this soil may commence as soon as the NHW Landfill is constructed or when a suitable storage area is identified as a staging area for off-site transport.
- Tier II soil: Excavation of this soil may commence at any time.
- Type B soil: Excavation of all Type B soil requiring treatment should be completed immediately upon landfarm construction, which should be of high priority for the contractor, as noted above.

7.8 Borrow Sources

To confirm that sufficient sources of the various granular material types were identified during the Phase III ESA, an estimate of the required granular material volumes was completed for the recommended remedial options discussed above. The following summarizes the estimated volumes required for each granular material type:

- ***Type 1:*** no requirements for Type 1 granular fill.
- ***Type 2:*** the estimated volume of Type 2 granular fill required for the construction of an on-site NHW Landfill (for a "Conventional Remediation" or "Combined Contract" design), base course at the landfarm and as granular cover for "Regrade" areas, is approximately 8,800 m^3. Additional granular fill required for access road upgrades (approximately 10,000 m^3) which includes resurfacing of the road, localized widening of the road, embankment improvements, washout repairs, and culvert installations.
- ***Type 3:*** the estimated volume of Type 3 granular fill required for backfilling contaminated soil excavations is approximately 450 m^3.
- ***Type 4:*** the estimated volume of Type 4 granular fill required for the construction of an onsite Landfarm is approximately 1,200 m^3.
- ***Type 5:*** there is no requirement for Type 5 granular fill, since there will be no construction of an SSDF or leachate containment system.
- ***Type 6:*** the intermediate fill requirement for the construction of the on-site NHW Landfill is estimated at 1,400 m^3. There is not a sufficient volume of known Tier I/Type A soils at Durban and Padloping Island site to cover the intermediate fill volume requirement, so additional Type 6 material will need to be provided from an on-site borrow source.

A review of granular quantity requirements compared to estimates of borrow volumes available indicates that sufficient granular types have been identified for the construction of on-site facilities, regrades, and contaminated soil backfill. Well graded sand and gravel is limited, however, at the Lower Site and may cause challenges for upgrading the access road. The estimated volume of granular material for upgrading the road is approximately 10,000 m^3 of which most or all will need to be well graded, angular, sand and gravel. It is expected that this material will be sourced from a combination of Borrow Area 7 for the lower portion of the road and Borrow Area1 for the Upper Portion of the road.

It should be noted that the majority of the borrow areas are situated on Inuit Owned Lands. It is expected that, of the 22,000 m^3 of granular material required for construction, approximately 19,500 m^3 will be sourced from borrow areas situated on Inuit Owned Lands.

Selective sourcing, processing, and blending will be required to produce the desired granular material type. The following table summarizes granular material types and the estimated available volumes prior to processing for each of the borrow areas.

Table 5. Borrow Area Summary

Borrow Area	Material Type	Estimated Volume (m^3)	Comments
1A	Types 2/3	31,500	Undisturbed. Located on Inuit Owned Lands.
1B	Types 2/3	14,400	Undisturbed. Located on Inuit Owned Lands.
1C	Type 1	2,300	Undisturbed. Located on Inuit Owned Lands.
1D	Type 3/5/6	10,800	Disturbed. Located on Inuit Owned Lands.
2	Types 3/4/5/6	11,300	Disturbed. Located on Inuit Owned Lands.
3	Types 3/4	3,600	Undisturbed. Located on Crown Lands.
4	Types 1/3	2,500	Undisturbed. Located on Crown Lands.
5	-	-	Deemed unsuitable for construction use due to non-granular nature and high moisture content.
6	Types 3/4	20,000	Undisturbed. Located on Crown Lands.
7	Types 2/3/6	5,600	Disturbed. Located on Crown Lands.
8	Types 2/3/6	4,000	Disturbed. Located on Inuit Owned Lands.

7.9 Summary

The following summarizes the site access and remediation implementation developed for FOX-E, Durban Island:

- The remediation activities at FOX-E are anticipated to be completed in one full year with mobilization by sealift with barge support in the late summer/fall of calendar Year 1 and construction and demobilization in the summer/fall of Calendar Year 2.
- A total of nine existing Waste Disposal Area lobes have been identified for remediation at FOX-E, representing a total area of about 956 m^2. All lobes are designated as Class C and an associated remediation of regrading.
- The demolition of buildings and structures at FOX-E represents a crushed volume of 345 m^3 of non-hazardous debris requiring disposal to a NHW Landfill and 103 m^3 of hazardous debris requiring off-site disposal to a licensed southern facility or in the case of non-painted asbestos, double bagging and disposal to a NHW Landfill.
- A total of twenty debris areas were identified on-site with an estimated crushed volume of 2,075 m^3 of non-hazardous debris, including crushed barrels, requiring disposal to a NHW Landfill and 10 m^3 of hazardous debris requiring off-site southern disposal. A large percentage of both the non-hazardous and hazardous surface debris is located within the Dump A limits, which is limited to helicopter access.
- The total number of barrels with hydrocarbon or mixed phase contents requiring processing is unknown. It is expected that the bulk of the barrel contents will be able to be either discharged or incinerated on-site while an estimated volume of 500 litres of barrel product will require off-site disposal.
- An engineered NHW Landfill is required for the disposal of 2,420 m^3 of crushed non-hazardous waste from FOX-E and 1,860 m^3 of non-hazardous waste from Padloping Island for a total waste volume of 4,280 m^3. A landfarm treatment area is required for the treatment of 378 m^3 of Type B hydrocarbon contaminated soil at Durban Island.
- The priority for contaminated soil excavation is dependent on the disposal or treatment requirements. The priority from high to low is as follows: 1. Type B (requires sufficient time for treatment), 2. Tier II and Hazardous Soil (requires suitable container volume) and 3. Tier I/Type A (requires disposal in Non-Hazardous Waste Landfill).
- A total of 7 usable borrow sources were identified at FOX-E. The estimated total volume of granular material required for FOX-E remediation construction, including road upgrades, is 22,000 m^3 while the total volume of borrow material identified is in excess of 105,000 m^3. It is expected that the majority of the granular material sourced during construction will from borrow sources situated on Inuit Owned Lands.

- To allow for work efficiencies, cost savings, and a “Walkaway Solution” for the Padloping Island site, AECOM recommends that non-hazardous waste from the nearby Padloping Island US Coast Guard Weather Station site be transported and consolidated in the Durban Island NHW Landfill. The total estimated volume of non-hazardous waste from Padloping Island is 1,860 m^3. Additionally, AECOM recommends a “Combined Contract” be implemented for the two sites.

8. Alternate Design Scenarios

The remedial options recommendations provided herein are considered to be "Conventional Remediation" design solutions, where the site is considered to be independent and long term monitoring of remediated landfills and new on-site disposal facilities would be required as per the provisions of the AMSRP. Because of the close proximity of the FOX-E, Durban Island Site to the nearby Padloping Island Site, there is consideration for alternate design scenarios including the provision of a "Combined Contract" with FOX-E and Padloping Island, a "Walkaway Solution" and combinations thereof. The different design scenarios are discussed below. Comparative cost estimates are provided under separate cover (AECOM 2011) for these different design scenarios.

8.1 "Conventional Remediation" Design

A "Conventional Remediation" typically includes the provision of an on-site non-hazardous waste landfill for disposal of demolition, debris and Tier I and Type A Contaminated Soils. This design scenario also typically includes the construction of a landfarm/treatment facility for the treatment of Type B Hydrocarbon Contaminated Soils. If there is suitable volume of Tier II Contaminated Soil identified at site, then a Secure Soil Disposal Facility is provided on-site, otherwise smaller volumes of Tier II Contaminated Soils are containerized and disposed of off-site. All hazardous soil and debris are typically containerized and disposed of off-site at a licensed hazardous waste disposal facility. Monitoring is typically required at the landfarm/treatment facility (during operation only) and long term monitoring is required for all new disposal facilities including the Non-Hazardous Waste Landfill and Secure Soil Disposal Facility.

8.2 "Combined Contract" Design Scenario

A "Combined Contract" can be applied to two or more sites in relatively close proximity to each other. The site assessment and provision of a Remedial Action Plan for Padloping Island has been undertaken concurrently with FOX-E, Durban Island. The Padloping Island site is only 24 kilometers away from the FOX-E site. A contractor may be able to share resources and realize cost savings if these two sites are tendered together. For this combined scenario, the contractor could procure remediation for the sites concurrently or consecutively with the mobilization of one camp and equipment fleet. Further cost savings could be realized if only one NHW Landfill was built and the waste was consolidated to one location from the two sites.

Although a NHW landfill could be built at Padloping Island, the landfill sites and availability of Type 2 Borrow material at Durban Island make it the better location for a consolidated NHW Landfill Facility. For a "Combined Contract" design scenario, it is recommended that a consolidated NHW Landfill be constructed at the FOX-E, Durban Island Site for the disposal of waste from the Padloping and Durban Island sites.

To allow for work efficiencies and cost savings, AECOM recommends that a combined contract be implemented for the Padloping and the FOX-E, Durban Island Sites and a consolidated landfill be constructed at Durban Island for the disposal of non-hazardous waste from both sites. The "Combined Contract" solution is considered to be a "Walkaway Solution" (refer to Section 8.3) for the Padloping Island site as there would be no requirements for long term monitoring.

8.3 "Walkaway Solution" Design Scenario

PWGSC and INAC have requested consideration for a "Walkaway Solution" for the Padloping and Durban Island sites. The "Walkaway Solution" would include the application of remedial solutions to preclude the requirement for post construction monitoring, including provisions for the following:

- The elimination of any new on-site disposal facilities including a NHW Landfill and SSDF
- The off-site disposal of all site waste and contaminated soil to established southern disposal facilities.

- There is no long monitoring requirement for existing landfills less than 1,000 m^2 in area. For a "Walkaway Solution", all WDA's greater than 1,000 m^2 would have to be excavated with the resulting debris and contaminated soil disposed of at an established southern disposal facility. There are no existing WDA'S with areas exceeding 1,000 m^2 at the Durban Island site.
- The landfarm treatment facility would proceed as planned as there is no monitoring required once the treatment soils are remediated.
- The "Walkaway Solution" could be applied to either an "Individual" or "Combined Contract" scenario for the Padloping and Durban Island Sites.

As a result of the comparative cost estimates for the different design scenarios provided under separate cover (AECOM 2011), INAC has indicated that "Combined Contract" and "Walkaway Solution" are the preferred remediation strategies for both the Padloping and Durban Island sites.

9. References

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Appendix A

Figures

B SIZE 11" x 17" (279.4mm x 431.8mm)

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534 000 E
535 000 E
536 000 E
537 000 E
538 000 E
539 000 E

7 442 000 N
7 441 000 N
7 440 000 N

0 150 300 m

SCALE 1:15000

ROAD SECTION 1
ROAD SECTION 2
ROAD SECTION 3
ROAD SECTION 4

CROWN LANDS
INUIT OWNED LANDS

INUIT OWNED LANDS
CROWN LANDS

DUMP A

FIGURE 2.0
STATION AREA

FIGURE 3.0
SOUTHWEST OF STATION AREA

FIGURE 4.0
OLD CONSTRUCTION CAMP

FIGURE 5.0
BEACH LANDING

FIGURE 6.0
DUMP A - PLAN

LEGEND:

- SITE GRID (1000m INTERVAL)
- PARCEL BOUNDARY
- POTENTIAL LANDFILL AREAS
- DEBRIS AREAS
- FIGURE SHEET LIMITS
- ROAD SECTION LIMITS

Public Works and Government Services Canada
FOX-E Durban Island Site Investigation

AECOM

Overall Site Plan
Figure 1.0

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GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 0.5m INTERVAL.

LEGEND:

- SITE GRID (100m INTERVAL)
- DEBRIS AREA
- BURIED DEBRIS AREA
- POTENTIAL CAMP AREA
- 10-0000 SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 SAMPLE LOCATION (NOT ANALYZED)
- 10-0000 TIER I
- 10-0000 TIER II
- 10-0000 TIER I / TYPE A PHC
- 10-0000 TYPE B PHC
- TP-14 TEST PIT LOCATION
- EXISTING POWER POLE
- TIER I ESTIMATED AREA OF CONTAMINATION
- TIER I / TYPE A PHC ESTIMATED AREA OF CONTAMINATION
- TIER II ESTIMATED AREA OF CONTAMINATION
- TYPE B PHC ESTIMATED AREA OF CONTAMINATION

0 12.5 25 m SCALE 1:1250

Public Works and Government Services Canada
FOX-E Durban Island Site Investigation

Station Area
Figure 2.0

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GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

LEGEND:

- SITE GRID (500m INTERVAL)
- DEBRIS AREAS
- POTENTIAL BORROW AREA
- POTENTIAL LANDFILL AREA
- PARCEL BOUNDARY
- 10-0000 SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 SAMPLE LOCATION (NOT ANALYZED)
- TP-9 TEST PIT LOCATION

SCALE 1:5000
0 50 100 m

CULVERTS (2)
ACCESS ROAD
POTENTIAL BORROW AREA 2
POTENTIAL BORROW AREA 1
POTENTIAL BORROW AREA 4
POTENTIAL LANDFILL AREA 1
POTENTIAL LANDFILL AREA 2
POTENTIAL LANDFILL AREA 3
DEBRIS AREA 1
DEBRIS AREA 2
DEBRIS AREA 3
DEBRIS AREA 4
DEBRIS AREA 5
DEBRIS AREA 6
DEBRIS AREA 7
DEBRIS AREA 8
DEBRIS AREA 9
DEBRIS AREA 10
DEBRIS AREA 11
LOBE 8
BARREL CACHE
FORMER BARREL STORAGE AREA
ABOVE GROUND CABLE
WIND SOCK
HELIPAD
INUIT OWNED LANDS
CROWN LANDS
1A
1B
1C
1D
TP-1 TP-2 TP-3 TP-4 TP-5 TP-6 TP-7 TP-8 TP-9 TP-10 TP-11 TP-12 TP-13 TP-14 TP-15 TP-16 TP-17 TP-18
10-0325 10-0326 10-0323 10-0324 10-0356 10-0357
10-0275 10-0276 10-0270/71 10-0269 10-0266 10-0267 10-0272 10-0264 10-0265
N 7 441 000 N 7 441 500 N 7 442 000 N 7 442 500
E 536 000 E 536 500 E 537 000 E 537 500

Public Works and Government Services Canada
FOX-E Durban Island Site Investigation

AECOM

Southwest of Station Area
Figure 3.0

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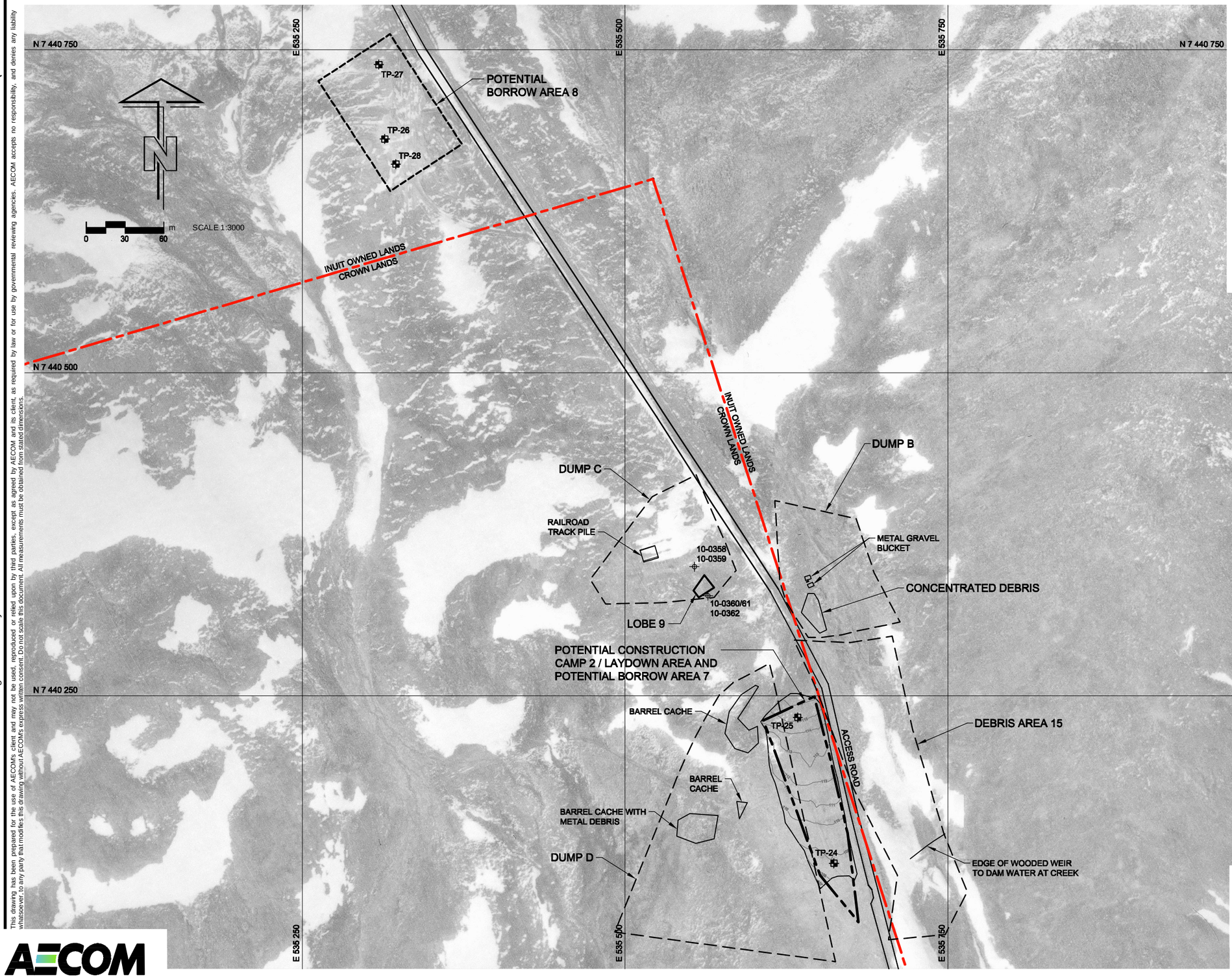

GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

LEGEND:

- SITE GRID (250m INTERVAL)
- DEBRIS AREAS
- BURIED DEBRIS AREA
- POTENTIAL BORROW AREA
- CONCENTRATED DEBRIS AREA
- CONSTRUCTION SITE LAYDOWN AREA
- PARCEL BOUNDARY
- 10-0000 — SAMPLE LOCATION (BELOW CRITERIA)
- TP-26 — TEST PIT LOCATION

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Old Construction Camp
Figure 4.0

B SIZE 11" x 17" (279.4mm x 431.8mm)

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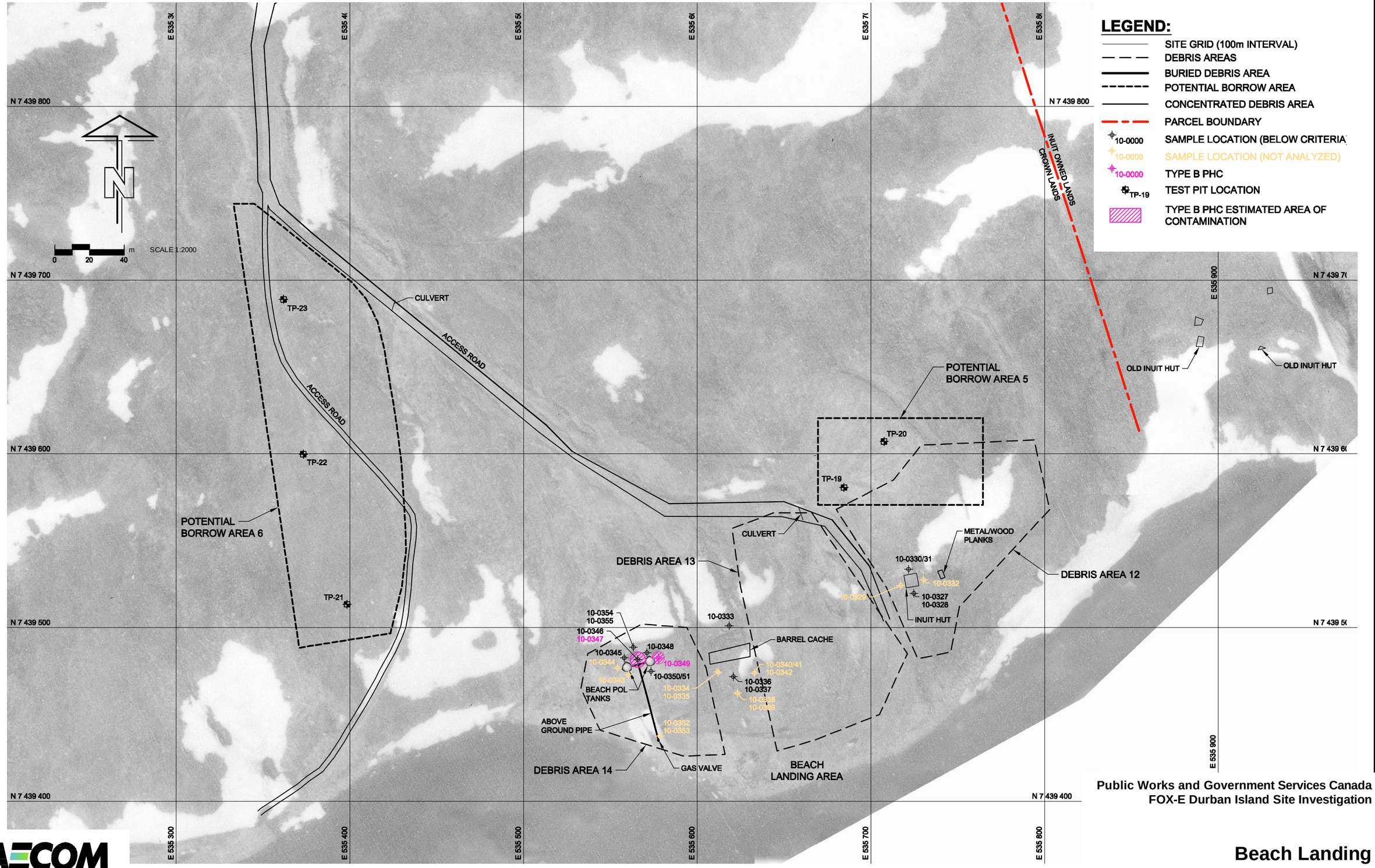

Public Works and Government Services Canada
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Beach Landing
Figure 5.0

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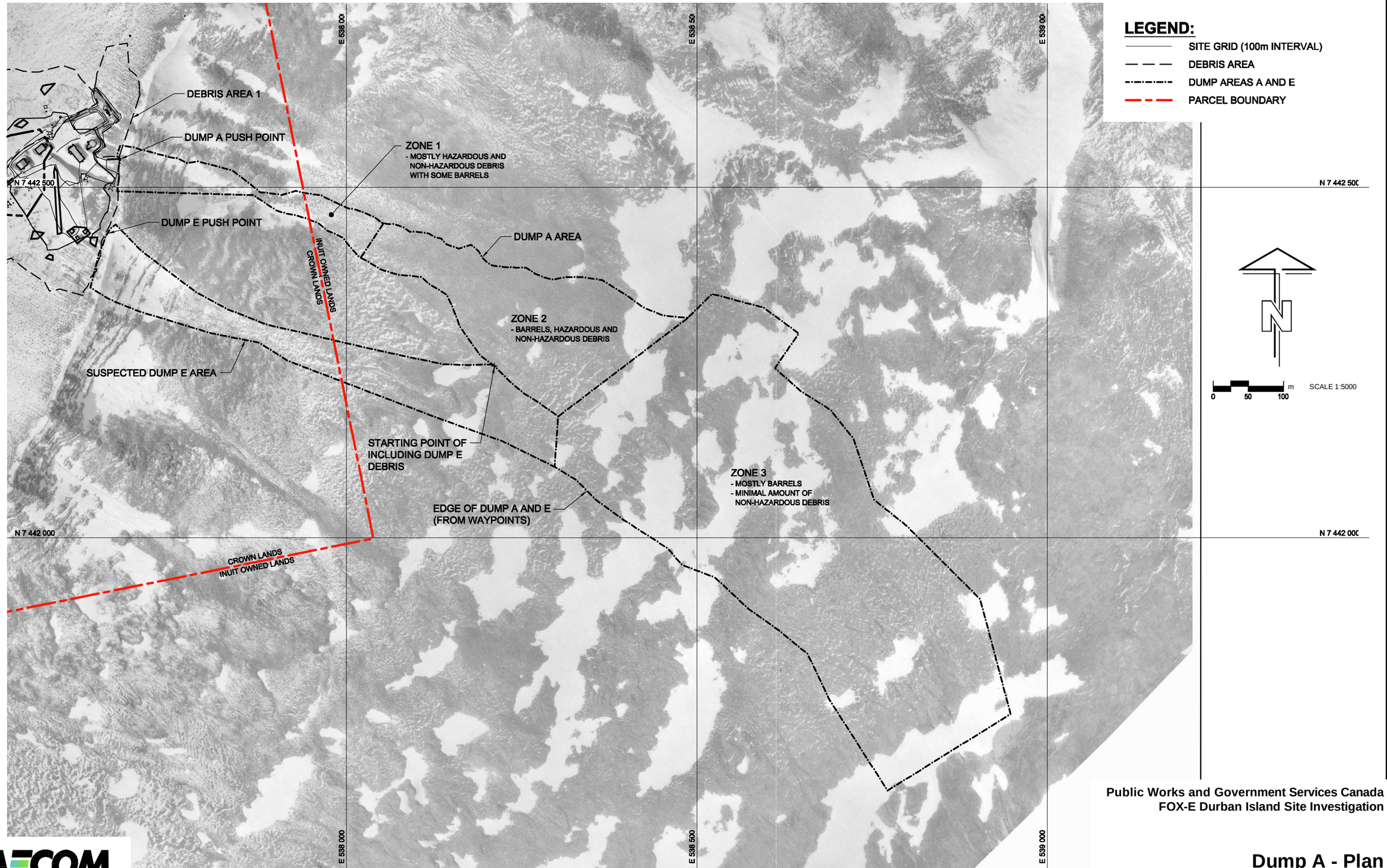

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Dump A - Plan
Figure 6.0

Appendix B

Summary of Contaminated Soil Areas

Remedial Action Plan for FOX-E, Durban Island
Table B1: Summary of Contaminated Soil Areas

Location	Area (Ref. by Tag Number)	Contaminants	Tier I		Tier II		Tier I /Type A PHC		Type B PHC		Tier I Volume m^3	Tier II Volume m^3	Tier I/Type A PHC Volume m^3	Type B PHC Volume m^3
			Area m^2	Depth m	Area m^2	Depth m	Area m^2	Depth m	Area m^2	Depth m				
Station POL Tanks and Pumphouse	(10-0164; 10-0170/71), 10-0165	Type B PHC							63	0.5	0	0	0	32
Module Train	10-0209	PCB	76	0.3							23	0	0	0
Module Train	10-0199 to 10-0202	Type B PHC							112	0.6	0	0	0	67
Warehouse	(10-0226;10-0227)	Type B PHC							16	0.6	0	0	0	10
Garage	(10-0237;10-0238)	PCB, Pb/Type A PHC					35	0.3			0	0	11	0
Garage	10-0236	Type B PHC							40	0.3	0	0	0	12
Garage	10-0232	Cd			47	0.3					0	14	0	0
Inuit Building	10-0256	As, Cu			14	0.3					0	4	0	0
Beach POL Tanks	10-0347	Type B PHC							63	0.7	0	0	0	44
Beach POL Tanks	10-0349	Type B PHC							38	0.3	0	0	0	11
Lobe 3	10-0310	Type B PHC							289	0.7	0	0	0	202
										CONTAMINATED SOIL AREAS	**23**	**19**	**11**	**379**
										Buried Debris EXCAVATION	**0**	**0**		
										TOTAL	**23**	**19**	**11**	**379**

Appendix C

Summary of Debris and Demolition

Remedial Action Plan for FOX-E, Durban Island

Table C1: Summary of Surface Debris Areas

Debris Area	Description	Location	Estimated Areal Extent (m^2)	Estimated Uncrushed Volume (m^3)	Estimated Non-Hazardous Volume (crushed) (m^3)	Estimated Hazardous Volume (crushed) (m^3)	Comments
1	Debris: Tin cans, wood, electrical wire, fiberglass, rope	Station Area, Southeast of POL Tanks	6,250	8	4	-	Sparsely scattered debris with higher concentrations of surface debris near the edge of the plateau.
2	Debris: Tine cans, wood (timbers, planking, post), fiberglass, glass, concrete, metal wire, metal pipes, scrap metal, components of a piece of construction equipment, electrical wire and conduit, 2 electrical panels, stoves, counter tops, plumbing, Asbestos floor tiles, clay ceramic with unknown white powder, fire extinguisher.	Station Area including Inuit Huts and Inuit Kitchen, not including the fallen Antenna	38,520	70	50	2	Sparsely scattered debris except at areas of concentrated debris at the Inuit Huts, Inuit Kitchen, and push point for Dump E. The Inuit Huts are demolished with remnants of a wood raft floor and it appears the Inuit Huts had electrical and water services, likely buried. The Inuit kitchen is also demolished with the remnants of a wood floor on concrete pads and is partially burnt.
3	Debris: Wood (planking, timber piles, etc.), rubber, glass, plastic, corrugated sheet metal, scrap metal, heater unit, large gas tank for vehicles (0.6m x 1.2m), mostly wood	North of Station	62,150	30	20		Sparsely scattered debris with higher concentrations of surface debris as you move towards the Station, especially around the Buried Debris Lobes. A large hole containing timber posts is present within the area and appears to have been blasted and may have been an attempt at a groundwater well. There is blast drill holes and detention cords in the area and there may be UXO (blast caps) in the area. The timber posts within the large hole may have been a foundation to support a structure. There were no remnants of the structure nearby.
4	Debris: Scrap metal, timber pallets, acrylic looking substance	West of Station	2,300	3	2		-
5	Debris: Tin cans, scrap metal, wood, destroyed battery, metal wire, fabric, mostly metal	West of Station	7,300	13	9	0.5	Sparsely scattered debris with two concentrated pockets of surface debris.
6	Debris: Tin cans, scrap metal, wood, mostly metal	Northwest of Station, along edge of plateau	800	3	2		Concentrated debris area very close to the edge of the plateau (shear face).
7	Debris: mostly wood, some scrap metal	Southwest of Station Area, Old Barrel Storage Pad	25,000	6	5		Very sparsely scattered debris in a large area, mostly within disturbed area. There is some partially buried debris within Barrel Storage Pad such wood planks, barrels, and tracks to an old piece of equipment.
8	Debris: metal cables, scrap metal, wood, equipment track pads	Southwest of Station Area	96,000	3	2		Very sparsely scattered debris in a large area.
9	Debris: scrap metal and mostly wood fragments	Southwest of Station Area	28,000	3	2		Very sparsely scattered debris in a large area.
10	Debris: mostly wood, some scrap metal and tin cans	Southwest of Station Area	1,600	1	1		Very sparsely scattered debris in a large area.
11	Debris wood fragments	Southwest of Station Area	1,900	1	1		Very small volume of debris within barrel cache.
12	Debris: wood, scrap metal, furnace, rubber equipment tracks, rope, canvas	Beach Landing Area	8,600	18	15		Some of the debris has been partially buried caused by surface runoff depositing transported material in this area.
13	Debris: wood, scrap metal, cables	Beach Landing Area	8,800	4	4		Most of the debris has been partially buried caused by surface runoff depositing transported material in this area.
14	Debris: wood, scrap metal, metal bed frames, metal cables, timber poles	Beach Landing Area	4,500	5	2	2	Some of the debris has been partially buried caused by surface runoff depositing transported material in this area.
15	Debris: wood, scrap metal, electrical cables, equipment track, wood weir, rubber	Old Construction Camp Area	14,000	21	18		Wood Weir is located in runoff stream. May have been used to pond fresh water for potable water.
Road Debris	Debris: mostly wood, scrap metal, a metal sled near Road Section #4	Within 30m of Access Road from Station to Beach Landing Area, excluding areas within other debris areas	-	30	20		-
Dump A	Debris: Barrels, tin cans, wood, rubber tires, plumbing, metal pipe values (painted), batteries, fibreglass, fire extinguisher, glass, rubber equipment tracks, paint cans, oil filters, rubber, mercury lamps, electrical wires and switches, grinding wheels, small compressed gas cylinder (50mm diam.), metal sled, plastic, metal cables, Styrofoam, fabric, metal tanks of various sizes, demolished vehicles, fire repressing tank (with exposed white powder, 03m diam x 0.75m), pieces of machinery,	South of Station, below plateau	265,610	-	355	5	Figures 6 and 7 provide additional information such as the terrain profile, debris zones, and locations of hazardous material.
Dump B	Debris: wood (beams, timbers), scrap metal, equipment tracks, machine parts, metal cables, electrical wire, metal hauling truck boxes	Old Construction Camp Area	6,800	52	35		Most of the debris is located in a concentrated area around the metal hauling truck boxes, but some debris does extend into the steam east of the area.
Dump C	Debris: wood, scrap metal, tin cans, metal strapping	Old Construction Camp Area	7,000	32	27		Some of the debris is partially buried and has been partially covered in vegetation.
Dump D	Debris: Barrels, wood, scrap metal, rubber, electrical cable, rope, machine parts, seat cushions, wooden crates, metal cables, wooden tables, equipment tracks, metal garbage cans, wooden cable spoils, tin cans, compressed gas cylinder , plumbing, metal strapping, stoves	Old Construction Camp Area	22,300	80	62		Some of the debris is partially buried.
Dump E	Debris: scrap metal, wood.	South of Station, below plateau west of Dump A	44,600	200 at top (not including bottom portion)	59		Lower portion of Dump E surface debris assessment incorporated into Dump A inventory as noted on Figure 6. The surface debris in the remaining area was estimated from a Helicopter fly by.
All Site Debris Areas	Barrels ~ 6,910				1,380		
TOTALS			**652,030**	**-**	**2,075**	**10**	

Remedial Action Plan for FOX-E, Durban Island
Table C2: Demolition Debris Inventory

Structure	Description of Components	Hazardous Material	Estimated Non-Haz (m^3) - crushed	Estimated Hazardous PAP (m^3) - crushed	Estimated Hazardous Asbestos (m^3) -	Estimated Hazardous Asbestos with PAP	Comments
Antenna and Guide Wire Anchor Pads	Structural steel and associated hardware, guide wires, guide wire anchors (concrete pads:3.92m x 3.92m x 0.4m thick).	none	80	-	-	-	Results from the orange and white paint samples collected from the Antenna Tower contained concentrations of PCBs below the relevant criterion. At previous
Module Train	25 m L x9 m W x 4.6 m H, metal cladding and insulated plywood paneling, timber crib foundation (creosote), Building contained electrical cabinets; 8 x CO_2 tanks, 2 generators, 4 x diesel tanks, 7 water tanks, motors in small water storage room.	PCB paint, both adhered and flaked on the walls, floor and structures such as tanks, generators, and the asbestos wrapped pipe. There is an estimated 250 lineal meters of asbestos wrapped pipe in the module train that was visible.	108	55	3	13	Results from the paint samples collected from the interior and exterior were all above the relevant PCB criterion with the exception of one grey paint sample collected from the metal cabinets in the electrical room. The concrete sample collected from a stained area in the electrical room contained a total PCB
Garage	12.7 m L x 10.5 m, concrete floor with grating in half the floor and grating within the access ramps; interior and exterior metal cladding (insulated), 3 CO_2 tanks, 2 diesel tanks, furnace,	PCB paint, both adhered and flaked on the walls and structures such as tanks, generators, and the asbestos wrapped pipe. There is an estimated 9 lineal meters of asbestos wrapped pipe in the	59	1	1	1	No substrate samples were collected from this location.
Warehouse	13.3 m L x 9.4 m W; metal cladding and insulated, plywood paneling, concrete, timber cribing and steel (beam) foundation, 1 x CO_2 tank, 2 diesel tank, furnace; water tanks, 2.8m x 4.6m washroom unit is	PCB paint, both adhered and flaked on the plywood interior walls, tanks, and the asbestos wrapped pipe. There is an estimated 15 lineal meters of asbestos wrapped pipe in the washroom addition that was visible.	38	13	2	-	An insulation sample was collected from the interior walls and was found to contain no chrysotile.
Windcone	Steel windcone	none	1.5	-	-	-	-
Water Reservoir Tank and Pumphouse	5.0 m diameter x 3.0 H Insulated tank; 2.0 m W x 2.0 m L pump house, fibreglass cladding and insulated, concrete pad, 2 diesel tanks, 2 x CO_2 tanks, steam generator	PCB paint, both adhered and flaked on the walls, ceiling, concrete floor generators, and the fiberglass wrapped pipe. There is an estimated 60 lineal meters of fiberglass wrapped pipe in the garage that was visible.	31	-	5	-	Results from the paint samples from the interior were all greater than the relevant PCB criterion. A piping insulation sample was collected from the interior and was found to contain 40 % chrysotile.
Station POL Tanks (x2) and Pumphouse	5.0 m diameter x 3.0 H tank (x2); 2.0 m W x 2.0 m L pump house, metal cladding; fuel pump, 6 large valves, piping, timber crib foundation, and no roof.	PCB paint, both adhered and flaked on the walls, timber cribbing, fuel pump, piping, and valves.	7	-	6	-	Results from the paint sample collected from the exterior of the POL Tank contained PCBs below the criterion but leachable lead of 68 mg/L which is above the TDG criterion (5 mg/L).
Beach POL Tanks (x2)	5.0 m diameter x 3.0 H tank tank (x2); and 4 valves	Assumed to be similar to the Station POL Tanks.	10	-	3	-	No substrate samples were collected from this location, but is should be assumed that it is similar to the Station POL tanks and above criteria for leachable lead.
Dump B Gravel Boxes	-	-	10	-	-	-	A paint sample was collected and analyzed for PCBs and was found to contain concentrations less than the applicable criterion.
TOTALS			345	69	20	14	

Appendix D

Analytical Results for Barrel Product

Remedial Action Plan for FOX-E, Durban Island

Table D1: Barrel Sample Summary

Sample Number and Label	Location	Depth of Contents (cm)	Contents Description	Comments	Analytical Results
B-1	West Beach	10	Aqueous	Rusty sediment	The aqueous contents contain 110 ppm lead and must be shipped offsite for southern disposal.
B-2	West Beach	10	Aqueous	Rusty sediment	No exceedences for the parameters tested under the Barrel Protocol Criteria.
B-3	West Beach	8	Aqueous	Rusty sediment, slight hydrocarbon odour	No exceedences for the parameters tested under the Barrel Protocol Criteria.
B-4	West Beach	50	Aqueous	Rusty sediment	No exceedences for the parameters tested under the Barrel Protocol Criteria.
B-5	West Beach	40	Aqueous	Clear liquid that is more viscous than water. Container is a 10 L plastic jug.	No exceedences for the parameters tested under the Barrel Protocol Criteria.
B-6	Upper Site	20	Organic/Aqueous	Dark brown organic layer and clear aqueous phase.	No exceedences for the parameters tested under the Barrel Protocol Criteria.

Appendix E

INAC Abandoned Military Site Remediation Protocol

Affaires indiennes et du Nord Canada
Indian and Northern Affairs Canada

Abandoned Military Site Remediation Protocol

Volume I – Main Report

Indian and Northern Affairs Canada
Northern Affairs Organization
Contaminated Sites Program

Final
March 2009

Canada

Indian and Northern Affairs Canada | Affaires indiennes et du Nord Canada

Abandoned Military Site Remediation Protocol

Volume I – Main Report

March 2009

Indian and Northern Affairs Canada

ACKNOWLEDGMENTS

This Protocol is an update on the previous Indian and Northern Affairs Canada (INAC) Abandoned Military Site Remediation Protocol, which was produced in 2005. Considerable intellectual effort has gone into the revisions and updates contained in this new Protocol and INAC wishes to recognize and thank the organizations involved in its development.

This document, which is comprised of Volume I (Main Report) and Volume II (Supporting Technical Documentation) is a product of the collaborative efforts by the following organizations:

- Environmental Sciences Group, Royal Military College of Canada
- Golder Associates Ltd.
- EBA Engineering Consultants Ltd.
- UMA Engineering Ltd. (now AECOM)
- Qikiqtaaluk Environmental Inc.
- Jacques Whitford Ltd.
- Dept. of Geological Sciences and Geological Engineering, Queen's University

INAC also wishes to recognize and thank the members of the Technical Advisory Working Group who provided invaluable input to development of this Protocol.

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1 INTRODUCTION

In the 1950s, at the height of the Cold War, a number of facilities were constructed in the Canadian Arctic to provide surveillance of northern approaches to the continent. The largest installation was the Distant Early Warning (DEW) Line, a series of radar stations spanning the northern coastline from Alaska to Greenland. In total, 63 stations were constructed, 42 of which were located in Canada. In 1963, due to advances in technology, installations at 21 of the sites were considered redundant and these sites were abandoned. All buildings, vehicles, Petroleum Oil Lubricant (POL) storage tanks and miscellaneous debris were left in place. Administration of these sites was transferred to Indian and Northern Affairs Canada (INAC) (Fletcher 1989; INAC 2002). Other abandoned military sites include those associated with the Pole Vault line in the eastern Arctic. Locations of INAC military sites in the Canadian Arctic are indicated on Figure 1. The remainder of the installations on the DEW Line continued to operate until the early 1990s, at which point most of them were converted to the North Warning System (NWS). Decommissioning and cleanup of these 21 sites, excluding facilities that are required for the operation of the NWS, is the responsibility of the Department of National Defence (DND).

Several environmental issues were at these abandoned military sites based on previous preliminary and detailed assessments at the INAC and DND sites (ESG 1991, 1993). These issues include physical hazards related to unconsolidated debris and aged structures, and environmental impacts associated with soil contamination. In 1996, DND initiated remediation of the DEW Line sites under its jurisdiction and cleanup of these sites is on going. The cleanup follows the conditions of the DEW Line Cleanup Protocol (ESG, 1993 and ESG/UMA, 1995) and the co-operation agreements between DND and Nunavut Tunngavik Inc. (NTI) (DGE 1998) and DND and the Inuvialuit Regional Corporation (IRC) (DGE 1996).

INAC has completed the remediation of a number of sites across the Canadian Arctic namely Iqaluit Upper Base, Resolution Island (BAF-5), Horton River (BAR-E), Sarcpa Lake (CAM-F), and Pearce Point (PIN-A). The approach adopted for remediation of these sites has generally been consistent with the methodology applied at the DND DEW sites (PWGSC 2001 to 2003). Due to the commitment of the Federal Government to future funding of contaminated site clean up, INAC recognizes the need for a consistent protocol for abandoned military site cleanup (INAC 2002).

A number of factors must be considered when determining the most suitable approach to site remediation for remote sites in the Arctic environment. The Abandoned Military Site Remediation Protocol (AMSRP) is based on an approach that addresses legal requirements, INAC's Contaminated Sites Policy (including risk management requirements), and standard environmental management practices (INAC 2002).

This Protocol also takes into consideration financially prudent methodologies that address environmental issues while striking a balance with remedial cost. An over-arching principle has been to balance the environmental benefits of remediation activities with potential negative physical impacts to the Arctic environment.

The primary objectives of this document are to provide sufficient background information to understand the environmental issues present at these sites, and to describe the guiding principles for their assessment and remediation. AMSRP, Volume 2 (INAC 2009) provides additional supporting technical information.

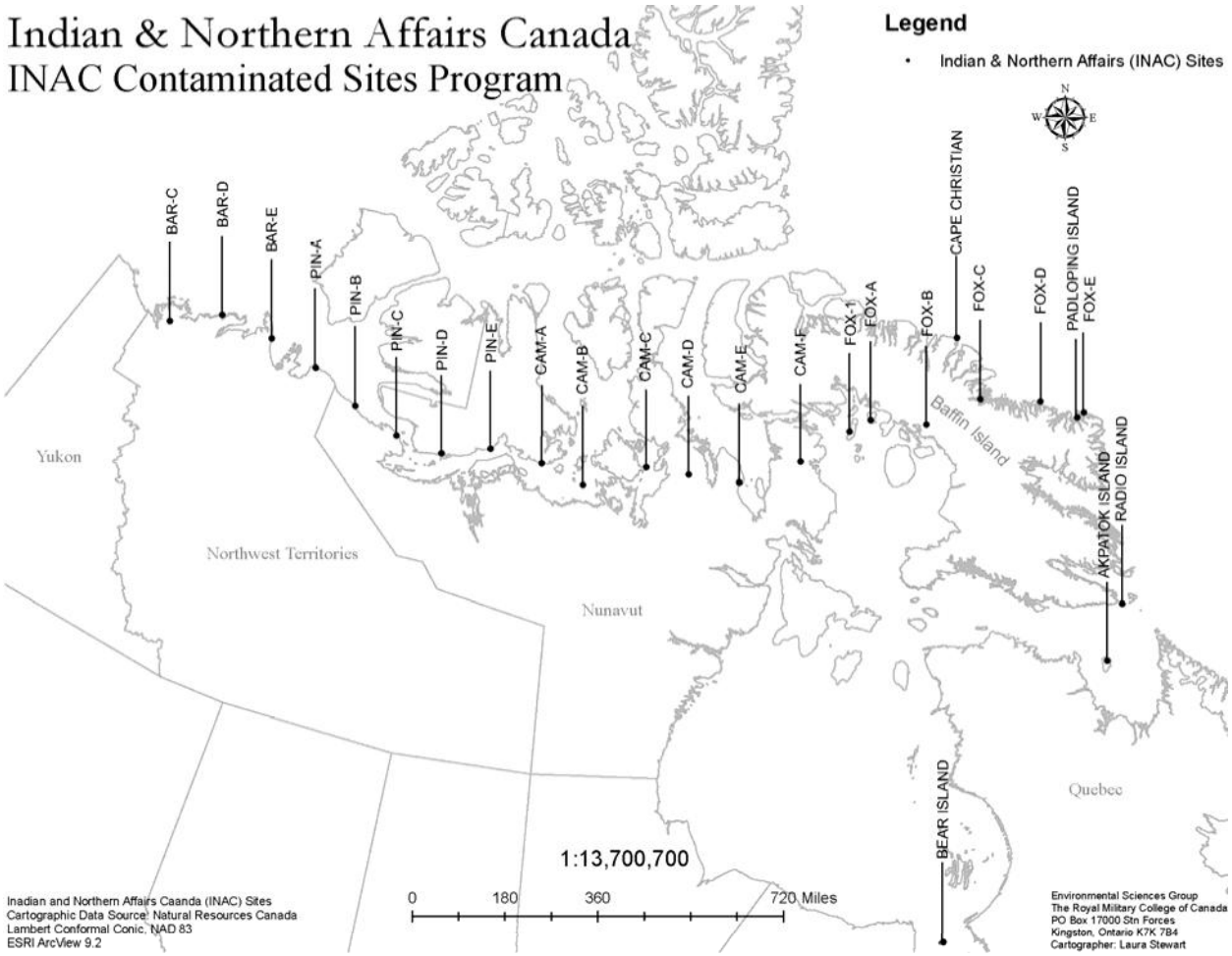

Figure 1 Location of INAC Military Sites

1.1 Scope of Document

This document is structured in a manner generally consistent with the steps outlined in the Federal Contaminated Sites Action Plan (CSM 2000) as shown in Figure 2. As previously indicated, issues of environmental concern have been identified at the INAC DEW Lines (Step 1). Extensive historical data (Steps 2 and 3) from initial environmental assessments, as well as detailed information collected through assessment of DEW sites under the jurisdiction of DND, has been used to develop the requirements for the detailed assessment of the INAC sites (Step 5), as described in Section 4. Guidelines for development of a remediation strategy (Step 7) are provided in Section 5. Implementation related issues, such as confirmatory sampling, waste manifesting, construction quality assurance/quality control measures (Step 9) are described in Section 6. Post-implementation monitoring requirements are described in Section 7 (Step 10).

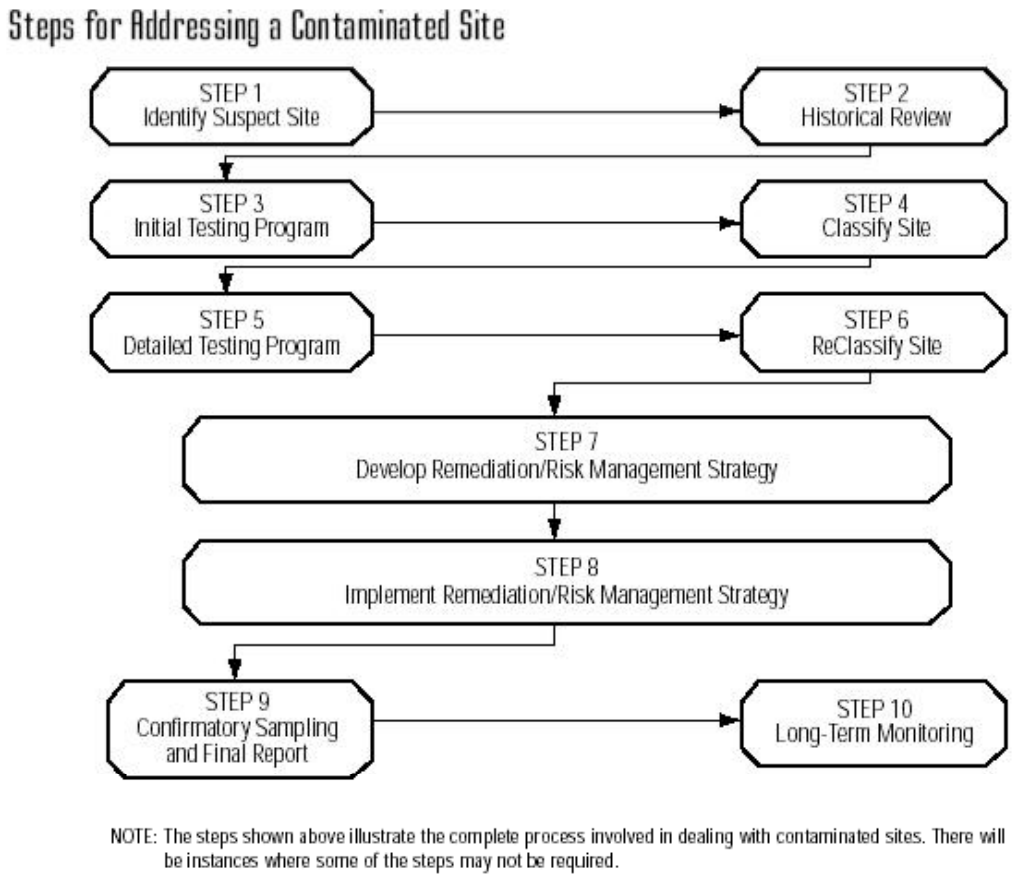

Figure 2 Steps for Addressing a Contaminated Site

2 BACKGROUND

2.1 CCME Environmental Quality Guidelines

Where remediation of federal real property is carried out, departments and agencies are to set remediation objectives in accordance with the most applicable of the three methods developed by the Canadian Council of Ministers of the Environment (CCME) (CCME 1997):

CCME Tier 1: Follow CCME Environmental Quality Guidelines (CCME 1997, 1999), as amended from time to time, and, where applicable, the *Canada-wide Standard for Petroleum Hydrocarbons in Soil* (CCME 2008), as amended from time to time. To the extent that guidelines do not exist for a particular type of contamination, or are technically or economically inappropriate for a particular situation, departments and agencies may follow equivalent guidelines or standards (e.g. provincial);

CCME Tier 2: Follow modified CCME Environmental Quality Guidelines where site conditions, land use, receptors, or exposure pathways differ only slightly from the protocols used in the development of the guidelines; and

CCME Tier 3: Develop site-specific remediation objectives based on a site-specific risk assessment, as outlined by the CCME, or equivalent, where site conditions are unique or particularly sensitive.

Although the CCME Environmental Quality Guidelines are broad in application and address a wide variety of land uses and potential contaminants from diverse sources, they do not specifically address the environmental conditions representative of the Arctic, as discussed in AMSRP Volume 2 (INAC 2009).

2.2 Department of National Defence (DND) DEW Line Cleanup (DLCU) Protocol

The initial environmental assessment of DEW Line sites under the jurisdiction of DND was one of the first major contaminant investigations in the Arctic related to point source contaminants. Following these assessments in the early 1990s, DND developed a remedial protocol in consultation with other government agencies and stakeholders (ESG 1991, 1993), and referred to it as the DEW Line Cleanup (DLCU) Protocol. This Protocol was developed at a time when no remediation standards and criteria specific to the Canadian Arctic existed. The remedial criteria were developed using a contaminant source and pathway targeted approach, consistent with CCME's Tier 3 method. A broad suite of chemicals was investigated and contaminants of concern at DEW Line sites were identified as those contaminants that were consistently elevated relative to the site background levels and the available Canadian federal or provincial guidelines (CCME 1991). The rationale for selection of contaminants of concern is provided in AMSRP Volume 2 (INAC 2009). Engineering input with respect to remediation strategies was used to refine the cleanup protocol (ESG/UMA 1995) prior to its implementation at the first DND sites in 1996.

Cleanup of Arctic sites presents a number of unique challenges, including but not limited to:

- Remote site location, with access limited to sea-lift and small aircraft during the summer months, and over-land during winter;
- Short construction season, typically from July to September, which may limit the technical feasibility of remedial options;
- Lack of centralized waste disposal facilities;
- High costs associated with mobilization of equipment and personnel to the sites, both during the site assessment and remedial phases; and
- Sensitivity of the Arctic ecosystem to changes in physical habitat.

Experience gained since 1996 at the DND sites has been reviewed annually to evaluate lessons learned and to incorporate new information and methodologies as they become available. The DLCU protocol therefore is the culmination of scientific and engineering expertise that has been applied across the Arctic at the DND sites.

Although there are many similarities between INAC and DND DEW sites, the INAC sites were in operation for a significantly shorter period of time, and environmental issues tend to differ in scale. In addition, there may have been other land use subsequent to the DEW Line activities. INAC sites and the associated known land uses are summarized in Table 2.1

Table 2.1 Summary of INAC Military Sites and Historic Land Use

Site Designation/Name	Location	Other Historic Land Use/ or Issues
BAR-C Tununuk Camp	NWT	Imperial Oil as Lessee
BAR-D, Atkinson Point	NWT	Canadian Marine Drilling (CANMAR) Canadian Reindeer Ltd. (note: cleanup on-going)
BAR-E Horton River	NWT	SRR, (note: cleanup completed, monitoring on-going)
PIN-A Pearce Point	NWT	Biological Research Station (note: cleanup completed, monitoring ongoing)
PIN-B Clifton Point	Nunavut/Kitikmeot	
PIN-C Bernard Harbour	Nunavut/Kitikmeot	
PIN-D Ross Point	Nunavut/Kitikmeot	
PIN-E Cape Peel	Nunavut/Kitikmeot	
CAM-A Sturt Point	Nunavut/Kitikmeot	
CAM-B Hat Island	Nunavut/Kitikmeot	Short Range Radar (SRR) as part of North Warning System
CAM-C Matheson Point	Nunavut/Kitikmeot	
CAM-D Simpson Lake	Nunavut/Kitikmeot	SRR (module train dismantled and buried on site)
CAM-E Keith Bay	Nunavut/Qikiqtaaluk	Module train gone/some evidence of burning
CAM-F Sarcpa Lake	Nunavut/ Qikiqtaaluk	Research Station (note: cleanup completed, monitoring ongoing)
FOX-1 Rowley Island	Nunavut/Qikiqtaaluk	SRR (large burn area, module train gone)
FOX-A Bray Island	Nunavut/Qikiqtaaluk	SRR (module train gone)
FOX-B Nudluardjuk Lake	Nunavut/Qikiqtaaluk	SRR (module train gone)
FOX-C Ekalugad Fiord	Nunavut/Qikiqtaaluk	
FOX-D Kivitoo	Nunavut/Qikiqtaaluk	Fire destroyed main building train in 1963
FOX-E Durban Island	Nunavut/Qikiqtaaluk	Partially burned building

Site Designation/Name	Location	Other Historic Land Use/ or Issues
Cape Christian	Nunavut/Qikiqtaaluk	LORAN Site
Padloping Island	Nunavut/Qikiqtaaluk	Navigational aid and weather station
Radio Island	Nunavut/Qikiqtaaluk	Navigational aid and weather station (note: cleanup completed, no monitoring required)
Bear Island	Nunavut/Qikiqtaaluk	Mid-Canada site
BAF-5 Resolution Island	Nunavut/Qikiqtaaluk	Pole-Vault site (note: cleanup completed, monitoring ongoing)
Iqaluit, Upper Base	Nunavut/Qikiqtaaluk	Pole-Vault site (note: cleanup completed, monitoring ongoing)

Cleanup objectives were set for the INAC sites, and the INAC AMSRP was developed as outlined in the following sections.

3 CLEANUP OBJECTIVES

Cleanup objectives, which are consistent with the Federal Contaminated Sites Management Working Group (CSMWG) objective to "integrate sustainable development and pollution prevention principles while meeting environmental regulations and protecting public health" (CSM 2000, TB 1998, 2000, 2002), are as follows:

- To restore sites to meet the environmental objectives established for northern sites;
- To prevent migration of contaminants into the Arctic ecosystem;
- To remove physical hazards for the protection of human health and safety; and
- To implement a cost effective remediation solution.

These objectives are consistent with those applied in the remediation of DEW Line sites under the jurisdiction of DND (DGE 1996, 1998). The following considerations need to be taken into account when developing and implementing a Remedial Action Plan (RAP) for INAC sites:

- Respect all historical agreements and obligations in a fair and reasonable manner;
- Ensure consistency with federal guidelines for management of contaminated sites;
- Apply the Canadian Council of Ministers of the Environment (CCME) environmental protection and management approaches (CCME 1996, 1997, 1999, 2001, 2008) as applicable;
- Apply simple, practical remedial solutions wherever possible, with flexibility as necessary to adjust to site-specific conditions when they are identified;
- Establish cost effective solutions through use of best practices to ensure appropriate levels of environmental protection for all sites;
- Recognize the concerns of climate change in an Arctic setting; and
- Ensure long-term effectiveness of the environmental remedial measures.

It is Canadian government policy that all federal departments and agencies ensure sound environmental stewardship with respect to property in their care by avoiding contamination and managing contaminated sites in a consistent and systematic manner that recognizes the principle of risk management and results in the best value for the Canadian taxpayer (TB 1998, 2000, 2002). The following section identifies the primary factors that have been considered in developing a remediation approach.

3.1 Biophysical Environment

The INAC abandoned military sites are located across the Arctic in the Southern Arctic Ecozone in the western Arctic, in the Northern Arctic Ecozone in the central and eastern Arctic, and the Arctic Cordillera along the east coast of Baffin Island. The majority of the sites are located along the coastline. (Agriculture and Agri-Food Canada, 1996).

Mean annual temperatures are in the range of -11^{0}C in the western Arctic and tend to be colder in the central and eastern Arctic. Accordingly, all sites are located within the zone of continuous permafrost. Much of the Arctic region is classified as polar desert as annual precipitation, predominantly as snow, is generally within the range of 100 to 300 mm. One exception is the eastern coastline of Baffin Island near Cumberland Peninsula, where precipitation can be in the order of 400 to 600 mm annually.

As indicated, the Arctic ecosystem is characterized by extreme environmental conditions, including cold temperatures, large seasonal fluctuations in incoming solar radiation, extensive snow and ice cover, and short growing seasons. These conditions affect the productivity, species diversity, wildlife behaviour (e.g., migration), and food chain characteristics of Arctic ecozones. For example, productivity in terrestrial, freshwater, and marine environments is reduced due to limited nutrient availability, low light, low temperatures, ice cover, and short growing seasons. Compared to most other ecosystems, the Arctic is characterized by relatively low reproduction, organisms that are slower to reach sexual maturity and are generally longer lived, lower species diversity, and distinctive sub-ice biological communities. Relatively short food chains, which are characteristically known for their dominance of marine mammals and birds, are associated with simple predator-prey relationships (e.g. phytoplankton-zooplankton-fish-seal-polar bear or phytoplankton-zooplankton-whale). The combination of all these physical factors affect the sparse distribution and number of Arctic biological communities and makes them very sensitive to physical disturbances such as habitat destruction (AMAP 1998, CACAR 2003).

The assessment and remedial protocols developed are cognizant of striking a balance between the physical disturbances of existing impacted areas versus the physical disturbances of developing new areas required to support remediation activities.

4 ASSESSMENT PROTOCOL

The elements of the assessment protocol have been developed through the review of previous work at related sites (eg. PWGSC 2001a-c, 2002a-f, IEG 2001, EWG 1998, 1999, UMA 1994) and take into consideration information of particular relevance to the unique character of the INAC sites. Typical environmental issues at abandoned military sites include:

- Contaminated soils;
- Existing solid waste disposal areas;
- Debris on surface and in waters near the sites;
- Debris associated with the demolition of structures/facilities; and
- Hazardous waste.

The objective of the environmental assessment of these sites is to collect sufficient information to allow development of a Remedial Action Plan (RAP).

Issues related to implementation, including but not limited to: environmental screening, permitting, and construction, also require information to be collected at the assessment stage. These information requirements can include:

- Geotechnical site information relating to potential development areas for landfills and/or hydrocarbon contaminated soil treatment area, and available borrow sources;
- Site access, such as condition of roadways, the airstrip, barge landing areas, requirements for winter roads or CAT train routes;
- Potable water supply and seasonal fluctuations of potable water supply;
- Siting of camp facilities and temporary storage areas;
- Natural Environment Assessment;
- Traditional Knowledge Surveys/Assessment; and
- Archaeological Assessment.

This section of the protocol provides guidance related to conducting an environmental site assessment that meets the requirements of the INAC cleanup objectives.

4.1 Background Geo-Chemical Assessment

Application of remedial criteria must take into account background concentrations of inorganic elements, as naturally elevated concentrations of a select number of inorganic elements may impact assessment and subsequent remedial activities. High natural variability in concentrations of inorganic elements on a local scale has been observed at several DND DEW Line sites (PIN-1, DYE-M, FOX-2, FOX-3). Based on a desk-top study of the geochemistry and surficial and bedrock geology, a detailed investigation of background concentrations is required in conjunction with the environmental site assessment of the following sites:

- Ross Point (PIN-D)
- Nadluarjuk Lake (FOX-B),
- Kivitoo (FOX-D),
- Durban Island (FOX-E) and
- Padloping Island.

A statistically valid approach must be used to design a sampling program for the collection of representative samples from background areas. Guidance for the background geochemistry investigation is provided in AMSRP Volume 2 (INAC 2009).

4.2 Contaminated Soils

4.2.1 Inorganic Elements and PCBs – DCC Criteria

The contaminants of concern for INAC abandoned military sites, where historic land use is limited to former DEW Line operations, is based on a detailed review of data collected to date from DND and INAC site assessment and delineation programs. The DEW Line Cleanup (DLCU) Protocol, which includes criteria for a specific, limited set of contaminants, is considered appropriate for INAC sites. Supporting documentation for selection of these criteria is provided in AMSRP Volume 2 (INAC 2009).

This provides a consistent approach across all sites, and is generally considered protective of the Arctic ecosystem as described in AMSRP Volume 2 (INAC 2009). Table 4.1 identifies the parameters and criteria.

Table 4.1 DEW Line Cleanup Criteria (DCC) for Soil[a]

Parameter in Soil	**CRITERIA[b]** mg/kg	
Inorganic Elements	*DCC Tier I [c]*	*DCC Tier II[d]*
Arsenic (As)		30
Cadmium		5.0
Chromium		250
Cobalt		50
Copper		100
Lead	200	500
Mercury		2.0
Nickel		100
Zinc		500
Polychlorinated biphenyls		
PCBs	*1.0*	*5.0*

a. These criteria were adopted specifically for the cleanup of Arctic DEW Line Sites from the 1991 versions of the Quebec Soil Contamination Indicators and the Canadian Council of Ministers of the Environment Interim Canadian Environmental Criteria for Contaminated Sites. They were validated by an assessment of the soil concentration at which the substance was taken up by vascular plants and thereby constituted an input to the Arctic ecosystem.

b. Soil criteria are given in parts per million, ppm.

c. Soils containing lead and/or PCBs at concentrations in excess of DCC Tier I, but less than DCC Tier II, may be landfilled in a Non-Hazardous Waste Landfill,

d. Soils containing one or more substrates in excess of DCC Tier II are to be treated/disposed of in a manner that precludes contact with the Arctic ecosystem.

A review of data collected on INAC sites with land use other than DEW Line activities indicated that the likelihood of other parameters occurring systematically at concentrations exceeding applicable criteria in the absence of other contaminants of concern is low (AMSRP Volume 2 (INAC 2009)).

Based on historic patterns of waste disposal and contamination observed at other abandoned military sites, soils contaminated in excess of the DCC criteria are typically found in the following locations:

- In the vicinity of buildings;
- Former sewage discharge areas;
- Former open storage areas;
- Where surface debris is present;
- Solid waste disposal areas; and
- Petroleum, Oil, Lubricant (POL) bulk storage areas and along fuel lines and transfer locations.

Delineation of the lateral extent and depth of contamination is required to determine quantities of sufficient accuracy to develop a RAP and the subsequent Contractual Drawings and Specifications. A detailed sampling plan shall be developed for each potential area of concern identified as part of historic review, and shall include the following information:

- Description of the objective for each potential area of concern;
- Sampling locations;
- Sampling methodology;
- Proposed number of samples and media;
- Parameters for analyses; and
- Analytical requirements and Quality Assurance/Quality Control measures.

Delineation shall be achieved by sampling in a grid pattern over the affected area. The estimated size of the area determines the grid spacing: the larger the estimated area, the larger the grid spacing. Test pits shall be excavated to determine the depth of contamination. Test pits shall also be excavated outside the area of surface contamination to evaluate whether sub-surface migration of contaminants has occurred. Greater sample density may be warranted based on site specific conditions, particularly in areas where soils contaminated with PCB concentrations in excess of 50 ppm are suspected; such as near buildings where electrical transformers were housed, vehicle maintenance structures, and near exit doors of facilities. It is recommended that a reasonable degree of over-sampling and an iterative approach to analyses be employed to provide greater confidence that closure is achieved during the assessment phase, recognizing that the cost of analyses is only a fraction of disposal costs.

Additional samples shall be collected and analysed to determine transport and disposal requirements should off-site disposal of contaminated soils be required.

4.2.2 Hydrocarbon Contaminated Soils

Where free product is encountered, the free phase liquid will be addressed prior to the application of a qualitative risk assessment method for establishing remediation requirements.

A review of the assumptions used for the derivation of the CCME CWS for Petroleum Hydrocarbons (PHC) as well as the need to minimize physical disturbance suggests that direct application of criteria for the protection of all receptors may not be appropriate at the INAC sites AMSRP Volume 2 (INAC 2009). A revised set of criteria are provided in Table 4.2. These criteria incorporate the CWS PHC as appropriate, as well as previous quantitative risk assessment results. Two classes of hydrocarbons were identified, Type A – non-mobile, and Type B – mobile. Type A refers to heavy end products, such as lubricating oils, and are easily differentiated by dark staining. Relative to the CWS PHC, Type A consists of the sum of F3 and F4 constituents. Type B includes lighter end or more volatile hydrocarbon products such as MoGas, jet fuel and diesel, and is approximately equal to the sum of the F1 through F3 fractions. When all four fractions are present, the dominant hydrocarbon type is defined by the percentage of the sum of F3 and F4, relative to the sum of F1 to F4 (total TPH). For Type A contaminated soil, the sum of F3 plus F4 must be greater than 70% of the total TPH concentration **and** the F2 concentration must be less than the F4 concentration.

Table 4.2 Remedial Objectives – Hydrocarbon Contaminated Soil – INAC Abandoned Military Sites

Exposure Pathway	F1	F2	F3	F4	Type B Hydrocarbon Contamination	Type A Hydrocarbon Concentration
Protection of Freshwater Aquatic Life[(a)]	1290[(a)]	330[(a)]	NA	NA	330[(a)]	NA
Direct Soil Eco-Contact	Not utilized – See AMSRP Volume 2 (INAC 2009)					
Protection of Terrestrial Wildlife					2500[(b)]	
Human Health		11000	20000			20,000
Management Limit					5000[(c)]	

Notes:

(a) Within 30 m of a water body

(b) For surface soils to 0.5 metres depth.

(c) Below 0.5 m depth, a value of 5000 mg/kg may be applied based on professional judgement.

Based on historic patterns of contamination observed at other abandoned military sites, soils contaminated with hydrocarbons are typically found in the following locations:

- In the vicinity of buildings near fuel distribution lines, fuel dispensing tanks;
- Former open storage areas and/or debris areas where barrels may be present;
- Petroleum, Oil, Lubricant (POL) bulk storage areas; and
- Solid waste disposal areas.

Delineation of the lateral extent and depth of contamination is required to determine quantities of sufficient accuracy to develop a RAP and the subsequent Contractual Drawings and Specifications. A detailed sampling plan shall be developed for each potential area of concern identified as part of historic review, and must include the following information:

- Description of the objective for each potential area of concern;
- Sampling locations;
- Proposed sampling methods for shallow and depth samples, where the depth sampling should achieve a depth consistent with the estimated active layer thickness;
- Proposed number of samples and media;
- Parameters for analyses in accordance with Table 4.2;
- Sampling methodology, analytical requirements, Quality Assurance/Quality Control measures.

At minimum, the information requirements as outlined in Table 4.2 shall be incorporated into the Sampling Plan.

Table 4.3 Hydrocarbon Contaminated Soil Information Requirements

Item	Comments
Hydrocarbon Contaminated Soils – Stained Soils (F3/F4 fraction) – Type A	
Areal Extent -Visible surface staining	Topographic survey and location/coordinates of stained areas and sample locations Provide sketches with measurements
Topography	Examine for evidence of erosion (drainage channels)
Soil Description	Include description of grain size distribution, well graded or poorly graded. Fine grained, coarse grained, maximum particle size
Sampling	Collect soil samples for analyses of F1 to F4 fractions to characterize contamination, analyses for presence of co-contaminants such as PCBs.
Confirm Depth of Staining	Testpit to extent of stain, collect soil sample for PHC analyses at 0.5 m depth.
In areas of multiple staining	Identify and survey extent of stains Collect individual samples from most visibly stained areas to represent "worst" case. Focus on stained areas larger than 4 m^2
Evidence of residual or free product	
Hydrocarbon Contaminated Soils – Near Fuel Storage, Distribution or Dispensing Areas (F1-F3 fraction) Type B	
Within 30 m of water body supporting aquatic life	
Describe surrounding environment	Consulting locals and elders who use the area may prove to be useful.
Sampling – Hydrocarbons	Delineate **laterally and at depth** to 330 mg/kg as per on-site analytical capabilities Collect sufficient samples for laboratory analyses of hydrocarbon fractions to confirm correlation with on-site analytical results. Over-sampling (within reason) and iterative analyses may be required where there is poor correlation with test-kits (organic materials)
Sample groundwater in testpit excavation in source zone.	Collect groundwater samples and analyze for dissolved hydrocarbons (F1, F2) and wastewater discharge criteria (Section 6). Measure water levels, and presence of free product, if applicable

Item	Comments
Greater than 30 m distant of water body supporting aquatic life	
Sampling – Hydrocarbons	Delineate **laterally and at depth** to 2500 mg/kg as per on-site analytical capabilities. Collect sufficient samples for laboratory analyses of hydrocarbon fractions to confirm correlation with on-site analytical results For the purposes of comparison, use the summation of F1 to F3 concentrations.
Collect soil samples for grain size distribution	Representative samples should be taken of soils within and downgradient of the source zone for determination of grain size distribution, and water content.
All Hydrocarbon Contaminated Soil Areas	
Topography	Survey sample locations and topography of source zone and surrounding area. Include min. 25 m buffer zone around contaminated areas. Document seepage zones (toe of embankments), if applicable. Evidence of erosion
Evidence of impacted vegetation	Note presence and extent of vegetation; identify areas of stressed vegetation if applicable.
Wildlife	Note presence or evidence of wildlife (nests, burrows, etc.) within impacted and surrounding area. Review in context with overall Natural Environment Survey (Section 4.9)

Additional representative samples shall be collected and analysed to assist in the determination of treatment requirements. Samples should be collected from areas representing the largest contributions to the PHC contaminated soil volumes (such as bulk fuel storage areas). These analyses include, but are not limited to:

- Water content
- Total Available Nutrients; Total Organic Carbon
- Treatability tests to assess bioremediation potential (bacterial counts, hydrocarbon degraders).

4.3 Solid Waste Disposal Areas

Solid Waste Disposal Areas (WDA) on INAC abandoned military sites are generally smaller in extent than those located on DND DEW Line sites, and may be more appropriately referred to as buried debris areas or dump sites. As part of the historic review, areas of ground disturbance/landfill activity will be identified for further investigation. A detailed investigation/sampling plan shall be developed for each area, and must include the following information:

- Description of the objective for each potential area of concern
- Methodology for determining extent of buried debris using non-intrusive geophysical surveys, such as Electro-Magnetic Surveys (EM) or Ground Penetrating Radar (GPR), and associated ground-truthing. The consultant is to indicate the type of geophysical survey to be used based on anticipated ground conditions. In general, a grid-survey pattern shall be used that provides adequate coverage of the area. Identification of areas of surface debris within the geophysical survey area is required to allow correlation with geophysical survey results. All geophysical surveys must be referenced to a UTM coordinate system.
- Identification of sampling locations both up- and down-gradient of the landfill, debris area or dump site.
- Proposed sampling methods for shallow and depth samples, where depth sampling should achieve a depth consistent with the estimated active layer thickness.
- Proposed number of samples and media.
- Parameters for analyses.
- Sampling methodology, analytical requirements, and Quality Assurance/Quality Control measures.

In addition, general site information shall be collected as outlined in Section 4.9 and 4.10, as well as specific information for each WDA as described below to support the evaluation of the potential environmental risk associated with the WDA (Annex A).

Physical Characteristics:

Areal Extent of WDA Extent

Depth of Buried Debris, as applicable

Contaminant Characterization (concentrations/extent)

Volume and extent of exposed debris, where exposed debris is defined as surface and/or partially buried debris within 0.5 meters of the surface.

Pathway/Transport Mechanisms

Surface expressions of contaminated soil and/or leachate.

Grades/Topography

Surface cover materials type and depth

Evidence of erosion

Precipitation

Distance to downgradient perennial surface water bodies

Receptor Characteristics

Distance to freshwater/marine habitat and habitat usage.

Terrestrial Habitat

Traditional Land Use

Minor modifications to the evaluation matrix prepared by the DND/NTI Environmental Working Group (EWG 1998) will be used for the assessment of potential environmental risk (Annex A). These modifications included:

- Addressing remedial requirements for dump sites and debris areas (generally smaller in size than landfills)
- Modifying contaminant characterization to include leachate migration and the presence of contaminants as one category.
- Including consideration of snow pack as well as annual precipitation.

Additional detail regarding the evaluation of WDAs is provided in Annex A.

4.4 Surface Debris

Surface debris is present on many of the sites, and may consist of a variety of waste materials including:

- Scrap metal and wood wastes (painted/unpainted);
- Barrels, potentially containing product; and
- Asbestos, batteries, and electrical equipment.

All areas of debris shall be inventoried to the extent possible to provide volume estimates and characterization of waste materials. Site debris shall be classified as inert, non-hazardous wastes or hazardous wastes in accordance with the following Acts and Regulations.

- Federal Transportation of Dangerous Goods Act and Regulations
- The Canadian Environmental Protection Act
- The Nunavut or Northwest Territories Environmental Protection Act

The number of barrels containing product shall be inventoried where it is safe to do so. However, it is impractical to sample and analyse contents of all barrels on site during the assessment phase. To provide information required for the Remedial Action Plan, a statistically relevant number of barrels shall be sampled and analysed. The actual number of barrels sampled will depend on the total number of barrels at the site, and should be determined using professional judgement. Samples will be analysed for parameters in accordance with the barrel protocol, and as summarized below:

Organic Phase: Total Chlorine, PCBs, Cadmium, Chromium, Lead

Aqueous Phase: % Alcohols and Glycols, Total Chlorine, Cadmium, Chromium, Lead

If the aqueous phase is less than 2% alcohols or glycols, water shall be analysed in accordance with waste water discharge criteria. Annex B provides further information on the Barrel Protocol.

4.5 Submerged Debris

Debris may be present in the near shore marine environment and/or lakes that are present on the site. Observations of debris in water shall be recorded to the extent possible and supplemented with local and anecdotal knowledge. Previous studies have confirmed that such debris is primarily a risk to navigation in shallow waters (AMSRP Volume 2 (INAC 2009)).

4.6 Buildings/Structure Inventory

Existing buildings and infrastructure at a site will be demolished down to their foundations as part of the cleanup. To assist in the development of the RAP, an inventory of building contents, foundation construction materials and details, and building/structure construction materials and dimensions are required. Building contents, where present, shall be inventoried and classified as non-hazardous or hazardous wastes. Hazardous building materials may include, but not be limited to: PCB and lead-amended paint, asbestos containing materials (ACMs), fluorescent lights, and mercury containing switches.

Painted building materials shall be tested for total lead and PCBs, and leachable lead and PCBs in order to determine disposal requirements. The thickness and density of the paint and substrate material shall be recorded as it may be required to calculate total PCB concentrations. Samples of concrete, excluding paint, shall be collected and analysed for PCBs. The locations and number of samples are to be determined in the field. Samples should be collected from both stained and non-stained areas on concrete on surface and at depth. Over-sampling and iterative analyses is recommended. As part of the assessment, a detailed waste inventory shall be prepared that includes: dimensions, building materials, foundation materials (concrete slab, timber piles, timber crib), estimated volume and mass of wastes, and the basis of any assumptions used in the estimate. Painted materials must be specifically identified and the extent of paint coverage and adherence quantified.

4.7 Geotechnical Requirements

4.7.1 Potential Development Areas

New engineered landfills and hydrocarbon treatment areas may be required during cleanup. Potential locations shall be identified and surveyed during the site assessment phase. Guidelines for the siting of potential development areas include:

- Avoidance of permafrost sensitive areas, vegetated areas and archaeological features.
- Avoidance of contaminated areas.
- Maintain a distance of 300 m or more from downgradient permanent water features.
- Locate at elevations greater than 2 metres above sea level or storm surge level
- Ground surface topography with grades of 6% or less.
- Proximity to borrow sources, waste materials.

The INAC sites are all located within the zone of continuous permafrost. The sensitivity of permafrost to climate warming consists of two components, the thermal response to warming and the impact of thaw (physical response) (Smith, Burgess, 2004) as cited in AMSRP Volume 2 (INAC 2009). The physical response of the terrain to permafrost degradation is mainly dependent on the ice content of the frozen material (Dyke et al., 1997). Warming of ice-rich perennially frozen ground would eventually lead to its thawing and the resultant thaw settlement, slope instability, thaw slumping, thermokarst, and other permafrost degradation-related processes. Excess ground ice can be identified by landforms at surface, such as patterned ground. An evaluation of the potential for impacts due to climate change is provided in AMSRP Volume 2 (INAC 2009).

Potential development areas shall be surveyed to provide detailed topographic information to allow generation of ground contours. A buffer zone of a minimum of 50 m should be surveyed around all proposed development areas. In previously disturbed areas, soil sampling and analyses shall be carried out to confirm or disprove the presence of any historic contamination using a targeted approach. Additional sampling should be carried out over a grid with spacing of approximately 50 m x 50 m.

4.7.2 Borrow Sources

During cleanup, borrow material is required for construction of new landfills, development of treatment areas, backfilling of contaminated soil excavation, closure of existing landfills, general regrading and for road construction/maintenance.

Available existing sources of borrow material should be exhausted before exploiting new areas. Areas of excess ground ice or of biophysical significance (denning/nesting areas) are to be avoided. Use of abandoned gravel pads and road infrastructure as granular source material is preferable, wherever possible. Existing gravel pads shall be screened for the presence of contaminants during the assessment phase.

Borrow sources shall be identified and characterized and estimated quantities developed. Test-pits shall be excavated to confirm subsurface stratigraphy, seepage, depth to permafrost table or bedrock, and ground ice conditions. Select soil samples shall be retained for geotechnical laboratory testing to assist in the development of Specifications. Testing shall include, but not be limited to: water content, grain size distribution, and moisture density relationships. At sites where background inorganic element concentrations are elevated, additional samples shall be collected for geo-chemical characterization of the borrow material.

4.7.3 Site Access

Access to the sites is typically by barge/ship and aircraft and on site by existing access roads. A limited number of sites are land-locked. Use of the airstrip is essential to mobilize materials and equipment required for site activities. An inspection and sampling of the airstrip fill materials shall be completed during the assessment phase to determine the load capacity to support a variety of aircraft. Drainage and erosion features shall be documented in order to assess the useable length, and/or upgrading requirements.

Investigation of potential CAT Train and/or other equipment mobilization options shall be investigated for the mobilization of heavy equipment. Construction records for Short Range Radar (SRR) sites located in the vicinity may be available as reference. Suitability of the beach for barge landing/sea lift access shall also be assessed. Local knowledge and Traditional Knowledge (TK) may prove useful in evaluating potential CAT train routes as well as suitable barge landing sites.

Helicopter landing pads, associated with Short Range Radar sites, are within the DND reserve. Only a non-intrusive visual inspection should be carried out to document the physical status of these areas.

4.7.4 Siting of Camp Facilities and Temporary Storage areas.

Laydown areas are required for temporary camp structures, equipment and storage during the cleanup. Potential locations shall be identified during the site assessment phase. Where possible, these will be located in previously disturbed areas such as borrow or storage areas, to minimize any new disturbances.

4.8 Potable Water Supply

A suitable drinking water supply shall be identified during the site assessment phase. A qualitative assessment of the flow rates (as applicable) shall be made at the time of the site assessment, as flow will vary throughout the season, with higher flows typically in spring run-off. Identifying the high water mark, and estimating depth of the stream/lake, as applicable, will aid in this evaluation. The Contractor will be advised that water withdrawal rates may not exceed 10% of the flow volume or 10% of the water volume in a lake, and to modify consumption as appropriate. Water samples shall be collected and analysed for criteria in accordance with the latest edition of the CCME Guidelines for Drinking Water Quality.

4.9 Natural Environment Assessment

A thorough assessment of the natural environment of the site and surrounding area shall be conducted as part of the detailed environmental site assessment. This assessment shall be carried out mainly by a biologist with input from a local community representative, where appropriate. This study shall consist of describing the regional and local setting, local ecosystems, species assemblage as well as potential impacts to vegetation and wildlife from cleanup activities and proposed mitigation measures. Additional information requirements are outlined in the following subsections.

4.9.1 Regional and Local Setting

The report should address the following information requirements.

- Location (site coordinates, main natural and man-made features present);
- Ecosetting (ecozones and ecoregions);
- Climate (mean temperature and precipitation data);
- Vegetation;
- Landforms and soils (main land features, soil types, general topography); and
- Human usage and disturbance (TK input will be valuable to assess human usage of the area).

4.9.2 Local Ecosystems

This subsection should describe 1) the various inland ecosystems; 2) the ecosystems present in the former operational areas (*i.e.*, disturbed areas and areas with infrastructure); as well as, if applicable, 3) the shore/coastline ecosystem; and the 4) open ocean ecosystem.

Each identified ecosystem should be described in terms of the various terrestrial and freshwater habitats, the vegetation and wildlife species present in those habitats, as well as past and current impacts and disturbances to habitats. Local and traditional knowledge from people who use these areas for hunting and fishing may provide useful information on plant and wildlife species present as well as ecosystem health.

4.9.3 Species Assemblage

This subsection should describe the various species at risk (*i.e.*, extirpated, endangered, threatened, or special concern) according to the Species at Risk Act (SARA) that occur in the general vicinity of the site, as well as any migratory species that known to breed or nest in the area (Migratory Birds Convention Act).

All species (*i.e.*, birds, mammals, fish, and plants) observed or known to use the site and surrounding areas should be documented. Observations should be described in terms of numbers and behaviour during sighting (*e.g.*, migrating, nesting/breeding, feeding, etc.). Species not observed on site but known to use the area may be documented by consulting local community representatives as well as various studies and reports.

4.9.4 Impacts and Mitigation

Potential impacts to vegetation and wildlife from site investigation and remediation activities should be clearly identified. Proposed constraints and other recommendations should also be presented as part of the Natural Environment Assessment, in order to incorporate these requirements into the Environmental Protection Plan.

4.10 Traditional Knowledge Surveys/Assessment

Traditional Knowledge (TK) forms an integral part of the development of the RAP. Incorporating TK during the assessment phase can provide guidance on targeting specific areas of concern to local residents. Qualitative knowledge provided by local residents can be used to complement and enhance the largely quantitative information provided by the physical studies completed.

TK can be efficiently obtained through a local community representative (*i.e.*, local TK consultant) who can liaise between the Consultant and various TK holders in the community. The local TK consultant may either be an Elder or someone else who knows the site well (*e.g.*, hunter, ranger). The ideal local TK consultant possesses some TK, but more importantly knows who to consult in the community to obtain relevant site information and TK.

4.10.1 Typical TK and Local Knowledge

TK may be grouped into four main categories:

1. Historical and Archaeological Features
2. Wildlife Use
3. Land Use
4. Site Specific Information

Historical and archaeological features provide information on traditional land use of the area. These features, often hidden from the untrained eye, will be identified by local TK holders as to their use and relative age, and can complement the work of the archaeological assessment.

Wildlife use of the land in and around the site includes migration routes, mating and calving grounds, as well as summer and winter-feeding areas of large land mammals. Nesting, moulting, and summer feeding grounds of migratory birds such as geese and ducks, as well as migration routes and feeding areas of sea mammals must also be identified.

Land use relates to traditional usage of the land and sea for hunting, fishing, camping, and harvesting products on land (*e.g.*, berries, eggs, medicine, tea, drinking water), and harvesting of sea products (*e.g.*, clams, kelp).

Site-specific information about the military site while it was under construction or in operation, including events (spills, accidents), waste management practices (storage, dumping), as well as natural occurrences, should also be documented.

4.11 Archaeological Assessment

The overall purpose of the archaeological assessment is to obtain the necessary archaeological regulatory approval at the assessment stage as required to implement the remediation program. The scope of the archaeological assessment shall include:

- Preparation and submission of permit applications to the Department of Culture, Language, Elders and Youth (Nunavut) or the Prince of Wales Northern Heritage Centre (NWT).
- Completion of an Overview for each site, which would include file searches to determine the number, nature and terrain associations of previously recorded sites.
- Completion of a field inventory and assessment of each site;
- Completion of a heritage features or structures evaluation for consideration of heritage value;
- Provision of a heritage resource impact assessment for each site
- Implementation of more detailed investigations at key sites and appropriate mitigation at significant sites affected by proposed projects (if required); and
- Preparation of a final permit report for each site and, if required, provides a summary of these results suitable for inclusion in a screening document.

Areas of high and moderate archaeological potential for containing cultural material will require detailed examination during the assessment phase, to ensure the protection and if required, development of mitigation measures to be implemented prior to or during cleanup.

5 REMEDIATION PROTOCOL

The elements of the remediation protocol have been developed through the review of previous work at related sites by DND and INAC, and take into consideration information of particular relevance to the unique character of the INAC sites.

The primary components of cleanup on the INAC abandoned military sites include:

- Treatment/Disposal of Contaminated Soil
- Disposal of Debris/Demolition Waste
- Closure of Existing Solid Waste Disposal Areas
- Construction of New Landfills
- Development of Borrow Sources and Site Grading Activities

The goals of a RAP are to provide the foundation for development of a cleanup design that will reduce the environmental liabilities present at the site, maximize benefits to local communities and provide good value to the Crown. More specifically, the RAP is to identify and evaluate options applicable to the treatment and/or disposal of waste materials present at a site. These waste materials typically include:

- Soil contaminated with inorganic elements, PCBs and/or petroleum hydrocarbons;
- Non-hazardous and hazardous wastes associated with building/facility demolition;
- Visible/accessible debris including barrel contents; and
- Buried debris/landfills as identified by geophysical surveys

The estimated volume of waste materials in each stream shall be determined and options evaluated on the basis of effectiveness to reduce and/or mitigate environmental risks in the short and long term, long term liability or residual risks, relative costs, monitoring costs and community acceptance. The costs associated with implementing remedial solutions include, but are not limited to: resources, such as materials, equipment, and personnel, and site logistics. Mobilization and site access constitute a significant cost for remote site cleanups, and can have significant impact on selection of the preferred remedial option. The evaluations shall be summarized and preferred remedial options identified for each waste stream. Options shall be integrated to finalize the recommended approach for site remediation.

During remediation planning public community consultations are conducted in surrounding communities to obtain feedback on the draft RAP.

5.1 Contaminated Soils

Contaminated soils are considered in three primary categories: soils that are regulated; soils classified as hazardous; and, soils classified as contaminated but not hazardous waste. Contaminated soils that are regulated shall be remediated and/or disposed of in compliance with the applicable regulations. Hazardous contaminated soils are defined as those that exceed criteria as provided in the Transportation of Dangerous Goods Act and Regulations. Contaminated soils that are not regulated or hazardous shall be excavated to the depth and extent to meet the DCC (see section 4.2.1) or PHC remedial targets (Section 4.2.2).

Three primary contaminated soil types have been identified; inorganic element contaminated soil, PCB contaminated soil and hydrocarbon contaminated soil. Where multiple contaminants are present in the soils, the most conservative remedial option that addresses all contaminant types shall be applied. A summary of remedial options for contaminated soils is presented in Table 5.1.

Table 5.1 Summary of Remedial Options – Contaminated Soil

Contaminated Soil	Remedial Options
DCC Tier I	▪ Excavate and place in an on-site engineered landfill or ▪ Cap in place under 0.3 m of clean fill if in a stable location
DCC Tier II	• Excavate and dispose of in an on-site Tier II facility or • Containerize for off-site disposal[1]
Inorganic Elements Leaching	• Transport in accordance with the TDGA for disposal at an off-site facility
PCB Contaminated Soil in excess of CEPA	• Store in accordance with PCB Regulations pending a decision regarding disposal
Type A TPH (Non-Mobile Hydrocarbon Contaminated Soil)	• Excavate and place in an on-site engineered landfill or • Scarify surficial stains that meet PHC criteria.
DCC Tier I -Type A TPH	• Excavate and place in an on-site engineered landfill or • Cap in place under 0.3 m of clean fill if in a stable location
DCC Tier II -Type A TPH	• Excavate and place in an on-site Tier II disposal facility or • Containerize for off-site disposal[1]
Type B TPH (Mobile Hydrocarbon Contaminated Soil)	• *In-situ* or *ex-situ* treatment to reduce environmental risk to meet guidelines
DCC Tier I -Type B TPH	• Ex-situ treatment to meet guidelines and place in an on-site engineered landfill or cap under 0.3 m of clean fill in a stable location after treatment. • Small areas of contamination may be excavated and disposed of in a Tier II disposal facility
DCC Tier II -Type B TPH	• Excavate and place in an on-site Tier II Facility or • Containerize for off-site disposal[1]
Hazardous Soil	• Dispose in compliance with applicable regulations

[1] Decision of whether to dispose of on or off-site is based on cost –benefit analyses (see Section 5.4.2).

5.2 Debris – Site Debris and Demolition Wastes

Site debris shall be collected and segregated into hazardous and non-hazardous waste streams for disposal:

Non hazardous waste: The volume of the non-hazardous materials shall be minimized through crushing, shredding, or incineration, prior to placement in an on-site engineered landfill. If there is no existing landfill on-site, and no suitable location for a new engineered landfill, non-hazardous materials shall be disposed of off-site; and

Hazardous waste: These materials shall be disposed of off-site, in accordance with the current regulations governing the handling and disposal of hazardous materials.

Hazardous materials referred to in this section are defined as any materials, which are, designated "hazardous" or "dangerous goods" under Territorial or Federal legislation. Generally, all hazardous materials identified at the site shall be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act (TC 2002), to a licensed hazardous waste disposal facility.

Hazardous materials that are typical of abandoned military sites and require special consideration include the following:

PCB Contaminated Concrete: Concrete (excluding paint) with PCB concentrations in excess of 50 ppm is regulated under the CEPA, and shall be collected and transported off-site, in accordance with the Transportation of Dangerous Goods Act and CEPA to a licensed hazardous waste disposal facility.

PCB Paint on Building Components: PCB paint and PCB painted components that are regulated under the CEPA, shall be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act and CEPA, to a licensed hazardous waste disposal facility. The thickness and density of the paint and substrate material shall be recorded as it may be required to calculate total PCB concentrations. Loose paint materials/paint chips are regulated under CEPA when PCB concentrations in the paint are greater than 50 ppm.

Lead-Based Paint on Building Components: Lead-based painted components that are classified as hazardous material shall be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act to a licensed hazardous waste disposal facility. Painted components that exceed the relevant federal or Territorial criteria but are not considered hazardous shall be collected and disposed in an on-site engineered landfill. Lead-based painted materials are considered hazardous when the lead leachate concentrations from a test of the component (paint and substrate) exceed 5 mg/L or the concentration as provided in the latest schedule of the TDGA. Additional discussion related to the classification of painted material is provided in AMSRP Volume 2, (INAC 2009).

There are also a few exceptions, which are described below:

Asbestos: Asbestos waste shall be collected, double bagged and disposed of in an on-site engineered landfill, in accordance with the appropriate legislation. Where no on-site facility is available, asbestos waste shall be shipped off-site for disposal. Where asbestos materials are painted, disposal requirements are based on paint analyses.

Petroleum Products: Petroleum products, such as gasoline or diesel, which do not contain other hazardous products (chlorine, PCB, metals, etc.) will be incinerated on-site under appropriate emissions controls. Heavier petroleum products such as lubricating oil will be disposed of off-site or mixed with lighter petroleum products and incinerated on-site under appropriate emissions controls in accordance with the Barrel Protocol provided in Annex B.

Compressed Gas Cylinders: Compressed gas cylinders with known contents shall be vented. Once empty, the metal cylinder shall be disposed on-site in an engineered landfill. Where no on-site facility is available, compressed gas cylinders shall be shipped off-site for disposal.

Creosote Treated Timbers: Timbers shall be wrapped in polyethylene sheets and disposed on-site in an engineered landfill. Where no on-site facility is available, creosote treated timbers shall be shipped off-site for disposal.

5.2.1 Submerged Debris

Submerged debris shall be removed from the near-shore environment to a depth of 2 metres or 30 metres off-shore, whichever is encountered first. Work in marine and freshwater environments shall be in accordance with all stipulations as provided by the Department of Fisheries and Oceans. Debris, once removed, shall be classified as hazardous or non-hazardous and disposed of as indicated in the previous sub-section.

5.2.2 Barrels

Barrels shall be handled according to the Barrel Protocol (Annex B) and as outlined below:

Empty Barrels: Empty barrels shall be crushed and disposed in an on-site engineered landfill;

Filled or Partially Filled Barrels: Barrel contents shall be inspected and tested if necessary and disposed of appropriately (off-site or incinerated). The empty barrel shall be rinsed, crushed and disposed on-site in an engineered landfill. The spent rinse liquid shall be tested and disposed of appropriately. Absorbent materials used as part of this process shall be incinerated if incineration criteria are met, or disposed of as hazardous material, as required; and

Buried Empty Barrels: Areas containing buried empty barrels will be inspected to determine if any of the barrels contain material and characterized through a geophysical survey. If the barrels are found to be empty, the area will be stabilized through compaction to crush any corroded barrels, if the area is deemed suitable from a geotechnical perspective. A cover of borrow material shall be placed over the area and compacted.

The criteria used to determine the acceptability of product for on-site incineration are summarized in Table 5.2 as follows:

Table 5.2 Barrel Protocol Criteria and Disposal Summary

Phase	% Alcohol or Glycols	PCBs	Chlorine ppm	Cadmium ppm	Chromium ppm	Lead ppm	Disposal
Organic		<2	<1000	<2	<10	<100	On-Site Incineration
Organic		>2	>1000	>2	>10	>100	Ship South
Aqueous	>2		>1000	>2	>10	>100	Ship South
Aqueous	>2		<1000	<2	<10	<100	On-Site Incineration
Aqueous	<2						Discard in accordance with wastewater discharge criteria

Wastewater generated during barrel cleaning shall be treated to meet discharge criteria in accordance with permits and licences issued for cleanup activities.

5.2.3 Buildings and Infrastructure

Existing buildings and infrastructure shall be demolished to concrete foundations. Above-grade timber foundations shall be removed. Where concrete foundations are above grade, the area will be re-graded with the placement of additional granular fill to match surrounding topography. Exposed timber piles shall be removed to a minimum of 0.3 m below ground surface. All hazardous materials shall be segregated prior to or during demolition. Non-hazardous demolition materials and asbestos shall be collected and disposed in an on-site engineered landfill. If there is no existing landfill on site and no suitable location for a new engineered landfill, the non-hazardous materials shall be disposed of off-site. Hazardous demolition materials shall be disposed off-site.

PCB amended painted material shall be containerized in accordance with the Transportation of Dangerous Goods Act, and transported off-site to a licensed treatment disposal facility.

Only in exceptional circumstances will existing buildings remain intact on site following the remediation program. These structures may remain as emergency shelters only once clear transfer of ownership has been established.

5.3 Solid Waste Disposal Area (WDA) Closure

The following section applies to landfills, dumps and debris areas, collectively referred to as WDA.Using the WDA evaluation matrix (Annex A), WDA can be classified into one of three broad categories. Actions associated with each category of WDA have been identified. Where a WDA exists on INAC abandoned military sites, the condition of the WDA shall be evaluated to determine the most appropriate action;

Class A: If the WDA is located in an unstable, high erosion location, it shall be relocated to a properly engineered landfill. A WDA located at an elevation of less than two metres above mean sea level will be removed. During the relocation process, any identified hazardous materials shall be segregated for off-site disposal.

Class B: If the WDA is located in a suitable, stable location, but there is evidence of contaminant migration, potential remedial solutions include excavation or provision of a suitably engineered containment system. Permafrost containment shall be designed in accordance with the geothermal requirements outlined in Section 5.4.2. The remedial solution selected shall be based on a cost-benefit analyses that includes consideration of construction costs and long-term monitoring costs.

Class C: If the WDA is located in a suitable, stable location, with no evidence of contaminant migration, it may be left in place. If required, additional granular fill shall be placed to ensure erosion protection and proper drainage. Consideration must be given to surrounding topography (to blend into existing terrain) and long term monitoring costs.

Additional information related to landfill design and closure is provided in AMSRP Volume 2, (INAC 2009).

5.4 Landfill Development

New engineered landfills may be required for the disposal of non-regulated contaminated soils and non-hazardous debris collected or generated during cleanup. Two classes of landfills are provided:

- Non-Hazardous Waste (NHW) Landfill
- Tier II Contaminated Soil Landfill

5.4.1 Non-Hazardous Waste Landfill

A NHW Landfill is a new landfill constructed for the disposal of non-hazardous debris and building demolition waste. Tier I contaminated soils and Type A PHC soil may also be disposed of in these landfills. Landfills constructed to date at DND DEW sites are predominately above ground facilities. These landfills do not rely on permafrost for containment nor do they include a geosynthetic liner.

The general design parameters include a perimeter berm and landfill cover constructed of a well graded sand and gravel. Clay is generally not available at the abandoned military sites. The sand and gravel should have a minimum of 8% fines (<0.08 mm) and be compacted to a minimum of 95% maximum dry density (ASTM D698). The landfill should have a maximum debris thickness of 3 m and minimum cover thickness of 1.0 m.

To reduce settlement and ground subsidence, debris should be placed in maximum 0.5 m thick lifts with granular fill placed over each lift of debris to fill the voids (intermediate fill). Intermediate fill should be a minimum of 0.15 m thick and worked into the underlying debris. The final landfill surface must be graded such that water ponding does not occur. Ponding and infiltration could increase the seasonal thaw depth or contribute to leachate generation. The landfill surface must not be so steep that it promotes erosion of the cover materials, which could expose debris.

Fill material for the landfill cap should be a well-graded material that is relatively erosion resistant and will have moderate water infiltration. Alternative designs or surface treatments, such as imported coarser gravels and cobbles, vegetation covers at sites where it is possible to vegetate the sites, roller compacted concrete or other synthetic surfaces, are required if erosion resistant materials are not present on site.

Final landfill design parameters including granular fill specifications, side slopes, cover thickness, and maximum height of landfill are dependent on site specific ground conditions and borrow availability. Designs must be reviewed by a geotechnical engineer with permafrost experience.

5.4.2 Tier II Contaminated Soil Landfill

The decision as to whether to construct a Tier II Contaminated Soil Landfill on site is based on a number of factors, including but not limited to those summarized in Table 5.3. These criteria were based on generic designs and relative cost estimates and may not accurately reflect site-specific conditions. These are provided as a guideline only.

Table 5.3 Decision Criteria Tier II Contaminated Soil Landfill

Is the site landlocked?	For landlocked sites, off-site transport costs increase significantly. Consideration should be given to on-site disposal facility.
Is landfill excavation required.	Landfill excavations pose contracting risks due to unknown quantities of waste material. To mitigate risks, an on-site Tier II disposal facility should be considered.
Are known contaminated soil volumes less than 300 to 500 m^3.	If yes, evaluate contingency factors and potential over-runs. If significant risk of quantity overrun is present, construct landfill on-site. If volume of contaminated soil estimated to be below these values, ship off-site for disposal.
Are known volumes of contaminated soil between 500 and 1000 m^3	Evaluate site specific conditions, and develop preliminary design and cost estimate for an on-site disposal facility using site specific information. Confirm availability and quality of borrow material.
Are known volumes of contaminated soil greater than 1000 m^3.	If yes, confirm availability and quality of granular borrow. If granular borrow sufficient, develop preliminary design and cost estimate for an on-site disposal facility, using site specific conditions. Re-evaluate on-site disposal costs versus off-site disposal and confirm cost-benefit.

The Tier II Contaminated Soil Landfill design is based on the containment of contaminated soil in a landfill provided with a geo-synthetic liner and a granular fill cover of sufficient thickness to maintain the contaminated soil in a frozen condition. The required fill thickness is a function of the climatic conditions selected as the design criteria.

Geothermal analyses are required to substantiate the use of permafrost as a means of containment for the landfills. Analyses are carried out to predict the short-term and long-term ground temperatures for the Tier II Contaminated Soil Landfill to determine:

- Length of time for landfill freezeback;
- Short-term and long-term thermal regime in the landfill; and
- Depth of annual thaw (active layer) in the cover material.

Geothermal analyses should be carried out for the landfills using two-dimensional finite element computer models. The models simulate transient, two-dimensional heat conduction with a change of phase for a variety of boundary conditions. Heat exchange at the ground surface should be modeled with an energy balance equation that considers air temperatures, wind velocity, snow depth, and solar radiation. The models should include the temperature phase change relationships for saline soils, such that freezing depression and unfrozen water content variations can be explicitly modeled.

Soil thermal properties required to carry out geothermal analyses include: porewater composition, latent heat, specific heat (frozen and unfrozen), and thermal conductivity (frozen and unfrozen). These properties are determined indirectly from well-established correlations with soil index properties, moisture content, grain size distribution, bulk density, salinity, etc. (Farouki, 1986; Johnston, 1981). Soil index properties are based on information collected during the site investigations.

Climatic data required for the thermal model include monthly mean air temperature, wind speed, solar radiation, and snow cover. The thermal analysis should be calibrated to measured temperatures and/or observed active layers thicknesses. The landfill designs include analyses for mean temperature conditions, warm conditions and long-term climate change. Statistical analyses are carried out to determine mean monthly temperatures representative of a 1 in 100 warm year. The freezing index and thawing index for each year are calculated from the recorded air temperature data. The index for each year is ranked in ascending order and plotted. A “best-fit” line is drawn through the set of points to estimate the 1 in 100 warm year index. Mean monthly air temperatures are increased by the ratio of the 1 in 100 warm year freezing or thawing index to the mean year freezing or thawing index to estimate the mean monthly temperatures of a 1 in 100 warm year. The influence of climate change should be evaluated by similar methods presented in ACIA (2005). This includes the average estimated seasonal temperature changes by various Global Circulation Models (GCMs).

Given the uncertainties in climate change and the cost of returning to a site at a future date, it is recommended that the Soil Disposal Facility be designed for 100 years of long-term climate warming (average of four GCMs) as a minimum. With this design condition, the active layer could penetrate the contaminated soil if a warm year occurred. Containment during this condition would be provided by the thick soil cover and the geomembrane liner. Additional factors of safety can also be applied to account for uncertainties in the geothermal model, soil input parameters, and climate input parameters, or the facilities can be designed for climate change plus one 1 in 100 warm year.

5.5 Borrow Source Development

Granular borrow material will be required for the development of new landfills and general site grading purposes.

5.5.1 Site Grading

Grading operations generally consist of the shaping and regrading of disturbed areas to blend in with the natural contours, in accordance with all applicable licenses. Disturbed areas may include:

- contaminated soil excavation areas,
- existing and new landfill areas,
- debris areas,
- areas disturbed during demolition activities,
- granular borrow areas, and
- any area disturbed during establishment and operation of the camp, equipment storage and maintenance activities.

5.6 Contractor Support Activities

For implementation of remedial activities, a Contractor will establish a camp and storage areas on-site, where required. Where possible, these will be located in previously disturbed areas such as borrow or storage areas, to minimize any new disturbances in accordance with all applicable licenses.

Domestic refuse generated by the camp shall be incinerated and disposed of on-site in an engineered landfill. Sewage shall be handled by an appropriately sized sewage treatment system, in accordance with applicable legislation and all applicable licenses.

Wastewater generated by the Contractor, shall be treated to meet discharge criteria as stipulated in permits and licenses issued for the project.

Potable water supplies at the site will be tested and used, only if they meet the Canadian Drinking Water Quality Standards (CCME 2002) or the latest edition thereof, in accordance with all applicable licenses.

Fuel required for the operation of the camp will be stored on-site in accordance with applicable legislation and licenses.

All hazardous materials shall be segregated prior to or during demolition. Non-hazardous demolition materials and asbestos shall be collected and disposed in an on-site engineered landfill. Hazardous demolition materials shall be disposed off-site.

Only in exceptional circumstances shall existing buildings remain intact on site following the remediation program. These structures may remain as emergency shelters once clear transfer of ownership has been established.

6 CONSTRUCTION RELATED IMPLEMENTATION REQUIREMENTS

Consistent with Step 9 of the Federal Contaminated Sites Action Plan, confirmation that the objectives of the RAP have been met is required. Based on the issues typically associated with the remediation of INAC sites, confirmatory testing encompasses a wider range of activities. These include, but are not necessarily limited to:

- Confirmatory testing of contaminated soils;
- Quality Assurance testing of earthworks associated with the remediation and construction of landfills;
- Testing as required for waste manifesting to allow for shipment and disposal of materials off-site; and
- Testing as required to meet the requirements of Land Use Permits, and/or other Licences/Permits issued for the cleanup program.

The requirements and/or guidelines for these testing programs are outlined in the following sub-sections.

6.1 Confirmatory Testing Contaminated Soils

Following excavation of contaminated material confirmatory samples shall be collected and analyzed to ensure that cleanup objectives have been met. Sampling will be conducted by a third party qualified to carry out such work. A detailed sampling plan shall be developed for each area of concern identified for excavation in the RAP, and must include the following information:

- Description of the objective for each potential area of concern
- Sampling locations
- Sampling methodology
- Proposed number of samples and media
- Parameters for analyses
- Analytical requirements, and Quality Assurance/Quality Control measures.

6.1.1 Tier I contaminated soils

Tier I criteria were developed to address aerial transport of contaminants; excavation and backfilling precludes this pathway. If, during the site assessment, sufficient evidence has been collected to demonstrate that soils at depths of greater than 0.3 m below surface do not exceed Tier II levels for inorganic elements or PCBs, confirmatory sampling will not be required.

6.1.2 Tier II contaminated soils

Confirmatory sampling shall be carried out using a systematic grid sampling design following the DND DLCU Confirmatory Sampling Protocol as summarized in Table 6.1. This design provides a practical and simple method for designating sample locations and ensures uniform coverage of a site. Discrete samples should be collected at every point on the grid. For small areas, all samples shall be analyzed, whereas for larger areas only a fraction of the interior grid samples shall be analyzed. When choosing sample locations for analysis, consideration shall be given to areas of previously high concentrations. No single sample result or the mean of a duplicate/replicate sample shall exceed the cleanup objectives. In cases where field analytical methodology is used, 10-20% of the samples analyzed in the field should also be analyzed in the laboratory for quality control purposes.

Table 6.1 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%

6.1.3 Hazardous Soils

Confirmatory sampling following excavation of soils considered hazardous according to CEPA (PCBs >50 ppm) or the TDGA may require a more closely spaced grid than outlined in Table 6.1 to minimize the overall volume of materials requiring off-site disposal.

6.1.4 Type B TPH (Fractions F1 to F3)

Confirmatory sampling following excavation of petroleum hydrocarbon impacted soils within 30 m of a water body supporting aquatic life will follow the confirmatory sampling protocol outlined in section 6.1.2. The remedial solution for petroleum hydrocarbon impacted soils further removed from surface water bodies involves excavation of source areas. In cases where field analytical methodology is used, 10-20% of the samples analyzed in the field should also be analyzed in the laboratory for quality control purposes. For comparison purposes, total petroleum hydrocarbons (TPH) data obtained by hexane extraction can be compared to data generated using the CCME analytical procedure for PHC in soils by summing fractions F1 to F3. The presence of residual petroleum hydrocarbon contamination is expected following excavation to design limits as outlined in the RAP. Representative samples from the base of the excavation will be collected and analyzed for record keeping purposes using the CCME analytical procedure for PHC in soils.

6.1.5 Ex-situ Confirmatory Sampling

Soils excavated from landfills and dumps will be classified ex-situ. Excavated soils will be placed in windrows or stockpiles with a maximum stockpile size of 20 m^3 (B.C. Environment, 1995). Debris is separated from the soil and sorted as potentially hazardous and non-hazardous under the supervision of the Hazardous Materials Specialist. Stained soil and soil associated with potentially contaminated debris such as battery waste or barrels must be stockpiled separately from other soil to prevent dilution and facilitate disposal.

As part of the sampling protocol, two types of soil samples shall be collected from stockpiles: discrete and composite. Sample locations are selected at various surface and depth locations in each stockpile to obtain samples that are representative of the entire pile. Five discrete samples are collected and analyzed for the first 20 stockpiles and every 20^{th} stockpile thereafter. Composite samples shall be collected and analyzed at all stockpiles. Composite samples consist of approximately equal volumes of soil collected from five discrete sample locations.

The standard deviation for each stockpile shall be calculated based on discrete sample results. These standard deviations are then used to calculate the average standard error for all stockpiles (Equation 1). Twice the average standard error is added to the analytical result for the composite sample to provide a 95% upper confidence limit (Equation 2).

$$SE_{avg} = \frac{\sum_{1}^{m}\left(\frac{SD}{\sqrt{n}}\right)}{m} \qquad \textbf{(Equation 1)}$$

$$UCL = \left[Composite_{x}\right] + 2\left(SE_{avg}\right) \qquad \textbf{(Equation 2)}$$

n = number of sample values,

SE_{avg} = average standard error,

SD = standard deviation of the sample values,

m = number of stockpiles,

UCL = upper confidence limit and

x = the stockpile number.

Classification of stockpiles for disposal is based on a comparison of the 95% upper confidence limit values and the relevant clean up objectives. The first 20 stockpiles shall be analyzed for the eight inorganic elements for which the DCC criteria are applicable and PCBs. Selection of samples for analysis for petroleum hydrocarbon will be based on visual and/or olfactory evidence. This process shall be repeated for every 20th stockpile thereafter. All the remaining stockpiles will be tested for copper, lead and zinc and any other analyte that exceeded the DCC criterion previously until it is no longer present (Table 6.2). Field analysis can provide adequate detection limits for statistical classification of certain contaminants (PCBs and PHC), while others (inorganic elements) must be analyzed in CAEAL accredited laboratories for more precise results.

Table 6.2 Analytical Requirements for Stockpile Sampling

Stockpile No.	Samples Collected	Analytical Suite	Samples for Analyses
1 through 20	**5 discrete** 1 composite	**PCBs, Cu, Ni, Co, Cd, Pb, Zn, Cr, As** PHC and Hg where evident	All discrete and all composite samples are analyzed for first 20 stockpiles
Every 20th thereafter	**5 discrete** 1 composite	**PCBs, Cu, Ni, Co, Cd, Pb, Zn, Cr, As** PHC and Hg where evident	All discrete and all composite samples are analyzed
Remaining stockpiles	**1 composite**	**PCBs, Cu, Pb, Zn** PHC, Hg and other inorganic elements where evident	Every composite sample is analysed.

Once the excavation is complete, the base of the landfill excavation must be sampled in accordance with confirmatory sampling protocol for Tier II soils.

6.1.6 Confirmatory Sampling of Material Processing Areas

Residual contamination may be present at barrel processing areas, hazardous materials processing areas, and stockpile lay down areas after clean up activities are complete. Once an area is no longer in use, a detailed inspection for evidence of staining and other indicators of contamination such as visible debris or paint flakes shall be carried out. Samples must be collected in these areas in a grid pattern based on the size of the area (see Table 6.1). In cases where field analytical methodology is used, 10-20% of the samples analyzed in the field should also be analyzed in the laboratory for quality control purposes.

6.2 Quality Assurance Testing of Earthworks

At most sites, earthworks will be carried out as part of the construction of new landfills, remediation of existing landfills, and/or development of hydrocarbon contaminated soil treatment areas. Contract Specifications developed for the project will identify specific requirements for fill gradation and compaction standards. As part of the testing to be carried out during cleanup, quality assurance (QA) testing is required to confirm that the earthworks are in conformance with the Specifications. The number and type of testing will be dependent on the volume of fill to be placed and the number of different material types employed in the cleanup. A QA program shall be developed in conjunction with the design engineer to determine the optimal number of tests required.

6.3 Testing Related to Permits/Regulatory Requirements

The Owner representative and the Contractor will be required to carry out testing to confirm that the requirements of the Land Use Permits and Water Licenses issued for the project are met.

This testing typically includes:

- Effluent testing for waste water generated from camp operations.
- Testing to confirm potability of drinking water supplies
- Testing of waste water generated from cleanup operations.

7 POST-CONSTRUCTION MONITORING

7.1 Introduction

A post-construction landfill monitoring program was developed by DND in conjunction with the Inuvialuit in the Western Arctic and the Inuit in Nunavut for landfills remediated and/or constructed during the cleanup of DEW Line sites. DND initiated cleanup of their DEW Line sites in 1996 and have collected a significant volume of landfill monitoring data since that time. Indian and Northern Affairs Canada, INAC, have initiated cleanup of abandoned military sites under their jurisdiction, and will implement a site monitoring program following remedial construction activities.

This section describes the recommended monitoring plan. It has been based on the DND landfill monitoring program and on landfill monitoring data collected at DND and INAC DEW Line sites to date. Additional monitoring requirements related to the natural environment and traditional knowledge have been added to the program.

A detailed description of the post-construction monitoring program is provided in AMSRP Volume 2 (INAC 2009).

7.2 Monitoring Program

The recommended monitoring program for abandoned military sites consists of:

- Baseline Geo-chemical Monitoring.
- Natural Environment Monitoring.
- Landfill Monitoring.

These are briefly described in the following subsections.

7.2.1 Baseline Geo-Chemical Monitoring

Geochemical Characterization of Soil Conditions

In all proposed development areas, and existing landfill areas (with the exception of existing landfills to be excavated), it is recommended that geochemical characterization of soil conditions be carried out during the assessment or remediation phase. For proposed development areas, sampling should be carried out on a grid spacing of approximately 50 m by 50 m. For existing landfills, testpits should be excavated at a minimum spacing of 50 m of landfill perimeter with a minimum of five testpits per area. Soil stratigraphy is to be logged in accordance with the Unified Soil Classification System, and evidence of

seepage and or soil staining recorded. Soil samples should be collected at surface and at 50 cm intervals to the maximum depth of the active layer, and analysed for the following parameters:

- PCBs (polychlorinated biphenyls);
- Hydrocarbon Fractions, F1, F2, F3 and F4; and
- Inorganic elements: arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc.

These data supplement information collected during the assessment phase of a site.

Geochemical Characterization of Groundwater Quality

In proposed landfill development areas or at landfills requiring leachate containment, it is recommended that a detailed characterization of groundwater quality be carried out. A minimum of three wells per area is recommended; however, this may be increased if the size of the landfill warrants increased coverage. The locations of monitoring wells should be selected based on the potential for groundwater (based on the testpit program for soil characterization), and to be representative of both up and downgradient areas. The depth of the monitoring well will be based on anticipated maximum depth of thaw. The monitoring wells should be located no further than 10 m beyond the final construction perimeter as defined by the design.

For baseline water quality, water samples should be collected at minimum monthly for one full season to allow assessment of changes in water quality as the active layer deepens. The wells for baseline sampling are typically installed in the final construction season. This minimizes the potential for damage during construction.

Recommended analytical requirements are outlined below:

- Petroleum Hydrocarbon Fractions, F1 and F2
- Total and dissolved metals.
- Major ions, hardness, total dissolved solids, total suspended solids.
- pH and conductivity.

Given the low solubility of PCBs, analyses of PCBs may be limited to once over the season, near the time of maximum thaw.

For each monitoring event, water level, pH, conductivity, and turbidity should be measured.

If significant variability is observed in groundwater monitoring data, a second season of baseline monitoring should be carried out following remedial activities.

Typically, only dissolved metals are measured in groundwater monitoring programs; however, previous concerns existed with respect to transport of contaminants with colloidal material. The requirement for total metal analyses should be reviewed at the completion of baseline monitoring, and eliminated if concentrations can be correlated with Total Suspended Solids (TSS) concentrations.

7.2.2 Natural Environment Monitoring

A natural environment assessment (NEA) conducted during the ESA phase of site remediation will serve as a reference for post-construction site monitoring. Local and traditional knowledge will be obtained from a local community representative familiar with the site (ideally the same person who assisted with the NEA). Natural environment data will be collected during the site visit as well as during community meetings with people who use or visit the site/area frequently (*i.e.*, year-round). The purpose of collecting this new data is not to find correlations with landfill monitoring data but rather to provide anecdotal data related to the presence of wildlife and changes over time.

Site specific data to be collected during the site visit should try to include as many of the following items:

- Wildlife sightings (species, number, gender, juveniles)
- Other evidence of recent presence of wildlife (droppings, tracks, feathers/fur, carcass remains, etc.)
- Wildlife activity (summering/nesting/denning, migratory/passing through)
- Qualitative assessment of relative numbers versus previous years (more, same, less)
- Revegetation of disturbed areas versus previous years (more, same, less)

Regional information to be collected during visits to the area throughout the year should include as many of the following items as possible:

- Use by people for traditional activities
- Season(s)
- Activities (hunting, fishing, trapping, camping, other harvesting)
- Relative frequency versus previous years (more, same, less)
- Wildlife species present (sightings or evidence)
- Wildlife presence versus previous years (more, same, less)
- Health of wildlife observed or harvested (good, average, poor)

- Relative health of wildlife versus previous years (better, same, worse)

7.2.3 Landfill Monitoring

In general, 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.

Based on site conditions at INAC's abandoned military sites, it is considered unlikely that leachate containment would be considered; however, it is included for consistency with previous monitoring plans at military sites. A summary of requirements is provided in Table 7.1.

Table 7.1 Summary of Landfill Monitoring Requirements

	Monitoring Requirements				
Landfill Type	**Baseline Monitoring** S- Soil GW - groundwater	**Visual Inspection**	**Soil Sampling**	**GW Sampling**	**Thermal Monitoring**
New Non-Hazardous Waste (NHW) Landfill (LF)	S, GW	✓	as required[a]	✓	
Regraded LF (low potential risk)	S	✓	as required[a]		
Leachate Contained LF (moderate potential risk)	S, GW	✓	as required[a]	✓	✓
New Tier II Soil Facility	S, GW	✓	as required[a]	✓	✓

[a] Refer to Section 7.3.4 for details.

Baseline monitoring requirements were described in Section 7.2.1. The details of the other four landfill monitoring elements are described in the following subsections.

7.3 Specific Monitoring Requirements

7.3.1 Visual Inspection

The physical integrity of the landfill should be inspected and reported using photographs (from the air, when possible, as well as ground level) and hand drawn sketches. Documented observations should at minimum include the items identified in Table 7.2. It is recommended that Table 7.2 be adapted for use as a field checklist to facilitate this data collection.

Table 7.2 Visual Inspection Requirements - Landfills

Item	**Presence/ Absence**	**Extent**	**Description Photographic Reference**
Settlement Erosion Frost Action Animal Burrows Vegetation Staining Vegetation Stress Seepage Points Exposed Debris Condition of Monitoring Instruments Other features of note	Yes or No	Provide dimensions, as applicable of: Length Width Depth	Features of note, photographic reference with scale, view point and direction

7.3.2 Groundwater Sampling

Results of analyses of groundwater samples from landfills should be compared to the baseline and background samples as this is indicative of changing environmental conditions at the site. In general, a

minimum of three to four groundwater monitoring wells will be associated with Non-Hazardous Waste Landfills, Tier II landfills and Existing Landfills – Leachate Containment.

Consistent with the baseline analyses, groundwater samples should be tested for:

- Petroleum Hydrocarbon Fractions, F1 and F2
- Total and dissolved metals.
- Major ions, hardness, total dissolved solids, total suspended solids.
- pH and conductivity.
- PCBs

For each monitoring event, water level, pH, conductivity, and turbidity should be measured in-situ. The evaluation of whether both total and dissolved metals are required will be evaluated after baseline monitoring.

Given the low solubility of PCBs in water, analyses of PCBs may be discontinued if not detected in the first five years of monitoring.

7.3.3 Thermal Monitoring

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 is placed; this is evaluated on a landfill-specific basis. Thermistor installation follows standard engineering practice.

7.3.4 Soil Sampling

As previously indicated, soil sampling and analyses provide limited information with respect to the performance of a landfill. Soil sampling will be limited to locations where seepage or staining has been identified as part of the visual inspection. Analytical requirements include:

- Petroleum Hydrocarbon Fractions, F1 to F4
- Arsenic, Cadmium, Cobalt, Copper, Chromium, Lead, Nickel, and Zinc
- PCBs
- Soil samples should be collected over the interval of 0 to 0.15 m, and 0.35 to 0.50 m depth.

7.4 Monitoring Frequency

Conceptually, three phases have been identified for landfill monitoring as described in the following sub-sections. Natural environment monitoring may be conducted according to the same schedule.

Phase I: Monitoring of conditions to confirm that thermal equilibrium and physical stability criterion are achieved.

During Phase I, monitoring would take place in years 1, 3, 5. 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.

Visual and thermal monitoring should be carried out on Tier II soil facilities and leachate contained landfills.

Visual inspections of the constructed and remediated landfills would also be carried out. It is anticipated that, if there is settlement or erosion within the initial years following remediation, it is likely attributable to construction quality. Changes after the first three years are more likely attributable to changes in the site conditions (i.e. warmer temperatures, changes in surface water drainage patterns).

It is recommended that groundwater monitoring take place in Years 3 and 5. The timing of the groundwater sampling event should consider the variability of water quality measured during the baseline monitoring.

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

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

At the completion of Phase I monitoring and review of the results, the Phase II monitoring frequency may be modified or downgraded. If no significant issues are identified for landfills of low potential environmental risk (as defined by the landfill evaluation matrix), monitoring may be discontinued at the conclusion of Phase I. If additional monitoring is warranted based on the thermal, groundwater or physical inspection, it is recommended that the monitoring frequency in Phase II 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.

Physical inspections of all landfills would be carried out at each monitoring event. The requirement for continued thermal monitoring would be based on Phase I results, or if significant climate changes had been recorded in the region.

Groundwater monitoring would be carried out at each monitoring event. The optimal time period for sampling would be based on the results obtained during baseline and Phase I monitoring.

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 re-evaluation of the monitoring program should 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 monitoring requirements.

7.5 Interpreting Monitoring Results

Landfill monitoring results (thermal, chemical and visual) have to be interpreted in concert with one another as described in AMSRP Volume 2 (INAC 2009).

7.6 Reporting Format

To provide a basis for comparison between monitoring events, it is recommended that a consistent format be used in reporting.

An outline is provided as follows:

1 Introduction. The introduction should provide an outline of the work elements, the timing of and weather conditions during field work, and describe the scope of the document.

For each individual landfill, the following information is to be provided.

2a. Landfill Summary: For each landfill, a summary should be prepared that describes the monitoring carried out, any notable groundwater analytical results, and any associated staining, seepage, exposed

debris, and/or evidence of vandalism. In addition, visual inspection issues identified as significant or unacceptable should be identified. The overall performance rating of the landfill should be provided.

2b. Completed Visual Inspection Report.

2c. A preliminary stability assessment, as described in Section 4.

2d. Annotated drawings on a tabloid paper, indicating all visual inspection features.

2e. Completed thermistor inspection reports, where appropriate.

2f. Photographic records.

2g. Thermal monitoring data, where appropriate.

2h Groundwater analytical data.

2i. Monitoring well sampling logs.

In Annexes to the report, the following information is to be provided.

- Formal laboratory results.
- QA/QC evaluation of the analytical results.
- Handwritten field notes.

Example field note templates are provided in AMSRP Volume 2 (INAC 2009).

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Annex A – Dump site, landfill and debris area (waste disposal area – WDA) evaluation

SUMMARY

In 1997, the DEW Line Cleanup Environmental Working Group (EWG), comprised of members representing Nunavut Tungaavik Inc. (NTI) and the Department of National Defence (DND) / Defence Construction Canada (DCC), was formed to address environmental issues associated with the DEW Line sites under the jurisdiction of DND. One of their tasks was the development of a matrix to assess potential environmental risk associated with existing landfills at the DEW Line sites. The evaluation matrix considered three primary categories, contaminant source, exposure pathways and potential receptors. In the development of the matrix, landfills typical of the DND DEW Line sites were considered. The DND DEW Line sites were in operation for nearly 40 years, and landfill activity was generally extensive.

By comparison, most INAC Abandoned Military Sites were generally only operational for a much shorter period of time, approximately five to six years. Accordingly, waste disposal practices were different. At many sites, waste materials were not consolidated in a single area, and dump sites and/or isolated areas of partially buried debris are common. These areas are collectively referred to as Waste Disposal Areas (WDA).

This current document presents an Evaluation Matrix for WDAs that considers conditions more specific to INAC Abandoned Military sites.

1 INTRODUCTION

To address the varied nature of landfills at abandoned military sites, a consistent method for the assessment of their potential risk to the arctic environment, in the form of a risk evaluation matrix, was developed by the DND/NTI EWG in 1997 (EWG 1998). Since that time, the matrix has been utilized to develop recommendations for landfill remediation at DND DEW Line sites. This document provides a modified evaluation matrix to address the dump sites, landfills and buried debris areas more typical of the abandoned military sites under the jurisdiction of INAC. As a whole, these are referred to as Waste Disposal Areas (WDAs).

The DND/NTI evaluation matrix was based on the CCME National Classification System for Contaminated Sites, and adapted to address the particular concerns of the Arctic environment. This revised version also references the Federal Contaminated Site Action Plan (FCSAP) Contaminated Site Classification Guidance Document. 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 intended purpose of the matrix is to evaluate the potential environmental risk posed by WDAs in their current condition.

Two conservative assumptions are made during the evaluation of all WDAs

- The contents of WDAs are generally unknown and all potential contaminants may be present.
- If contaminants come into contact with receptors, they could have adverse effects on the receptors.

2 MATRIX FACTORS

2.1 Contaminant Source – Category A

Four factors were considered under Contaminant Source to describe specific disposal areas as follows:

A.1 Areal extent of waste disposal.

A.2 Estimated depth of buried debris

A.3 Contaminant Characteristics – combined presence of leachate and surface contaminated soil.

A.4 Presence of Surface Debris

Contaminant characteristics were assigned the greatest weighting in this category as it is a strong indicator of potential environmental risk associated with the WDAs. The volume of a WDA is considered to be related to its potential to be contaminated – the greater the volume, the greater the risk that contaminants are present. The volume of the waste disposal area is divided into two parameters, area and depth. The area is relatively easy to measure; the estimated depth of the buried waste is given less weight in the matrix as it is difficult to measure using non-intrusive techniques.

A.1 Areal Extent of Waste Disposal

The larger the area impacted by waste disposal, the greater the potential for contaminants to be present exists. The areal extent of dump sites can be easily surveyed based on the presence of surface wastes. Landfill or buried debris areas are based on the results of geotechnical/geophysical site surveys and visual observations. A value of 10 000 m^2 is used as the basis for comparison. All WDAs greater than 10 000 m^2 are awarded the maximum points for this category. Scoring for all other WDAs is prorated relative to 10 000 m^2. WDAs less than 1000 m^2 are referred to as debris areas.

Scores are provided for all WDAs following the detailed field investigations that are carried out prior to cleanup/construction. The objectives of these investigations are to delineate the extent of known contamination, and confirm existing site and WDA conditions.

A.2 Estimated Depth

The depth of landfills and debris areas can be estimated by visual inspection of surrounding topographic features. The average depth of the active layer is 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 and buried debris with estimated depths of greater than 1.5 meters were scored higher than those with estimated depths of less than 1.5 meters. For the majority sites, it is anticipated that the depth of buried waste is 1.5 metres or less. Exceptions to this may include dumping within ravine areas or other natural depressions. A minimum score of 2 is allotted to all WDAs in the absence of specific data.

A.3 Contaminant Characteristics

Contamination associated with WDAs may be elevated with respect to background concentrations, but less than applicable criteria. In this case, elevated concentrations may be indicative of chronic low levels of contaminants leaching from the WDA, as a result of infiltration and percolation of surface water, or flow of active layer groundwater through areas of buried debris. In some cases, contamination on the surface may exceed applicable criteria as a result of direct spills or leaking containers.

With consideration of the FSCAP Hazard Ranking of contaminants and the DCC Criteria, all contaminants included in the DCC are considered high concern, with the exception of Petroleum Hydrocarbon Fractions F3 and F4. The F3 and F4 fractions are considered essentially insoluble and are therefore immobile. In the scoring of this category, four categories are provided:

- Concentrations not elevated with respect to background; however, the potential for contamination is considered possible.
- Concentrations elevated with respect to background; but less than DCC criteria. Elevated with respect to background refers to a concentration in excess of the three times the mean background concentration. With respect to organic contaminants, such as hydrocarbons and PCBs, the method detection limit is assumed to represent background concentrations.
- Concentrations in excess of DCC Tier I guidelines.
- Concentrations in excess of DCC Tier II guidelines.

A.4 Presence of surface debris

At some WDAs, in particular dump sites, 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 WDA that has surface debris covering more than 50% of its surface receives a full score. Debris areas, and dump sites as implied by the designation, generally receive full score for this category.

2.2 Pathways – Category B

The primary transport mechanisms for contaminants at these sites are considered to be:

B.1 Aerial transport of fine particles; and

B.2 Dissolved phase and/or colloidal transport in water, 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 impacted soils imply the potential for aerial transport. This factor is given a low weight because the quantity of contaminated soil on the surface 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

Dissolved phase and/or colloidal transport in water includes 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 generally subject to the same driving forces or gradients as surface water. The intent of this sub-category is to examine factors that affect migration away from the WDA – slope, runoff, extent and type of cover on below grade disposal areas, annual precipitation and distance to surface water. Among these factors, topography, runoff potential and proximity to surface water are given the greatest weight.

B.2.1 Topography

The degree of the slope on which the WDA is located is one of the major factors contributing to transport of contaminants. Scoring is carried out on a progressive scale. In cases where there are different slopes in the area, a weighted average is used.

B.2.2 Cover Material – Depth

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

B.2.3 Cover Material – Type

The erosion potential of a WDA is partly based on the type of cover material. Erosion can eventually lead to the exposure of the waste. 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 WDA, 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 in the area.

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, and potentially erosion. The majority of the abandoned military sites receive less than 500 mm of precipitation annually, with the exception of sites on the lower east coast of Baffin Island. Typically, the amount of precipitation at any site is relatively low. Any given rainfall event is unlikely to generate major run-off; however, spring thaw and corresponding run-off may be significant at some sites. Detailed precipitation data is not available for the INAC sites; therefore data was interpolated from the Hydrological Atlas of Canada Maps [accessed on line: http://atlas.nrcan.gc.ca/site/english/maps/archives/5thedition] as summarized below for various areas. For sites not listed below, the aforementioned maps should be consulted.

Sites	Annual Precipitation (mm)	Annual Snowfall (cm)	Average Maximum Snow Pack depth (cm)
Clifton Point	100-200	100	30
Bernard Harbour east to Matheson Point	100-200	80	30
Simpson Lake to Sarcpa Lake	150-200	100	50
Bray Island, Rowley Island	150-200	100	60
Nadlaurdjuk Lake	200-300	100	60
Ekalugad Fiord	200-300	200	70
Kivitoo	350	240	100
Durban Island	+400	240	100

As spring run-off likely represents the maximum precipitation event, scoring is provided relative to the maximum snow pack depth, with a score of 4 allotted to snow pack depth of 100 cm. If site specific factors, such as drifting in the WDA are present, the score may be increased to 5, the maximum allotted to this category.

B.2.6 Distance to Down-gradient 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 WDA, or streams and lakes downgradient from the WDA, 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 elevation difference. 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 away from the WDA.

2.3 Receptors – Category C

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

Selection of the water body in this category is based on potential effects on the receiving habitat. Consideration must be given to the regional drainage patterns. For example, where the drainage from a WDA is overland (i.e. there is no direct connection between the WDA and the downgradient water body), water bodies beyond two 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 WDA 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 a significant body of water near the limit of the WDA where contaminants are likely to have an impact. 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 limit of the WDA toe. The objective is to select a habitat that supports receptors rather than identify the closest body of water. It is assumed that only habitat downgradient from the WDA is to be considered (given that aerial transport of contaminants to habitat upgradient from the WDA will be addressed by the remediation of contaminated soil).

C.1.2 Estimated Habitat Usage – Freshwater/Marine

The score within this category is based on the frequency of usage within the selected receiving environment and considers the level of biodiversity and the occurrence of calving/spawning grounds. Freshwater and/or marine wildlife are potentially more at risk compared with terrestrial wildlife or avifauna, the latter of which are exposed through water ingestion. Thus, when terrestrial wildlife or avifauna are 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

The extent of vegetation considers the area within 300 metres downgradient of the WDA. Within this distance, vegetation is expected to be most susceptible to uptake of contaminants if they are leaching from the WDA. However, topography and the potential for run-off must be considered and a greater or lesser distance could be considered.

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 are 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 surface is not frozen. Within this factor, the scoring takes into account the likelihood and the duration of contact. Using this method, 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 Table 1 below. Unmanned Short Range Radar (SRR) sites, part of the North Warning System, are co-located at some of the former abandoned military sites, and periodic maintenance of these facilities is carried out. As a

conservative approach, it may be considered that maintenance workers may have a low likelihood of contact and low duration of contact.

Table 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

Different areas on a site may need to be considered individually.

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 WDA is to be considered in this factor.

C.3.3 Food Consumption

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

Sedentary organisms are more susceptible to local inputs as their exposure is greater if they are downgradient from the WDA. 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 sites do not have elevated levels of contaminants, as 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 abandoned military 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 site has the potential to pose a higher risk than a low consumption, although in general the risk remains low.

2.4 Special Considerations

As indicated in the introduction to the matrix, 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 their 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 that are not general to all of the abandoned military 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 a WDA, 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

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 WDA.

Example 2. Proximity to a community

In the WDA risk evaluation matrix, human exposure to a WDA is measured in the following way: people can spend time at the WDA (potential dermal exposure), they can drink water from an area near the WDA (potential ingestion), they could live very close to the WDA (potential exposure through aerial transport) or they could eat animals that feed near the WDA (potential ingestion). These considerations form section C.3 of the risk evaluation matrix. If a WDA is located near a community, there is a greater likelihood that people will spend time at the site than there is for areas far from a community. It is not necessarily the case, however, that WDAs near communities receive frequent visits; therefore, instead of creating a special section addressing proximity to a community, the risk of human exposure (see Table 1-1) is more accurately evaluated by measuring time spent at a WDA. In these cases, however, "special considerations" points may be added to the receptors category to address a community's specific concerns, such as the physical hazards associated with an exposed dump site.

2.5 Traditional Knowledge

The matrix for the evaluation of potential environmental risk was developed recognizing that local input would be relied upon in the scoring of WDAs. Additional guidance on the collection of Traditional Knowledge is provided in Section 4.10 of the protocol.

3 INTERPRETATION OF SCORES

The score obtained through the application of the matrix is intended to represent the potential environmental risk posed by a given WDA in its current state. The objective of remediation is to mitigate the risk associated with a WDA by preventing the migration of contaminants that may be present in the landfill, and by removing physical hazards.

During the development of the matrix by the EWG, WDAs at four different sites were evaluated by environmental scientists and engineers to assess the applicability of the matrix and to determine cut-off values between categories. WDA scoring 105 points or more is classified as potentially high risk (Class A) and require excavation. The high score accorded to these WDAs is generally a result of the ecological sensitivity of the area and the geometry and surrounding topography of the landfill, which precludes the development of a cost-effective and long-term design solution such as pathway intervention and/or stabilization of the landfill. WDAs with a score of 100-104 points must be considered on a case by case basis – some may require complete excavation while others may be considered Class B landfills. WDAs that score less than 105 require excavation/removal if one or more of the following conditions are met:

- The WDA is located at an elevation of less than 2 m higher than an ocean.
- The WDA consists of unconsolidated wastes at surface. Debris should be removed, classified, and sorted, and non-hazardous contents placed in an engineered landfill.
- WDA, with areal extent of less than 1000 m^2 and scoring a total of 89 points or more are classified as potentially high risk and require excavation to the full extent/depth of the debris. In addition, if these WDAs score greater than 23 points in the contaminant source category, complete excavation of the area is recommended.

A WDA with a score in the range 75 to 99 points is classified as moderate potential environmental risk (Class B). An engineered leachate containment system will be provided for these WDAs to mitigate against potential environmental risks. In specific cases where an engineered leachate containment system cannot be constructed, an evaluation of excavation will be carried out with the objective of determining whether complete excavation or partial excavation with a leachate containment system is required.

For WDAs of less than 1000 m^2, it is considered unlikely that leachate containment will be cost-effective when compared to excavation and removal of debris. Consideration must therefore be given to the level of contamination present. If contaminants are present in excess of criteria, it is recommended that the debris area be excavated to its full extent. If contamination does not exceed criteria, debris should be cut-off and removed within the upper 0.5 metres of the ground surface. The area should then be regraded to match surrounding topography.

A WDA with a score of 75 or less is classified as low potential environmental risk (Class C). In general, the remediation approach for these areas includes placement of an engineered cover, following collection, sorting, and appropriate disposal of debris from the surface, and excavation and disposal of any surface contaminated soils from the area. Some of the factors to be considered in the design of the cover include: thickness and type of the existing cover materials; slopes on the landfill; surrounding topography and available granular fill. The cover is designed to promote surface water run-off (i.e. no areas of standing water), prevent erosion, and mitigate against settlement. Where required, the slope of the WDA may be modified and/or geotextiles may be incorporated into the granular cover to provide a long-term solution. Generally, the final thickness of cover material is approximately 0.75 metres, and may be greater, dependent on site specific conditions. The granular cover material is to be placed in layers and compacted before the placement of the next layer of granular fill, until the design thickness is reached.

Overall, it is to be stressed that the matrix is to be used in the assessment of potential environmental risks associated with a specific WDA. It is not intended to be used as the sole criterion in determining the remediation solution for a WDA. The results of the matrix, both total score and the score from each major category, are to be considered in conjunction with the engineering evaluation of site conditions, to determine appropriate design solutions. Review of the individual category scores relative to the total score will highlight particular areas of concern that are to be addressed during the design process.

The potential impacts of climate change are also to be considered in evaluating remedial solutions.

It should be emphasized that the total score has an error associated with it of approximately 5 points; there is inevitable subjectivity in the scoring process and scores that fall near decision points should be considered on a case by case basis.

4 REFERENCES

BC Environment. June 1996. Guideline #1 Contaminated Sites: Site Characterization and Confirmation Testing. Draft.

CCME. 1992 National Classification System for Contaminated Sites.

COSEWIC, 1997, Categories of the Committee on the Status of Endangered Wildlife in Canada, Canadian Wildlife Service, Environment Canada.

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ATTACHMENT 1

WASTE DISPOSAL AREA

EVALUATION MATRIX

	ENVIRONMENTAL RISK EVALUATION MATRIX WASTE DISPOSAL AREAS - ABANDONED MILITARY SITES	Maximum Score
A.	**CONTAMINANT SOURCE**	
A.1	**AREAL EXTENT OF WASTE DISPOSAL AREA**	
	>10,000 m2	10
	For areas less than 10,000 = Area of Waste Disposal Area X 10 / 10 000	2-9
	Minimum Score	1
A.2	**ESTIMATED DEPTH OF BURIED WASTES**	
	greater than 1.5 m	5
	less than 1.5 m	2-4
A.3	**CONTAMINANT CHARACTERIZATION**	
	Concentrations in excess of DCC Tier II Criteria	25
	Concentrations in excess of DCC Tier I Criteria	20
	Concentrations elevated relative to background	10
	Potential Contamination	5
A.5	**PRESENCE OF SURFACE DEBRIS**	
	>50% of surface area	10
	<50% of surface area, pro-rated	1-9
	No debris observed	0
	SPECIAL CONSIDERATIONS	+/- 5
	TOTAL SCORE - CONTAMINANT SOURCE	

	ENVIRONMENTAL RISK EVALUATION MATRIX WASTE DISPOSAL AREAS - ABANDONED MILITARY SITES	Maximum Score
B.	**PATHWAY/TRANSPORT MECHANISMS**	
B.1	**AERIAL TRANSPORT OF CONTAMINANTS**	
	All Waste Disposal Areas Scored as 2, if surface sol contamination (A.4) or leachate (A.3) has been identified.	
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
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
B.2.3	**COVER MATERIAL – TYPE**	
	No cover	5
	Silty/Sandy Material	4
	Sandy/Gravel Material	3
	Gravel Material	1-2

B.	**PATHWAY/TRANSPORT MECHANISMS continued**	
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
B.2.5	**PRECIPITATION**	
	> 100 cm snow pack	4
	< 100 cm snowpack (pro-rated)	1-4
	Snow Drifting	1
B.2.6	**DISTANCE TO DOWNGRADIENT PERENNIAL SURFACE WATER/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
	SPECIAL CONSIDERATIONS	+/- 5
	TOTAL SCORE – PATHWAYS	

	ENVIRONMENTAL RISK EVALUATION MATRIX WASTE DISPOSAL AREAS - ABANDONED MILITARY SITES	Maximum Score
C.	**RECEPTORS**	
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
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
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
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

C.	**RECEPTORS continued.**	
C.3	**POTENTIAL HUMAN EXPOSURE THROUGH LAND USE**	
C.3.1	**Presence/Occupation**	
	Duration of Contact /Likelihood of Contact	7-8
	see chart and provide rationale for scoring	4-6
		1-3
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
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
	High quantity of migratory organisms	2
	Moderate quantity of migratory organisms	1
	Low quantity of migratory organisms	0.5
	No consumption	0
	SPECIAL CONSIDERATIONS ***TOTAL SCORE – RECEPTORS***	+/-5
	TOTAL SCORE	

Annex B – Barrel Protocol

1 INTRODUCTION

In order to determine the correct disposal method for barrels and their contents, the contents must first be identified. All barrel contents should be sampled and analyzed according to DND DEW Line Cleanup standard procedures, as described in this section.

Analytical data obtained for the samples collected from barrels located at the site should 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. The flash point of organic waste and aqueous waste (> 2% glycols/alcohols) must also be determined. Uncontaminated aqueous phases can be disposed of on the land according to the discharge criteria; 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.

During the delineation phase of the site investigation, an inventory of the number and locations of barrels at the site is to be compiled. This inventory should include buried or partially buried barrels that will be taken out of the landfills during excavation. Where significant numbers of barrels are present on a site, and if safe to do so, representative samples shall be collected to provide a preliminary indication of whether on-site incineration is a viable alternative. Otherwise, barrels are only sampled during the cleanup phase and as such, the handling, transportation and opening of barrels is the responsibility of the site Contractor.

Other waste fuels and oils are also sampled according to this protocol. These may come from a variety of sources including, but not necessarily limited to, old generators, fuel tanks and pipelines, and transformers.

2 INSPECTION

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

- 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.
- 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.
- Signs of deterioration or damage such as corrosion, rust, or leaks at seams, rims, and V grooves, or signs that the barrel is under pressure such as bulging and swelling.
- Spillage or discoloration on the top and sides of the barrel.

3 SAMPLING

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.

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.

Barrels should only be opened according to accepted procedures and under qualified supervision, preferably using remotely operated, non-sparking equipment.

Once open, barrels will be sampled by personnel wearing proper personal protective equipment as described below. Samples of the contents of all barrels shall be extracted using a drum thief and placed into a pre-labelled glass vial. The number and type of liquid phases, and their respective thickness, and the size of each barrel are to be recorded.

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.

All barrels shall be clearly numbered using spray paint or other suitable paint marker. The number on this label should be the only sample coding provided to the laboratory.

The barrel locations and barrel sample descriptions should be recorded.

Samples should be kept at ambient temperatures and shipped by guaranteed freight to laboratories where they should be kept cold pending analysis.

4 TESTING

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.

The contents of barrels containing organic materials, including aqueous samples which contain more than 2% glycols or alcohols, shall be tested for flash point, PCBs, total chlorine, cadmium, chromium and lead following the targeted barrel testing approach presented in Figure 1. Analyses will be conducted on a rush basis where indicated. In addition, major organic components should be identified e.g. fuel oil, lubricating oil.

If on site incineration of waste is not planned, waste samples need only be tested for flash point, PCB, and pH (at regular turnaround time) in order to classify the waste for transport and disposal options.

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 provided in the protocol.

5 DISPOSAL OF BARREL CONTENTS

Barrels containing only rust and sediment shall be treated as empty barrels.

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 shall be tested prior to discharge in accordance with wastewater discharge criteria. Where water meets criteria, it may be discharged to the ground a minimum of 30 meters distance from natural drainage courses. Used oil absorbent material shall be treated as described in the following subsection.

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, 100 ppm lead, and that have a flash point between 25°C and 225°C, 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 not be leachable shall be disposed of as DCC Tier II contaminated soil. Leachable material shall be treated as hazardous waste and disposed of off-site at a licensed disposal facility.

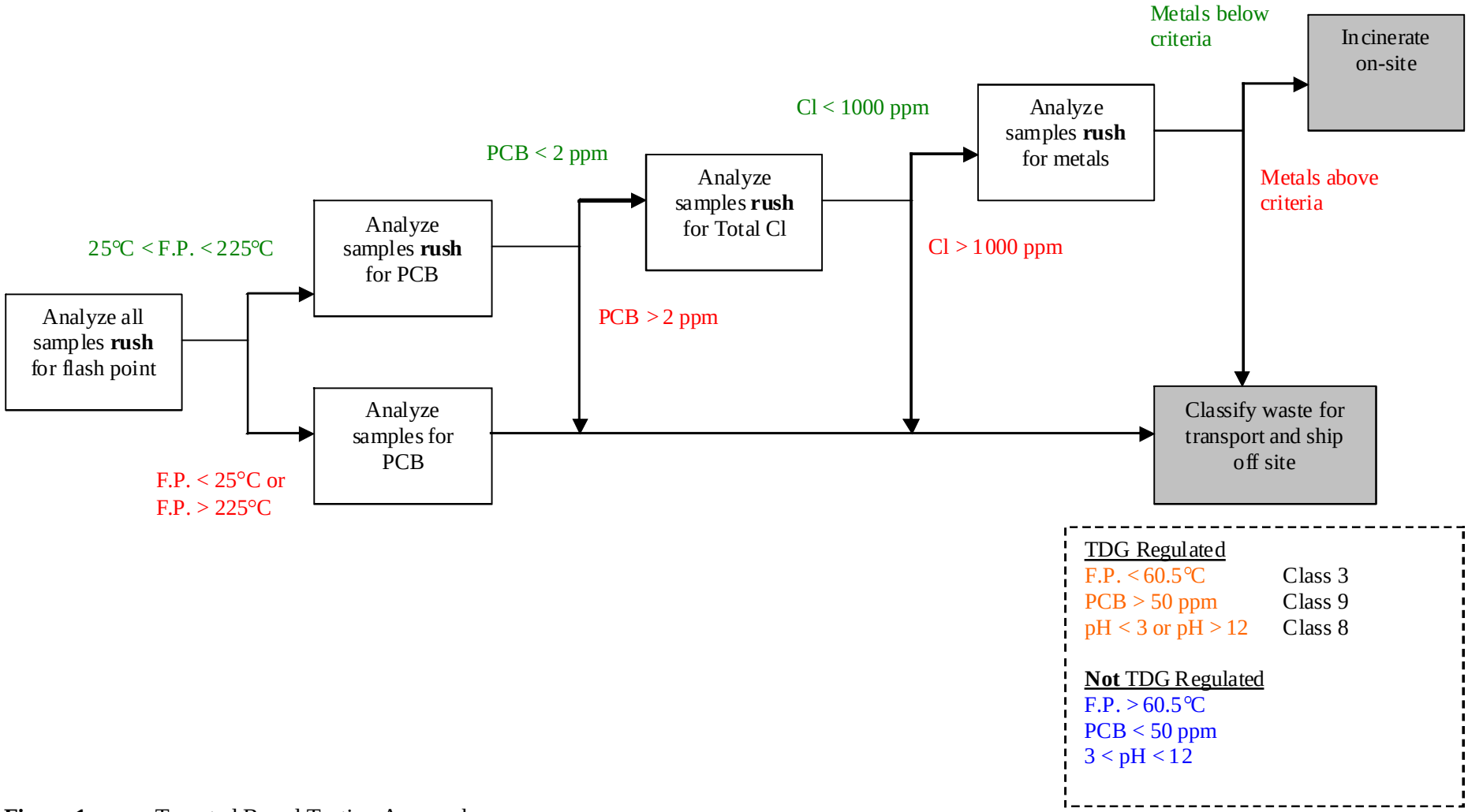

Figure 1 Targeted Barrel Testing Approach

Barrel contents, which contain greater than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium or 100 ppm lead, or that have a flash point below 25°C or greater than 225°C shall be disposed of off-site at a licensed disposal facility. Contents may be combined with compatible materials for shipping purposes.

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.

6 DISPOSAL OF BARRELS

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.

7 PERSONNEL PROTECTIVE EQUIPMENT

Safety equipment required includes a respirator with organic vapour cartridges, safety glasses, a hard hat, rubber safety boots, double gloves (chemically resistant on the outside, and latex or vinyl on the inside) and disposable Syranex-coated coveralls.

A decontamination procedure should be established at the barrel sampling area(s) to prevent tracking potentially contaminated liquids outside of the sampling area(s).

It is advisable to have one person outside of the sampling area to observe the sampler(s) in case of unexpected hazards, and also to record the samplers' observations.

Appendix F

Golder Archaeological Impact Assessment Report

FINAL REPORT

ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF THE FOX-E INTERMEDIATE DEW LINE SITE, DURBAN ISLAND, NUNAVUT

Submitted to:

The Department of Culture, Language, Elders and Youth (CLEY), Nunavut
Nunavut Permit No. 2010-017A

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EXECUTIVE SUMMARY

During August of 2010, Golder Associates Ltd. conducted an Archaeological Impact Assessment (AIA) of the FOX-E Intermediate DEW Line Site in on Durban Island, Nunavut on behalf of AECOM working for Public Works and Government Services Canada (PWGSC) and Indian and Northern Affairs Canada (INAC). This AIA was carried out in conjunction with the Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation and Remedial Action Plan. All required fieldwork was completed under an Archaeological Permit (2010-017A) issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut to Brent Murphy of Golder.

The Intermediate DEW Line Site is located on Durban Island, approximately 95 km southeast of Qikiqtarjuaq, Nunavut. Low-level aerial reconnaissance of the site area was conducted in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential. Lack of vegetation and sedimentation enabled surface examination of the facility areas to adequately assess for the presence of cultural materials. As requested, areas which will not be impacted during remediation were not examined. During the study the previously recorded FOX-E DEW Line site, MgBs 2, was revisited and one new site, MgBs 4, was identified and documented as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003).

PWGSC has fulfilled the requirements to identify the potential for impact to heritage resources during the proposed remediation/reclamation of the FOX-E DEW Line site on Durban Island. The AIA included the participation of Losie Audiakiak and Johnny Kooneeliusie from the local community of Qikiqtarjuaq, who acted as bear monitors and participated in the identification and recordation of the heritage resource sites.

The AIA included revisiting the previously recorded DEW Line site, MgBs 2, and the identification of one new heritage resource site, MgBs 4. The FOX-E Dew Line Site, MgBs 2, is considered to be of limited significance given the amount of information that is currently known about the site. MgBs 4 is a stone feature site that is considered to be

of moderate significance and it is recommended that this site be avoided during remediation activities.

It is recommended that PWGSC and INAC have met their obligations to assess the potential for impact to heritage resources during the proposed Remedial Action Plan. It is also recommended that the newly identified site MgBs 4 be avoided during reclamation activities.

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1. INTRODUCTION

During August of 2010, Golder Associates Ltd. (Golder) conducted an Archaeological Impact Assessment (AIA) of the FOX-E Intermediate DEW Line Site, Durban Island in conjunction with the Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation, Remedial Action Plan on behalf of AECOM and Public Works and Government Services Canada (PWGSC). All required fieldwork was completed under an Archaeological Permit (2010-017A) issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut to Brent Murphy of Golder.

Low-level aerial reconnaissance of the site area was initially flown in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential. The AIA was intended to identify any artifacts or heritage resource areas that might be impacted by a remediation program and, as such, only those areas of previous and potential disturbance were assessed. The intent of this program was not to conduct a full AIA of the entire Durban Island. However, during traverses of the former DEW Line station some lands outside of proposed impacts were surveyed (Figure 1).

The amount of previous disturbance associated with the DEW Line site and lack of vegetation facilitated assessment of the facility areas and increased visual assessment for the presence and/or absence of cultural materials. As requested, areas that will not be impacted during remediation were not fully examined. One previously recorded site, the FOX-E DEW Line site (MgBs 2) was revisited and one previously unrecorded heritage resource site (MgBs 4) were identified by the author during the program, which were documented as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003).

2 0 2
SCALE KILOMETRES

LEGEND

PROJECT AREA

REFERENCE

TOPOGRAPHIC MAP 16M & N 3rd EDITION OBTAINED FROM Canmatrix.© 1994 HER MAJESTY THE QUEEN IN RIGHT OF CANADA. DEPARTMENT OF NATURAL RESOURCES : TRANSVERSE MERCATOR DATUM : NAD83 COORDINATE SYSTEM : UTM ZONE 20W.

FOX-E DEW LINE SITE DURBAN ISLAND

TITLE

FOX-E PROJECT LOCATION

Golder Associates
Calgary, Alberta

PROJECT 10.1333.0023.8420			FILE No. 10133300238470A001	
DESIGN	BM	12/10/10	SCALE AS SHOWN	REV. 0
CADD	KJM	19/10/10	FIGURE: 1	
CHECK	BM	19/10/10		
REVIEW	DB	19/10/10		

2. LOCATION, POTENTIAL IMPACTS, AND OBJECTIVES

2.1 Location

The FOX-E Intermediate DEW Line site is located on Durban Island 95 km southwest of Qikiqtarjuaq, Nunavut. Durban Island is located off the northeast coast of Baffin Island on the Hudson Strait. The site area is made up of a beach area at sea level with the former DEW Line site being located on a flat plateau 650 m above sea level (Plates 1 and 2). The FOX-E site was constructed between 1957 and 1959 and included a module train, warehouse, garage, bulk fuel storage tanks, Inuit house, Quonset huts, water storage, helicopter landing pads and antenna. In addition to the main site two beach landing areas, bulk fuel storage tanks, construction camp, borrow source and an access road were constructed. The site was deactivated in 1963 and has remained this way since.

Plate 1 Aerial photo of the Beach area of the FOX-E DEW Line site, the POL tanks are in the centre of the photo.

Plate 2 View east of FOX-E DEW Line Site showing the module train, warehouse, garage, bulk fuel storage tanks and antenna.

2.2 Potential Impacts

The potential impacts to heritage resources around the FOX-E site on Durban Island are dependent upon the proximity of those resources to the remediation activities that will be conducted to remove the remnants of the former DEW Line site. Heritage resource sites are non-renewable resources that may be located at or near ground level or may be deeply buried. Prehistoric or precontact archaeological sites are those sites which contain features, artifacts or ecofacts reflecting the use of a given land base by people prior to European influences and technologies. Features are non-portable articles that indicate a human modification of the local environment such as hearths, pits, tent rings, stone cairns and Inuksuk. Artifacts are portable items that have been modified by people at some time in the past. These include such items as projectile points, stone flaking debris, and cut and modified bone. Ecofacts are naturally occurring items such as preserved plant remains or pollen that can aid in the interpretation of archaeological sites. Historic

archaeological sites include the features, artifacts and ecofacts relating to the past few hundred years of human occupation. These sites are typically identified by the presence of buildings or structural remains, but may include any site that has evidence of historic use of the landscape.

Alteration of the landscape can result in the damage or complete destruction of all or portions of historic resource sites. These alterations often involve the displacement of artifacts resulting in the loss of valuable contextual information or may involve the destruction of the artifacts and features themselves resulting in complete information loss. These losses are permanent and irreversible. Primary, secondary and tertiary impacts are possible with any new development. Remediation can be considered a new development in this context if it impacts previously undisturbed areas during operation.

Primary impacts include those disturbances resulting immediately from a project. The primary impact zone is the area within the remediation footprint including access roads, temporary work zones, borrow pits and dumps. Individual sites are likely to be affected to varying degrees if they are located within the development area. Artifact context is fundamental to interpretation of archaeological sites. By disturbing the context in which artifacts and features are recovered, interpretations of heritage resources sites and, ultimately, past lifeways are affected negatively.

Secondary impacts can occur when the support services or additional access required by development adversely affects heritage resources outside the primary target areas. The remediation project should have no secondary effect on heritage resources.

Tertiary impacts are the results of project induced changes in demography and land use patterns. Increased rates of intentional and unintentional impacts can be expected as a result of increased visitation to an area if the project were large enough to affect regional population bases. Tertiary impacts are anticipated to be very low for this project, especially because changes to the site through remediation will probably only negatively affect the visitation rates.

The study detailed in this report is intended to identify areas of possible impact and to determine whether the current proposed project will disturb those heritage resources located in proximity to the development.

2.3 Project Objectives

The objective of the 2010 study at the FOX-E Intermediate DEW Line site located on Durban Island is to ensure that heritage resources are not inadvertently impacted by the proposed clean-up and remediation project. The purpose of this AIA is to:

- conduct a pre-impact assessment of the proposed remediation areas;
- identify any archaeological sites within those areas (if present);
- make recommendations to CLEY, AECOM and PWGSC to mitigate or avoid those sites;
- make recommendations on surveillance and monitoring;
- provide a cost estimate on implementing the recommendations during the construction phase; and
- prepare a draft Final Report to be reviewed by AECOM and PWGSC, followed by a Final Report for distribution as required and submission to CLEY.

3. PHYSICAL AND CULTURAL SETTING

3.1 Environmental Context

An understanding of past environmental conditions and the environmental factors that shape human approaches to subsistence and settlement patterns enable archaeologists to not only locate sites, but also to provide more accurate interpretations of individual sites. The physical aspects of the environs (topography, drainage, climate and soils) as well as resource availability (flora, fauna, lithic materials and water) are prime criteria for the identification of site location and function. Assessments of the universal cultural activities of site location, travel within and through the area, and resource exploitation are key components of any archaeological site analysis.

The anthropological theory of environmental determinism suggests that, to a great extent, environmental factors condition human behavioural and cultural adaptations, or patterns of behaviour. The environment has likely influenced many of the activities that contribute to the character of the regional prehistoric record. All available environmental variables must be considered as indicators of prehistoric use of the landscape.

The regional environment influences where specific activities and occupation are located in a pattern of seasonal movements according to the availability of resources: a seasonal round. The variables of archaeological site distribution can be identified and combined into useful criteria for suggesting the potential of an environment to hold heritage resources that includes a wide variety of landforms frequently associated with coastlines and lake shores, river banks, eskers and kames, and bedrock knolls in Arctic environs. Distribution patterns partially reflect environmental opportunities presented to human groups as well as cultural preferences demonstrated by site location. Topography influences much human activity including travel, communication, resource catchments, dwelling locations and eventually constrains human activity areas to defined localities. Based on existing heritage resources, the environment is a key factor in human settlement patterns.

3.2 Regional Environment

Prior to contact with Europeans, the environment in which the people of North America lived strongly influenced their culture and economy. The people who inhabited the North took advantage of the seasons and all the resources that were available.

Baffin Island is part of the Canadian Shield, an old erosion surface of Precambrian rocks. Specifically, the northeast coast is mountainous and framed by numerous fjords, inlets, cliffs, eroded sandstone valleys and intricate alpine glaciers flowing to the sea (Collignon 2005). Hundreds of small islands surround the coast. The vegetation is diverse by sparse and dwarfed with sedges, saxifrage, dryas, Arctic willows, cottongrass, broad-leafed willows, herbs and Arctic poppies being the most common plants of the 350 species recorded on the island. Caribou, wolf, Arctic fox, lemming, Arctic hare, and polar bears are the most common land mammals on the island while sea mammals include walrus and several species of seals and whales are found in coastal waters.

The FOX-E site area is characterized by a beach landing areas that is at sea level with the actual DEW Line Site being located on a high volcanic plateau up to 650 m above sea level surrounded by steep cliffs. The beach landing is connected to the station by a road that was cut into a steep valley with several switch backs. During the study wildlife that was observed near the station area included a polar bear with two cubs, numerous seals and whales. Although the volcanic plateau area is sparsely vegetated wet areas near the beach landing are heavily vegetated with sedges, willows and many flowering plants, grasses and rushes.

3.3 Heritage Resources

Archaeology is the study of human history through the material remains of culture, now known as heritage resources. The ultimate goal in archaeology is to describe the cultures and events responsible for the creation and deposition of the remains at a given archaeological site. As such, archaeologists use material remains to determine the nature

and age of cultural occupations at a site. Artifacts, ecofacts and features deposited into the natural environment, along with their inter-relationships, are the integral parts that make up an archaeological site. The *Nunavut Archaeological and Palaeontological Sites Regulations* (2003) define heritage resources as: "but not limited to, archaeological and historical sites, burial grounds, palaeontological sites, historical buildings and cairns."

Predating the arrival of Europeans, precontact archaeological sites are comprised of artifacts, features and residues of native origin typically characterized by modified bone and stone, and stone structures. Historic sites are those structures, features, and objects of European influence that date back to contact with the Europeans but can also represent more recent activity of more than 50 years. Depending on the context, sites less than 50 years old may be considered to represent traditional land use and are identified to document continued use and occupation of an area to the present time. A key component of the historic period record are the sites, artifacts and affiliated resources relating to post-contact Aboriginal people's use of the landscape. These include both archaeological sites and objects such as standing and collapsed cabins, campsites, graves, and traditional sites and resources, such as special places, hunting and plant collecting areas, traplines and their associated remains, oral traditions and various documents. These latter resources are usually identified through consultation procedures such as Traditional Use Studies (TUS) or community consultations.

Additionally, heritage resources include, as well as the sites where events took place in the past, all of the objects that they contain and any of the contextual information that may be associated with them and will aid in their interpretation, including natural specimens and documents or verbal accounts.

Heritage resources are non-renewable and are susceptible to alteration, damage, and destruction by construction and development activities. The value of heritage resources cannot be measured in terms of individual artifacts or biological specimens, rather the value of these resources lies in the integrated information which is derived from the relationship of the individual artifacts and fossil specimens, associated features, spatial

relationships (distribution), and contextual situations. Interpretation of heritage resource materials, and the ability to interpret the significance of particular sites in a landscape, is based on an understanding of the nature of the relationship between individual archaeological and palaeontological materials as well as the sediments and strata within which they are contained. As such, removal or mixing of cultural or fossil bearing sediments results in the permanent loss of information basic to the understanding of these resources. As a result, heritage resources are increasingly susceptible to destruction and depletion through disturbance.

Similarly, tundra areas north of the tree line are characterized by extremely slow rates of soil development and sediment accumulation. Accordingly, at repeatedly occupied sites, there is little chance of distinguishing occupations relating to different periods within the 5,000-year record of human occupation in the region without recovering a diagnostic indicator. Some areas of high sediment deposition rates are present within the study area, but these are not the typical scenario.

The lack of temporally diagnostic artifacts, the absence of materials suitable for radiocarbon dating, and the natural mixing of shallow archaeological deposits serve to limit the definition of the recognized prehistory for the region. In contrast, extant documents, records, and oral testimony provide a firmer basis for understanding the historic period of the region.

3.3.1 Cultural Chronology

Many of the archaeological materials in the project area represent human activity after the ice sheet receded from Baffin Island about 5,000 years ago. Soon afterward the island was colonized by Paleo-Eskimos with Southwestern Baffin Island, Melville Peninsula, Southhampton Island and the north of Quebec being considered to be part of the core area of Pre-Dorset and Dorset Culture Development.

3.3.1.1 Arctic Small Tool Tradition (4200 B.P. to 2800 B.P.)

There is presently little evidence to link Palaeo-Arctic tradition occupations to the Arctic Small Tool tradition (ASTt) occupations that succeed them. The ASTt represents a widespread cultural manifestation that covers all of the Canadian Arctic as well as parts of Alaska and Greenland. The ASTt is typically thought to date between approximately 4,200 and 2,800 B.P. (McGhee 1990). It includes the Denbigh Flint complex in northern Alaska, the Independence I culture of the Canadian High Arctic, the Inuvik Phase and the Pre-Dorset culture in Arctic Canada, and the Sarqaq culture in Greenland. It is thought that the ASTt relates to a separate migration of peoples from Siberia and does not appear to be related to the preceding Palaeo-Arctic tradition. As the name implies, the toolkit of the ASTt is comprised of lithic artifacts that are finely made and smaller than tools of similar function and age from elsewhere in North America. These include microblades and microcores, burins, gravers, small side and end scrapers, side and end blades, and bipointed (arrow) and triangular (harpoon) projectile points (Wright 1995). In Alaska it appears to have developed into the cultures of the Norton tradition while in Canada it developed into the Dorset culture.

3.3.1.2 Dorset Culture (2,500 B.P. to 1,000 B.P.)

The Dorset culture occupied the Canadian Arctic from 2,500 B.P. until at least 1,000 B.P. (McGhee 1990). Best known for miniature carvings, Dorset appears to have been a more successful adaptation to the conditions of the north than the preceding ASTt cultures from which it developed. This is demonstrated by the huge area occupied by Dorset groups and by evidence that they had perfected winter hunting on the sea ice. Cooler conditions in the northern hemisphere around 3,000 years ago resulted in expansion of the sea ice and a shift away from terrestrial hunting of caribou and hunting of sea mammals from boats in open water to a procurement of sea mammals from coastal edges and sea ice. This is evidenced in the archaeological record with a shift away from bow hunting to harpoon and spear hunting (McGhee 1990). Artifacts recovered from sites representing this period are more diverse and “reflect a richer and more secure way of life

than that of earlier Palaeo-Eskimos." including the establishment of permanent winter villages (McGhee 1990).

However, when the people of the Thule culture arrived in the Canadian Arctic approximately 1,000 years ago, the Dorset culture had largely or entirely disappeared for reasons that are not well understood (McGhee 2001; Wright 1999).

3.3.1.3 Thule (1,000 B.P. to 400 B.P.)

The Thule tradition dates from approximately 1,000 to 400 B.P. and is derived from the Norton tradition in northern Alaska. More specifically, Thule grows out of the Old Bering Sea and Punuk traditions, which have numerous similarities to Thule cultural assemblages. These assemblages suggest subsistence based on maritime resources such as seals and whales that were hunted from kayaks or umiaks as identified by harpoon floats. Thule represented a new kind of adaptation to the Arctic environment, based on the hunting of large sea mammals in open water through the use of drag floats attached to the harpoon line. Large skin boats and the use of dogs to pull large sleds were other Thule innovations. Winters were spent in sometimes large communities of semi-subterranean houses, subsisting on a stored surplus obtained most typically by hunting bowhead whales. The introduction of Thule into the Canadian Arctic is noted by a distinct change in a number of cultural markers from the Dorset culture. The earliest Thule occupations currently recognized are on islands in the Bering Strait and exhibit an almost complete reliance on maritime resources; however, later sites demonstrate that both maritime and terrestrial resources were utilized (McGhee 1990). Climatic changes following the thirteenth century likely caused the Thule to modify their way of life into that of the various historic Inuit groups.

3.3.2 Historic Inhabitants

Historic use of the project area is identified with the 'Baffin Eskimo'. This group inhabited the southern two-thirds of Baffin Island and some of the nearby islands off its

shores (Kemp 1984:464). The remaining northern region of the Island is inhabited by the Iglulik (Kemp 1984:464). The island region that is inhabited by the Baffin Eskimo is characterized by freshwater systems located in the central interior and mountainous areas in the northeast and southwest (Kemp 1984:464). The region was first inhabited by the Pre-Dorset approximately 4,200 years ago, supported by archaeological sites identified at Lake Harbour, Frobisher Bay, and Pond Inlet (Desrosiers 2005:193). Prior to this inhabitation, a large ice sheet had covered the island until its melting 5,000 years ago (Desrosiers 2005:193). Dorset groups are identified in the archaeological record following this, between 2,500 and 600 years ago. The regions of southwestern Baffin Island, Melville Peninsula, Southampton Island, and northern Quebec are considered the central regions of Pre-Dorset and Dorset cultural development (Desrosiers 2005:193). Thule groups entered the area during the final 200 years of the Dorset occupation of the area. These two archaeologically distinct cultures coexisted in the region, but the character of this relationship is unclear. Much of the information known of the historic Thule, or Baffin Eskimo, is based on the ethnographic recordings of Franz Boas from the late 1800's. At this time, Boas recognized seven distinct regional populations within the Baffin Eskimo area (Kemp 1984:464). These populations were "linked together by [bilateral] kinship and the mutual use of hunting and territory, to form larger territorial and social groupings...bands" (Kemp 1984:464). Importantly, by the time of Boas' ethnography the Baffin Eskimo possessed many European goods, which influenced and altered the traditional life-ways of the local groups.

European contact with the Baffin Eskimo populations began in the 16th Century with the Frobisher Expedition (Kemp 1984:467), whose task it was to find the North West Passage (Desrosiers 2005:193). However, previously Baffin Bay had been explored by the Norse (Heinrichs 2005:191). During the 10th Century these Norseman built settlements on Greenland and perhaps Newfoundland but little evidence remains of where and how far they had actually travelled as these same settlements collapsed during the 13th Century. Baffin Bay was next explored and recorded by John Davis in 1587. European interaction gradually increased with the rise of European whale hunting; whaling stations began operating throughout the eastern arctic in the 1880's (Kemp

1984:466). Such whaling activities around Davis Strait originated in the 1700's, but it was not until the 1850's that all the inhabitants of the Cumberland Sound and Davis Strait regions were in contact with whalers (Kemp 1984:466). The whaling industry was eventually eclipsed by fur trapping in 1910 (Kemp 1984:474). Also at this time Anglican missionaries entered the region (Kemp 1984:474).

The Baffin Eskimo have historically utilized a vast array of subsistence resources, including marine, terrestrial, avian, and freshwater game; however, the wolf was sought but not utilized for subsistence (Kemp 1984:467). A vast array of tools was used for hunting, such as plugs to stop the bleeding of seals that made it easier for their transport. Bird nets were also constructed and used to ensnarl various avian species (Kemp 1984:468). Hunting weapons included breathing-hole harpoons that had compound elements, and single-curve bows (Kemp 1984:69). Metal, along with driftwood, antler, bone, and stone, were used in the construction of these implements. In addition, Baffin Eskimo technology allowed for water transportation via kayaks and umiaks, or women's boats (Kemp 1984:469); the form of the kayaks was not consistent throughout the Baffin Eskimo area. Dog sleds were used as well. These sleds were the dominant method of transportation until the 1960's when snowmobiles were introduced (Kemp 1984:469). With these forms of transportation, the Baffin Eskimo interacted with neighbouring groups such as those from northern Quebec (Kemp 1984:465). However, this interaction did not occur regularly.

Different subsistence resources were procured based on the season. For instance, seals (particularly ringed seal) were hunted along the floe-edge during the spring months, and caribou herds were hunted during the fall in the interior and coastal regions (sometimes with the aid of drives) (Kemp 1984:467-468). As this instance suggests, Baffin Eskimo mobility was seasonal and influenced by the location of what game they were pursuing. As a rule, Baffin Eskimo groups resided primarily in the coastal regions. It was the caribou that pulled groups into the interior, whereby three particular lakes were favoured as hunting locals: Nettling, Amadjuak, and Sylvia Grinnel Lakes (Kemp 1984:468). During these interior hunts, if excess caribou meat was produced, then it would be cached

at these interior locations and retrieved at times of food stress during the winter months (Kemp 1984:468). In addition to there being differences in subsistence procurement based on seasonality, there were also differences in dwellings. Winter dwellings were commonly snow houses, although occasionally early and abandoned Thule houses were reused through the addition of roofs (Kemp 1984:470). In contrast to the winter, skin tents were utilized during the warmer months. These tents varied in form and size depending on how far they were to be transported and their use (Kemp 1984:470). A further seasonal distinction is found in Baffin Eskimo clothing; only caribou skin was used for winter clothing, and seal skin was used in addition to caribou for summer clothes (Kemp 1984:470).

3.3.3 Heritage Studies

Prior to the current study of the FOX-E Intermediate DEW Line site on Durban Island, only one heritage resources site was recorded in the Nunavut or Canadian Museum of Civilization database for this location. The site, MgBs 2 was recorded as the location of both a whaling station and the FOX-E DEW Line site. MgBs 2 is reported in more detail below. There have also been four sites recorded in the surrounding area that were not revisited during the present study.

MgBs 1 is located directly south of MgBs 2 on Cumberland Point, southwestern Baffin Island. MgBs 1 is described as a historic British campsite consisting of 4 qarmats, numerous tent rings, caches, and a marker. A boulder at this site had the following inscribed upon its surface: “67"1' N / 62"20" W / TR J.G. PHD / July 17, 1837”. The carving may have been used for future sailors to check their navigation instruments. The “TR J.G. PHD” is thought to relate to the crew of the Joseph Green (J.G.) out of Peterhead (PHD), Scotland, captained by J. Volum. An alternate explanation is that the inscription was made by the crew of the "Traveller" (TR), also a member of the Peterhead whaling fleet in that year.

Four islands, situated in close proximity to Durban Island hold four further previously archaeological sites. These islands are called: Qaqaluit Island, Paugnang Island, Block Island, and Padloping Island. The MhBt 1 was also known as the Cape Searle site, located on the north shore of Qaqaluit Island. The site was recorded by D. Clark in 1964 as a stone cairn with undetermined temporal and cultural associations. The second site, MgBt 2, was a prehistoric site located on a rocky ledge along the south shore of Paugnang Island. George Sabo in 1975 recorded this (and MgBt 1) site while conducting the Thule Archaeology Conservation Project. There were a total of three structures identified, two of which were looted. The other structure was eroding but did not evidence looting. These three structures were associated with the late Thule. The third site, MgBt 1, was located on the south shore of Block Island. The site was identified as 4 closely placed villages. The first was an Inuit village comprised of numerous wood platformed qarmats. The second, a Thule village, was also comprised of qarmats (n=2) but were made of stone and one had a stone cairn built within. The third village, associated with the Thule, had 3 stone houses. One of these structures had a recent cache placed within it and two burial cairns placed behind the structure's back walls. Nearby to this structure were 2 kayak rests, a number of tent rings, and additional caches. Approximately 105 M. to the north of these three villages was the forth and final grouping of structures. These structures (n=3) were associated with the Thule. Finally, MhBt 2 is a previously recorded site located on Padloping Island and was identified by D. Clark in 1964 as a cairn of undetermined age.

4. METHODOLOGY

4.1 Field Inventory and Assessment

All field work was conducted under a valid Class II Archaeological Permit issued by CLEY. The field program focused on assessment of all areas of high and moderate archaeological potential within the disturbed DEW Line site, and the proposed borrow source and landfill locations. The purpose of the field investigation was to identify archaeological materials, document location and content and provide data to be used in the development of recommendations for future remediation programs. Inventory and assessment techniques followed established practices and consisted of the following:

- visual examination of the identified areas to determine the presence of such surficial features such as standing or collapsed buildings, dumps, cache pits, cabin foundations, etc. and exposed precontact cultural materials such as stone tool making debris and tools;
- visual examination of the identified areas to determine the presence of items of historical military interest;
- excavation of shovel tests (ca. 40 x 40 cm) to varying depths to determine the potential for subsurface precontact cultural remains if deposition is present;
- visual examination of bedrock exposures (if any) or gravels for precontact quarrying activity;
- excavation of either additional shovel tests or 1 x 1 m units for the purpose of identifying the distribution, density, and nature of cultural remains associated with sites identified through inventory procedures;
- documentation of the location (GPS coordinates), nature, size, and complexity of each identified site; and
- documentation of individual site features to record content, context, potential identity, and to provide information required to develop a mitigation program.

These results, along with updates and recommendations will be included in written submissions to CLEY as required by the Permit to conduct the AIA, and discussed with the Chief Archaeologist of Nunavut.

4.2 Heritage Feature / Structure Evaluation

Evaluations of heritage features and standing structures were to be completed for features/structures that are observed during the investigations. These evaluations would consider perceived heritage resource value and community cultural value as well as the predicted impact from the proposed program. In general, disturbed sites with limited cultural remains would be assigned lower archaeological resource values than undisturbed sites, large sites with large amounts of cultural material, complex sites, and multicomponent sites. Undisturbed multicomponent sites would generally be assigned the highest heritage resource value.

Community input will play a role in the evaluation of site value, and the inclusion of members of the local community on the field crew aided in the in-field discussions regarding site significance.

4.3 Detailed Archaeological Site Investigations / Mitigation

If required, mitigation of significant heritage resources sites may include a number of different options. Prior to evaluation of these mitigative options, the perceived value of the identified archaeological sites will be discussed with the AECOM Project team to determine the feasibility of avoiding important sites. Only if site avoidance is not possible, will other mitigative measures such as collection and documentation, and controlled mapping/excavation be considered. In areas of no sediment deposition surface collection and mapping of artifacts and features may satisfy regulatory requirements for mitigation. Recommendations for excavation may include a controlled excavation mitigative plan and will specify the number of square metres and suggest locations for excavation units/blocks.

Overall mitigative options may be summarized by:

- collection and documentation undertaken at the time of the field assessment at all sites with low archaeological resource value;
- avoidance if feasible at all sites assigned high archaeological resource value;
- mitigative excavations which will be recommended at those sites assigned high archaeological resource value that could not be avoided by borrow source relocation; and
- a management plan for required mitigation relative to the proposed construction schedule will be discussed with the site project team.

4.4 Reporting

Analysis of collected artifacts includes cleaning, cataloguing, identification, inventory, and description of each individual piece for inclusion in the final report. GPS site information is provided for mapping relative to the former site structures at the site and to CLEY, but not included in the final versions of this report. Archaeological site maps, photographs, and artifact scans are prepared as digital files.

5. RESULTS

Upon completion of the field component and the artifact curation, a draft report was prepared. This final permit report on the archaeological studies will be forwarded to AECOM for review, and then submitted to CLEY for review. This report includes a project description, the environmental setting, the historical and archaeological context for the project area, field methodology, and the results of the field reconnaissance. The report includes descriptive data on the sites, artifacts, and features identified, as well as detailed information on the nature, content, and significance of the artifacts and features identified. Cultural material that was recovered was inventoried, described, and discussed within the report text to aid in evaluation of scientific and interpretive value. All identified sites have been documented on appropriate site inventory forms.

If required, a summary of the findings will be prepared for inclusion in a screening document.

The following workplan was followed:

- avoidance has been recommended where feasible at all sites assigned high archaeological resource value (this to include all constructed features: burials, tent rings, caches, hunting blinds, hearths);
- collection and documentation has been undertaken as a mitigative option of sites with low archaeological resource value and as a method of protecting the heritage resource from future undocumented impacts due to increased personnel activity in the vicinity; and
- acceptable methods of mitigation were discussed with CLEY and the Territorial Archaeologist, and may lead to a recommendation for detailed mapping, collection and/or test excavations at those sites assigned high archaeological resource value that cannot be avoided by reclamation project.

A management plan for required mitigation, monitoring or surveillance relative to the proposed remediation will be developed as part of the contracted services deliverable to PWGSC. This includes site mitigation, additional survey of any project re-locates required due to site avoidance, and verification of those heritage sites located outside the proposed development activity area that should remain outside re-located areas.

A search of the Canadian Museum of Civilization database identified only one previously recorded site on Durban Island. That site, MgBs 2, is a 19th century whaling station and the FOX-E DEW Line Site. Therefore the current study included the revisit of MgBs 2.

5.1 Community Consultation

Consultation regarding the FOX-E Intermediate DEW Line site Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation, Remedial Action Plan is ongoing.

5.2 Field Results

The AIA assessment included all of the areas of moderate to high archaeological potential that has been disturbed by the FOX-E DEW Line site as well as areas identified as having potential for future borrow sources or dumps. The disturbed areas that were surveyed included the Station Area (Plate 2), access road, beach landing area (Plate 1), barrel dumps, landfills (Plate 3 and 4) and all the existing roads and anywhere there was evidence of a bull dozer push or any other disturbance. Previously undisturbed areas that were examined included the periphery of all the impacted areas as well as several areas that were identified as potential borrow areas and landfills for remediation activities (Plates 5).

During the survey the previously recorded site MgBs 2 was revisited and one new site, MgBs 4 was identified and recorded. The sites include the FOX-E Intermediate DEW line station and reported whaling station and a stone tent ring site, MgBs 4, which are described in more detail below. In addition to the heritage sites, a land use site consisting

of the remains of 11 Inuit houses were observed. Although the structures have been removed from the beach, material culture left behind indicates that at least eleven Inuit houses were present on the beach approximately 500 m west of the Secondary beach landing area (Plate 6 and 7). Material culture observed includes domestic artifacts such as children's toys (Plate 8), flat glass, piece of clothing, ceramic and plastic plate fragments, bed frame, container glass, seal and bird bone as well as electrical wire, metal stove (Plate 9), metal strapping, remains of a mop, electrical switches and other unidentified artifacts related to the DEW Line site (Plate 10). There were additional house remains to the east that were not recorded as they were outside of the study area.

Plate 3 View southeast of Dump A, material was pushed off the side of the cliff.

Plate 4 View northeast of B with fuel barrels and construction equipment.

Plate 5 View east of road going down to the beach area and possible borrow source on top of the hill.

Plate 6 View south of house remains made up of dimensional lumber and plywood.

Plate 7 View north of house remains with bed frame, food cans and dimensional lumber.

Plate 8 Photo of home made toy cat or bulldozer that was among the house remains.

Plate 9 Photo of iron stove that was among the house remains.

Plate 10 Vehicle instrument panel that was found among house remains.

5.3 Revisited Heritage Resource Site

5.3.1 MgBs 2

MgBs 2 was originally recorded by Philips (1980) for the Historical Archaeological Survey Auyuittuq National Park and Vicinity as the location of a whaling station as well as the FOX-E DEW Line Site. Although the site was not visited, historic records indicated that there were three whaling companies that established at this site: the Robert Kinnes Co. (1910-14), The Arctic Gold Exploration Syndicate (1914-16) and the Sabellum Trading Company (1924-27) (CMC 2010). During the current study there were no signs of a whaling station within the project footprint. However, due to the amount of disturbance involved in the terra forming of the beach landing area, construction of the POL tank platform, construction camp and access road to the DEW Line site any remains of a whaling stations could have been easily destroyed and/or buried (Plate 1 and Plate 11).

The FOX-E DEW Line is made up of the beach landing area and station area on top of a high plateau that are connected by a road that was ploughed into the steep banks of a valley (Plate 12; Figure 2). The beach area consists of two beach landing areas, POL tanks, the remains of the construction camp (Plate 13), three dumps, a barrel cache (Plate 14), the wooden floor of a building and numerous smaller dump location, roads and gravel borrow areas.

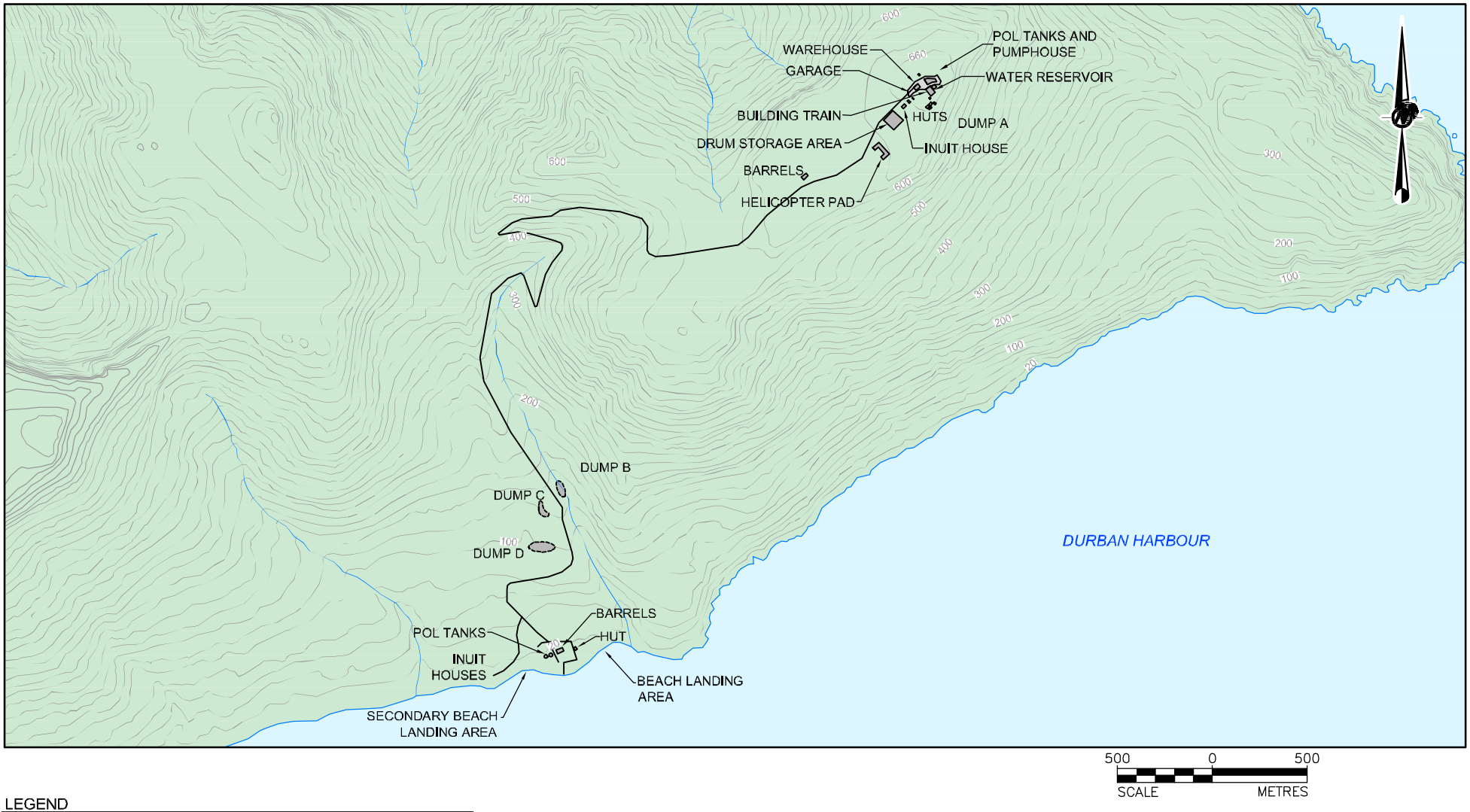
The station consists of a garage, warehouse, Module train, antennae (Plate 15), bulk water storage, POL tanks, remains of what is believed to be the Inuit house (Plate 16), the remains of three Quonset huts (Plate 17), helicopter landing pad a main dump, barrel dump and several smaller dump areas. With the exception of the Inuit house, which has burned down and the Quonset huts all of the buildings are standing and in relatively good shape.

Plate 11 View south of Beach Landing Area showing POL tanks, barrel dumps and disturbance area.

Plate 12 View south of road from the FOX-E site to the Beach Landing area.

Plate 13 View south construction camp area, the foundation of the camp can be seen in the right side of the photo.

L:\2010\1333\10-1333-0023\8470\Report A\Fig 2 10133300238470A002 Site Plan.dwg Nov 23, 2010 - 11:37am



500 0 500
SCALE METRES

LEGEND

- CONTOUR (METRES)
- ROAD
- WATERCOURSE
- WATERBODY

REFERENCE

ALBERTA NTDB DIGITAL DATA OBTAINED FROM GEOMATICS CANADA, AUGUST 2001. MAPSHEET 16M01 DATUM: NAD83 PROJECTION: UTM ZONE 20

PROJECT

FOX-E DEW LINE SITE DURBAN ISLAND

TITLE

SITE LOCATION MAP

Golder Associates
Calgary, Alberta

PROJECT 10.1333.0023.8470			FILE No. 10133300238470A003	
DESIGN	BM	15/10/10	SCALE AS SHOWN	REV. 0
CADD	KJM	19/10/10		
CHECK	BM	19/10/10		
REVIEW	DB	19/10/10		

FIGURE: 2

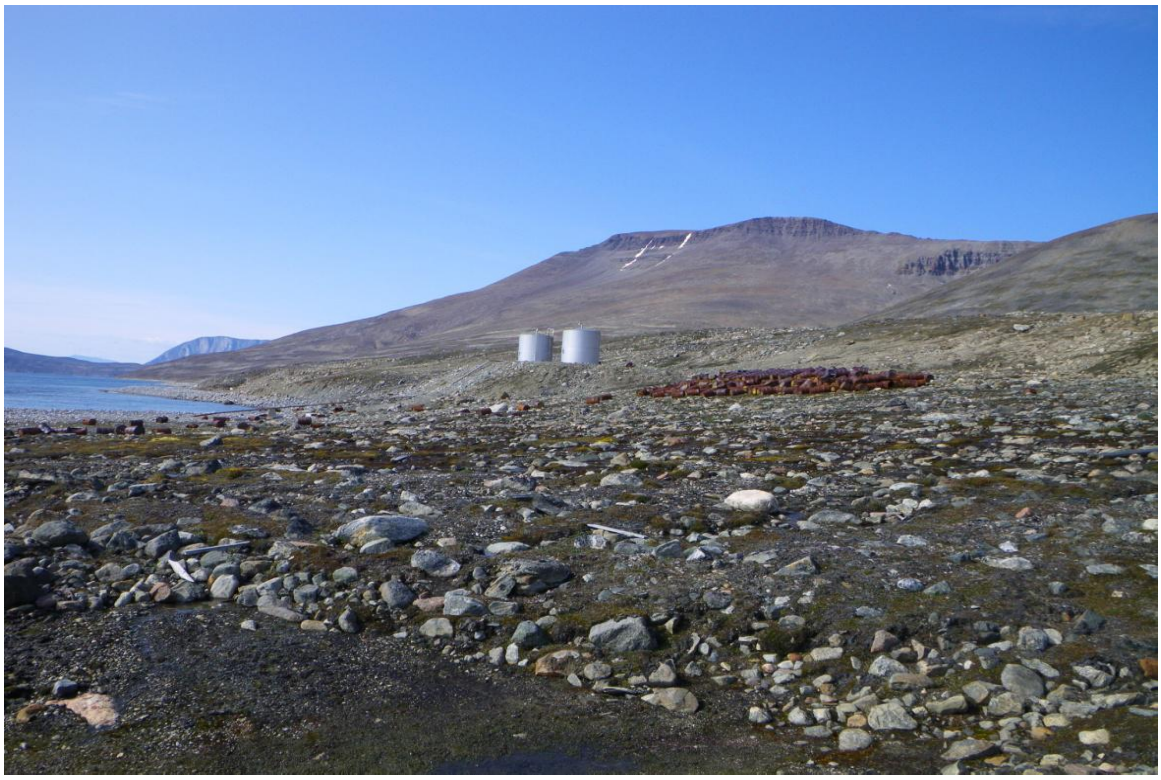


Plate 14 View west of barrel cache with POL tanks in the background.

Plate 15 View northeast of the base of the antennae, module train and POL tanks in the background.

Plate 16 View north east of Inuit House remains with garage and warehouse in the background.

Plate 17 View northeast of the remains of two of the three Quonset huts.

MgBs 2 was originally recorded as the location of both a 20th Century whaling station as well as the FOX-E Intermediate DEW Line. During the current study there were no signs of a whaling station within the project footprint. It is thought that either the station location is wrong or that the remains of the whaling station may have been disturbed by the construction of the FOX-E DEW Line Site. Johnny Kooneeliusie suggested that the location of the whaling station was across Hudson Strait from Durban Island on Baffin Island and that his grandfather had worked as a whaler at that location.

All the remains of the FOX-E Intermediate DEW Line Site will be removed during the planned remediation by PWGSC. No further work is recommended as the recording of the site is thought to be sufficient mitigation.

5.4 Newly Identified Heritage Resource Site

5.4.1 MgBs 4

MgBs 4 is a stone feature site that is made up of two stone circles on beach ridge overlooking the beach landing area and POL tanks associated with the FOX-E DEW Line site. Feature 1 is made up of more than 80 stones in a 5.5 m diameter that are partially buried (Plate 18). There also appears to be a stone centre feature dividing the stone feature in half. Feature 2 is made up of more than 27 stones in a 5 m diameter and is somewhat dispersed (Plate 19). The site is thought to predate the FOX-E DEW Line site due to the lack of cultural material found. A single hand wrought iron spike was recorded amongst the stones in Feature 1 (Plate 20). The origin of the features is unknown as it may represent European use if this area as a whaling station in the early 20th Century or may represent Inuit occupation that predated the FOX-E DEW Line site. MgBs 4 is thought to be of moderate to high significance and it is recommended that any impacts to the site be avoided. At this time there area no plans to disturb MgBs 2 during the remediation of the FOX-E DEW Line site.

Plate 18 View southwest Feature 1, MgBs 4 with POL tanks in the background.

Plate 19 View southwest Feature 2, MgBs 4 with POL tanks in the background.

Plate 20 Detail of hand wrought iron spike associated with Feature 2, MgBs 4.

6. SUMMARY AND RECOMMENDATIONS

The AIA of the FOX-E Intermediate DEW Line site conducted under Nunavut Permit 2010-017A produced the results discussed in Section 5 and outlined in Table 1. The disturbed nature of the site and lack of vegetation and sedimentation enabled a high visibility surface examination of the facility areas to adequately assess for the presence of cultural materials. As requested, areas which will not be impacted during remediation were not fully examined. During the study one previously recorded site, MgBs 2, was revisited and one new site, MgBs 4 was identified and recorded as per the *Guidelines for Applicants and Holders of Nunavut Territory Archaeology and Palaeontology Permits* (CLEY 2003).

Table 1 Heritage Site Recommendations

Site	Type	Significance	Recommendations
MgBs 2	DEW Line Site	Limited	No further work is recommended
MgBs 4	Stone Feature	Moderate	Avoidance is recommended

PWGSC has fulfilled the requirements to indentify the potential for impact to heritage resources during the proposed remediation/reclamation of the FOX-E DEW Line site on Durban Island. The AIA of the FOX-E Site included the participation of Losie Audiakiak and Johnny Kooneeliusie from the local community of Qikiqtarjuaq, who acted as bear monitors and participated in the identification and recording of the heritage resource sites.

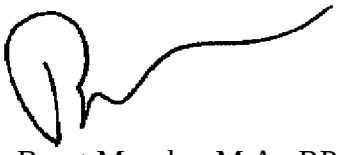
The AIA included revisiting the previously recorded DEW Line site, MgBs 2, and the identification of one new heritage resource site, MgBs 4. The FOX-E Dew Line Site, MgBs 2, is considered to be of limited significance given the amount of information that is currently known about the site. MgBs 4 is a stone feature site that is considered to be of moderate significance and it is recommended that this site be avoided during remediation activities.

7. CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

GOLDER ASSOCIATES LTD.

Report prepared by:



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Report reviewed by:

David Blower, Ph.D., RPA
Associate, Senior Archaeologist

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APPENDIX I

PHOTOGRAPH LOG

FOX-E AIA Photo Log

Number	Borden Number (if applicable)	Comment
10-017Aphoto1		View south of bottom of site - west of the POL tanks - from the air
10-017Aphoto2		View south of bottom of site with the POL tanks - from the air
10-017Aphoto3		View south of bottom of site with the POL tanks - from the air
10-017Aphoto4		View east from eastern edge of landform
10-017Aphoto5		View northeast of the North dump
10-017Aphoto6		Detail of the north dump
10-017Aphoto7		View northeast from north dump
10-017Aphoto8		View east from eastern edge of landform
10-017Aphoto9		View down from the top of the north dump
10-017Aphoto10		Detail of the north dump
10-017Aphoto11		View west from the northern edge of landform
10-017Aphoto12		View west from the northern edge of landform
10-017Aphoto13		View west of garage and warehouse
10-017Aphoto14		View north of POL tanks
10-017Aphoto15		View west of module train
10-017Aphoto16		View north of module train and POL tanks
10-017Aphoto17		View east of the base of the tower
10-017Aphoto18		View northeast of the fallen tower
10-017Aphoto19		View northeast of fallen tower and module train
10-017Aphoto20		View northwest of tower
10-017Aphoto21		View northwest of tower, garage and warehouse
10-017Aphoto22		View northwest of tower
10-017Aphoto23		Photo of billboard on the top of the tower
10-017Aphoto24		View northeast of Quonset hut
10-017Aphoto25		View east of Quonset
10-017Aphoto26		View north of Quonset
10-017Aphoto27		View west of Quonset with module train in the background
10-017Aphoto28		View north of Quonset
10-017Aphoto29		View east of Quonset
10-017Aphoto30		View north of module train, water storage and POL tanks
10-017Aphoto31		Detail of the base of the tower
10-017Aphoto32		View west from metal dump
10-017Aphoto33		View west from metal dump
10-017Aphoto34		view southwest of debris along edge of landform
10-017Aphoto35		Barrel and can dump on the west side of landform
10-017Aphoto36		View north along edge of landform
10-017Aphoto37		Sleigh with brunt metal cans of something
10-017Aphoto38		Detail of cans
10-017Aphoto39		View west from western edge of landform
10-017Aphoto40		View north of large cairn on the southwest edge of landform
10-017Aphoto41		View north of large cairn on the southwest edge of landform

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-017Aphoto42		View north of FOX-E from cairn
10-017Aphoto43		View west of cairn
10-017Aphoto44		Barrel dump south of site along road
10-017Aphoto45		View northeast from site
10-017Aphoto46		View northeast from site
10-017Aphoto47		View northwest from site
10-017Aphoto48		View north of station
10-017Aphoto49		View south down the valley to the bottom site
10-017Aphoto50		View southeast of the road where it starts to descend
10-017Aphoto51		View north of landform that the station is on from potential borrow source
10-017Aphoto52		View west from potential borrow source
10-017Aphoto53		Inuit house at the station that has burned down
10-017Aphoto54		Inuit house at the station that has burned down
10-017Aphoto55		Inuit house at the station that has burned down
10-017Aphoto56		Inuit house at the station that has burned down
10-017Aphoto57		View north of tower
10-017Aphoto58		Photo of potential dump
10-017Aphoto59		View northeast of barrel storage area
10-017Aphoto60		View north of station from barrel storage area
10-017Aphoto61		Photo of dump south of helicopter landing pad
10-017Aphoto62		Snowshoe north of helicopter landing pad
10-017Aphoto63		Snowshoe north of helicopter landing pad
10-017Aphoto64		Inside the module train
10-017Aphoto65		Inside the module train
10-017Aphoto66		Inside the module train
10-017Aphoto67		Inside the module train
10-017Aphoto68		View southeast of the module train
10-017Aphoto69		Photo of the water storage tank for the base
10-017Aphoto70		View west across valley along road to the bottom of site
10-017Aphoto71		View southwest across valley along road
10-017Aphoto72		View southwest across valley along road
10-017Aphoto73		View southwest across valley along road
10-017Aphoto74		View south down valley from road
10-017Aphoto75		View south of drainage and MgBs-2 from the air
10-017Aphoto76	MgBs-2	View north of Feature 1, MgBs-2
10-017Aphoto77	MgBs-2	View north of Feature 1, MgBs-2
10-017Aphoto78	MgBs-2	View southeast of Feature 1, MgBs-2
10-017Aphoto79	MgBs-2	Detail of mop head
10-017Aphoto80	MgBs-2	Misc electrical panel
10-017Aphoto81	MgBs-2	View south of Feature 2, MgBs-2

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-017Aphoto82	MgBs-2	View southwest of Feature 2, MgBs-2
10-017Aphoto83	MgBs-2	Children's sled
10-017Aphoto84	MgBs-2	Children's sled with scale
10-017Aphoto85	MgBs-2	Photo of sled
10-017Aphoto86	MgBs-2	View south of Feature 3, MgBs-2
10-017Aphoto87	MgBs-2	View north of Feature 3, MgBs-2
10-017Aphoto88	MgBs-2	View northeast of Feature 4, MgBs-2
10-017Aphoto89	MgBs-2	View northeast of Feature 4, MgBs-2
10-017Aphoto90	MgBs-2	View northeast of Feature 5, MgBs-2
10-017Aphoto91	MgBs-2	Detail of cut bone
10-017Aphoto92	MgBs-2	Detail of army heater
10-017Aphoto93	MgBs-2	Shipping crate from California
10-017Aphoto94	MgBs-2	Toy tractor
10-017Aphoto95	MgBs-2	Toy tractor
10-017Aphoto96	MgBs-2	Toy tractor
10-017Aphoto97	MgBs-2	Toy tractor
10-017Aphoto98	MgBs-2	View north of Feature 1, MgBs-2
10-017Aphoto99	MgBs-2	View east of Feature 1, MgBs-2
10-017Aphoto100	MgBs-2	View south of Feature 1, MgBs-2
10-017Aphoto101	MgBs-2	View south of Feature 2, MgBs-2
10-017Aphoto102	MgBs-2	View south of Feature 6, MgBs-2
10-017Aphoto103	MgBs-2	View west of Feature 6, MgBs-2
10-017Aphoto104	MgBs-2	View south of Feature 7, MgBs-2
10-017Aphoto105	MgBs-2	View northwest of Feature 7, MgBs-2
10-017Aphoto106	MgBs-2	View southeast of Feature 7, MgBs-2
10-017Aphoto107	MgBs-2	View north of Feature 8, MgBs-2
10-017Aphoto108	MgBs-2	View east of Feature 8, MgBs-2
10-017Aphoto109	MgBs-2	View south of Feature 8, MgBs-2
10-017Aphoto110	MgBs-2	Detail of wood debris
10-017Aphoto111	MgBs-2	View south of Feature 9, MgBs-2
10-017Aphoto112	MgBs-2	View north of Feature 9, MgBs-2
10-017Aphoto113	MgBs-2	View east of Feature 10, MgBs-2
10-017Aphoto114	MgBs-2	View east of Feature 10, MgBs-2
10-017Aphoto115	MgBs-2	View north of Feature 11, MgBs-2
10-017Aphoto116	MgBs-2	View southwest of Feature 11, MgBs-2
10-017Aphoto117	MgBs-2	View south of Feature 11, MgBs-2
10-017Aphoto118		Detail of radio
10-017Aphoto119		View north of the plowed road with switchbacks in the background
10-017Aphoto120		View north of the plowed road with switchbacks in the background
10-017Aphoto121		View north of the plowed road with switchbacks in the background
10-017Aphoto122		View east of POL tanks

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-017Aphoto123		View east of POL tanks
10-017Aphoto124		View southeast of pipe from POL tanks
10-017Aphoto125		View west of POL tanks and barrels on the beach
10-017Aphoto126		View west of POL tanks and barrels on the beach
10-017Aphoto127		View north of hut on the beach
10-017Aphoto128		View west of hut on the beach
10-017Aphoto129		Survey monument marked by a cairn
10-017Aphoto130	MgBs-4	View northeast of stone ring, Feature 1, MgBs-4
10-017Aphoto131	MgBs-4	View east of Feature 1, MgBs-4
10-017Aphoto132	MgBs-4	View southwest of Feature 1, MgBs-4
10-017Aphoto133	MgBs-4	Detail of cloth that has blown in
10-017Aphoto134	MgBs-4	View southwest of Feature 2, MgBs-4
10-017Aphoto135	MgBs-4	View north of Feature 2, MgBs-4
10-017Aphoto136	MgBs-4	View east of Feature 2,MgBs-4
10-017Aphoto137	MgBs-4	View southeast of Feature 2, MgBs-4
10-017Aphoto138	MgBs-4	Detail of iron spike among ring rocks in Feature 2, MgBs-4
10-017Aphoto139	MgBs-4	Detail of iron spike among ring rocks in Feature 2, MgBs-4
10-017Aphoto140	MgBs-4	View east off Feature 2, MgBs-4 showing centre feature
10-017Aphoto141		View south of modern cairn - survey?
10-017Aphoto142		View southwest of modern cairn
10-017Aphoto143		View southeast of cat train sleigh
10-017Aphoto144		View north of road showing huge plowed area
10-017Aphoto145		View south of lower site area showing, disturbed areas, washed out barrel culvert and POL tanks
10-017Aphoto146		View south of lower site area showing, disturbed areas, washed out barrel culvert and POL tanks
10-017Aphoto147		View south of lower site area showing, disturbed areas, washed out barrel culvert and POL tanks
10-017Aphoto148		Photo of washed out culverts along road
10-017Aphoto149		View east of barrel dump
10-017Aphoto150		View southeast of another barrel dump
10-017Aphoto151		View south of road at a turn showing the amount of disturbance
10-017Aphoto152		View east of water reservoir
10-017Aphoto153		View northwest of water reservoir
10-017Aphoto154		Detail of water reservoir
10-017Aphoto155		View west of barrel dump
10-017Aphoto156		View north of barrel dump
10-017Aphoto157		View northeast of heavy equipment and barrels
10-017Aphoto158		View northeast of heavy equipment and barrels
10-017Aphoto159		View south of construction camp location
10-017Aphoto160		View northeast of construction camp
10-017Aphoto161		View southeast of camp and surrounding are showing debris

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-017Aphoto162		View southeast of camp and surrounding are showing debris
10-017Aphoto163		View south of borrow area with bear monitor
10-017Aphoto164		View north of road from borrow area
10-017Aphoto165		View south of road and borrow area with bear monitor
10-017Aphoto166		View south of road and borrow area with bear monitor
10-017Aphoto167		View south of road and borrow area with bear monitor
10-017Aphoto168		View north of road with switch backs in the background
10-017Aphoto169		View north of road with switch backs in the background
10-017Aphoto170		View south of road
10-017Aphoto171		View south of road
10-017Aphoto172		View south of road

Public Works and Government Services Canada

Final Remedial Action Plan Padloping Island Former US Coast Guard Weather Station

Prepared by:

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Project Number:

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Date:

March, 2011

Statement of Qualifications and Limitations

The attached Report (the “Report”) has been prepared by AECOM Canada Ltd. (“Consultant”) for the benefit of the client (“Client”) in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the “Agreement”).

The information, data, recommendations and conclusions contained in the Report:

- are subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the “Limitations”)
- represent Consultant’s professional judgement in light of the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to Consultant which has not been independently verified
- have not been updated since the date of issuance of the Report and their accuracy is limited to the time period and circumstances in which they were collected, processed, made or issued
- must be read as a whole and sections thereof should not be read out of such context
- were prepared for the specific purposes described in the Report and the Agreement
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time

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March 23, 2011

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Dear Ms. Cotta:

Project No: **60158472**
Regarding: **Final Remedial Action Plan, Padloping Island former US Coast Guard Weather Station**

AECOM is pleased to submit the final Remedial Action Plan for the Padloping Island Former US Coast Guard Weather Station. We thank you for the opportunity to complete this work on behalf of Public Works and Government Services Canada.

Should you have any questions or require additional information, please do not hesitate to contact the undersigned at (780) 486-7000.

Sincerely,
AECOM Canada Ltd.

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NO:slm

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
0	NJO	December 17, 2010	Draft RAP Report
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PERMIT TO PRACTICE
AECOM Canada Ltd.
Signature
Date March 24/11
PERMIT NUMBER: P639
NWT/NU Association of Professional Engineers and Geoscientists

Executive Summary

The Padloping Island former US Coast Guard Weather Station is located at 67° 02' N, 62° 44' W in Merchants Bay on the southeast side of the island, near the southwest end. Padloping Island is located off the northeast coast of the Cumberland Peninsula of Baffin Island, approximately 440 km north-northeast of Iqaluit and 75 km southeast of Qikiqtarjuaq.

AECOM completed a Phase III Environmental Site Assessment at Padloping Island in August 2010. The objective of this assessment was to collect all data necessary to develop a detailed clean-up design. The results of this assessment were used to develop the following Remedial Action Plan according to the Abandoned Military Site Remediation Protocol, the Canadian Environmental Protection Act, the Transportation of Dangerous Goods Act and Regulations and the Nunavut/NWT Guidelines for the General Management of Hazardous Waste.

There are a number of access trails throughout the site connecting the Main Station Area with the Beach Areas, Old Hamlet Site and the Water Supply Lake. These routes were often times, barely discernable in the field and consisted of trails where the surficial vegetation had been bladed away in the past and had re-established since. The existing site access trails are not expected to be suitable to allow access for heavy equipment or pick-up trucks. Access roads will have to be completely established by constructing roadway embankments with sandy gravel material from local borrow sources. It would be preferable to use the existing site access routes so as not to impact undisturbed native tundra areas.

An archaeological investigation has been completed for Padloping Island by Golder Associates and the final "Archaeological Impact Assessment Report" is appended to this Remedial Action Plan for the identification of heritage features needing protection or avoidance during site remedial activities.

The investigation and delineation of contaminated soil at Padloping was completed for the contaminants of concern listed in the protocol. This protocol specifies clean-up criteria for inorganic elements, petroleum hydrocarbons and polychlorinated biphenols.

Five buried debris sites with a total of thirteen lobes were investigated during the 2010 site investigation. The total area of buried debris within the dump sites is approximately 567 m^2. Based on the location and condition of the dumps and contaminant migration assessment results, each dump site was assigned as a Class A, B, or C dump according to the protocol. The remedial requirements for each dump were initially assessed according to the recommended remedial method specified in the protocol for the various dump classifications. In addition, for development of remedial recommendations, site specific information for each dump was considered, such as proximity to surface water bodies, presence and sensitivity of down-gradient receptors (terrestrial and aquatic), and long term geotechnical stability potential. Based on these evaluations, all of buried debris areas have been recommended for excavation for a total volume of 425 m^3.

Based on the surface debris assessment, demolition inventory and sampling, barrel inventory and sampling, and the estimated component to be derived from dump excavations, the volume of hazardous waste identified at Padloping Island is 34 m^3. The estimated volume of non-hazardous waste, including surface and buried debris, is 1,860 m^3.

At Padloping Island, two locations were identified during the site investigation that would be suitable for construction of a new Non-Hazardous Waste Landfill Facility. There is concern, however, that there is limited available well graded (Type 2) granular material at local borrow sources. The facility could, however, be constructed with general (Type 3) granular material with flatter and/or Rip Rap (Type 1) protected sideslopes. Finally, based on information from other northern military sites, the volume of surface debris at this site does suggest that construction of an on-site non-hazardous waste landfill facility is warranted.

The site investigation and development of the remedial action plan for the nearby FOX-E, Durban Island Intermediate DEW Line site is proceeding concurrently with the program for the Padloping Island site. In order to allow for potential cost savings, AECOM recommends that a "Combined Contract" be implemented for the two sites and consideration should be given to a consolidated non-hazardous waste disposal facility at one of these sites. Although, a non-hazardous waste landfill could be built at Padloping Island, it is understood that the landfill sites and availability of well graded (Type 2) granular material would make Durban Island the better location for a consolidated non-hazardous waste landfill facility. It is therefore recommended that a NHW Landfill be constructed at the FOX-E, Durban Island Site for the disposal of waste from Padloping Island.

The following volumes of contaminated soil were identified at Padloping Island:

- Tier I soil: 47 m^3, of which 43 m^3 is derived from dump excavations;
- Tier II soil: 120 m^3, of which 43 m^3 is from dump excavations;
- Type A soil: 131 m^3 , all of which is within the top 0.3 meters;
- Type B soil: 116 m^3, of which 6 m^3 is from the Beach POL area which is subject to a more stringent criteria; and
- Hazardous soil: 21 m^3, of which 5 m^3 is derived from dump excavations.

Tier I and Type A contaminated soil can be disposed of in the non-hazardous waste landfill. Based on the low volume of Tier II Contaminated Soil identified, it is recommended that Tier II soil be containerized and disposed of off-site. The recommended remedial option for treatment of Type B soil is aeration or landfarming. The recommended location for the hydrocarbon soil treatment or landfarm area is Landfill Site LF-4.

Based on the above remedial recommendations, it is estimated that the cleanup at Padloping Island will require one full summer construction season and when considering the timing for contractor mobilization, the clean-up would require one full year including portions of two calendar and fiscal years. Contractor mobilization would be completed by sealift with barge support during the late summer/fall of the year before the main construction season and the contractor could initiate the work, weather permitting. The bulk of the construction activities would be completed during main construction season with contractor demobilization in the fall. The number one priority for the contractor, in terms of main work elements, will be to complete the treatment facility or landfarm and transport and spread the Type B Contaminated Soils, requiring treatment, to this facility during the mobilization year to allow for treatment of PHC-impacted soils to commence as soon as possible and to facilitate achieving the remedial endpoint criteria by the end of main construction season. Following construction of the treatment facility or landfarm, the construction activity focus should switch to buried debris excavation and hazardous waste segregation from surface debris areas to confirm the provision of suitable containers to site. Because of some unknowns related to barrel contents, barrel consolidation is recommended to be completed as much as possible during mobilization year to allow for collection of samples and analysis.

In addition to a "Combined Contract" design scenario, Public Works and Government Services Canada and Indian and Northern Affairs Canada have also expressed interest in a "Walkaway Solution" where there would be no requirements for long term monitoring. If the "Combined Contract" design scenario is incorporated, then the non-hazardous waste at Padloping Island would be disposed of off-site at FOX-E, Durban Island and Padloping Island would become a "Walkaway" site.

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1. Introduction

AECOM was retained by Public Works and Government Services Canada (PWGSC), on behalf of Indian and Northern Affairs Canada (INAC), Nunavut Regional Office Contaminated Sites Program, to complete a Phase III Environmental Site Assessment (ESA) and a Remedial Action Plan (RAP) with Class "C" Cost Estimate for the Padloping Island former US Coast Guard Weather Station.

The scope of work for the Phase III ESA included the assessment of:

- Contaminated soil areas;
- Surface water and sediment quality;
- Building materials and demolition requirements, including identification of hazardous materials;
- Existing dumps (aided by the completion of a geophysical survey of the area);
- Barrel contents;
- Areas of surface debris;
- Any other potentially hazardous materials on-site other than barrels or demolition items;
- The sources and volume of non-hazardous waste materials;
- Site access roads and barge landing areas;
- Borrow sources for use during clean-up activities; and
- Traditional knowledge regarding past and present land use of the site from the elders of the nearby communities.

The results of the Phase III ESA have been reported previously in (AECOM 2010a).

This report discusses remedial options for site issues identified during the Phase III ESA and provides recommendations for the preferred options. This report has been structured as follows:

- Section 2.0 outlines the background information that forms the basis of the remedial option evaluations and recommendations;
- Section 3.0 discusses remedial options for site buried debris areas;
- Section 4.0 identifies remedial requirements for hazardous waste elements at the site;
- Section 5.0 summarizes the sources of non-hazardous waste at the site and provides recommendations for disposal;
- Section 6.0 summarizes the findings of the contaminated soil investigation and assesses remedial options for the various types of contaminated soil;
- Section 7.0 discusses issues related to the implementation of the recommended remedial options.
- Finally, Section 8.0 discusses implications of alternate design scenarios including a "Combined Contract" with nearby FOX-E, Durban Island remediation site and a "Walkaway Solution". Cost estimates for the different design scenarios are provided under separate cover in (AECOM 2011).

Figures are presented in Appendix A.

2. Background

2.1 Site Location and History

In 1943, the United States Military constructed a United States Air Force (USAF) weather station on Padloping Island, codenamed Crystal III. The station was operated by the USAF until the end of the Second World War and subsequently operated by the Canadian Department of Transport until 1956. A long history of Inuit settlement at Padloping Island site predates the weather station and a written history of an Inuit community dates back to 1884. The remains of a hamlet, abandoned in the early 1960s, are co-located on Padloping Island with the remains of the weather station facilities.

The Padloping Island site is located at 67° 02' N and 62° 44' W in Merchants Bay on the southeast side of the island. Padloping Island is located off the northeast coast of the Cumberland Peninsula of Baffin Island and the nearest community is Qikiqtarjuaq, located approximately 75 km to the northwest. The FOX-E, Durban Island, Intermediate Distant Early Warning (DEW) Line Site is located approximately 24 km to the northeast of the Padloping Island Site. The nearest air charter base is Iqaluit, approximately 440 km to the southwest; however, there is no airstrip at this site and summer access could only be facilitated by rotary wing aircraft or boat. It is understood that an ice airstrip, located in the bay, has been utilized during winter operations in the past.

The Main Station Area comprises the abandoned weather station facilities, which are located on a coastal plain approximately 400 m from the Delight Anchorage Bay to the south. The Main Station Area is bordered by a steep cliff beyond two shallow lakes to the west and undulating hills to the east. Debris from the weather station extends from the Main Station Area south to the bay where barges have historically landed (West Beach Area). There is further debris along the beach at the Old Hamlet, Original Weather Station and East Beach Sites, all located within approximately 1,600 m from the West Beach area. The sites are characterized by abandoned buildings in various states of advanced disrepair, fuel tanks, barrels, contaminated soil, hazardous materials and scattered debris.

The Main Station Area was comprised of numerous buildings including the Library Building, Generator Building, Kitchen and Mess Hall, Shower and Washroom Building, Supply Depot, Accommodations Building, Maintenance Garage and Boiler / Incinerator Building. The Old Hamlet Area includes the remains of numerous Inuit dwellings while the Original Weather Station includes debris from two warehouses, the original powerhouse and additional Inuit dwellings. There are poorly defined access trails linking the site areas. A fresh water lake is located approximately 1.5 km northwest of the Main Station along an additional access trail. An overall plan showing the site areas is provided on Figure 1.0.

2.2 Remedial Protocols and Criteria

The remedial recommendations provided herein are based primarily on the latest version of the INAC Abandoned Military Site Remediation Protocol (AMSRP) (INAC 2009), which provides assessment and remedial guidelines for Waste Disposal Areas (WDA's) including dump sites, landfills and debris areas; disposal of barrel contents; development of borrow sources and landfills and provides clean-up criteria for contaminated soil. There are no criteria for the classification of hazardous waste at federal sites, except for materials regulated under the Canadian Environmental Protection Act (CEPA), including the Inter-provincial Movement of Hazardous Waste Regulations. The classification and remedial recommendations for materials not covered under CEPA has been based on the Transportation of Dangerous Goods (TDG) Regulations and the Nunavut/NWT Guideline for the General Management of Hazardous Waste (1998), under the territorial Environmental Protection Act (R.S.N.W.T 1998 c.E-7). More detailed information related to remedial guidelines or requirements under the sources noted above is provided in the issue-specific sections below.

2.3 Site Specific Remedial Considerations

The following sections provide site specific considerations that have been applied in the development of this Remedial Action Plan.

2.3.1 Off-Site Access

The Padloping Island site is located along the eastern coast of Baffin Island and barges have historically landed at the West Beach Area. The ground at the beach is comprised of generally well drained, coarse-grained beach deposits, which are competent and are not expected to pose a problem for beaching or using heavy equipment in the area for movement of materials upon landing. Tidal prediction rates for August and September were available for two nearby sites - Qikiqtarjuaq to the west and Cape Dyer to the east - from the Department of Fisheries and Oceans (DFO) website. For this time of year, tidal fluctuations are in the order of approximately 1.2 m at Qikiqtarjuaq and 2.4 m at Cape Dyer.

AECOM has obtained nautical charts published by the Canadian Hydrographic Service. These nautical charts indicate the presence of an anchorage area approximately 800 m from the shore at the West Beach Area at Padloping Island. These nautical charts also include suitable ocean depth information for access corridors to and between Padloping and Durban Island.

There were two sunken barges observed at the West Beach Area during the 2010 Site Investigation at Padloping Island, indicating that barge landing has occurred in the past. Also, the “Le Diamant” cruise ship operated by Compagnie du Ponant from France was observed accessing the site area during the 2010 Site Investigation. Based on the above information, barge or sealift landing at Padloping Island is not expected to pose a significant challenge.

Because of the general location and distance from any communities, combined with the availability of barge access, it is possible, but considered unlikely that overland mobilization (i.e. cat train) would be considered a viable option for contractor mobilization. It has therefore been assumed for the preparation of this RAP and its associated cost estimate, that primary access to the site for mobilization and demobilization of contractor equipment and supplies for remediation will be via barge or sealift.

Since there is no airstrip at Padloping Island, it is anticipated that the remediation contractor will utilize a helicopter to facilitate crew transportation and food re-supply flights during the summer construction season.

The site assessment and provision of a RAP for the FOX-E, Durban Island Intermediate DEW Line Site is being undertaken concurrently with the Padloping Island site. Other INAC and Department of National Defence (DND) abandoned military site remediation projects have realized cost savings by having concurrent operations and consolidated waste disposal facilities for two sites as opposed to one. The PIN-D and PIN-E remediation contracts were combined into one contract with a consolidated NHW facility at PIN-D. The PIN-B and PIN-2 contracts were awarded to the same contractor and operated concurrently with successful sharing of resources.

If the Padloping and Durban Island projects were combined into one contract, then it is expected that the work activities could be done concurrently and the Contractor could shuttle workers between the Padloping and Durban Island sites with a helicopter or boat.

PWGSC and INAC have also expressed interest in “Walkaway Solution”, where a design would be implemented that would eliminate the requirement for long term monitoring. The “Walkaway Solution” design would include the elimination of any new on-site disposal and would require the off-site shipment of all waste and contaminated soil to established licensed disposal facilities in the south. A “Walkaway Solution” design was successfully implemented at the Bear Island Mid-Canada Line Radar Site.

2.3.2 On-Site Access

There are a number of access trails throughout the site which connect the Main Station Area with the Beach Areas, Old Hamlet Site and the Water Supply Lake. These routes were often times, barely discernable in the field and consisted of trails where the surficial vegetation had been bladed away in the past and had re-established since. The access trails are typically 3 to 4 m wide and consist of slightly depressed pathways in the tundra vegetation. In some cases, the access trails have become preferential drainage pathways for surficial runoff and are quite wet. There are various drainage pathways running across the access trails to the Water Supply Lake and Beach Areas. These sections are barely passable with ATVs and may be more problematic in the spring.

The existing site access trails are not expected to be suitable to allow access for heavy equipment or pick-up trucks. Access roads will have to be completely established by constructing roadway embankments with sandy gravel material from local borrow sources. It would be preferable to use the existing site access routes so as not to impact undisturbed native tundra areas. The top width of the roadway embankment should be constructed with a minimum top width of 5 m for single lane heavy construction equipment traffic. Widened or pull out sections will be required for two way heavy equipment traffic.

2.3.3 Environmental Considerations

Information regarding traditional knowledge and land use of the site was obtained through conversations with Mr. Johnny Kooneeliusie (Bear Monitor) during the site investigation activities. Mr. Kooneeliusie indicated that the site was a former Inuit Community and has historically been used for hunting and fishing.

The indigenous wildlife of the area includes the polar bear, arctic fox, arctic hare, ermine, lemming, ptarmigan, snowy owl, geese, migratory seabirds and marine mammals including whales, walrus and seals. In Davis Strait and the surrounding rivers, lakes, and fjords, there are Arctic cod and char, as well as sculpins and Greenland sharks in some of the fjords.

The vegetation is typical of East Baffin Island tundra and is composed of low-lying scrub consisting of willows, grasses, sedges, lichens and mosses.

2.3.4 Geology/Geomorphology/Hydrology

The surficial geology at Padloping Island is predominantly exposed bedrock overlain by thin patches of till and erratic boulders and residuum fields of predominantly bedrock blocks with interstitial sand and gravel with some glacial erratic and till mixed in by freeze-thaw action. At the site location, the surficial geology is comprised of ground morainal glacial till. The ice flow in the area generally came from the south and/or southwest, so the composition of the till probably reflects bedrock in that direction.

The bedrock at Padloping Island mainly consists of Precambrian sedimentary migmatite and metamorphosed greywacke, siltstone and pelite of the Hoare Bay Group. About 10 km north of the south end of the island, there is a roughly east-west striking, 1 km wide shear zone of foliated granite of the Cumberland Batholith. At the northeast end of Padloping Island, about 15 km from the site, overlying the Precambrian rocks, there are coarse clastic sedimentary rocks (sandstone, mudstone, and conglomerate) of the Cape Searle and Quqaluit Formations overlain by basaltic volcanic rocks of the Cape Dyer Formation.

A background geochemical assessment was undertaken for Padloping Island and reported in (ESG 2010). The goal of the background geochemical assessment at Padloping Island was to establish what the natural levels of inorganic contaminants are in the surrounding environment. The report concluded that naturally occurring, slightly elevated background levels of nickel in soil were discovered at the Padloping Island site. Further discussions on the implementation of this study, relative to the criteria included in the INAC ASMRP, are provided in Section 6.2.

The Padloping Island site areas, including the Main Station, Old Hamlet and Original Station, are situated in a broad valley, approximately 4 km wide with a steep cliff to the west and undulating hills to the east. The valley slopes relatively consistently at about 8% towards the bay to the south.

Based on the results of the 2010 investigation, there are no site areas exhibiting significant signs of mineral soils erosion as a result of existing site drainage. Most of the site has nearly continuous organic cover and the natural drainage channels typically flowed within the organic layer with no significant erosion in the mineral soil underlying the organics. Areas near the coast may be subject to future erosion by wave action in the event of sea level rise with global warming. Any borrow development in the vicinity of the beach areas may require drainage control to prevent sediment loading to the coastal area. Areas covered with organics and identified for new development (borrow and potential new landfill construction) may be at risk for erosion if the areas are left exposed.

2.3.5 Archaeological Features

Golder Associates have completed an archaeological investigation at Padloping Island and summarized the findings in the report “Archaeological Impact Assessment (AIA) of the former USAF Padloping Island Weather Station, Padloping, Nunavut”, which is provided in Appendix F. The findings and results are summarized below in Table A.

Table A - Summary of Archaeological Features and Recommendations

Site	Site	Significance	Recommendations
MgBu 5	Weather Station	Limited	No further work is recommended
MgBu 6	Inuit Settlement	High	Avoidance is recommended
MgBu 7	Graveyard	High	Avoidance is recommended

2.3.6 Community Consultation

A community meeting was held in Qikiqtarjuaq on February 21, 2011 and included a presentation from Stephen Hooey from INAC on the proposed remediation programs at the Padloping Island and FOX-E, Durban Island sites. Taylor Eshpeter from AECOM also attended to provide support and answer technical questions on the remedial options presented. The presentation was held in the town hall gymnasium and attracted approximately 40 community members. The presentation communicated the intent of the clean-up, as outlined in the draft version of this RAP, while adding additional information on the “Combined Contract” and “Walk-Away Solution” design scenarios. The community showed interest in the project, especially for the prospect of employment. Following the presentation, the floor was open to questions or concerns by the community. There were no concerns raised by the community regarding the remedial options presented for the two sites. One elder, though, was keen to share his knowledge of the area, especially for Padloping where he lived for years while the site was in operation. Notes from his conversation are summarized below.

The following items represent the discussions held with Markosie Audlakiak at the community meeting:

- 1,000 boxes of dynamite were stored on-site at Padloping Island. This dynamite was probably detonated previously, but we should keep in mind that there might be some left over.
- The dynamite was stored well away from the Hamlet area and was covered with a tarp.
- The American Army detonated the dynamite after WWII. But there might still be some left.
- When the dynamite detonated, the whole island shook and pictures fell from the walls of houses.
- We should make sure there is no dynamite remaining.
- They were red sticks, with detonators attached.
- Some of the dynamite and ammunitions may have been dumped in the sea.
- On the other side of Padloping Island, there may be some large equipment submerged in the sea.
- On Padloping Island, there was a radio station located on the top of the adjacent mountain. There might still be some equipment up there.

- The radio equipment was used to test for the location of the DEW Line Sites.
- Padloping Island was closed after they opened the DEW Line Site.
- There might be some stone rings near the old hamlet site.
- At Padloping Island, there was a weather station, residents for employees and two garages. Markosie's concern is that there may be some PCBs in the building where they inflated the weather balloons.
- The engines of the D8 dozers at Padloping Island might still be in good condition.
- There were many cases of frost bite at Padloping Island. One person died of impact to the head.
- There is still some building materials left at Padloping Island, including insulation.
- Where the dynamite was blasted at Padloping Island, there is still a cratered area that is visible.
- At Padloping Island, the existing road could potentially be upgraded into a runway.
- At Padloping Island, DC3's would land at the site in the winter and floaters would land in the summer.
- At Padloping Island across from the main site on a point there might be a grave site and a camp site from the 1800's. Markosie indicated that he visited the graveyard last year and he observed that the gravesites were all damaged, except one.

The following represents the question and answer session between Stephen Hooey from INAC and Markosie Audlakiak at the community meeting:

- Stephen H. – "How were the graves marked?"
- Markosie A. – "They must be very old. Without coffins. Bones are visible."
- Stephen H. – "How many graves are there at this location?"
- Markosie A. – "The exact number is unknown."
- Stephen H. – "What is the name of this area where the graves are located?"
- Markosie A. – "Amittuarjugusiq."
- Stephen H. – "Is this area well known?"
- Markosie A. – "Yes, it is well known, but the campers are deceased. I traveled there by canoe."
- Stephen H. – "Are there other artefacts in the area?"
- Markosie A. – "In 1955, when they closed Padloping Island, they traveled by dog sled to Qikiqtarjuaq. There are very few people remaining who lived at Padloping Island. I know all the people who had lived there are here in this areas. If you have any questions, please call."

To act on this knowledge, an allowance should be included for explosive experts in the Potential Additional Work (PAW) of the tender documents. Additionally, there should be no reason that equipment or personnel will be on adjacent islands during construction; therefore, disturbing historical camps or graves on these adjacent Islands is highly unlikely.

The local participants at Qikiqtarjuaq also identified a request for a fish and shellfish sampling program at the Freshwater Lake and shoreline at the Padloping Island site.

2.3.7 Site Assessment Information

The preparation of this RAP has been based on data from the following reports:

- AECOM, November 2010, Phase III Environmental Assessment, Padloping Island Former US Coast Guard Weather Station, prepared for Public Works and Government Services Canada;
- AECOM, November 2010, Phase III Environmental Assessment, FOX-E, Durban Island, NU, Intermediate DEW Line Site, prepared for Public Works and Government Services Canada;
- Andzans Associates, 1984 - DEW Line Datafile Covering Letter;
- AVATI Ltd., 1997 - Remediation Options for Abandoned US Coast Guard Bases at Cape Christian and Padloping Island, NWT;
- DND, 1987 - Padloping Island Military Inspection Form;
- Earth Tech/PWGSC, 2001-2002 - Limited Phase III Environmental Site Assessment and Limited Remedial Action Plan;
- ESG/RMS, 1997 - An Environmental Assessment of Padloping Island, NWT (Phase I & II);
- ESG, 2010 - Padloping Island Background Geochemistry Study;
- Gartner Lee, 2003/2004 - Contaminated Sites Water Monitoring Program – East Nunavut;
- Holtz *et al.*., 1986 - Removal of Contaminants from DEW Sites in Canada's Eastern Arctic;
- Qikiqtaaluk Corporation, 1998 - Risk Assessment for 7 Abandoned Military Stations in the Eastern Arctic;
- SENES, 2003 - Padloping Island Human Health Screening Level Risk Assessment; and
- SENES, 2003 - Padloping Island Ecological Risk Assessment.

3. Dump Remediation

3.1 Dump Remedial Protocol

The evaluation of Waste Disposal Areas (WDA's) at Padloping Island, including dump site, landfill and debris areas, was completed with the goal of classifying the WDA's according to the three categories specified under the INAC Abandoned Military Site Remediation Protocol (AMSRP):

- ***Class A - High Risk:*** WDA's located in an unstable, high erosion location. Remediation will involve relocation of dump contents to an engineered landfill.
- ***Class B - Moderate Risk:*** WDA's in a suitable, stable location, but there is evidence of contaminant migration. Remedial solutions include the installation of an engineered containment system, or relocation, whichever is deemed more cost effective.
- ***Class C - Low Risk:*** WDA's in a suitable, stable location, and there is no evidence of contaminant migration. In such cases, the debris may be left in place, with the placement of additional granular cover as required.

WDA's greater than 1000 m^2 in size are typically referred to as Dump Sites or Existing Landfills and their assessment involves the collection of soil samples up and down-gradient of the areas, at surface and depth. Contaminant concentrations obtained from down-gradient samples are compared to those from up-gradient samples, and also to average levels of contaminants from all of the Landfill assessment samples. Where down-gradient samples were consistently higher than up-gradient (by at least two times the concentration of average or up-gradient samples), and elevated concentrations were present over a significant proportion of the total sample locations (i.e. more than one isolated event), the Landfill was evaluated to have evidence of contaminant migration. The potential for surface soil contamination was also assessed by noting any staining or the presence of types of debris that might act as contaminant sources (such as battery debris). In areas where contamination was suspected, surface and shallow depth soil samples were collected to assess and delineate the extent of contamination.

WDA's less than 1000 m^2 in size are typically referred to as Buried Debris Areas and are typically not investigated to the same detail as Dump Sites or Existing Landfills, which are greater than 1000 m^2. It is unlikely that leachate containment will be cost effective when compared to excavation for Buried Debris Areas. If contaminants are present, the AMSRP recommends that the Buried Debris Areas be excavated to their full extent. If there is no contaminated soil present within Buried Debris Areas, then the AMSRP recommends that the debris should be cut off and removed within the Upper 0.5 m of the ground surface and the ground surface should be regraded to match surrounding topography.

The following sections describe specifics related to the three recommended requirements for each of the three classes of WDA's. For all WDA's, it is recommended that any surface debris or surface contaminated soil be removed prior to initiating the WDA remediation remedial requirements outlined above.

3.1.1 Excavation/Relocation (Class A Dump Site or Landfill)

All WDA's have the potential to contain buried hazardous waste materials and contaminated soil, in addition to the expected non-hazardous waste debris. For this reason, where the recommended remedial action is excavation and relocation of WDA contents, the contents of the WDA will require segregation during excavation to allow classification of the various waste streams. Debris should be separated from soil, with segregation of hazardous and non-hazardous waste. Soil should be sampled to identify any contaminant levels. Contaminated soil identified during sampling should be disposed of according to the requirements outlined in the INAC AMSRP provided in Appendix F.

Through work on the DND DEW Line sites, AECOM has developed and maintained a database recording the breakdown in WDA excavation components. This database is currently comprised of WDA excavation information from 15 sites. From this database, the average excavation volume breakdown is as follows:

- Tier I soil: 15%
- Tier II soil: 20%
- Non-hazardous debris: 15%
- Hazardous debris: 2%
- Clean fill: 48%

For excavation of WDA's at DEW Line sites under the jurisdiction of the Department of National Defence (DND), AECOM has typically applied these standard percentages during the design stage. However, where site-specific information suggests a higher or lower level of contaminated soil (based on the results of environmental sampling), a higher level of hazardous debris component (based on exposed debris observations), or different concentration of debris (i.e. higher or lower debris content based on extent of cover or a weak and/or spotty geophysical anomaly), the percentages have been modified accordingly.

Based on observations from other northern military sites under INAC's jurisdiction and on observations from historical air photo review completed at DND DEW Line sites, it was common during the early stages of site operation that debris disposal at WDA's did not, generally, involve the placement of cover over debris upon disposal. WDA's in these circumstances were typically comprised almost entirely of debris and oftentimes had contaminated soil associated with them as a result of the type of debris disposed, but there was little-to-no surface cover. At the DND sites, however, where the sites were in operation over a longer period of time, landfilling operations gradually evolved such that debris began to be covered with granular fill with the common implementation of excavation of existing ground, stockpiling of excavated granular material and placement of debris, with subsequent debris backfilling with the stockpiled granular material. The DND WDA's typically have reasonably good surface cover overlying debris, with the majority of debris exposure restricted to along the toe, where backfilling was not so thorough. Observations from Padloping Island suggest that small localized pockets of debris were buried with soil excavated from adjacent ground as ponded areas remain in some cases.

The results of the geophysical surveys at Padloping Island Buried Debris Areas (in terms of anomaly strength) suggest that a lower concentration of debris is present in these Buried Debris Areas, compared to typical DND site WDA's, which is consistent with their operation over a much shorter timeframe. However, a definitive comparison could not be completed because the geophysical method used at Padloping Island was slightly different than that which has been used at DND sites. Contaminated soil was not identified at the Padloping Island Buried Debris Areas and contaminant levels observed down-gradient were never at significantly high concentrations. These observations suggest that a lower level of contaminated soil should be expected from within the WDA contents. The standard component breakdown for Buried Debris Areas at the Padloping Island site has therefore been assumed as the following:

- Tier I soil: 10%
- Tier II soil: 10%
- Non-hazardous debris: 20%
- Hazardous debris: 1%
- Clean fill: 59%

The volume of non-hazardous debris has been assumed to be the same as the average breakdown from DND sites because of the inability to compare the geophysical survey results directly. This is felt to be a conservative measure. The percentages of Tier II and Tier I soils, and hazardous debris has been decreased, with a corresponding increase in the volume of clean fill. As noted above, these standard percentages have been further modified where warranted by dump-specific information.

WDA's requiring excavation should be excavated to the limits of debris. Where contaminated soil has been detected in the excavated contents, it is also recommended that confirmatory testing of the excavation base be completed to ensure no contaminated soil remains. The excavation area should be backfilled and graded to conform to surrounding terrain and provide positive drainage.

3.1.2 Leachate Containment (Class B Dump Site or Landfill)

The typical design that has been used for leachate containment at existing northern military site WDA's involves the excavation of a trench just beyond the limits of the buried debris. The trench extends into either ice rich permafrost or saturated ground, typically at a depth of about 1.0 m or shallower at the Padloping Island site. A geosynthetic liner system is placed extending from the base of the trench over the Landfill area. The trench is then backfilled with low-permeability (Type 4) granular fill which may also extend upslope of the trench. Well graded sand and gravel (Type 2 fill) is placed and compacted over the surface to a thickness that will promote permafrost aggradation through the key trench and into the Landfill contents. The primary long-term containment system is the saturated granular fill. Once the material freezes, it becomes a low-permeable containment barrier. The geosynthetic liner provides essential short-term containment until permafrost aggrades into the Landfill and continues to provide longer-term containment following freeze back.

Geothermal modelling completed for the remedial design at the nearby DYE-M (Cape Dyer) site, where terrain and vegetative cover is similar, specified a design thickness of 3.9 m of Type 2 fill at the Lower Site for freezeback of contents. Geothermal modelling considered 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 (from 1959 to 1999 from Environment Canada), an estimated 1 in 100 warm year air temperatures, and an estimate of the effect of global warming. The effect of global warming was estimated using the most recently published data summarizing global warming rate estimates for Arctic environments (ACIA 2005). The design cover thickness specified for the Lower Site at DYE-M has been used for consideration of remedial options at Padloping Island.

This remedial option has initiated the need for significant post clean-up monitoring with the installation of thermistors within the dump to confirm that contents are frozen. To confirm that no further contamination migration is occurring, groundwater monitoring wells are installed up and down-gradient for the collection of groundwater samples and soil samples are collected adjacent to the monitoring wells. This monitoring has typically been done on a yearly basis for the first five years following site clean-up (which is the estimated time required to achieve thermal equilibrium), and then upon a reduced frequency after 5 years.

Because of the complicated construction requirements for the contractor and the need for long-term monitoring, this remedial option is oftentimes not cost-effective, when compared to excavation, for smaller WDA's. For this reason, the option of excavation has also been evaluated in discussions below for dumps classified as Class B.

3.1.3 Regrading (Class C Dump Site or Landfill)

For WDA's located in a geotechnically stable location, with no evidence of contaminant migration, the recommended remedial action is regrading with the placement of additional granular cover. It is typically recommended that the extent of regrading be extended slightly beyond the extent of the identified limits of debris (a 2 m offset has been used historically). The granular fill cover placed over the WDA should be well-graded (Type 2), erosion resistant, and well-compacted to limit infiltration of water. Where there is the potential for erosion from surface drainage, it is typical to strategically place armouring material (Type 1 Granular Fill). The placement of fill should be configured in such a way so as not to promote ponding of water and graded to conform to surrounding terrain. Typically, a fill thickness of 0.75 m has been used, but for smaller areas, with no appreciable topographic expression, a thinner fill thickness of 0.5 m has been applied.

The following sections provide a summary of the Buried Debris Areas identified at Padloping Island and recommendations for remediation.

3.2 Original Station Buried Debris Areas – Lobes A, B and C

Lobes A, B and C are Buried Debris Areas located at the Original Station Area, as shown on Figure 6.0 in Appendix A. The geophysical survey indicated that Lobe A covers a plan area of about 18 m^2 and is situated adjacent to the original powerhouse building footprint. Lobes B and C comprise an area of 135 m^2 and 64 m^2, respectively and are both located on the beach ridge at the southern portion of the Original Station Area near the ocean. These buried debris lobes will be most easily accessed from the ocean beach ridge which consists of coarse gravel and cobbles.

Very little surface debris was noted on the surface of Lobes A, B, and C. These buried debris lobes were all completely covered with a surficial organic layer with an occasional exposed rock. There are numerous drainage channels running through the organic layer in the vicinity of the Original Station Area with the overall surface drainage to the southwest towards the ocean.

The ocean is the aquatic receptor for these buried debris lobes and these area would be subjected to flooding during storm surges. No animal burrows were identified at these buried debris lobes, likely because of soil saturation levels. No surface staining was identified at Lobes A, B, and C and samples were not collected at this location. Lobes B and C are classified as Class A (High Risk) Buried Debris Areas because of their location in a geotechnically unstable, high erosion location. Because of their immediate proximity to the marine environment, it is recommended that Lobes A, B, and C be excavated in their entirety. The estimated depth of debris is 0.75 m, for a total excavation volume of 163 m^3. The estimated excavation component breakdown has been assumed as the average values: 10% Tier I, 10% Tier II, 20% non-hazardous debris, 59% clean fill, with a hazardous waste allowance of 1%.

3.3 Old Hamlet Buried Debris Area - Lobe D

Lobe D is a small Buried Debris Area located in the concentrated surface debris zone at the Old Hamlet Site, located approximately 700 m east of the sunken barges at the West Beach Area, as shown on Figure 5.0 in Appendix A. The geophysical survey indicated that Lobe D covers a plan area of about 13 m^2 and is situated approximately 50 m from the ocean. This buried debris lobe will be most easily accessed from the ocean beach ridge which consists of coarse gravel and cobbles. There is an access trail just up-gradient of the beach ridge that runs from the West Beach to the Original Station Area; however, this trail is not expected to be suitable for construction traffic access as it traverses wet, soft tundra areas.

The Lobe D and Original Hamlet Area is moderately disturbed with a fair amount of surface debris consisting of wood, metal barrels, domestic waste and the remains of wooden Inuit dwellings. The cover soil consisted primarily of thin layer of surface organics with some exposed sandy gravel surface and the occasional exposed boulder or rock outcrop. The Hamlet site slopes gently at a 3 to 4% grade to the south toward the ocean. No evidence of erosion was noted at this buried debris lobe.

The environmental investigation did not indicate contaminant migration from the minimal buried debris at Lobe D and this buried debris lobe is situated in a disturbed and geotechnically stable area. Lobe D is therefore assessed as a Class C (Low Risk) with an associated remedial action of regrading. Because of the very small size of this lobe, its location in a disturbed area and the extensive surface debris removal that will take place in this area, it may be preferable to excavate this lobe to be able to complete the debris removal at the Old Hamlet Area.

The estimated depth of debris in these lobes is 0.75 m, for a total excavation volume of 10 m^3. The estimated excavation component breakdown has been assumed as the average values: 10% Tier I, 10% Tier II, 20% non-hazardous debris, 60% clean fill.

3.4 Pond Buried Debris Area - Lobes E, F and G

The Pond Area includes three buried debris Lobes E, F and G located approximately 700 m north of the Main Station Area as shown in Figure 7.0 in Appendix A. This area includes a small pond with slightly mounded areas on three of four sides and a drainage course / outlet on the fourth (southwest) side. This area was accessed along a very wet, 400 m long access trail off the main site access trail from the Station Area to the Freshwater Lake. The geophysical survey identified Pond Buried Debris Area Lobes E, F and G to have areas of 23 m^2, 58 m^2, and 107 m^2, respectively

There was occasional surface debris noted at the Pond Area buried debris lobes, consisting of wood, steel debris and cable. The cover soil consisted of exposed gravel and cobbles immediately adjacent to the pond and continuous organic cover further outside of the pond. The overall drainage of this area is to the southwest towards the Tidal Bay, which is approximately 900 m away. The grade is gentle to flat, with a 2 to 4% slope to the southwest. There was significant flow from the outlet/drainage course on the south side of the pond, adjacent to Lobe G and erosion of the surface organics along drainage course. There was no surface staining noted or evidence of contamination migration from these buried debris lobes.

Lobe G is located adjacent to the outlet / drainage course on the south side of the pond and there is the potential for erosion and exposure of this landfill lobe over time. This application of a granular cover to Lobe G is therefore not considered stable in the long term for this location and the recommended remedial option is full excavation of Lobe G. The natural vegetation cover at Padloping Island insulates and stabilizes the soft wet ground in this general area. Because Lobes E and F are very small and located on the perimeter of the pond where the organic cover has been disturbed and the water levels of the pond could fluctuate, it is also recommended that Lobes E and F be excavated in their entirety in conjunction with Lobe G.

The estimated depth of debris in these lobes is 0.75 m, for a total excavation volume of 141 m^3. The estimated excavation component breakdown has been assumed as the average values: 10% Tier I, 10% Tier II, 20% non-hazardous debris, 59% clean fill, with a hazardous waste allowance of 1%.

3.5 Station South Mound Buried Debris Area - Lobes H and I

Lobes H and I are Buried Debris Areas located at the South Mound Buried Debris Area situated on the south side of the Main Station Area, as shown on Figure 2.0 in Appendix A. The geophysical survey indicated that Lobes H and I cover a plan area of 55 m^2 and 21 m^2, respectively. These buried debris lobes are accessible from the main access trail.

The South Mound Lobes H and I are moderately disturbed with occasional surface debris consisting of wood, metal and barrels. The cover soil consisted primarily of thin layer of surface organics with some exposed sandy gravel. The Main Station Area slopes gently at about 2 to 4% grade to the south toward the Ocean. No evidence of erosion was noted at this buried debris lobe.

The environmental investigation did not identify any contaminant migration from the buried debris lobes H and I, which are is situated in a disturbed and geotechnically stable area. Lobes H and I are therefore assessed as Class C (Low Risk) with an associated remedial action of regrading. Because of the very small size of these lobes, their mounded shape and the surrounding organic-rich terrain, it may be preferable to excavate this lobe to complete the debris removal at the Main Station Area. The estimated depth of debris is 0.75 m, for a total excavation volume of 57 m^3. The estimated excavation component breakdown has been assumed as the average values: 10% Tier I, 10% Tier II, 20% non-hazardous debris, 59% clean fill, with a hazardous waste allowance of 1%. Upon completion of excavation, this area should be backfilled to match surrounding terrain and the excavated organics should be replaced as surface cover.

3.6 Station West Mound Buried Debris Area - Lobes J, K, L and M

The West Mound Buried Debris Area includes Lobes J, K, L, and M, which are situated on the southwest side of the Main Station Area, as shown on Figure 3.0 in Appendix A. The geophysical survey indicated that Lobe J, K, L, and M cover a plan area of 20 m^2, 15 m^2, 20 m^2, and 18 m^2, respectively. These buried debris lobes are accessible from the main access trail.

The West Mound Lobes J, K, L, and M are moderately disturbed with occasional surface debris, consisting of wood, metal and barrels. The cover soil consisted primarily of thin layer of surface organics with some exposed sandy gravel. The Main Station Area slopes gently at about 2 to 4% grade to the south toward the Ocean. No evidence of erosion was noted at this buried debris area.

No surface staining or evidence of contaminant migration was identified at the West Mound Buried Debris Lobes and samples were not collected at this location. These buried debris lobes situated in a moderately disturbed and geotechnically stable area. West Mound Lobes J, K, L and M are therefore assessed as Class C (Low Risk) with an associated remedial action of regrading. Because of the very small size of these lobes, their mounded shape and the surrounding organic-rich terrain, it may be preferable to excavate these lobes to complete the debris removal at the Main Station Area. The estimated depth of debris is 0.75 m, for a total excavation volume of 55 m^3. The estimated excavation component breakdown has been assumed as the average values: 10% Tier I, 10% Tier II, 20% non-hazardous debris, 59% clean fill, with a hazardous waste allowance of 1%. Upon completion of excavation, this area should be backfilled to match surrounding terrain and the excavated organics should be replaced as surface cover.

A summary of the buried debris areas at Padloping Island is provided in the Table C-1 in Appendix C.

4. Hazardous Waste Remediation

4.1 Protocols and Regulatory Requirements

The AMSRP defines hazardous waste materials as any materials, which are designated as "hazardous" under Nunavut Territorial or Federal legislation; or as "dangerous goods" under the Transportation of Dangerous Goods Act (TDGA) and regulations.

As part of the assessment of Padloping Island, an inventory of hazardous waste materials was compiled and supplemented with sampling during the 2010 site investigation. Various hazardous waste materials were identified during the survey and included site debris, consisting of asbestos, batteries, gas cylinders, electrical components and lead sheathed cable.

The storage, treatment, and destruction of PCB materials with concentrations of greater than 50 mg/kg are regulated under the Chlorobiphenyls Regulations, which are governed by the Canadian Environmental Protection Act (CEPA). The regulations have been amended recently and Part 1 Section 1(2) of SOR/2008-273, that came into effect on September 17, 2008, states, "*For the purposes of these Regulations, if a solid or a liquid containing PCBs is composed of several matrices, the concentration of PCBs is based on the mass of the matrix in which the PCBs are located*." This means that for classification of waste painted with PCB amended paint, the mass of the substrate cannot be factored in with the mass of the paint to determine a total PCB concentration for the painted item as a whole, as has been done previously. All paint testing from the 2010 site investigation returned results indicating very low PCB concentrations and the application of these regulations is not an issue at the Padloping Island site.

Previously, where materials were not regulated under CEPA, classification of hazardous waste defaulted to the federal TDG Act and Regulation under Guideline for the General Management of Hazardous Waste. At Padloping Island, materials classified under these regulations tend to be associated with painted materials where PCB concentrations were not in excess of CEPA concentrations, but where lead concentrations may be in excess of the leachate criterion stipulated under the TDG regulations, which have been amended (Amendment 6 - SOR/2008-34) so there is no longer a classification of materials with toxic leachate. Regulations regarding movement of these materials now falls to Environment Canada (EC) under the following two regulations: Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (1999, 2005 amendment), and Interprovincial Movement of Hazardous Waste and Hazardous Recyclable Material Regulations (1999, 2002 amendment). Both EC documents specify a criterion for lead leachate at 5 mg/L, which was the same criterion previously specified under the TDGR.

Projects that will result in the disturbance of Asbestos-Containing Materials (ACMs), including vermiculite, must satisfy the regulatory requirements under the Canada Labour Code - Part II and the Nunavut Environment Protection Act. In addition, the Canadian Occupational Safety and Health Regulations, Part X - Hazardous Substances would be applicable to asbestos-containing materials. The Environmental Guideline for Waste Asbestos (GN 2002) defines asbestos-containing materials as any type of material with greater than 1% asbestos by weight.

Treated or creosote-impregnated waste materials (e.g. poles, timbers, etc.) are only considered "toxic", as defined under Section 11 of CEPA, if the waste creosote or its component compounds enter or are likely to enter the environment in a concentration or quantities or under conditions that could lead to exposure of humans or other biota at levels that could cause adverse effects. At northern military sites, these components have been determined to be non-hazardous as the components leach at a very slow rate and as such, do not present a threat to the environment if properly contained.

4.2 Surface Debris Component

A surface debris inventory was completed by dividing the site into sections with coverage of the areas completed on foot or by ATV. The limits of debris were identified by hand-held GPS by collecting waypoints at each transect where no further debris was visible or, in areas where debris was more sporadic, by collecting waypoints at debris locations. The GPS waypoints were downloaded onto the site plan drawing and the debris area perimeters were drawn by connecting the debris limit waypoints, or by grouping individual debris locations accordingly. The areas of surface debris created by these debris limits or groupings were assigned a name or numerical label. Along transects, debris types were noted, and volumes were tracked, with a total volume and description of all types of debris recorded for each debris area.

There are no buildings that remain standing at Padloping Island as all of the structures have been burned, previously demolished or collapsed over time due to weather. Most of the building debris remains at or near the original building footprint. As such, all site waste, including building debris, at Padloping Island has been designated as surface or buried debris.

Three paint samples were collected from the site debris at Padloping Island to assess PCB and lead concentrations. Samples were collected from two generators (yellow and orange) remaining at the Generator Building while the third sample was collected from a paint can south of the Maintenance Garage containing the same mint green paint that was found on some small pieces of site debris. The maintenance garage sample was also submitted for leachable lead analysis.

The results from the paint analysis found that none of these samples had PCB levels above the Canadian Environmental Protection Act (CEPA) criterion of 50 mg/kg. The results also found that the lead leachate from the garage sample was <0.1 mg/L and well below the TDGA criterion of 5.0 mg/L. Based on the results, these materials are considered non-hazardous and can be disposed of in an engineered NHW landfill.

Two concrete samples were collected, each from stained areas on the concrete supporting the generators at the Generator Building and the Old Generator Building. The results found that the PCB concentration in these concrete samples was <0.1 mg/kg and 0.2 mg/kg, respectively and well below the CEPA criterion of 50 mg/kg. Based on the results, these concrete materials are considered non-hazardous and can be disposed of in an engineered NHW landfill.

The surface debris survey identified approximately 34 m^3 of hazardous site debris consisting primarily of asbestos containing materials and barrel contents. A summary of hazardous waste components identified from the surface debris inventory is provided in Table C-2 in Appendix C. Specifics related to barrel contents are discussed below.

4.3 Barrel Component

The classification of barrel contents and remedial requirements is based on the Barrel Protocol outlined in the INAC AMSRP. This protocol provides specifics related to when hydrocarbon-containing barrels may be safely incinerated on-site, may be safely discharged (in the case of aqueous contents), and where contents require off-site disposal. The specifics of the protocol are provided in the INAC AMSRP in Appendix E.

The assessment of barrels was completed at the same time as the inventory of surface debris; contents were identified as either aqueous or hydrocarbon-containing, and their classification and sample number (if applicable) was noted on the barrel with a paint marker.

The 2010 site investigation identified numerous caches with crushed or intact barrels located primarily in the vicinity of the Main Station and West and East Beach Areas. A volume estimate of the crushed barrels was facilitated by the surveyor who located the extent of the crushed barrel piles. AECOM also identified 1261 uncrushed barrels

(scattered or in small piles) at the site, located primarily along the road to the Freshwater Lake and to the west of the Main Station and Metal Dump access roads. The majority of barrels identified are empty and will require no sampling or processing during clean-up.

A total of seventeen barrels were identified to have liquid contents and of these, eight barrel samples were collected and analyzed for the parameters outlined in the Barrel Protocol. The results of the barrel contents testing are provided in Table D-1 in Appendix D and indicate that all 8 samples are aqueous, do not exceed the applicable parameters and are suitable for discharge.

4.4 Demolition Component

A demolition investigation would typically be conducted to determine an inventory of the site facilities that would require dismantling for disposal. Almost all of the buildings and facilities at Padloping Island have been partially burned, previously dismantled or weathered to a state where demolition would be minor or not required at all. As such, all site waste at Padloping Island is considered to be surface or buried debris.

4.5 Estimated Dump Excavation Component

Nominal volumes of hazardous material are typically encountered during dump excavation, including, but not limited to battery waste, electrical components, asbestos, and petroleum products. As noted above, based on experience from other northern military sites, it is anticipated that a small quantity of hazardous soil will be encountered during excavation of dump sites, generally in the range of 1% of the overall excavation volume.

Based on the volume of dumps where the recommended remedial action is excavation, the estimated volume of hazardous waste to be derived is 5 m^3.

4.6 Remedial Requirements

Some of the hazardous materials identified at the site will have to be collected and transported off-site, in accordance with the Transportation of Dangerous Goods Act (TDGA) (TC 2001) and Regulations and the CEPA Inter-provincial Movement of Hazardous Waste Regulations (SOR/2002-301), to a licensed hazardous waste disposal facility.

Particulars are described below:

- Asbestos: Asbestos waste will be collected, double bagged and disposed of in an engineered NHW landfill, in accordance with the appropriate legislation;
- Petroleum Products: Petroleum products, such as gasoline or diesel, which do not contain other hazardous products according to the Barrel Protocol (chlorine, PCB, heavy metals, etc.) will be incinerated on-site under appropriate emissions controls. Heavier petroleum products such as lubricating oil will be disposed of off-site or mixed with lighter petroleum products and incinerated on-site under appropriate emissions controls;
- Compressed Gas Cylinders: Compressed gas cylinders with known contents will be vented. Once empty, the metal cylinder will be disposed of in an engineered NHW landfill;
- Creosote Treated Timbers: Timbers will be wrapped in polyethylene sheets and disposed of in an engineered NHW landfill;
- PCB Paint on Building Components (if identified in buried debris): PCB paint and PCB painted components, which are regulated under the CEPA, will be collected and transported off-site, in accordance with the Transportation of Dangerous Goods Act and CEPA, to a licensed PCB disposal facility; and
- Lead-Based Paint on Building Components (if identified in buried debris): Lead-based painted components which are classified as hazardous material will be collected and transported off-site, in accordance with the CEPA Inter-provincial Movement of Hazardous Waste Regulations, to a licensed hazardous waste disposal facility.

5. Non-Hazardous Waste Remediation

5.1 Surface Debris Component

The method for completion of the surface debris inventory is described above. Based on the 2010 ESA inventory, the majority of surface debris was identified as non-hazardous, including barrel contents. The estimated volume (crushed) is 1774 m^3. A summary of surface debris areas and volumes is provided in the Table C-2 in Appendix C.

5.2 Estimated Dump Excavation Component

As noted above, the estimated volume of non-hazardous waste from dump excavations has been based on site-specific modification of average values obtained from dump excavations at other northern military sites. In certain cases, based on the results of the geophysical survey and ground truthing, this number has been modified. The total volume estimated to arise from dump excavations has been estimated as 86 m^3.

5.3 Remedial Recommendations

The total volume of material identified as non-hazardous waste during the 2010 Phase III ESA is approximately 1860 m^3. According to the INAC AMSRP, the assessment of the need for construction of an on-site NHW Landfill should consider primarily the availability of suitable locations to build such a facility at the site. Additional considerations include the availability of appropriate granular borrow materials and the volume of non-hazardous waste identified for disposal.

At Padloping Island, two locations were identified during the Phase III ESA site investigation that would be suitable for construction of a new NHW landfill facility. There is concern, however that there is limited available Type 2 Granular Fill at local borrow sources. The facility could, however, be constructed with Type 3 or 4 Granular Fill with flatter and/or Type 1 Rip Rap-protected sideslopes. Finally, based on information from other northern abandoned military sites, the volume of surface debris at this site does suggest that construction of an on-site facility for disposal is warranted. Considerations for alternate disposal options for non-hazardous waste are discussed below and in Section 8.0.

AECOM has provided recommendations Section 8.2 to proceed with a “Combined Contract” for the Padloping and Durban Island sites and consideration should be given to a consolidated NHW disposal facility at one of these sites. Although, a NHW landfill could be built at Padloping Island, a review of the Durban Island ESA (AECOM 2010) has revealed that the landfill sites and availability of Type 2 Borrow material would make Durban Island the better location for a consolidated NHW Landfill Facility. For a “Combined Contract” design scenario, it is recommended that a consolidated NHW Landfill be constructed at the FOX-E, Durban Island Site for the disposal of waste from the Padloping and Durban Island sites.

6. Contaminated Soil Remediation

6.1 Remedial Criteria and Clean-up Protocols

The investigation and delineation of contaminated soil at Padloping Island was completed for the contaminants of concern identified under the INAC AMSRP, including arsenic, cadmium, cobalt, copper, lead, nickel, zinc, and PCBs. The INAC AMSRP identifies two levels of contamination - Tier I soil which is considered an environmental risk only when located at surface and Tier II soil which is considered an environmental risk at any depth of impact. Soils are classified as Hazardous under the Transportation of Dangerous Goods Act (TDGA) and Regulations when they leach contaminants in excess of the concentrations listed in Part V of the regulations.

Delineation of Petroleum Hydrocarbon (PHC) impacts was completed using the parameters defined in the INAC AMSRP. Analyses of PHC's in soil are typically completed using a methane extraction method and measure concentrations of carbon chain sizes between C_6 and C_{34}. Type A hydrocarbons are defined as impacts comprised of 70% or more of the heavier fractions (F3 and F4), which corresponds to impacts derived from lubricating (lube) oil or grease spills. Type B hydrocarbons are defined as those impacts comprised primarily of lighter end components (F1-F3), derived from fuel spills. The INAC AMSRP process specifies different numerical cleanup criteria based on the type of hydrocarbon impacts (Type A versus Type B), proximity to significant water bodies and depth of impacts.

Table A below provides a summary of contaminated soil remedial criteria and volumes identified during the Phase III ESA using the parameters defined in the INAC AMSRP. A more detailed summary of contaminated soil volumes is provided in Table B-1 in Appendix B. Volumes estimated to arise from dump excavations have also been noted, as these volumes have also been considered for evaluation of contaminated soil disposal options below. The total volumes noted below combine the volumes from these two sources, with the volume derived from dump excavation estimates noted in parentheses below.

Table B - Summary of Contaminated Soil Remedial Criteria and Quantities

Contaminated Designation	Description	Soil Volume (m^3)
Tier I Contaminated Soil	Soils containing concentrations of any or all contaminants listed as follows: • Lead ..... 200 to 499 ppm • PCBs..... 1 to <5 ppm	47 (43 from dump excavations)
Tier II Contaminated Soil	Soils containing concentrations equal to or greater than any or all contaminants listed as follows: • Arsenic ..... 30 ppm • Cadmium..... 5 ppm • Chromium..... 250 ppm • Cobalt..... 50 ppm • Copper ..... 100 ppm • Lead ..... 500 ppm • Mercury ..... 2 ppm • Nickel ..... 100 ppm • Zinc ..... 500 ppm • PCBs..... >5 ppm;<50 ppm	120 (43 from dump excavations)
TPH Type A Soils F3 and F4 Fractions	Soils contaminated with hydrocarbons consisting primarily of oil and grease at concentrations equal to or greater than: • TPH, Sum of F3 and F4 fractions ..... 20,000 ppm	131
TPH Type B Soils F1-F3 Fractions	Soils contaminated with hydrocarbons consisting primarily of fuel oil, and/or diesel, and/or gasoline, with concentrations equal to or greater than the following concentrations : • Beach POL Area: TPH F1 fraction..... 1,290 ppm F2 fraction..... 330 ppm • Station Area:	116 (6 within 30 m of water body)

Contaminated Designation	Description	Soil Volume (m^3)
	Surface soils to 0.5 m depth ..... 2,500 ppm (TPH, sum of F1 through F3 fractions) Subsurface soils below 0.5 m in depth ..... 5,000 ppm (TPH, sum of F1 through F3 fractions)	
Hazardous Contaminated Soil	Soils leaching concentrations of contaminants listed as follows: • Leachable Lead..... 5.0 mg/L	16

The specified remedial requirements under the INAC AMSRP are as follows:

- ***Tier I soil:*** cap in place with a minimum of 0.3 m of granular fill, or dispose of in an engineered NHW Landfill.
- ***Tier II soil:*** dispose in Secure Soil Disposal Facility (SSDF) or transport off-site for disposal in engineered territorial or provincial disposal facility;
- ***Type A Soils:*** scarify and leave in place if under criteria or dispose of in a engineered NHW Landfill;
- ***Type B Soils:*** excavate and treat ex-situ or in-situ through aeration or landfarming or dispose of in SSDF, if available. Note that disposal in the SSDF is only considered appropriate if concentrations are sufficiently low that there are no concerns for inhibiting freezing of contents and/or with free-product development, which could compromise the liner integrity at the facility.
- ***Hazardous soil:*** containerize and transport off-site for disposal in engineered territorial or provincial Hazardous Waste Landfill;

6.2 Background Geochemical Assessment

The Background Geochemical Assessment (ESG 2010) concluded that naturally occurring elevated background levels of nickel in soil were discovered at the Padloping Island site. The ESG assessment recommended that the INAC AMSRP Tier II nickel level of 100 ppm be increased to 107 ppm.

6.3 Tier I and Type A Soil

The total estimated volume of Tier I soil is 47 m^3. This volume includes the estimated Tier I component of soil that will be encountered during dump excavations, as noted above. It is recommended that the Tier I soil be disposed of in of in an engineered NHW Landfill.

The total estimated volume of Type A soil is 131 m^3, all of which is within the top 0.3 m of the identified areas. It is recommended that the Type A soil be excavated to a depth of 0.3 m and disposed of in an engineered NHW Landfill.. The Type A contaminated soil below a depth of 0.3 m can be left in place as long as the top 0.3 m is backfilled with clean granular fill.

Tier I and Type A soil can be used as intermediate fill for an on-site NHW Landfill, as required.

A detailed breakdown showing area-specific volumes of Tier I and Type A Contaminated Soil is provided in the Table B-1 in Appendix B.

6.4 Type B Soil

Various areas of PHC impacted soil (Type B) requiring remedial action were identified during the site investigation and include the Old Generator Building Maintenance Shed, Boiler/Incinerator Building, West Barrel Cache and Former AST Site. The total volume of PHC Type B soil identified for remediation is 116 m^3. A summary of contaminated soil volumes by area is presented in Table B-1 in Appendix B.

Remedial options applicable to the treatment of hydrocarbon impacted soil include:

- In-situ biological treatment or chemical oxidation;
- Ex-situ, on-site aeration (using an excavator with standard or “Allu” type bucket;
- Ex-situ, on-site aeration and biological treatment (landfarming); and
- Ex-situ, off-site treatment and/or disposal in a Licensed Disposal Facility.

Advantages and disadvantages of each treatment option are described in Table B. Based on the applicability of the various treatment options at Padloping Island, the recommended remedial option is on-site ex-situ aeration, (using a standard or “Allu” type bucket) or on-site ex-situ aeration and biological treatment, (i.e. landfarming).

Recent monitoring results from landfarm operations at a former DEW Line site (FOX-C Ekalugad Fjord) have indicated that treated soil criteria are achievable through on-site aeration and biological treatment methods; however, more highly contaminated soils may take extended periods of treatment to meet the criteria. Based on the volume of impacted soil and moderate hydrocarbon concentrations observed during the 2010 investigation, it is anticipated that aeration or landfarming may be completed within a 1 year period provided site conditions are monitored and optimized where possible (i.e., moisture conditioning, nutrient amendment).

Soils contaminated with PHC’s should be excavated and treated ex-situ by aeration or aeration with biological treatment methods in an on-site treatment or landfarm facility. Soils concentrations should be reduced, when required, to meet the criteria outlined in the AMSRP. The total volume of hydrocarbon impacted soil, requiring treatment, is estimated at 116 m^3.

Table C - Summary of Remedial Options - Hydrocarbon Contaminated Soil

Remedial Option	Description / Requirements	Applicability	Advantages	Disadvantages / Limitations	Implementation
In-situ Biological Treatment / Chemical Oxidation	• Application of ozone, peroxide or permanganate through instrumentation within the impacted area.	• Amenable to light and medium end hydrocarbons (F1, F2, F3 fractions).	• Under optimal conditions can reduce concentrations below criteria. • Minimize excavation and disturbance of existing vegetation.	• Monitoring required. • Difficult to confirm that target concentrations are met throughout the contaminated area. • Not applicable to metal contaminated soil.	• Not appropriate for hydrocarbon areas located in close proximity to water bodies (West Barrel Cache).
On-Site,Ex-situ Aeration by standard excavator or “Allu” type bucket	• Hydrocarbon contaminated soils are excavated and placed within a contained treatment area. • Soils are periodically turned and nutrients added to optimize treatment conditions.	• Hydrocarbon contaminated soils, including F1, F2 and F3 fractions.	• Contaminant concentrations reduced. • No environmental risks associated with potential spills during off-site transport. • Generally good for intense treatment of small soil volumes	• More effective on lighter end hydrocarbons. • May be difficult to aerate soils with excessive moisture, fine-grained soils and rock using the Allu system. • Impermeable membrane/low permeable soils required for containment.	• Adequate location and granular materials identified for construction of treatment facility. • Geosynthetic liner required for perimeter containment.
On-Site,Ex-situ Treatment by Landfarming / Bioremediation	• Hydrocarbon contaminated soils are excavated and placed within bermed treatment area. • Soils are periodically turned and nutrients added to optimize treatment conditions.	• Hydrocarbon contaminated soils, including F1, F2 and F3 fractions.	• Contaminant concentrations reduced. • No environmental risks associated with potential spills during off-site transport.	• More effective on lighter end hydrocarbons. • Generally requires 1-2 treatment seasons for contaminant reduction to criteria. • Restricts use of the site during treatment operations. • Impermeable membrane/low permeable soils required for containment.	• Adequate location and granular materials identified for construction of treatment facility. • Geosynthetic liner required for perimeter containment.
Off-Site Treatment and Disposal	• Contaminated soils are transported off-site for treatment or disposal.	• All contaminated soil types.	• Contaminated soils removed from site eliminating risk of exposure.	• Considerable costs associated with off-site transport. • Project costs are very sensitive to contaminated soil volumes. • Potential environmental risks during transport.	• Shipment and disposal off-site is technically appropriate, but at considerable costs.

6.5 Tier II Soil

The 2010 site investigation identified small volumes of Tier II Contaminated Soil at the Kitchen/Mess Hall, Maintenance Garage, Maintenance Shed, Water Tank Building, Metal Dump and Original Powerhouse to a depth of 0.3 m. The 2010 site investigation also identified small volumes of Tier II Copper Contaminated Soil at the Weather Building to a depth of 0.6 m and Tier II Lead Co-contaminated with Type B PHC's at the Shower/Washrooms to a depth of 0.3 m. The total volume of Tier II soil identified for remediation is 120 m^3, of which 43 m^3 is the estimated Tier II soil component from dump excavations, and 77 m^3 is from delineated contamination areas. A summary of contaminated soil by area is presented in Table B-1 in Appendix B.

The INAC AMSRP indicates that all soils with metal and/or PCB concentrations exceeding the DLCU Tier II Criteria (but not regulated by CEPA) will be disposed of according to the following options:

- On-site disposal within a Secure Soil Disposal Facility (SSDF) consisting of double containment within permafrost encapsulation and a geosynthetic liner system in the base and cover of the facility; or
- Containerization and off-site disposal at a licensed southern disposal facility.

For an on-site SSDF, the 2010 investigation identified three suitable locations for this facility, including Proposed Landfill LF-2 at the Main Station, Landfill LF-3 at the Metal Dump and Landfill / Landfarm LF-4 at the Borrow No. 6. Assessment of existing and new potential granular borrow sources was completed during the 2010 investigation. The assessment identified various locations where suitable Type 4 borrow material is available; however, borrow quantities for Type 2 and 5 are in very limited supply at Padloping Island for the construction of a SSDF. Therefore, based on the results of the 2010 assessment, there are concerns relative to borrow material availability for building an SSDF at Padloping Island.

The decision criteria to determine if a Secure Soil Disposal Facility (SSDF) is required at a northern abandoned military site is outlined in Table 5.3 of the INAC AMSRP. The site is not landlocked and landfill excavation accounts for about a third of the Tier II soil volume that requires disposal. The estimated Tier II soil volume is 120 m^3, which is less than the decision criteria volume of 300 to 500 m^3 and the risk of overrun is considered to be low to moderate. Based on the criteria outlined in Table 5.3, containerization and off-site southern disposal is considered the preferred remedial option for disposal of Tier II soil at Padloping Island.

6.6 Hazardous Soil

The 2010 site investigation identified a small volume of leachable lead contaminated soils at the Original Powerhouse to a depth of 0.3 m in depth. The total volume of leachable lead contaminated soils identified for disposal remediation is 17 m^3. All soils that exceed the lead leachate criterion of 5 mg/L are to be containerized and disposed of off-site at an approved southern hazardous waste disposal facility.

6.7 Summary

Remedial options have been evaluated for the contaminated soils identified in the 2010 site investigation at Padloping Island. Based on the estimated volumes of contaminated soils and technical considerations for locating and developing suitable disposal and/or treatment facilities, it is recommended that all Tier I and Type A PHC soils at Padloping Island be disposed of in an engineered NHW landfill while the PHC Contaminated Soil (Type B) can be treated on-site. Tier II and hazardous contaminated soils will need to be containerized and disposed of off-site. Based on the applicability of the various disposal and treatment options, the following recommendations are made:

- Soils contaminated with Tier I levels of PCBs and inorganic elements should be excavated and placed in an engineered Non-Hazardous Waste Landfill. The total volume of Tier I soil is estimated at 47 m^3, of which 43 m^3 is from dump excavations. These soils may be utilized as intermediate fill during placement of non-hazardous waste within an on-site NHW landfill, if applicable.
- Soils contaminated with Type A fractions should excavated to a depth of 0.3 m and backfilled with clean granular fill. The total volume of Tier A soil is estimated at 131 m^3. Type A contaminated soils should be disposed of in an engineered NHW Landfill and may be utilized as intermediate fill during placement of non-hazardous waste in an on-site NHW Landfill, if applicable.
- Soils contaminated with Tier II levels of PCB's and/or inorganic elements should be excavated, containerized and shipped off-site for disposal. The total volume of Tier II Contaminated Soil identified is 120 m^3, of which 43 m^3 is the estimated volume from dump excavations.
- Soils contaminated with light end PHC's (Type B Soils) should be excavated and treated ex-situ by aeration supplemented with biological methods in an on-site treatment or landfarm facility. TPH concentrations in soils should be reduced, when required, to meet the INAC AMSRP. The total volume of hydrocarbon impacted soil requiring treatment is 116 m^3.

7. Implementation

7.1 Schedule

It is expected, based on the assumption of barge access, that the contractor would mobilize to the site in the fall and initiate the construction with some critical items and then complete the remediation activities in the main construction season in the year following mobilization. During this timeframe, it is reasonable to assume that the contractor would be able to set-up their camp, potentially investigate recommended borrow sources, upgrade the roadway (as required) and build a treatment facility or landfarm to allow placement of the Type B soils requiring treatment.

Based on the recommended remedial actions outlined above, construction activities will require at least one full season of clean-up activity following contractor mobilization to site. Specifics related to timing and prioritization of contractor activities is described in the sections in the following sections.

Refer to Section 8.2 for discussion of “Alternate Design Scenarios”. If the Padloping and Durban Island projects were combined into one contract, then it is expected that the work activities could be done concurrently. Since there is more work and more variety of work activities at Durban Island, it is anticipated that the contractor would set up his primary operations, including the provision of a construction camp, at the Durban Island Site and shuttle workers to and from the Padloping Island Site with a helicopter or boat. For a combined contract solution, the site waste would also be consolidated at the Durban Island site.

7.2 Dump Remediation

Table C below summarizes the recommended remedial requirements for buried debris areas at Padloping Island. Where the recommended remediation is excavation, waste segregation during excavation is recommended to separate hazardous and non-hazardous waste. Non-hazardous waste can be disposed of in an engineering NHW Landfill. Hazardous waste will require off-site disposal and must be segregated based on PCB-containing waste (for disposal at a licensed PCB disposal facility), or other hazardous waste, which can be disposed of in a licensed Hazardous Waste Landfill. It is recommended that soil be separated from debris during excavation and stockpiled in such a manner to allow sampling and classification according to the contaminant criteria outlined under the INAC AMSRP. Soil that does not exceed any contaminant criteria may be used as for backfilling excavations, but based on the difficulty with removing small pieces of debris during waste segregation, it is recommended that this soil be used for intermediate fill, where applicable and not be used for surface backfilling of Existing buried Debris Areas.

In terms of timing for excavation, because of the anticipated contaminated soil and debris components from excavation, the implementation of WDA excavations should not proceed until the berms are constructed for an on-site NHW Landfill or when a suitable storage is identified as a staging area for off-site transport.

Because of the uncertainty regarding Tier II contaminated soil volumes from dump excavations, it would be preferred that the contractor commence landfill excavation early in the main construction season to ensure that there are ultimately sufficient containers on-site. This would allow for mobilization of additional containers later in the year. Tier II contaminated soil areas should not be excavated until suitable containers are available at site. For dumps where the recommended remedial action is regrading, this work can likely commence upon completion of the NHWL construction when surface debris pickup at the dumps can be completed efficiently.

Table D - Summary of Recommended Dump Remedial Requirements

Dump	Area (m^2)	Depth (m)	Volume (m^3)	Environmental and Geotechnical Investigation	Waste Disposal Area (WDA) Classification	Recommended Remediation Based on Engineering Considerations
Original Station Buried Debris Area (Lobes A, B and C)	217	0.75	163	• Samples not collected from this location because of its immediate proximity to the ocean. • No potential for surface contaminated soil identified. • No erosion noted. • Low to Moderate vegetation.	Class A, due to proximity to ocean	Excavate Lobes B and C due to the proximity to the ocean and excavate Lobes A based on the small size of this lobe, its mounded shape and the surrounding organic-rich terrain.
Old Hamlet Buried Debris Area (Lobe D)	13	0.75	10	• Samples not collected from this location because of its immediate proximity to the ocean. • No potential for surface contaminated soil identified. • Complete vegetation cover. • No erosion noted.	Class C, with an associated remedial action of Regrading	Excavate, based on the small size of these lobes, their mounded shape and the surrounding organic-rich terrain.
Pond Buried Debris Area (Lobes E, F and G)	188	0.75	141	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • Partial vegetation cover. • Erosion of organics in drainage course/outlet on south side of pond.	Class C, with an associated remedial action of Regrading	Excavate Lobe G, based the presence of a drainage course/outlet and excavate Lobes E and F based on the small size of these lobes, their mounded shape and the surrounding organic-rich terrain.
South Mound Buried Debris Area (Lobes H and I)	76	0.75	57	• Samples not collected from this location because of its immediate proximity to the ocean. • No surface contaminated soil identified. • Erosion potential from storm surges.	Class C, with an associated remedial action of Regrading	Excavate, based on the small size of these lobes, their mounded shape and the surrounding organic-rich terrain.
West Mound Buried Debris Area (Lobes J, K, L and M)	73	0.75	55	• No evidence of contaminant migration. • No potential for surface contaminated soil identified. • Complete vegetation cover. • No erosion noted.	Class C, with an associated remedial action of Regrading	Excavate, based on the small size of these lobes, their mounded shape and the surrounding organic-rich terrain.

7.3 Surface Debris

Twenty-eight surface debris areas were identified during the 2010 Phase III ESA. The identified limits of these areas cover approximately 480,000 m^2. The crushed volume of hazardous materials identified is 34 m^3, while the crushed volume of non-hazardous waste is 1,774 m^3. These volumes also include barrels and their contents, based on results of barrel inventory and sampling. A detailed breakdown of surface debris areas and debris volumes is provided in Table C-2 in Appendix C. The limits of surface debris areas are shown on Figures 2.0 to 7.0. Non-hazardous waste can be disposed of in an engineered NHW Landfill. Hazardous waste, other than asbestos, must be packaged in accordance with TDGA regulations for shipping to an off-site licensed hazardous waste disposal facility. Asbestos that is double bagged can be placed in an engineered NHW Landfill.

Building foundations at Padloping Island consist of intact and partially burned timber piles and concrete slabs (Generator Building and Boiler/Incinerator Building). All timber piles and concrete can be disposed of in an engineered NHW Landfill.

It is recommended that the segregation and containerization of hazardous waste components be commenced early during the main construction season. This will facilitate the general removal of site debris, which can be commenced once construction of the NHW Landfill berms is completed or when a suitable staging area for off-site transport is identified.

7.4 Barrel Remediation

The 2010 inventory of barrels at Padloping indicates there are 1,261 uncrushed barrels on-site. Of these, 17 were identified with liquid contents and 8 of the 17 barrels with liquid contents were tested with no exceedances for the parameters tested under the Barrel Protocol Criteria.

There are numerous consolidated barrel areas and scattered barrels at Padloping Island. The results of the Phase III ESA indicated that the majority of barrels are empty and will require no sampling or processing during clean-up. For the consolidated barrel areas, only the exterior barrels were checked for contents. For these areas, the contents in the interior barrels should be assessed, suitably consolidated and sampled to confirm disposal requirements.

Because of the need to classify some barrels that could not be properly assessed during the ESA, it is recommended that collection of barrels, with consolidation of like products, be completed early during main construction season to allow for sampling of contents in a timely manner, with incineration or additional consolidation for off-site transport completed during the remainder of the season.

7.5 Proposed New Containment Facilities

7.5.1 Non-Hazardous Waste Landfill (NHWL)

The total crushed volume of non-hazardous waste, from all sources, is approximately 1,860 m^3. The estimated footprint for a new engineered NHW Landfill to accommodate this volume is approximately 30 x 30 m. The preferred Padloping Island location for the NHW Landfill is, Proposed Landfill LF-2. The landfill can be placed just north of the Library Building footprint and will have to avoid the Type A and B Contaminated Soil Area to the east of the Library. There are no contaminated soil areas identified for excavation in the near up-gradient area. Therefore, there is no requirement for provision of a sufficient buffer to avoid complication of long-term landfill monitoring data interpretation.

In terms of contractor priorities for construction of new facilities during clean-up, construction of the NHW Landfill is considered the second priority, behind the treatment facility or landfarm (see below). It is expected that construction of the facility can be completed during the main construction season with disposal of waste also commencing this same season.

7.5.2 Treatment Facility or Landfarm

The total volume of Type B soil identified for remediation is approximately 116 m^3. The estimated footprint for a treatment facility or landfarm to accommodate this soil volume is approximately 20 x 20 m. Proposed Landfarm LF-4 was identified as the preferred treatment area or landfarm site as it is in close proximity to the majority of the Type B Contaminated Soils areas near the Main Station Areas and would not require extensive debris removal to allow for preparation of the treatment area or landfarm footprint. The treatment area or landfarm should be located along the east site of Landfarm LF-4 site to maintain a suitable buffer from the Tidal Bay.

The construction of the treatment area or landfarm is a priority as the treatment of soil could potentially delay the contractor's demobilization from site.

7.6 Contaminated Soil Excavation

- Tier I soil: Excavation of this soil may commence as soon as the engineered NHW Landfill is constructed or when a suitable storage is identified as a staging area for off-site transport.
- Type A soil: Excavation of this soil may commence as soon as the NHW Landfill is constructed or when a suitable storage is identified as a staging area for off-site transport.
- Tier II soil: Because of the uncertainty regarding ultimate Tier II soil volumes that will be derived from dump excavations, it is recommended that excavation and containerization of Tier II soils commence early during the main construction season. This will allow a better assessment of the ultimate number of containers that will be required for shipping off-site, and will allow the contractor opportunity to bring in additional containers later in the season.
- Type B soil: Excavation of all Type B soil requiring treatment should be completed immediately after the treatment area or landfarm is constructed and this should be the number one priority for the contractor, as noted above.

7.7 Borrow Sources

To confirm that sufficient sources of the various granular material types were identified during the Phase III ESA, an estimate of the required granular material volumes was completed for the recommended remedial options discussed above. The following summarizes the estimated volumes for each granular material type:

- ***Type 1:*** possible requirements for 800 m^3 Type 1 Granular Fill for the sideslopes of the Non-Hazardous Waste Landfill.
- ***Type 2:*** the estimated potential required is approximately 8,500 m^3, which includes "Conventional Remediation" design allowance for an on-site engineered NHW Landfill and treatment area or landfarm facility for the treatment of Type B Contaminated Soils.
- ***Type 3:*** the estimated volume required is in the order of 500 m^3, which includes backfilling of WDA's and contaminated soil excavations. It should be noted here, that, based on our estimate of clean fill that will be derived from dump excavations, the majority of the dump backfilling requirements will likely be met by using this soil.
- ***Type 4:*** no requirement since there is no SSDF or leachate containment of existing WDA's.
- ***Type 5:*** again, no requirement, similar to Type 4.
- ***Type 6:*** the intermediate fill requirements for an on-site NHW Landfill is approximately 560 m^3. Some of the requirements for intermediate fill may be met by using Tier I/Type A and clean landfill excavation soil.

The following summarizes the estimated available borrow materials at Padloping Island:

Table E - Borrow Area Summary

Borrow Area	Material Type	Estimated Volume (m^3)	Comments
BA-1	Type 4	80,000	Undisturbed area between Freshwater Lake and Tidal Bay identified in as potential source of Type 4 Granular Fill. Not expected to be used because of limited requirements for Type 4 Material.
BA-2 (Ridge)	Type 2/4	20,000	Disturbed area at Ridge north of Main Station. Identified in Site Investigation plan as only potential source of Type 2 Granular Fill. Selective mining or screening may be required to achieve suitable gradations for Type 2 Granular Fill. Material with excess fines may be difficult to process for Type 2 Material. May have been former borrow but most material appears to remain.
BA-2 (Boulder Field)	Type 1	40,000	Disturbed area at Ridge north of Main Station. Identified in Site Investigation plan as only potential source of Type 1 Granular Fill. May have been former borrow but most material appears to remain.
BA-3	Type 4	120,000	Undisturbed area north of Old Hamlet Site identified in as potential source of Type 4 Granular Fill. Not expected to be used because of limited requirements for Type 4 Material.
BA-4	Type 4	500	Small undisturbed area northeast of Main Station identified in as potential source of Type 4 Granular Fill. Not expected to be used because of small size and limited requirements for Type 4 Material.

Borrow Area	Material Type	Estimated Volume (m^3)	Comments
BA-5	Type 4	5,600	Disturbed Area located at the Metal Dump identified in as potential source of Type 4 Granular Fill. Not expected to be used because of extensive debris cover and limited requirements for Type 4 Material.
BA-6	Type 4	50,000	Undisturbed area west of Metal Dump identified in as potential source of Type 4 Granular Fill for the Treatment Area or Landfarm.
BA-7	Type 4	40,000	Disturbed Area located at the Main Station Area identified in as potential source of Type 4 Granular Fill. Not expected to be used because of extensive debris cover and limited requirements for Type 4 Material.
Talus Material near BA-1	Type 2/5/6	Unknown	Naturally Disturbed Area at bottom of cliff to the west of Borrow BA-1. Not investigated during because of time constraints but identified for further evaluation.

Based on these estimates, there is concern with the availability of sufficient Type 2 Granular Fill at Borrow BA-2 at Padloping Island.

7.8 Summary

The following summarizes the site access and remediation implementation developed for Padloping Island:

- The remediation activities at Padloping Island are anticipated to be completed in one full year with mobilization by barge in the late summer/fall of Year 1 and construction and demobilization in the summer/fall of Year 2.
- A total of 5 existing buried debris areas with 13 lobes have been identified for remediation at Padloping Island, representing a total area of about 425 m^2. All 13 lobes (A to M) have been designated for excavation.
- A total of 28 debris areas were identified on-site with an estimated crushed volume of 1774 m^3 of non-hazardous debris requiring on-site disposal and 34 m^3 of hazardous debris requiring specialized packaging for on-site or off-site disposal.
- A total of 1,261 uncrushed barrels were identified for processing with 17 having liquid contents and 8 tested to have aqueous contents suitable for discharge. It is expected that the bulk of the barrel contents will be able to be either discharged or incinerated on-site.
- An engineered NHW Landfill is required for the disposal of 1,860 m^3 of crushed building materials and debris. All of the identified Tier I and Type A Contaminated Soil could used as Intermediate Fill for this facility if it is located on-site.
- The proposed new on-site treatment area or landfarm is required for treatment of 116 m^3 of Type B hydrocarbon contaminated soil.
- The priority for contaminated soil excavation is dependent on the disposal or treatment requirements. The priority from high to low is as follows: 1. Type B (requires sufficient time for treatment), 2. Tier II and Hazardous Soil (requires suitable container volume) and 3. Tier I/Type A (requires disposal in an engineered NHW Landfill, as required).
- A total of 7 borrow sources were identified at Padloping Island and only one (Borrow BA-2) with suitable source materials for the production of Type 1 and 2 Granular Fill. The estimated total volume of Type 2 Granular Fill required for a “Conventional Remediation” design, including a NHW Landfill is 8,500 m^3 with additional requirements for access road upgrades. The total volume of Type 2/4 Granular Fill from Borrow BA-2 is 20,000 m^3 and material with excess fines may be difficult to process into Type 2 Granular Fill.

8. Alternate Design Scenarios

The remedial options recommendations provided herein are considered to be “Conventional Remediation” design solutions, where the site is considered to be independent and long term monitoring of remediated landfills and new on-site disposal facilities would be required as per the provisions of the AMSRP. Because of the close proximity of the FOX-E, Durban Island Site, there is consideration for alternate design scenarios including the provision of a “Combined Contract” with FOX-E, a “Walkaway Solution” and combinations thereof. The different design scenarios are discussed below. Comparative cost estimates are provided under separate cover (AECOM 2011) for these different design scenarios.

8.1 “Conventional Remediation” Design

A “Conventional Remediation” typically includes the provision of an on-site non-hazardous waste landfill for disposal of demolition, debris and Tier I and Type A Contaminated Soils. This design scenario also typically includes the construction of a treatment facility or landfarm for the treatment of Type B Hydrocarbon Contaminated Soils. If there is suitable volume of Tier II Contaminated Soil identified at site, then a Secure Soil Disposal Facility is provided on-site, otherwise smaller volumes of Tier II Contaminated Soils are containerized and disposed of off-site. All hazardous soil and debris are typically containerized and disposed of off-site at a licensed hazardous waste disposal facility. Monitoring is typically required at the treatment facility or landfarm (during operation only) and long term monitoring is required for all new disposal facilities including the Non-Hazardous Waste Landfill and Secure Soil Disposal Facility.

8.2 “Combined Contract” Design Scenario

A “Combined Contract” can be applied to two or more sites in relatively close proximity to each other. The FOX-E site is only 24 km away from the Padloping Island site, The contractor may be able to share resources and realize cost savings if these two sites are tendered together. For this combined scenario, the contractor could procure remediation for the sites concurrently or consecutively with the mobilization of one camp and equipment fleet. Further cost savings could be realized if only one NHW Landfill was built and the waste was consolidated to this location from the two sites.

Although a NHW landfill could be built at Padloping Island, a review of the Durban Island ESA (AECOM 2010) has revealed that the landfill sites and availability of Type 2 Borrow material would make Durban Island the better location for a consolidated NHW Landfill Facility. For a “Combined Contract” design scenario, it is recommended that a consolidated NHW Landfill be constructed at the FOX-E, Durban Island Site for the disposal of waste from the Padloping and Durban Island sites.

To allow for work efficiencies and cost savings, AECOM recommends that a combined contract be implemented for the Padloping and the FOX-E, Durban Island Sites and a consolidated landfill be constructed at Durban Island for the disposal of non-hazardous waste from both sites. The “Combined Contract” solution is considered to be a “Walkaway Solution” (refer to Section 8.3) for the Padloping Island site as there would be no requirements for long term monitoring.

8.3 "Walkaway Solution" Design Scenario

PWGSC and INAC have requested consideration for a "Walk-Away Solution" for the Padloping and Durban Island sites. The "Walk-Away Solution" would include the application of remedial solutions to preclude the requirement for post construction monitoring, including provisions for the following:

- The elimination of any new on-site disposal facilities including a NHW Landfill and SSDF.
- The off-site disposal of all site waste and contaminated soil to established southern disposal facilities.
- There is no long monitoring requirement for existing landfills less than 1000 m^2 in area For a Walk-Away Solution", all WDA's greater than 1000 m^2 would have to be excavated with the resulting debris and contaminated soil disposed of at an established southern disposal facility. There are no existing WDA'S with areas exceeding 1000 m^2 at either Padloping or Durban Island.
- The treatment facility or landfarm would proceed as planned as there is no monitoring required once the treatment soils are remediated.
- The "Walkaway Solution" could be could be applied to both an "Individual" or "Combined Contract" Scenarios for the Padloping and Durban Island Sites.

As a result of the comparative cost estimates for the different design scenarios provided under separate cover (AECOM 2011), INAC has indicated that "Combined Contract" and "Walkaway Solution" are the preferred remediation strategies for both the Padloping and Durban Island sites.

9. References

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Appendix A

Figures

- Figure 1.0 - Overall Site Plan
- Figure 2.1 - Main Station Area – Environmental Plan
- Figure 2.0 - Main Station Area
- Figure 3.0 - South of Main Station Area
- Figure 4.0 - West Beach Area
- Figure 5.0 - Old Hamlet Site
- Figure 6.0 - Original Station Site and East Beach Area
- Figure 7.0 - Pond Area
- Figure 8.0 - Geotechnical Plan

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N 7 437 000
N 7 436 500
N 7 436 000
N 7 435 500
N 7 435 000
E 510 000
E 510 500
E 511 000
E 511 500
E 512 000
E 512 500
E 513 000
E 513 500

SCALE 1:10000
0 100 200 m

FRESHWATER LAKE
TIDAL BAY
DELIGHT ANCHORAGE

TP-01
TP-02
TP-03
TP-04
TP-05
TP-06
TP-07
TP-08
TP-09
TP-10
TP-11
TP-12
TP-13
TP-14
TP-15
TP-16
TP-17

BORROW AREA BA-1
BORROW AREA BA-2
BORROW AREA BA-3
BORROW AREA BA-4
BORROW AREA BA-5
BORROW AREA BA-6
BORROW AREA BA-7

LANDFILL LF-1
LANDFILL LF-2
LANDFILL LF-3
LANDFILL LF-4

POSSIBLE EXTENSION TO BORROW AREA BA-2
INUIT OWNED LANDS
CROWN LANDS
POWER CABLE

FIGURE 2.0
MAIN STATION AREA

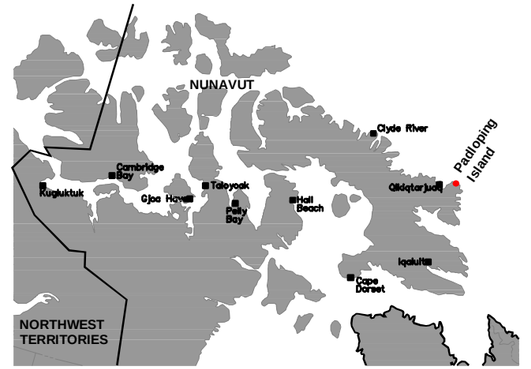
FIGURE 3.0
SOUTH OF MAIN STATION AREA

FIGURE 4.0
WEST BEACH AREA

FIGURE 5.0
OLD HAMLET SITE

FIGURE 6.0
ORIGINAL STATION SITE AND EAST BEACH AREA

FIGURE 7.0
POND AREA



LOCATION OF PADLOPING ISLAND WITHIN NUNAVUT TERRITORY
N.T.S.

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Overall Site Plan

Figure 1.0

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E 511 500 | E 511 600 | E 511 700 | E 511 800

N 7 436 100 | N 7 436 000

0 10 20 m SCALE 1:1000

BOILER/INCINERATOR BUILDING
LIBRARY
MAINTENANCE SHED
MAINTENANCE GARAGE
OLD GENERATOR BUILDING
TRACTOR
TRUCK
ACCESS ROAD
FALLEN COMMUNICATIONS TOWER
TOP OF COMMUNICATION TOWER
WEATHER BUILDING
CONCRETE
KITCHEN/MESS HALL
ACCOMMODATIONS BUILDING
SHOWER / WASHROOMS
SUPPLY DEPOT BUILDING
SHOWER / WASHROOM
LOBE H
LOBE I
STATION AREA SOUTH MOUND

TP-18
TP-19

PI47 PI48 PI49 PI50

ESG-7507 ESG-7508 ESG-7509 ESG-7519 ESG-7558 ESG-7559 ESG-7560 ESG-7562/63 ESG-7564 ESG-7566 ESG-7567 ESG-7568 ESG-7569

10-0000 series sample locations

GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

LEGEND:

- SITE GRID (100m INTERVAL)
- BURIED DEBRIS AREA
- ESG-7000 — ESG SAMPLE LOCATION - TIER I
- ESG-7000 — ESG SAMPLE LOCATION - TIER II
- 10-0000 — SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 — SAMPLE LOCATION (NOT ANALYZED)
- 10-0000 — TIER I
- 10-0000 — TIER I / TYPE B PHC
- 10-0000 — TIER II
- 10-0000 — TIER II / TYPE B PHC
- 10-0000 — TYPE A PHC
- 10-0000 — TYPE B PHC
- PI48 — EARTH TECH SAMPLE LOCATION
- EXISTING POWER POLE
- TIER II ESTIMATED AREA OF CONTAMINATION
- TIER II / TYPE B PHC ESTIMATED AREA OF CONTAMINATION
- TYPE A PHC ESTIMATED AREA OF CONTAMINATION
- TYPE B PHC ESTIMATED AREA OF CONTAMINATION

AECOM

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Main Station Area Environmental Plan
Figure 2.1

B SIZE 11" x 17" (279.4mm x 431.8mm)
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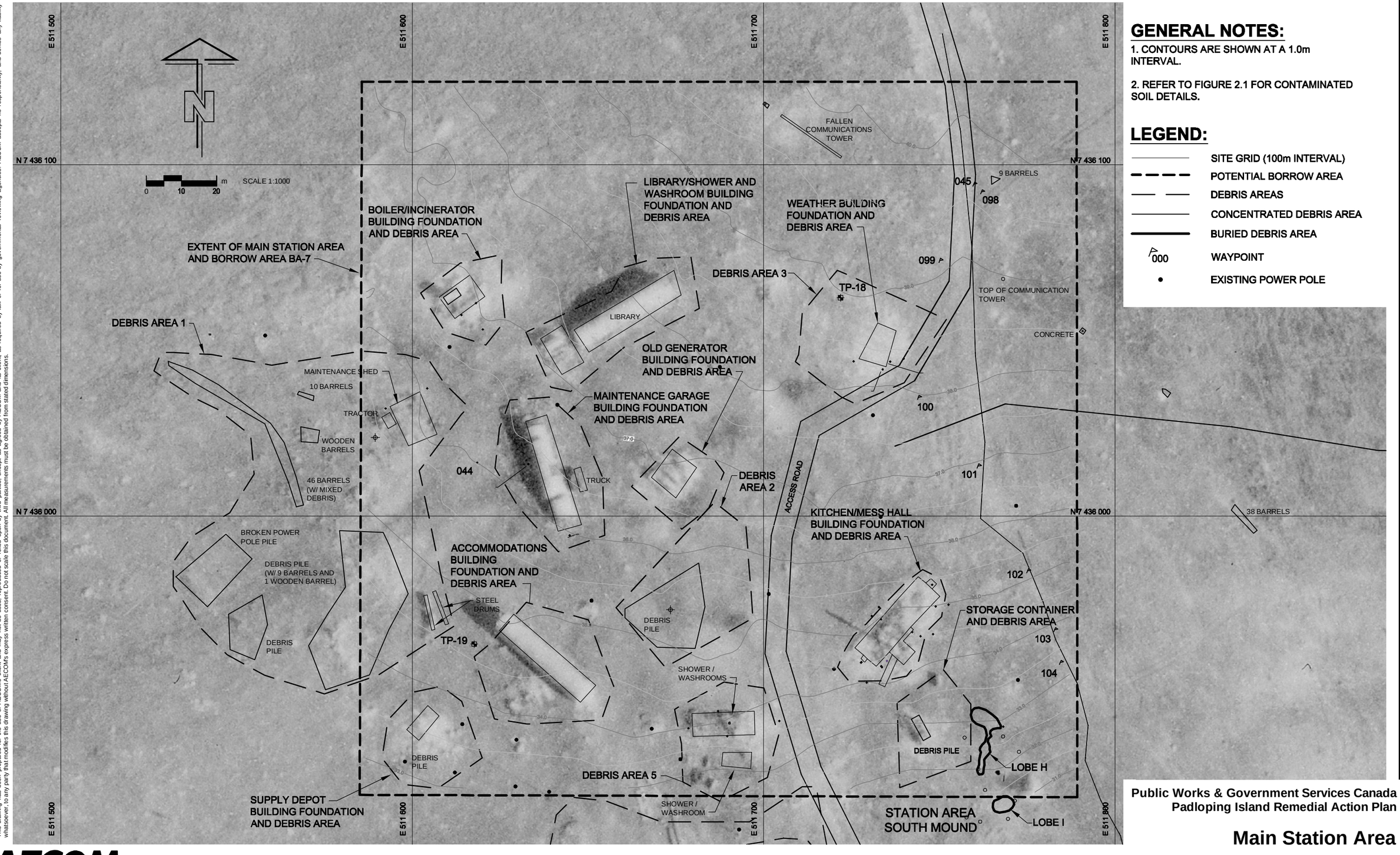

GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

2. REFER TO FIGURE 2.1 FOR CONTAMINATED SOIL DETAILS.

LEGEND:

- SITE GRID (100m INTERVAL)
- POTENTIAL BORROW AREA
- DEBRIS AREAS
- CONCENTRATED DEBRIS AREA
- BURIED DEBRIS AREA
- 000 WAYPOINT
- EXISTING POWER POLE

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Padloping Island Remedial Action Plan

Main Station Area

AECOM

Figure 2.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
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N 7 435 900
N 7 435 800
N 7 435 700
E 511 600
E 511 700
E 511 800
E 511 900

SCALE 1:1000
0 10 20 m

OLD GENERATOR BUILDING FOUNDATION AND DEBRIS AREA
DEBRIS PILE
10-0089
10-0090/91
LOBE J
10-0088
10-0099
10-0097
10-0096
105
38 BARRELS
10-0087
LOBE K
10-0092
10-0093
LOBE L
LOBE M
10-0098
10-0094
10-0095
BUILDING DEBRIS WITH 7 BARRELS
UNKNOWN BUILDING
UNKNOWN BUILDING
10-0100/01
ESC-7598
10-0103
10-0104
0105
10-0102
17 BARRELS
WATER TANK BUILDING
DEBRIS AREA 4
17 BARRELS
DEBRIS AREA 5
WOODEN STORAGE CONTAINER
10-0152
10-0153
10-0149
10-0150/51
10-0145
10-0146
48 BARRELS
DEBRIS PILE
87 BARRELS
CRUSHED BARRELS
ACCESS ROAD
TRUCK
220 BARRELS
8 BARRELS
DEBRIS PILE
5 BARRELS
WOODEN X-STRUCTURE
DEBRIS AREA 6
UNKNOWN BUILDING
UNKNOWN METAL OBJECT
ACCESS ROAD
DEBRIS PILE WITH 2 BARRELS
METAL DUMP DEBRIS AREA AND BORROW AREA BA-5
TP-14
TRUCK
TRUCK
TRUCKS
GRADER
AMPHIBIOUS VEHICLE
TRUCK
AMPHIBIOUS VEHICLE
10-0109
10-0107
10-0106
10-0108
10-0110/11
DEBRIS AREA 8
DEBRIS PILE WITH 13 BARRELS
13 BARRELS

LEGEND:

- SITE GRID (100m INTERVAL)
- POTENTIAL BORROW AREA
- DEBRIS AREA
- CONCENTRATED DEBRIS AREA
- BURIED DEBRIS AREA
- EXISTING POWER POLE
- 000 WAYPOINT
- 10-0000 SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 SAMPLE LOCATION (NOT ANALYZED)
- 10-0000 TIER II
- 10-0000 TYPE A PHC
- 10-0000 TYPE B PHC
- TIER II ESTIMATED AREA OF CONTAMINATION
- TYPE A PHC ESTIMATED AREA OF CONTAMINATION
- TYPE B PHC ESTIMATED AREA OF CONTAMINATION
- BUILDING FROM 1967 AERIAL PHOTO THAT NO LONGER REMAINS

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

South of Main Station Area

AECOM

Figure 3.0

B SIZE 11" x 17" (279.4mm x 431.8mm)

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E 511 600 | E 511 700 | E 511 800 | E 511 900

N 7 435 600 | N 7 435 500

METAL DUMP

10-0114
10-0117
10-0112
10-0116
10-0115

TRACTOR
CAR
TRACTOR
CAR

METAL DUMP DEBRIS AREA AND BORROW AREA BA-5

28 BARRELS

ACCESS TRAIL

13 BARRELS

UNKNOWN BUILDING

DEBRIS PILE

DEBRIS PILE

WEST BARREL CACHE

10-0126
CRUSHED BARRELS
10-0130/31
10-0132
10-0133

CRUSHED BARRELS
10-0134

10-0127
10-0128
10-0129
CRUSHED BARRELS

10-0135
CRUSHED BARRELS
10-0140/41
10-0142
10-0136

10-0143
STEEL OBJECT

PARTIALLY SUBMERGED BARGE

DEBRIS PILE
ACCESS ROAD
WOODEN PLATFORM
DEBRIS PILE
DEBRIS PILE

DEBRIS AREA 10

DEBRIS PILE
GRADER BLADE
METAL OBJECT

DEBRIS PILE

HIGH TIDE LEVEL (VEGETATION OBSERVED DURING 2010 SITE INVESTIGATION)

ESTIMATED NORMAL HIGH TIDE

LOW TIDE LEVEL (OBSERVED DURING 2010 SITE INVESTIGATION)

SUBMERGED BARGE

DEBRIS AREA 11

DELIGHT ANCHORAGE

N

0 10 20 m

SCALE 1:1000

LEGEND:

- SITE GRID (100m INTERVAL)
- POTENTIAL BORROW AREA
- DEBRIS AREA
- CONCENTRATED DEBRIS AREA
- 000 WAYPOINT
- 10-0000 SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 SAMPLE LOCATION (NOT ANALYZED)
- 10-0000 TIER II
- 10-0000 TYPE B PHC
- TIER II ESTIMATED AREA OF CONTAMINATION
- TYPE B PHC ESTIMATED AREA OF CONTAMINATION
- BUILDING FROM 1967 AIR PHOTO THAT NO LONGER REMAIN

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Padloping Island Remedial Action Plan

West Beach Area

AECOM

Figure 4.0

B SIZE 11" x 17" (279.4mm x 431.8mm)

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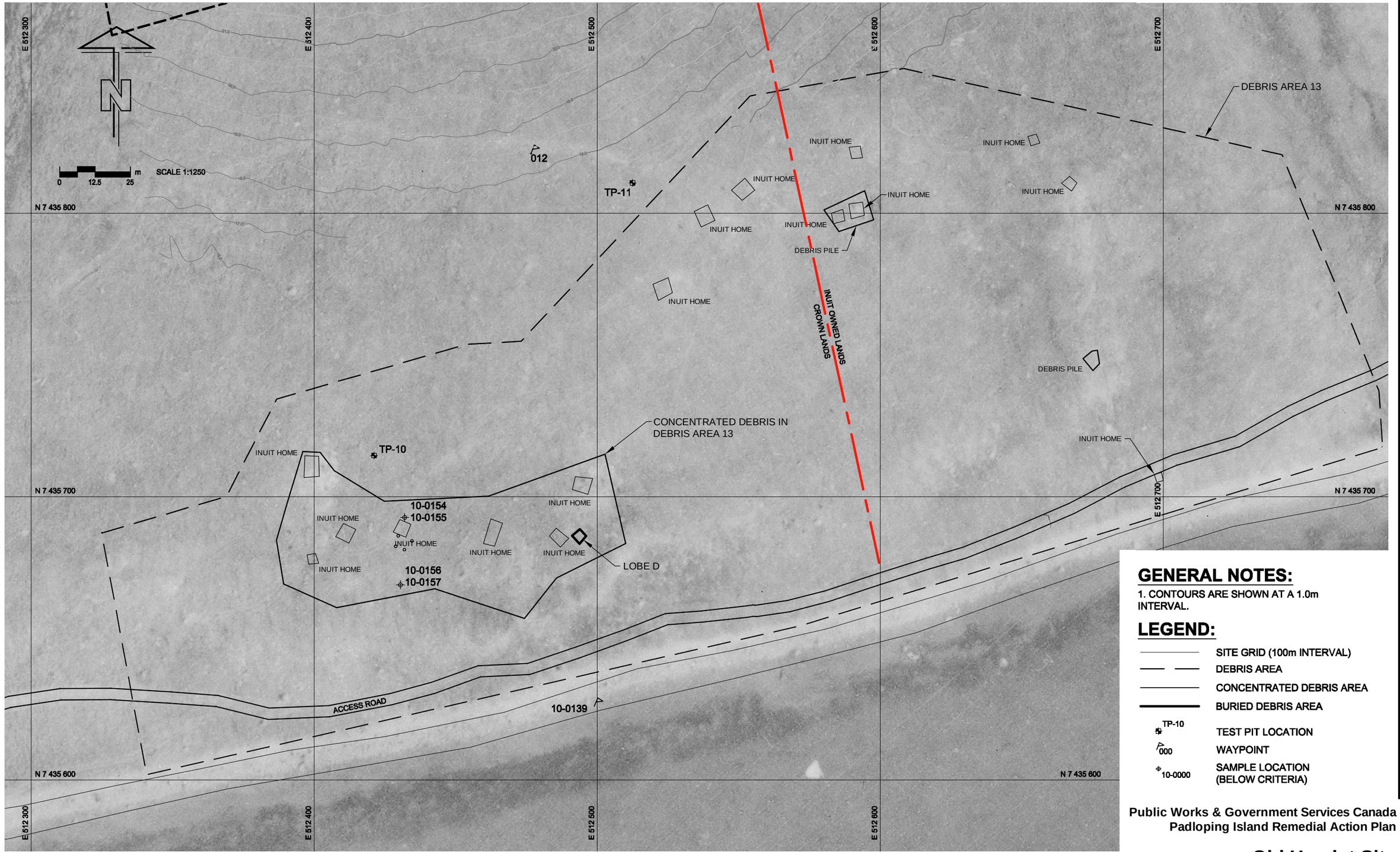

GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

LEGEND:

- SITE GRID (100m INTERVAL)
- DEBRIS AREA
- CONCENTRATED DEBRIS AREA
- BURIED DEBRIS AREA
- TP-10 — TEST PIT LOCATION
- 000 — WAYPOINT
- 10-0000 — SAMPLE LOCATION (BELOW CRITERIA)

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Padloping Island Remedial Action Plan

Old Hamlet Site

AECOM

Figure 5.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
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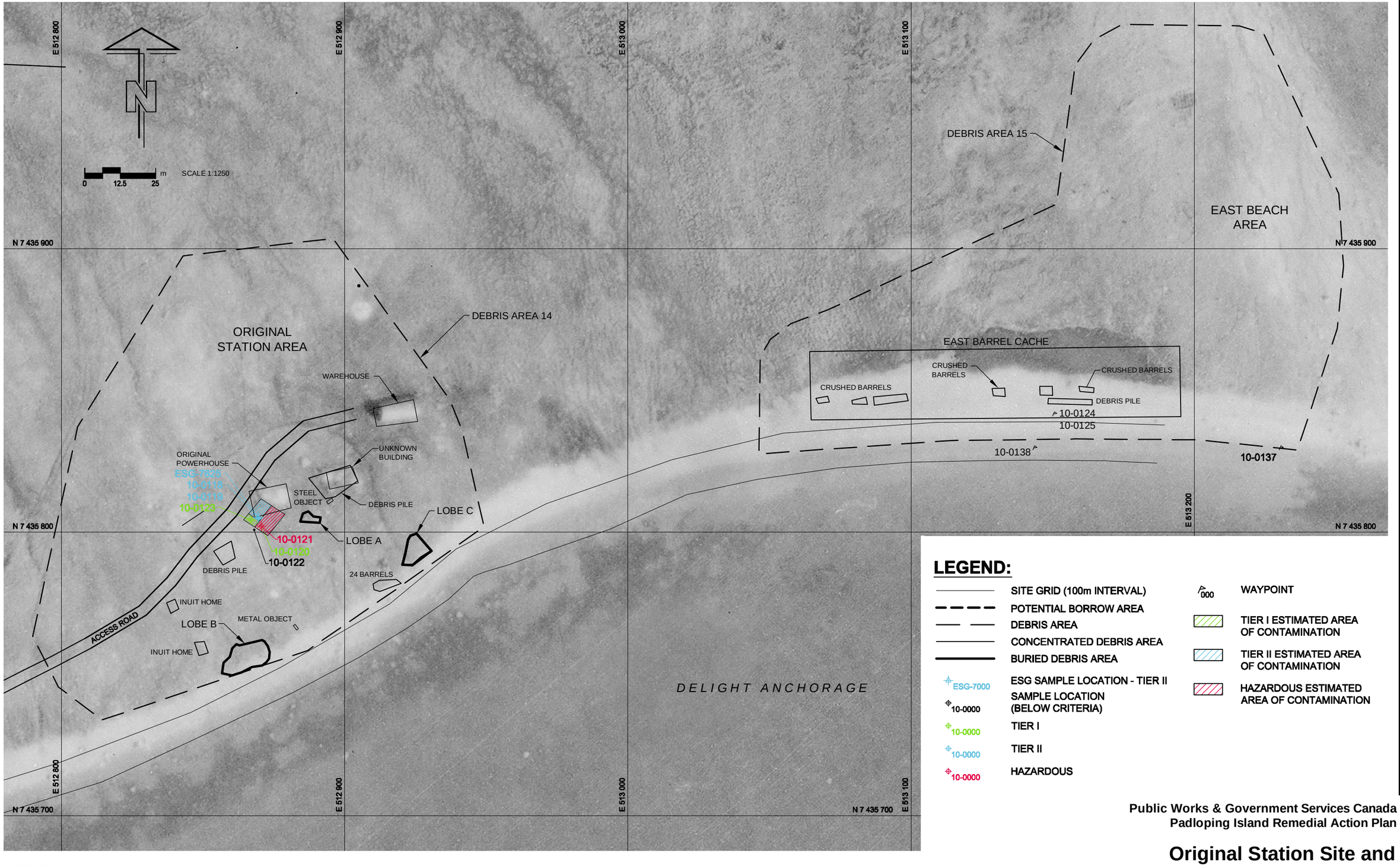

LEGEND:

- SITE GRID (100m INTERVAL)
- POTENTIAL BORROW AREA
- DEBRIS AREA
- CONCENTRATED DEBRIS AREA
- BURIED DEBRIS AREA
- ESG-7000 — ESG SAMPLE LOCATION - TIER II
- 10-0000 — SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 — TIER I
- 10-0000 — TIER II
- 10-0000 — HAZARDOUS
- 000 — WAYPOINT
- TIER I ESTIMATED AREA OF CONTAMINATION
- TIER II ESTIMATED AREA OF CONTAMINATION
- HAZARDOUS ESTIMATED AREA OF CONTAMINATION

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Padloping Island Remedial Action Plan

Original Station Site and East Beach Area
Figure 6.0

AECOM

B SIZE 11" x 17" (279.4mm x 431.8mm)

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E 511 300
E 511 400
E 511 500
E 511 600
E 511 700

N 7 436 800
N 7 436 700
N 7 436 600

0 12.5 25 m SCALE 1:1250

POND DEBRIS AREA
LOBE E
LOBE F
POND AREA
LOBE G
ACCESS TRAIL

LEGEND:

- SITE GRID (100m INTERVAL)
- DEBRIS AREA
- BURIED DEBRIS AREA

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Pond Area

AECOM

Figure 7.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
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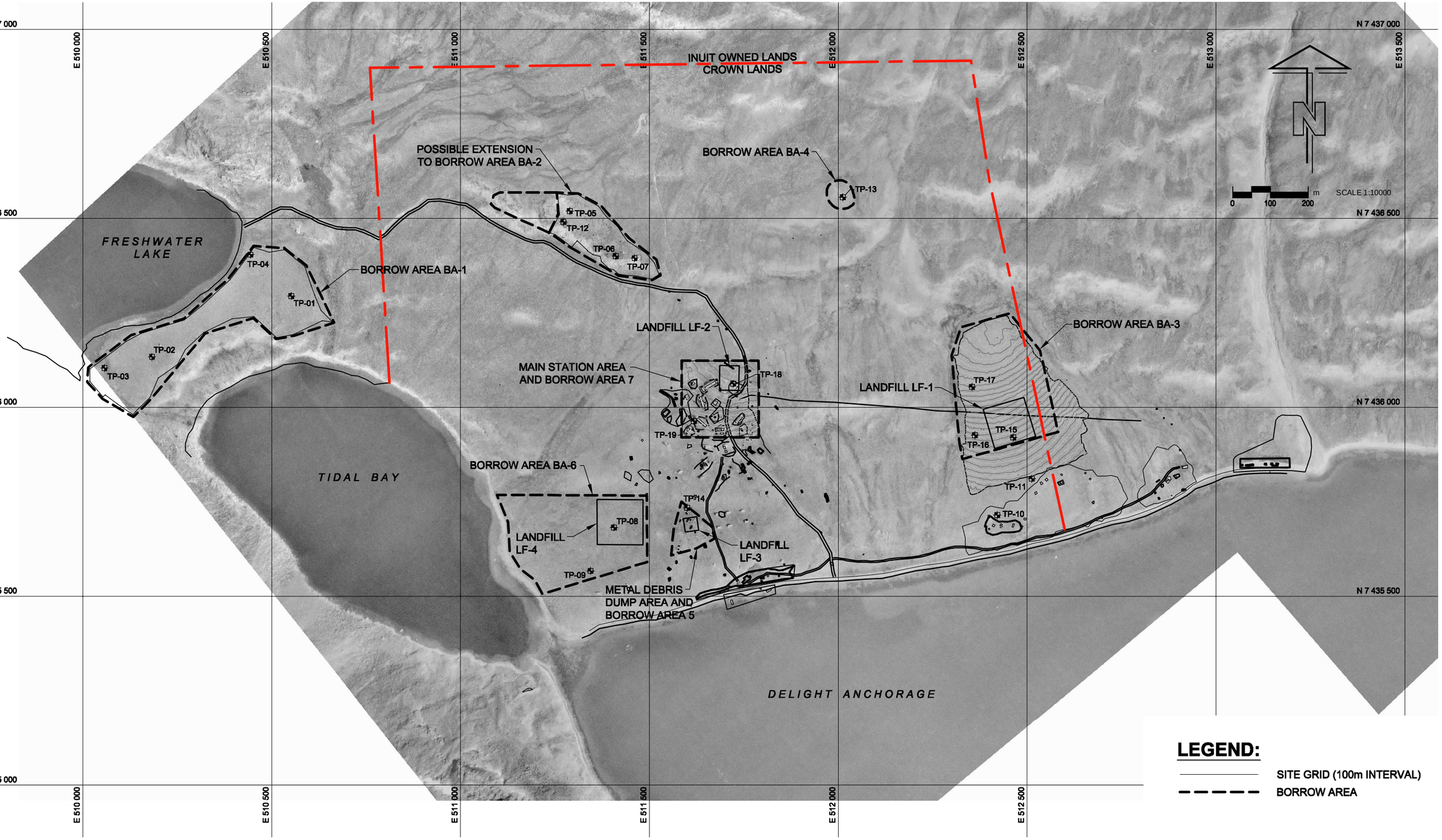

LEGEND:

- SITE GRID (100m INTERVAL)
- BORROW AREA

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Geotechnical Plan

Figure 8.0

Appendix B

Summary of Contaminated Soils Areas

Table B-1: Summary of Contaminated Soil Areas at Padloping Island

Location	Reference Sample No.	Contaminants	Hazardous			Tier II			Tier II/Type B PHC			Tier I			Type A PHC			Type B PHC			Comments
			Area (m^2)	Depth (m)	Volume (m^3)	Area (m^2)	Depth (m)	Volume (m^3)	Area (m^2)	Depth (m)	Volume (m^3)	Area (m^2)	Depth (m)	Volume (m^3)	Area (m^2)	Depth (m)	Volume (m^3)	Area (m^2)	Depth (m)	Volume (m^3)	
Weather Building	(10-001;10-002), 10-003 - 10-005	Cu				29	0.6	17.4													Not Fully Delineated
Kitchen/Mess Haul	10-0019, 10-0023, 10-0024	Pb, Type B PHC				21	0.3	6.3													
Kitchen/Mess Haul	10-0025, 10-0029, ESG7562/63	Pb, Zn				24	0.3	7.2													
Kitchen/Mess Haul	10-0033	Cb, Pb				17	0.3	5.1													Not Fully Delineated
Shower/Washrooms	10-0043, ESG7564	Pb, Type B PHC							22	0.5	11										Not Fully Delineated
Generator Building	10-0047/48	Type A PHC													8	0.3	2.4				
Generator Building	10-0049, 10-0050/51, 10-0052	Type A PHC													74	0.3	22.2				
Generator Building	10-0053	Type A PHC													14	0.3	4.2				
Maintenance Garage	ESG-7519	Zn				9	0.3	2.7													Not Fully Delineated
Maintenance Shed	10-0069	Cu				47	0.3	14.1													
Maintenance Shed	10-0072	Type B PHC																27	0.3	8.1	Not Fully Delineated
Boiler/Incinerator	10-0082	Type B PHC																27	0.3	8.1	Not Fully Delineated
Old Generator Building	10-0087	Type B PHC																13	0.3	3.9	
Old Generator Building	10-0093	Type A PHC													5	0.3	1.5				
Old Generator Building	10-0094	Type A PHC													9	0.3	2.7				
Water Tank Building	ESG-7596	Pb				7	0.3	2.1													
Metal Dump	10-0112	Cu, Pb				5	0.3	1.5													Not Fully Delineated
Original Powerhouse	(10-0118;10-0119), 10-0120/21, 10-0123	Pb, Zn	54	0.3	16.2	31	0.3	9.3				13	0.3	3.9							Not Fully Delineated
West Barrel Cache	10-0127	Type B PHC																8	0.3	2.4	Not Fully Delineated
West Barrel Cache	(10-0140/41; 10-0142)	Type B PHC																8	0.4	3.2	Not Fully Delineated
Former AST Site	PI-47 to PI-50	Type A and B PHC													196	0.5	98	196	0.5	98	
TOTALS:					16			66			11			4			131			124	

Notes: Reference Sample Numbers are either from AECOM 2010 (i.e. 10-012), ESG 1997 (i.e. ESG7596 and Earth Tech 2002 (i.e. PI-47

Appendix C

Summary of Buried Debris and Surface Debris Areas

Table C-1: Summary of Buried Debris Areas

	Existing Buried Debris Areas												
	Lobe A	**Lobe B**	**Lobe C**	**Lobe D**	**Lobe E**	**Lobe F**	**Lobe G**	**Lobe H**	**Lobe I**	**Lobe J**	**Lobe K**	**Lobe L**	**Lobe M**
Reference Drawing	Original Station Site	Original Station Site	Original Station Site	Old Hamlet Site	Pond Area	Pond Area	Pond Area	South Mound	South Mound	West Mound	West Mound	West Mound	West Mound
Photo Reference	P8110107.jpg	P8110107.jpg	P8110107.jpg	E16 - 12Aug10.jpg	IMG_3532	IMG_3531	IMG_3534	E6 - 12Aug10.jpg	E6 - 12Aug10.jpg	E8 - 12Aug10.jpg	E8 - 12Aug10.jpg	E8 - 12Aug10.jpg	E8 - 12Aug10.jpg
Estimated Landfill Extent	18 m^2	135 m^2	64 m^2	13 m^2	23 m^2	58 m^2	107 m^2	55 m^2	21 m^2	20 m^2	15 m^2	20 m^2	18 m^2
Estimated Depth	0.75 m	0.75 m	0.75 m	0.75 m	0.75 m	0.75 m	0.75 m	0.75 m	0.75 m	0.75 m	0.75 m	0.75 m	0.75 m
Estimated Excavation Volume	14	101	48	10	17	44	80	41	16	15	11	15	14
Estimated Volume of Hazardous Material	2 m^3 (1%)			n/a m^3 (1%)	n/a m^3 (1%)	n/a m^3 (1%)	1 m^3 (1%)	1 m^3 (1%)		1 m^3 (1%)			
Estimated Volume of Non-Hazardous Material	3 m^3 (20%)	20 m^3 (20%)	10 m^3 (20%)	2 m^3 (20%)	3 m^3 (20%)	10 m^3 (20%)	16 m^3 (20%)	8 m^3 (20%)	3 m^3 (20%)	3 m^3 (20%)	2 m^3 (20%)	3 m^3 (20%)	3 m^3 (20%)
Estimated Volume of Tier II Contaminated Soils	2 m^3 (10%)	10 m^3 (10%)	5 m^3 (10%)	1 m^3 (10%)	2 m^3 (10%)	5 m^3 (10%)	8 m^3 (10%)	4 m^3 (10%)	2 m^3 (10%)	2 m^3 (10%)	1 m^3 (10%)	2 m^3 (10%)	2 m^3 (10%)
Estimated Volume of Tier I Contaminated Soils	2 m^3 (10%)	10 m^3 (10%)	5 m^3 (10%)	1 m^3 (10%)	2 m^3 (10%)	5 m^3 (10%)	8 m^3 (10%)	4 m^3 (10%)	2 m^3 (10%)	2 m^3 (10%)	1 m^3 (10%)	2 m^3 (10%)	2 m^3 (10%)
Presence of Contaminants	No samples collected. No surface staining noted.	No samples collected. No surface staining noted.	No samples collected. No surface staining noted.	There was no surface staining or evidence of contaminant migration from this lobe.	No samples collected. No surface staining noted.	No samples collected. No surface staining noted.	No samples collected. No surface staining noted.	The downgradient areas of Lobes H & I were evaluated together as there is only a small break between the two lobes. No surface staining or contaminant migration was identified.	The downgradient areas of Lobes H & I were evaluated together as there is only a small break between the two lobes. No surface staining or contaminant migration was identified.	No samples collected. No surface staining noted.	No samples collected. No surface staining noted.	No samples collected. No surface staining noted.	No samples collected. No surface staining noted.
Presence of Exposed Debris	Occasional metal and cable in area.	Occasional metal and cable in area.	Occasional metal and cable in area.	Wooden building materials and various domestic debris in general area	Occasional wood and steel cable is exposed.	Occasional wood and steel cable is exposed.	Occasional wood and steel cable is exposed.	Various Main Station Debris in area including, wood, metal, barrels etc.	Various Main Station Debris in area including, wood, metal, barrels etc.	Various Main Station Debris in area including, wood, metal, barrels etc.	Various Main Station Debris in area including, wood, metal, barrels etc.	Various Main Station Debris in area including, wood, metal, barrels etc.	Various Main Station Debris in area including, wood, metal, barrels etc.
Topography	The lobe is located on the plateau above the beach ridge and gently slopes toward the ocean.	The lobe is located on the beach ridge and gently slopes toward the ocean.	The lobe is located on the beach ridge and gently slopes toward the ocean.	The lobe is located on the plateau above the beach ridge and gently slopes toward the ocean.	This area consists of a small pond with slightly mounded areas on three of four sides and a drainage course / outlet on the fourth (southwest) side.	This area consists of a small pond with slightly mounded areas on three of four sides and a drainage course / outlet on the fourth (southwest) side.	This area consists of a small pond with slightly mounded areas on three of four sides and a drainage course / outlet on the fourth (southwest) side.	The surface of lobe H slopes at about 5% to the South towards the ocean.	The surface of lobe I slopes at about 5% to the South towards the ocean.	The surface of lobe J slopes at about 5% to the South towards the ocean.	The surface of lobe K slopes at about 5% to the South towards the ocean.	The surface of lobe L slopes at about 5% to the South towards the ocean.	The surface of lobe M slopes at about 5% to the South towards the ocean.
Cover Material	organics	organics	organics	organics	sand and gravel	gravel and cobbles	sand and gravel	organics, some rocks	organics, some rocks	organics, some rocks	organics, some rocks	organics, some rocks	organics, some rocks
Vegetation Cover	There is approximately 90% vegetation cover on the lobe.	There is approximately 90% vegetation cover on the lobe.	There is approximately 90% vegetation cover on the lobe.	There is approximately 90% vegetation cover on the lobe.	There is approximately 90% vegetation cover on the lobe.	There is approximately 90% vegetation cover on the lobe.	There is approximately 90% vegetation cover on the lobe.	There is approximately 80% vegetation cover on the lobe.	There is approximately 80% vegetation cover on the lobe.	There is approximately 90% vegetation cover on the lobe.	There is approximately 80% vegetation cover on the lobe.	There is approximately 90% vegetation cover on the lobe.	There is approximately 80% vegetation cover on the lobe.
Evidence of Erosion	There is no evidence of erosion.	Located on beach ridge which could be subject to wave action during storm surges	Located on beach ridge which could be subject to wave action during storm surges	There is no evidence of erosion.	There is no evidence of erosion.	There is no evidence of erosion.	There is no evidence of erosion.	There is no evidence of erosion.	There is no evidence of erosion.	There is no evidence of erosion.	There is no evidence of erosion.	There is no evidence of erosion.	There is no evidence of erosion.
Annual Precipitation	250-300 mm	250-300 mm	250-300 mm	250-300 mm	250-300 mm	250-300 mm	250-300 mm	250-300 mm	250-300 mm	250-300 mm	250-300 mm	250-300 mm	250-300 mm
Distance to Downgradient Waterbodies	The lobe is located on the beach ridge approximately 40 m away from high tide vegetation.	The lobe is located on the beach ridge approximately 10 m away from high tide vegetation.	The lobe is located on the beach ridge approximately 10 m away from high tide vegetation.	The lobe is located on the beach ridge approximately 40 m away from high tide vegetation.	Approximately 900 m from the Tidal Bay to the Southwest.	Approximately 900 m from the Tidal Bay to the Southwest.	Approximately 900 m from the Tidal Bay to the Southwest.	There is a small area of standing water between Lobes H and I.	There is a small area of standing water between Lobes H and I.	Approximately 400 m away from the Ocean to the South.	Approximately 400 m away from the Ocean to the South.	Approximately 400 m away from the Ocean to the South.	Approximately 400 m away from the Ocean to the South.
Distance to freshwater/marine habitat	The lobe is located approximately 40 - 50 m from the ocean.	The lobe is located on the beach ridge at 10 - 20 m from the ocean.	The lobe is located on the beach ridge at 10 - 20 m from the ocean.	The lobe is located on the approximately 40 - 50 m from the ocean.	Approximately 1100 m from the Freshwater Pond to the West.	Approximately 1100 m from the Freshwater Pond to the West.	Approximately 1100 m from the Freshwater Pond to the West.	Approximately 400 m away from the Ocean to the South.	Approximately 400 m away from the Ocean to the South.	Approximately 400 m away from the Ocean to the South.	Approximately 400 m away from the Ocean to the South.	Approximately 400 m away from the Ocean to the South.	Approximately 400 m away from the Ocean to the South.
Terrestrial Habitat	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.	Polar Bear, Caribou, Arctic Fox, Hare and Lemming are among the wildlife known to frequent the general area.
Land Use	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing	hunting and fishing
Comments	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size and location in a disturbed area where extensive surface debris will be removed, excavation of Lobe A is recommended to complete the debris removal at the Original Station Area.	Due to the proximity to the marine environment and the potential for erosion during storm events, this lobe has been classified as Class A.	Due to the proximity to the marine environment and the potential for erosion during storm events, this lobe has been classified as Class A.	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size and location in a disturbed area where extensive surface debris will be removed, excavation of Lobe D is recommended to complete the debris removal at the Old Hamlet Site.	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size and location adjacent to the pond, excavation of Lobe E is recommended.	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size and location adjacent to the pond, excavation of Lobe F is recommended.	Based on the lack of contaminant migration, this lobe is being classified as Class C, however, because of the instability of this lobe at the outlet / drainage course on the south side of the pond and the potential for future erosion, complete excavation of Lobe G is recommended.	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe H is recommended to complete the debris removal at the Main Station Area.	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe I is recommended to complete the debris removal at the Main Station Area.	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe J is recommended to complete the debris removal at the Main Station Area.	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe K is recommended to complete the debris removal at the Main Station Area.	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe L is recommended to complete the debris removal at the Main Station Area.	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe M is recommended to complete the debris removal at the Main Station Area.

Table C-2: Summary of Surface Debris Areas

Debris Area	Figure No.	Photos	Description	Location	Waypoints on Figures	Estimated Areal Extent (m^2)	Estimated Crushed Volume (m^3)	Hazardous Uncrushed Volume Component (m^3)	Comments
Library / Shower and Washroom Building Foundation and Debris	2.0	IMG_0454.JPG	**Foundation:** Approx. 50 - 200 mm square timber piles **Debris:** Corrugated sheet metal, structural steel, metal heaters, galvanized and steel plumbing, wire and electrical components, water tanks (2), misc. metal debris, timber flooring and planking, glass, porcelain, fibreglass insulation, asbestos board/shingles/ floor tile (hazardous)	Main Station	-	1,000	50	3	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Generator Building Foundation and Debris	2.0	IMG_3543.JPG	**Foundation:** Raised concrete slab on approx. 20 - 200 mm square timber piles. **Debris:** Generators (2), cylindrical steel tank (1500 US Gal.), misc. concrete and wood, barrels (2), misc. electrical wire and components, power poles (4), lead acid truck batteries (hazardous), lubricating oil (50 L) in diesel electric generators (hazardous)	Main Station	-	400	30	1	Access to Main Station Area Buildings is fair with site road requiring significant upgrades.
Kitchen / Mess Hall Foundation and Debris	2.0	IMG_3515.JPG	**Foundation:** Approx. 50 - 200 mm square timber piles (some partially burned). **Debris:** Concrete chimney, metal ducting, small cylindrical tanks (6), corruguated sheet metal, power pole, misc. wood and steel, barrels, misc. electrical wire and components, pipe sections, lead sheets (hazardous), asbestos board/shingles/floor tile (hazardous)	Main Station	-	600	40	5	Access to Main Station Area Buildings is fair with site road requiring significant upgrades.
Storage Container and Debris	2.0	IMG_3529.JPG	**Debris:** Remnants of a 20' Barge Container including steel angle iron structure and sheet metal on bottom half, corrugated sheet metal, fibreglass insulation, miscellaneous wood, metal and barrels, cylindrical steel tank (1500 US Gal.), misc. electrical wire and components	Main Station	-	500	20	-	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Showers / Washroom Foundation and Debris	2.0	IMG_3527.JPG	**Foundation:** Approx. 32 - 200 mm square timber piles (some partially burned). **Debris:** Steel angle iron, steel cylindrical water tanks (2), tracked flatbed carrier machine, corruguated sheet metal, misc. wood and steel, barrels, misc. electrical wire, cable and components, ducting, power poles (2)	Main Station	-	800	50	-	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Supply Depot Building Foundation and Debris	2.0	IMG_0460.JPG	**Debris:** corrugated metal panels, steel angle iron, power poles (3), timber beams, wood planking, barrels (1), metal strapping, wood boxes, wax paper rolls, misc. wood and metal, asbestos board/shingles/floor tiles (hazardous)	Main Station	-	600	25	4	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.

Table C-2: Summary of Surface Debris Areas

Debris Area	Figure No.	Photos	Description	Location	Waypoints on Figures	Estimated Areal Extent (m^2)	Estimated Crushed Volume (m^3)	Hazardous Uncrushed Volume Component (m^3)	Comments
Accomodations Building Foundation and Debris	2.0	IMG_3536.JPG	**Foundation:** Approx. 32 - 200 mm square timber piles (some partially burned) **Debris:** steel angle iron, corrugated metal panels, wooden wall sections, fibreglass insulation, steel cable, bags of grout, yellow heavy steel machinary part, misc. wood and metal	Main Station	-	1,000	40	-	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Maintenance Garage Foundation and Debris	2.0	IMG_3548.JPG	**Foundation:** Approx. 52 - 200 mm square and 300 x 200 mm timber piles (some partially burned) **Debris:** steel angle iron frame (intact), Corrugated sheet metal, truck, misc. barrels and metal pails, rebar, power poles (2), steel equipment parts including tracks, misc. wire and electrical components, water tanks (2), misc. metal debris	Main Station	-	1,000	60	-	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Boiler / Incinerator Building Foundation and Debris	2.0	IMG_0457.JPG	**Foundation:** Approx. 12 - 200 mm square timber piles **Debris:** Brick Chimney Structure (partially intact) on a concrete foundation, timber planking, steel water tanks (4), ducting, galvanized steel pipes, insulated wall panelling, cable, bags of cement, barrels (6), heater unit, power pole, misc. wood and steel, misc. electrical wire, asbestos board/shingles/floor tiles (hazardous)	Main Station	-	400	55	4	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic. Standing Water in and around building footprint.
Metal Dump Debris Area	3.0	IMG_3475.JPG	**Debris:** trucks, cars, tractors, grader, motors, barrels, steel angle iron, barrels, power poles, misc. machinary parts, wood and metal	South of Main Station Area	-	8,000	250		Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.
West of Main Station and Metal Dump Roads	1.0	113.jpg	**Debris:** approximately 200 barrels, power poles, misc. wood and metal	50 m to 300 m West of Road through Station and Metal Dump and Outside Previously Identified Debris Areas		160,000	30		Access to Area >50 m West of Main Station and Metal Dump Site Roads is fair to poor with some wet, boggy areas. ATV Access only.
1	2.0	IMG_0464.JPG	**Debris:** dozer, motors, barrels, structural steel, corrugated metal panels, ducting, auger flights, steel barrels, pile of power poles, wooden barrels, misc. wood and metal	East of Main Station Area	WP503 - 531	6,000	60	-	Access to Main Station Area is fair with site roads requiring significant upgrades for construction traffic.
2	2.0	IMG_0466.JPG	**Debris:** steel angle iron, corrugated sheet metal, misc. wood and metal debris	Main Station Area - South of Generator Building	WP532 - 537	1,100	5	-	Access to Main Station Area is fair with site roads requiring significant upgrades for construction traffic.

Table C-2: Summary of Surface Debris Areas

Debris Area	Figure No.	Photos	Description	Location	Waypoints on Figures	Estimated Areal Extent (m^2)	Estimated Crushed Volume (m^3)	Hazardous Uncrushed Volume Component (m^3)	Comments
3	2.0	IMG_0468.JPG	**Debris:** gas cylinders (9), ducting, metal heater, tin cans, galvanized piping, misc. electrical wire, misc. wood and metal debris, asphalt shingles, asbestos board/shingles/floor tiles (hazardous), gas cylinders (hazardous), lead acid truck batteries (hazardous)	Weather Building Debris Area	WP538 - 546	300	5	5	Access to Main Station Area is fair with site roads requiring significant upgrades for construction traffic.
4	3.0	IMG_0470.JPG	**Debris:** steel water tanks (2), stainless steel water tank, ducting, barrels, equipment tracks (2 sets), plumbing pipe, misc. electrical wire, timber planking, power pole, misc. wood, brick and metal debris, plaster pieces, fibreglass insulation, cardboard sheets, floor mats, asbestos board/shingles/floor tiles (hazardous)	Former Water Tank Building Site South of Main Station Area	WP547 - 553	1,200	10	4	Access to Areas south of Main Station Area is good.
5	3.0	IMG_0472.JPG and IMG_0474.JPG	**Debris:** corrugated sheet metal, barrels, metal heater, galvanized plumbing pipe, steel water tanks, timber planking, power poles, cardboard sheets, glass, plastic, ceramic, concrete blocks (2), misc. wood and metal debris, lead acid batteries (hazardous)	South of Main Station Area	WP554 - 575	3,200	40	-	Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.
6	3.0	IMG_0477.JPG	**Debris:** barrels (approx. 240), plumbing pipe, metal heater, steel water tanks, truck, domenstic debris including tin cans and bedsprings, timber planking (some partially burnt), plastic, porcelin, glass, misc. electrical wire, wood and metal debris	South of Main Station Area	WP576 - 593	2,700	70	-	Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.
7	3.0	IMG_0480.JPG	**Debris:** corrugated sheet metal, barrels, misc. metal debris	South of Main Station Area	WP595	20	2	-	Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.
8	4.0	IMG_0482.JPG	**Debris:** dozer, sheet metal, bed springs, cinder blocks, wood planking, wooden barrels, misc. wood and metal, asbestos board/shingles/floor tiles (hazardous)	Metal Dump Area	WP596 - 601	200	2	4	Access to Metal Dump Area is fair with site roads requiring significant upgrades for construction Traffic.
9	4.0	IMG_0483.JPG and IMG_0484.JPG	**Debris:** corrugated metal panel, steel angle iron, bed springs, misc. wood and metal, asbestos floor tiles (hazardous)	Metal Dump Area	WP602 & 603	50	10	4	Access to Metal Dump Area is fair with site roads requiring significant upgrades for construction Traffic.
10	4.0	IMG_0491.JPG	**Debris:** crushed barrels, dozer blade, steel angle iron, wooden platform, OSB sheets, plastic garbage bags, ceramic electrical insulators, misc. wood and metal	West Beach Area	WP609 - 646 & WP636 - 648	5,500	450	-	Access to West Beach Area is fair with site roads requiring significant upgrades for construction Traffic.
11	4.0	IMG_0489.JPG and IMG_3535.JPG	**Debris:** one submerged barge, one partially submerged barge, steel chassis with hitch	West Beach Area - Submerged or Partially Submerged Items	-	4,500	90	-	Barges and steel chassis with hitch are partially to fully submerged dependant on the tide.
12	3.0	IMG_0498.JPG	**Debris:** small tanks, toilet, garbage can, steel angle iron, bed frames, corrugated sheet metal, misc. wood debris	South of Main Station Area	WP651	30	10	-	Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.

Table C-2: Summary of Surface Debris Areas

Debris Area	Figure No.	Photos	Description	Location	Waypoints on Figures	Estimated Areal Extent (m^2)	Estimated Crushed Volume (m^3)	Hazardous Uncrushed Volume Component (m^3)	Comments
13	5.0	IMG_0504.JPG	**Debris:** corrugated sheet metal, barrels, steel angle iron, bed frames, snowmobile base, metal house frame, domestic debris including clothing, shoes, dishes, etc., timber planking, plywood, plastic bottles, misc. wood and metal debris	Old Hamlet Site - Concentrated Debris Area	WP731 - 753	3,500	50	-	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on upgradient tundra .
	5.0	IMG_0505.JPG		Old Hamlet Site - Overall Debris Area	WP652 - 730	54,000	30	-	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on upgradient tundra .
14	6.0	IMG_0509.JPG	**Debris:** steel angle iron, corrugated sheet metal, ducting, timber piles and planking, barrels, misc. wood debris	Original Station Site	WP754 - 787	16,000	50	-	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on upgradient tundra .
15	6.0	IMG_3485.JPG	**Debris:** crushed barrel piles (6), steel angle iron, corrugated sheet metal, boxes of tile, bags of grout, misc. wood and metal debris	Original Station Site - East	-	10,000	130	-	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on upgradient tundra .
Site Roads Debris Corridor	2.0, 3.0, 4.0, 5.0 & 6.0	IMG_3483.JPG	**Debris:** approx. 120 scattered barrels, approx. 340 consolidated barrels in eight caches, power poles, fallen communication tower, wooden cross structure, steel drum roller (3), wooden storage container, misc. wood and metal debris	Within 50 m from Centreline of Site Roads and Outside Previously Identified Debris Areas	-	190,000	100		Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on upgradient tundra .
Power Cable(s) between Main Station and Original Station Site	6.0		**Debris:** power cable	Between Main Station and Original Station Sites	-	5,500	10	-	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on upgradient tundra .
TOTALS						**478100**	**1774**	**34**	

Appendix D

Analytical Results for Barrel Product

Table D-1: Barrel Assessment Summary

Sample Number	Location	Depth of Contents (cm)	Description of Contents	Comments	Analytical Results
B1	511415 E 7435699 N	15	Aqueous	Clear	No exceedances for the parameters tested under the Barrel Protocol Criteria
B22	511475 E 7435787 N	10	Aqueous	Light brown silt	No exceedances for the parameters tested under the Barrel Protocol Criteria
B201	511430 E 7435814 N	15	Aqueous	Light brown silt	No exceedances for the parameters tested under the Barrel Protocol Criteria
B204	511471 E 7435831 N	20	Aqueous	Light brown silt/rusty sediment	No exceedances for the parameters tested under the Barrel Protocol Criteria
B219	511498 E 7435799 N	5	Aqueous	Light brown silt/rusty sediment	No exceedances for the parameters tested under the Barrel Protocol Criteria
B291	North of West Barrel Cache	15	Aqueous	Rusty sediment	No exceedances for the parameters tested under the Barrel Protocol Criteria
B301	Northwest of West Barrel Cache	15	Aqueous	Rusty sediment	No exceedances for the parameters tested under the Barrel Protocol Criteria
B303	Northwest of West Barrel Cache	5	Aqueous	Rusty sediment	No exceedances for the parameters tested under the Barrel Protocol Criteria

Notes: GPS waypoint not collected for B291, B301 and B303

Appendix E

INAC Abandoned Military Site Remediation Protocol

Affaires indiennes et du Nord Canada
Indian and Northern Affairs Canada

Abandoned Military Site Remediation Protocol

Volume I – Main Report

Indian and Northern Affairs Canada
Northern Affairs Organization
Contaminated Sites Program

Final
March 2009

Canada

Indian and Northern Affairs Canada | Affaires indiennes et du Nord Canada

Abandoned Military Site Remediation Protocol

Volume I – Main Report

March 2009

Indian and Northern Affairs Canada

ACKNOWLEDGMENTS

This Protocol is an update on the previous Indian and Northern Affairs Canada (INAC) Abandoned Military Site Remediation Protocol, which was produced in 2005. Considerable intellectual effort has gone into the revisions and updates contained in this new Protocol and INAC wishes to recognize and thank the organizations involved in its development.

This document, which is comprised of Volume I (Main Report) and Volume II (Supporting Technical Documentation) is a product of the collaborative efforts by the following organizations:

- Environmental Sciences Group, Royal Military College of Canada
- Golder Associates Ltd.
- EBA Engineering Consultants Ltd.
- UMA Engineering Ltd. (now AECOM)
- Qikiqtaaluk Environmental Inc.
- Jacques Whitford Ltd.
- Dept. of Geological Sciences and Geological Engineering, Queen's University

INAC also wishes to recognize and thank the members of the Technical Advisory Working Group who provided invaluable input to development of this Protocol.

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1 INTRODUCTION

In the 1950s, at the height of the Cold War, a number of facilities were constructed in the Canadian Arctic to provide surveillance of northern approaches to the continent. The largest installation was the Distant Early Warning (DEW) Line, a series of radar stations spanning the northern coastline from Alaska to Greenland. In total, 63 stations were constructed, 42 of which were located in Canada. In 1963, due to advances in technology, installations at 21 of the sites were considered redundant and these sites were abandoned. All buildings, vehicles, Petroleum Oil Lubricant (POL) storage tanks and miscellaneous debris were left in place. Administration of these sites was transferred to Indian and Northern Affairs Canada (INAC) (Fletcher 1989; INAC 2002). Other abandoned military sites include those associated with the Pole Vault line in the eastern Arctic. Locations of INAC military sites in the Canadian Arctic are indicated on Figure 1. The remainder of the installations on the DEW Line continued to operate until the early 1990s, at which point most of them were converted to the North Warning System (NWS). Decommissioning and cleanup of these 21 sites, excluding facilities that are required for the operation of the NWS, is the responsibility of the Department of National Defence (DND).

Several environmental issues were at these abandoned military sites based on previous preliminary and detailed assessments at the INAC and DND sites (ESG 1991, 1993). These issues include physical hazards related to unconsolidated debris and aged structures, and environmental impacts associated with soil contamination. In 1996, DND initiated remediation of the DEW Line sites under its jurisdiction and cleanup of these sites is on going. The cleanup follows the conditions of the DEW Line Cleanup Protocol (ESG, 1993 and ESG/UMA, 1995) and the co-operation agreements between DND and Nunavut Tunngavik Inc. (NTI) (DGE 1998) and DND and the Inuvialuit Regional Corporation (IRC) (DGE 1996).

INAC has completed the remediation of a number of sites across the Canadian Arctic namely Iqaluit Upper Base, Resolution Island (BAF-5), Horton River (BAR-E), Sarcpa Lake (CAM-F), and Pearce Point (PIN-A). The approach adopted for remediation of these sites has generally been consistent with the methodology applied at the DND DEW sites (PWGSC 2001 to 2003). Due to the commitment of the Federal Government to future funding of contaminated site clean up, INAC recognizes the need for a consistent protocol for abandoned military site cleanup (INAC 2002).

A number of factors must be considered when determining the most suitable approach to site remediation for remote sites in the Arctic environment. The Abandoned Military Site Remediation Protocol (AMSRP) is based on an approach that addresses legal requirements, INAC's Contaminated Sites Policy (including risk management requirements), and standard environmental management practices (INAC 2002).

This Protocol also takes into consideration financially prudent methodologies that address environmental issues while striking a balance with remedial cost. An over-arching principle has been to balance the environmental benefits of remediation activities with potential negative physical impacts to the Arctic environment.

The primary objectives of this document are to provide sufficient background information to understand the environmental issues present at these sites, and to describe the guiding principles for their assessment and remediation. AMSRP, Volume 2 (INAC 2009) provides additional supporting technical information.

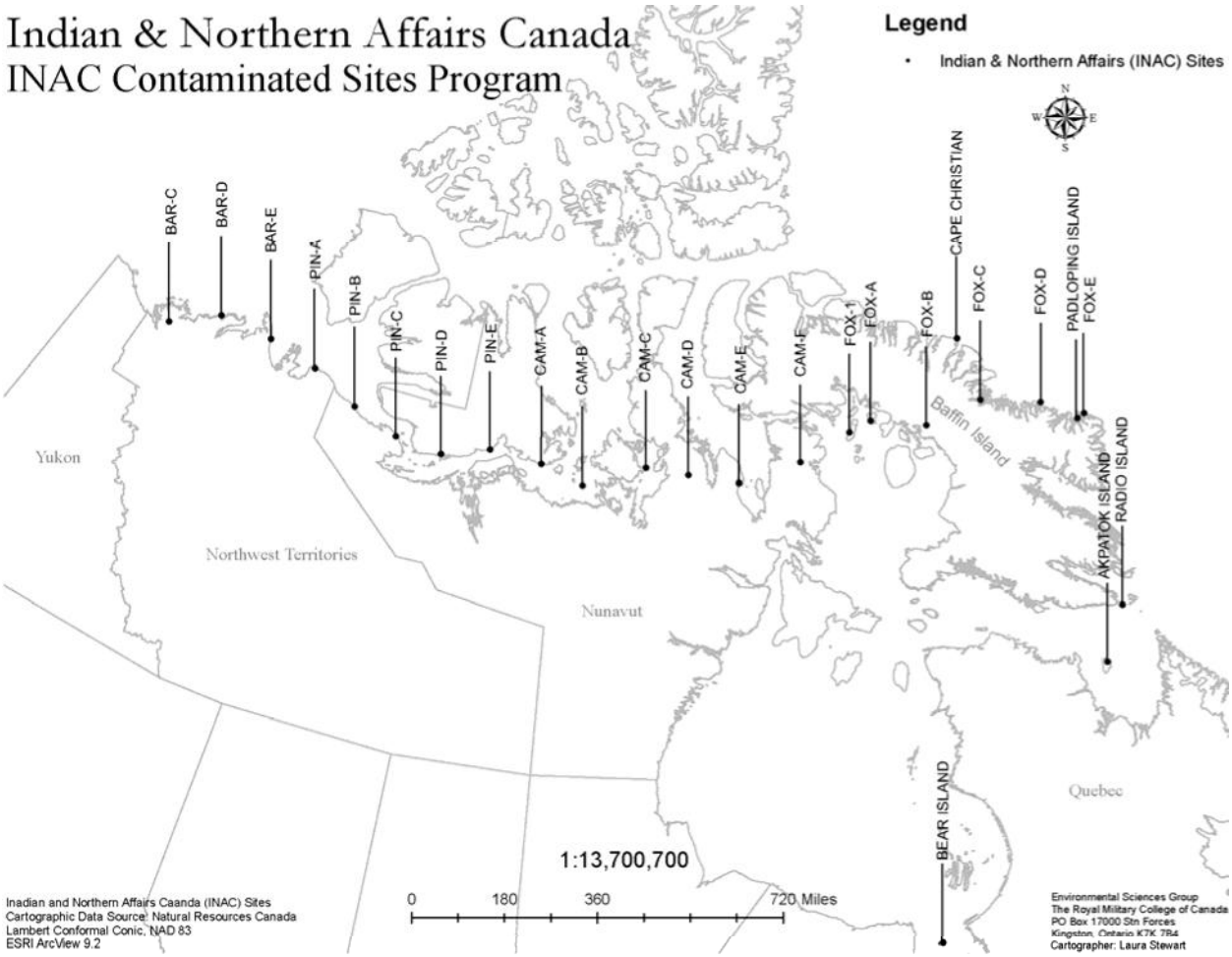

Figure 1 Location of INAC Military Sites

1.1 Scope of Document

This document is structured in a manner generally consistent with the steps outlined in the Federal Contaminated Sites Action Plan (CSM 2000) as shown in Figure 2. As previously indicated, issues of environmental concern have been identified at the INAC DEW Lines (Step 1). Extensive historical data (Steps 2 and 3) from initial environmental assessments, as well as detailed information collected through assessment of DEW sites under the jurisdiction of DND, has been used to develop the requirements for the detailed assessment of the INAC sites (Step 5), as described in Section 4. Guidelines for development of a remediation strategy (Step 7) are provided in Section 5. Implementation related issues, such as confirmatory sampling, waste manifesting, construction quality assurance/quality control measures (Step 9) are described in Section 6. Post-implementation monitoring requirements are described in Section 7 (Step 10).

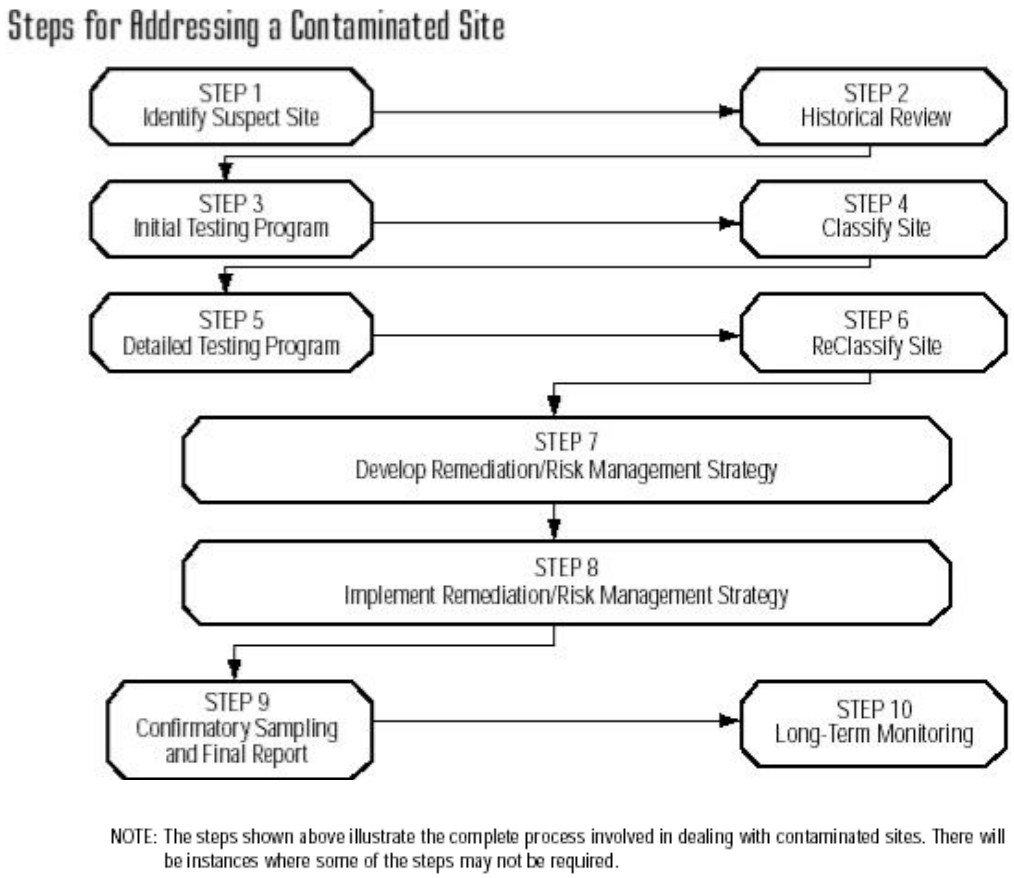

Figure 2 Steps for Addressing a Contaminated Site

2 BACKGROUND

2.1 CCME Environmental Quality Guidelines

Where remediation of federal real property is carried out, departments and agencies are to set remediation objectives in accordance with the most applicable of the three methods developed by the Canadian Council of Ministers of the Environment (CCME) (CCME 1997):

CCME Tier 1: Follow CCME Environmental Quality Guidelines (CCME 1997, 1999), as amended from time to time, and, where applicable, the *Canada-wide Standard for Petroleum Hydrocarbons in Soil* (CCME 2008), as amended from time to time. To the extent that guidelines do not exist for a particular type of contamination, or are technically or economically inappropriate for a particular situation, departments and agencies may follow equivalent guidelines or standards (e.g. provincial);

CCME Tier 2: Follow modified CCME Environmental Quality Guidelines where site conditions, land use, receptors, or exposure pathways differ only slightly from the protocols used in the development of the guidelines; and

CCME Tier 3: Develop site-specific remediation objectives based on a site-specific risk assessment, as outlined by the CCME, or equivalent, where site conditions are unique or particularly sensitive.

Although the CCME Environmental Quality Guidelines are broad in application and address a wide variety of land uses and potential contaminants from diverse sources, they do not specifically address the environmental conditions representative of the Arctic, as discussed in AMSRP Volume 2 (INAC 2009).

2.2 Department of National Defence (DND) DEW Line Cleanup (DLCU) Protocol

The initial environmental assessment of DEW Line sites under the jurisdiction of DND was one of the first major contaminant investigations in the Arctic related to point source contaminants. Following these assessments in the early 1990s, DND developed a remedial protocol in consultation with other government agencies and stakeholders (ESG 1991, 1993), and referred to it as the DEW Line Cleanup (DLCU) Protocol. This Protocol was developed at a time when no remediation standards and criteria specific to the Canadian Arctic existed. The remedial criteria were developed using a contaminant source and pathway targeted approach, consistent with CCME's Tier 3 method. A broad suite of chemicals was investigated and contaminants of concern at DEW Line sites were identified as those contaminants that were consistently elevated relative to the site background levels and the available Canadian federal or provincial guidelines (CCME 1991). The rationale for selection of contaminants of concern is provided in AMSRP Volume 2 (INAC 2009). Engineering input with respect to remediation strategies was used to refine the cleanup protocol (ESG/UMA 1995) prior to its implementation at the first DND sites in 1996.

Cleanup of Arctic sites presents a number of unique challenges, including but not limited to:

- Remote site location, with access limited to sea-lift and small aircraft during the summer months, and over-land during winter;
- Short construction season, typically from July to September, which may limit the technical feasibility of remedial options;
- Lack of centralized waste disposal facilities;
- High costs associated with mobilization of equipment and personnel to the sites, both during the site assessment and remedial phases; and
- Sensitivity of the Arctic ecosystem to changes in physical habitat.

Experience gained since 1996 at the DND sites has been reviewed annually to evaluate lessons learned and to incorporate new information and methodologies as they become available. The DLCU protocol therefore is the culmination of scientific and engineering expertise that has been applied across the Arctic at the DND sites.

Although there are many similarities between INAC and DND DEW sites, the INAC sites were in operation for a significantly shorter period of time, and environmental issues tend to differ in scale. In addition, there may have been other land use subsequent to the DEW Line activities. INAC sites and the associated known land uses are summarized in Table 2.1

Table 2.1 Summary of INAC Military Sites and Historic Land Use

Site Designation/Name	Location	Other Historic Land Use/ or Issues
BAR-C Tununuk Camp	NWT	Imperial Oil as Lessee
BAR-D, Atkinson Point	NWT	Canadian Marine Drilling (CANMAR) Canadian Reindeer Ltd. (note: cleanup on-going)
BAR-E Horton River	NWT	SRR, (note: cleanup completed, monitoring on-going)
PIN-A Pearce Point	NWT	Biological Research Station (note: cleanup completed, monitoring ongoing)
PIN-B Clifton Point	Nunavut/Kitikmeot	
PIN-C Bernard Harbour	Nunavut/Kitikmeot	
PIN-D Ross Point	Nunavut/Kitikmeot	
PIN-E Cape Peel	Nunavut/Kitikmeot	
CAM-A Sturt Point	Nunavut/Kitikmeot	
CAM-B Hat Island	Nunavut/Kitikmeot	Short Range Radar (SRR) as part of North Warning System
CAM-C Matheson Point	Nunavut/Kitikmeot	
CAM-D Simpson Lake	Nunavut/Kitikmeot	SRR (module train dismantled and buried on site)
CAM-E Keith Bay	Nunavut/Qikiqtaaluk	Module train gone/some evidence of burning
CAM-F Sarcpa Lake	Nunavut/ Qikiqtaaluk	Research Station (note: cleanup completed, monitoring ongoing)
FOX-1 Rowley Island	Nunavut/Qikiqtaaluk	SRR (large burn area, module train gone)
FOX-A Bray Island	Nunavut/Qikiqtaaluk	SRR (module train gone)
FOX-B Nudluardjuk Lake	Nunavut/Qikiqtaaluk	SRR (module train gone)
FOX-C Ekalugad Fiord	Nunavut/Qikiqtaaluk	
FOX-D Kivitoo	Nunavut/Qikiqtaaluk	Fire destroyed main building train in 1963
FOX-E Durban Island	Nunavut/Qikiqtaaluk	Partially burned building

Site Designation/Name	Location	Other Historic Land Use/ or Issues
Cape Christian	Nunavut/Qikiqtaaluk	LORAN Site
Padloping Island	Nunavut/Qikiqtaaluk	Navigational aid and weather station
Radio Island	Nunavut/Qikiqtaaluk	Navigational aid and weather station (note: cleanup completed, no monitoring required)
Bear Island	Nunavut/Qikiqtaaluk	Mid-Canada site
BAF-5 Resolution Island	Nunavut/Qikiqtaaluk	Pole-Vault site (note: cleanup completed, monitoring ongoing)
Iqaluit, Upper Base	Nunavut/Qikiqtaaluk	Pole-Vault site (note: cleanup completed, monitoring ongoing)

Cleanup objectives were set for the INAC sites, and the INAC AMSRP was developed as outlined in the following sections.

3 CLEANUP OBJECTIVES

Cleanup objectives, which are consistent with the Federal Contaminated Sites Management Working Group (CSMWG) objective to "integrate sustainable development and pollution prevention principles while meeting environmental regulations and protecting public health" (CSM 2000, TB 1998, 2000, 2002), are as follows:

- To restore sites to meet the environmental objectives established for northern sites;
- To prevent migration of contaminants into the Arctic ecosystem;
- To remove physical hazards for the protection of human health and safety; and
- To implement a cost effective remediation solution.

These objectives are consistent with those applied in the remediation of DEW Line sites under the jurisdiction of DND (DGE 1996, 1998). The following considerations need to be taken into account when developing and implementing a Remedial Action Plan (RAP) for INAC sites:

- Respect all historical agreements and obligations in a fair and reasonable manner;
- Ensure consistency with federal guidelines for management of contaminated sites;
- Apply the Canadian Council of Ministers of the Environment (CCME) environmental protection and management approaches (CCME 1996, 1997, 1999, 2001, 2008) as applicable;
- Apply simple, practical remedial solutions wherever possible, with flexibility as necessary to adjust to site-specific conditions when they are identified;
- Establish cost effective solutions through use of best practices to ensure appropriate levels of environmental protection for all sites;
- Recognize the concerns of climate change in an Arctic setting; and
- Ensure long-term effectiveness of the environmental remedial measures.

It is Canadian government policy that all federal departments and agencies ensure sound environmental stewardship with respect to property in their care by avoiding contamination and managing contaminated sites in a consistent and systematic manner that recognizes the principle of risk management and results in the best value for the Canadian taxpayer (TB 1998, 2000, 2002). The following section identifies the primary factors that have been considered in developing a remediation approach.

3.1 Biophysical Environment

The INAC abandoned military sites are located across the Arctic in the Southern Arctic Ecozone in the western Arctic, in the Northern Arctic Ecozone in the central and eastern Arctic, and the Arctic Cordillera along the east coast of Baffin Island. The majority of the sites are located along the coastline. (Agriculture and Agri-Food Canada, 1996).

Mean annual temperatures are in the range of -11^{0}C in the western Arctic and tend to be colder in the central and eastern Arctic. Accordingly, all sites are located within the zone of continuous permafrost. Much of the Arctic region is classified as polar desert as annual precipitation, predominantly as snow, is generally within the range of 100 to 300 mm. One exception is the eastern coastline of Baffin Island near Cumberland Peninsula, where precipitation can be in the order of 400 to 600 mm annually.

As indicated, the Arctic ecosystem is characterized by extreme environmental conditions, including cold temperatures, large seasonal fluctuations in incoming solar radiation, extensive snow and ice cover, and short growing seasons. These conditions affect the productivity, species diversity, wildlife behaviour (e.g., migration), and food chain characteristics of Arctic ecozones. For example, productivity in terrestrial, freshwater, and marine environments is reduced due to limited nutrient availability, low light, low temperatures, ice cover, and short growing seasons. Compared to most other ecosystems, the Arctic is characterized by relatively low reproduction, organisms that are slower to reach sexual maturity and are generally longer lived, lower species diversity, and distinctive sub-ice biological communities. Relatively short food chains, which are characteristically known for their dominance of marine mammals and birds, are associated with simple predator-prey relationships (e.g. phytoplankton-zooplankton-fish-seal-polar bear or phytoplankton-zooplankton-whale). The combination of all these physical factors affect the sparse distribution and number of Arctic biological communities and makes them very sensitive to physical disturbances such as habitat destruction (AMAP 1998, CACAR 2003).

The assessment and remedial protocols developed are cognizant of striking a balance between the physical disturbances of existing impacted areas versus the physical disturbances of developing new areas required to support remediation activities.

4 ASSESSMENT PROTOCOL

The elements of the assessment protocol have been developed through the review of previous work at related sites (eg. PWGSC 2001a-c, 2002a-f, IEG 2001, EWG 1998, 1999, UMA 1994) and take into consideration information of particular relevance to the unique character of the INAC sites. Typical environmental issues at abandoned military sites include:

- Contaminated soils;
- Existing solid waste disposal areas;
- Debris on surface and in waters near the sites;
- Debris associated with the demolition of structures/facilities; and
- Hazardous waste.

The objective of the environmental assessment of these sites is to collect sufficient information to allow development of a Remedial Action Plan (RAP).

Issues related to implementation, including but not limited to: environmental screening, permitting, and construction, also require information to be collected at the assessment stage. These information requirements can include:

- Geotechnical site information relating to potential development areas for landfills and/or hydrocarbon contaminated soil treatment area, and available borrow sources;
- Site access, such as condition of roadways, the airstrip, barge landing areas, requirements for winter roads or CAT train routes;
- Potable water supply and seasonal fluctuations of potable water supply;
- Siting of camp facilities and temporary storage areas;
- Natural Environment Assessment;
- Traditional Knowledge Surveys/Assessment; and
- Archaeological Assessment.

This section of the protocol provides guidance related to conducting an environmental site assessment that meets the requirements of the INAC cleanup objectives.

4.1 Background Geo-Chemical Assessment

Application of remedial criteria must take into account background concentrations of inorganic elements, as naturally elevated concentrations of a select number of inorganic elements may impact assessment and subsequent remedial activities. High natural variability in concentrations of inorganic elements on a local scale has been observed at several DND DEW Line sites (PIN-1, DYE-M, FOX-2, FOX-3). Based on a desk-top study of the geochemistry and surficial and bedrock geology, a detailed investigation of background concentrations is required in conjunction with the environmental site assessment of the following sites:

- Ross Point (PIN-D)
- Nadluarjuk Lake (FOX-B),
- Kivitoo (FOX-D),
- Durban Island (FOX-E) and
- Padloping Island.

A statistically valid approach must be used to design a sampling program for the collection of representative samples from background areas. Guidance for the background geochemistry investigation is provided in AMSRP Volume 2 (INAC 2009).

4.2 Contaminated Soils

4.2.1 Inorganic Elements and PCBs – DCC Criteria

The contaminants of concern for INAC abandoned military sites, where historic land use is limited to former DEW Line operations, is based on a detailed review of data collected to date from DND and INAC site assessment and delineation programs. The DEW Line Cleanup (DLCU) Protocol, which includes criteria for a specific, limited set of contaminants, is considered appropriate for INAC sites. Supporting documentation for selection of these criteria is provided in AMSRP Volume 2 (INAC 2009).

This provides a consistent approach across all sites, and is generally considered protective of the Arctic ecosystem as described in AMSRP Volume 2 (INAC 2009). Table 4.1 identifies the parameters and criteria.

Table 4.1 DEW Line Cleanup Criteria (DCC) for Soil[a]

Parameter in Soil	**CRITERIA[b]** mg/kg	
Inorganic Elements	*DCC Tier I [c]*	*DCC Tier II[d]*
Arsenic (As)		30
Cadmium		5.0
Chromium		250
Cobalt		50
Copper		100
Lead	200	500
Mercury		2.0
Nickel		100
Zinc		500
Polychlorinated biphenyls		
PCBs	*1.0*	*5.0*

a. These criteria were adopted specifically for the cleanup of Arctic DEW Line Sites from the 1991 versions of the Quebec Soil Contamination Indicators and the Canadian Council of Ministers of the Environment Interim Canadian Environmental Criteria for Contaminated Sites. They were validated by an assessment of the soil concentration at which the substance was taken up by vascular plants and thereby constituted an input to the Arctic ecosystem.

b. Soil criteria are given in parts per million, ppm.

c. Soils containing lead and/or PCBs at concentrations in excess of DCC Tier I, but less than DCC Tier II, may be landfilled in a Non-Hazardous Waste Landfill,

d. Soils containing one or more substrates in excess of DCC Tier II are to be treated/disposed of in a manner that precludes contact with the Arctic ecosystem.

A review of data collected on INAC sites with land use other than DEW Line activities indicated that the likelihood of other parameters occurring systematically at concentrations exceeding applicable criteria in the absence of other contaminants of concern is low (AMSRP Volume 2 (INAC 2009)).

Based on historic patterns of waste disposal and contamination observed at other abandoned military sites, soils contaminated in excess of the DCC criteria are typically found in the following locations:

- In the vicinity of buildings;
- Former sewage discharge areas;
- Former open storage areas;
- Where surface debris is present;
- Solid waste disposal areas; and
- Petroleum, Oil, Lubricant (POL) bulk storage areas and along fuel lines and transfer locations.

Delineation of the lateral extent and depth of contamination is required to determine quantities of sufficient accuracy to develop a RAP and the subsequent Contractual Drawings and Specifications. A detailed sampling plan shall be developed for each potential area of concern identified as part of historic review, and shall include the following information:

- Description of the objective for each potential area of concern;
- Sampling locations;
- Sampling methodology;
- Proposed number of samples and media;
- Parameters for analyses; and
- Analytical requirements and Quality Assurance/Quality Control measures.

Delineation shall be achieved by sampling in a grid pattern over the affected area. The estimated size of the area determines the grid spacing: the larger the estimated area, the larger the grid spacing. Test pits shall be excavated to determine the depth of contamination. Test pits shall also be excavated outside the area of surface contamination to evaluate whether sub-surface migration of contaminants has occurred. Greater sample density may be warranted based on site specific conditions, particularly in areas where soils contaminated with PCB concentrations in excess of 50 ppm are suspected; such as near buildings where electrical transformers were housed, vehicle maintenance structures, and near exit doors of facilities. It is recommended that a reasonable degree of over-sampling and an iterative approach to analyses be employed to provide greater confidence that closure is achieved during the assessment phase, recognizing that the cost of analyses is only a fraction of disposal costs.

Additional samples shall be collected and analysed to determine transport and disposal requirements should off-site disposal of contaminated soils be required.

4.2.2 Hydrocarbon Contaminated Soils

Where free product is encountered, the free phase liquid will be addressed prior to the application of a qualitative risk assessment method for establishing remediation requirements.

A review of the assumptions used for the derivation of the CCME CWS for Petroleum Hydrocarbons (PHC) as well as the need to minimize physical disturbance suggests that direct application of criteria for the protection of all receptors may not be appropriate at the INAC sites AMSRP Volume 2 (INAC 2009). A revised set of criteria are provided in Table 4.2. These criteria incorporate the CWS PHC as appropriate, as well as previous quantitative risk assessment results. Two classes of hydrocarbons were identified, Type A – non-mobile, and Type B – mobile. Type A refers to heavy end products, such as lubricating oils, and are easily differentiated by dark staining. Relative to the CWS PHC, Type A consists of the sum of F3 and F4 constituents. Type B includes lighter end or more volatile hydrocarbon products such as MoGas, jet fuel and diesel, and is approximately equal to the sum of the F1 through F3 fractions. When all four fractions are present, the dominant hydrocarbon type is defined by the percentage of the sum of F3 and F4, relative to the sum of F1 to F4 (total TPH). For Type A contaminated soil, the sum of F3 plus F4 must be greater than 70% of the total TPH concentration **and** the F2 concentration must be less than the F4 concentration.

Table 4.2 Remedial Objectives – Hydrocarbon Contaminated Soil – INAC Abandoned Military Sites

Exposure Pathway	F1	F2	F3	F4	Type B Hydrocarbon Contamination	Type A Hydrocarbon Concentration
Protection of Freshwater Aquatic Life[(a)]	1290[(a)]	330[(a)]	NA	NA	330[(a)]	NA
Direct Soil Eco-Contact	Not utilized – See AMSRP Volume 2 (INAC 2009)					
Protection of Terrestrial Wildlife					2500[(b)]	
Human Health		11000	20000			20,000
Management Limit					5000[(c)]	

Notes:

(a) Within 30 m of a water body

(b) For surface soils to 0.5 metres depth.

(c) Below 0.5 m depth, a value of 5000 mg/kg may be applied based on professional judgement.

Based on historic patterns of contamination observed at other abandoned military sites, soils contaminated with hydrocarbons are typically found in the following locations:

- In the vicinity of buildings near fuel distribution lines, fuel dispensing tanks;
- Former open storage areas and/or debris areas where barrels may be present;
- Petroleum, Oil, Lubricant (POL) bulk storage areas; and
- Solid waste disposal areas.

Delineation of the lateral extent and depth of contamination is required to determine quantities of sufficient accuracy to develop a RAP and the subsequent Contractual Drawings and Specifications. A detailed sampling plan shall be developed for each potential area of concern identified as part of historic review, and must include the following information:

- Description of the objective for each potential area of concern;
- Sampling locations;
- Proposed sampling methods for shallow and depth samples, where the depth sampling should achieve a depth consistent with the estimated active layer thickness;
- Proposed number of samples and media;
- Parameters for analyses in accordance with Table 4.2;
- Sampling methodology, analytical requirements, Quality Assurance/Quality Control measures.

At minimum, the information requirements as outlined in Table 4.2 shall be incorporated into the Sampling Plan.

Table 4.3 Hydrocarbon Contaminated Soil Information Requirements

Item	Comments
Hydrocarbon Contaminated Soils – Stained Soils (F3/F4 fraction) – Type A	
Areal Extent -Visible surface staining	Topographic survey and location/coordinates of stained areas and sample locations Provide sketches with measurements
Topography	Examine for evidence of erosion (drainage channels)
Soil Description	Include description of grain size distribution, well graded or poorly graded. Fine grained, coarse grained, maximum particle size
Sampling	Collect soil samples for analyses of F1 to F4 fractions to characterize contamination, analyses for presence of co-contaminants such as PCBs.
Confirm Depth of Staining	Testpit to extent of stain, collect soil sample for PHC analyses at 0.5 m depth.
In areas of multiple staining	Identify and survey extent of stains Collect individual samples from most visibly stained areas to represent "worst" case. Focus on stained areas larger than 4 m^2
Evidence of residual or free product	
Hydrocarbon Contaminated Soils – Near Fuel Storage, Distribution or Dispensing Areas (F1-F3 fraction) Type B	
Within 30 m of water body supporting aquatic life	
Describe surrounding environment	Consulting locals and elders who use the area may prove to be useful.
Sampling – Hydrocarbons	Delineate **laterally and at depth** to 330 mg/kg as per on-site analytical capabilities Collect sufficient samples for laboratory analyses of hydrocarbon fractions to confirm correlation with on-site analytical results. Over-sampling (within reason) and iterative analyses may be required where there is poor correlation with test-kits (organic materials)
Sample groundwater in testpit excavation in source zone.	Collect groundwater samples and analyze for dissolved hydrocarbons (F1, F2) and wastewater discharge criteria (Section 6). Measure water levels, and presence of free product, if applicable

Item	Comments
Greater than 30 m distant of water body supporting aquatic life	
Sampling – Hydrocarbons	Delineate **laterally and at depth** to 2500 mg/kg as per on-site analytical capabilities. Collect sufficient samples for laboratory analyses of hydrocarbon fractions to confirm correlation with on-site analytical results For the purposes of comparison, use the summation of F1 to F3 concentrations.
Collect soil samples for grain size distribution	Representative samples should be taken of soils within and downgradient of the source zone for determination of grain size distribution, and water content.
All Hydrocarbon Contaminated Soil Areas	
Topography	Survey sample locations and topography of source zone and surrounding area. Include min. 25 m buffer zone around contaminated areas. Document seepage zones (toe of embankments), if applicable. Evidence of erosion
Evidence of impacted vegetation	Note presence and extent of vegetation; identify areas of stressed vegetation if applicable.
Wildlife	Note presence or evidence of wildlife (nests, burrows, etc.) within impacted and surrounding area. Review in context with overall Natural Environment Survey (Section 4.9)

Additional representative samples shall be collected and analysed to assist in the determination of treatment requirements. Samples should be collected from areas representing the largest contributions to the PHC contaminated soil volumes (such as bulk fuel storage areas). These analyses include, but are not limited to:

- Water content
- Total Available Nutrients; Total Organic Carbon
- Treatability tests to assess bioremediation potential (bacterial counts, hydrocarbon degraders).

4.3 Solid Waste Disposal Areas

Solid Waste Disposal Areas (WDA) on INAC abandoned military sites are generally smaller in extent than those located on DND DEW Line sites, and may be more appropriately referred to as buried debris areas or dump sites. As part of the historic review, areas of ground disturbance/landfill activity will be identified for further investigation. A detailed investigation/sampling plan shall be developed for each area, and must include the following information:

- Description of the objective for each potential area of concern
- Methodology for determining extent of buried debris using non-intrusive geophysical surveys, such as Electro-Magnetic Surveys (EM) or Ground Penetrating Radar (GPR), and associated ground-truthing. The consultant is to indicate the type of geophysical survey to be used based on anticipated ground conditions. In general, a grid-survey pattern shall be used that provides adequate coverage of the area. Identification of areas of surface debris within the geophysical survey area is required to allow correlation with geophysical survey results. All geophysical surveys must be referenced to a UTM coordinate system.
- Identification of sampling locations both up- and down-gradient of the landfill, debris area or dump site.
- Proposed sampling methods for shallow and depth samples, where depth sampling should achieve a depth consistent with the estimated active layer thickness.
- Proposed number of samples and media.
- Parameters for analyses.
- Sampling methodology, analytical requirements, and Quality Assurance/Quality Control measures.

In addition, general site information shall be collected as outlined in Section 4.9 and 4.10, as well as specific information for each WDA as described below to support the evaluation of the potential environmental risk associated with the WDA (Annex A).

Physical Characteristics:

Areal Extent of WDA Extent

Depth of Buried Debris, as applicable

Contaminant Characterization (concentrations/extent)

Volume and extent of exposed debris, where exposed debris is defined as surface and/or partially buried debris within 0.5 meters of the surface.

Pathway/Transport Mechanisms

Surface expressions of contaminated soil and/or leachate.

Grades/Topography

Surface cover materials type and depth

Evidence of erosion

Precipitation

Distance to downgradient perennial surface water bodies

Receptor Characteristics

Distance to freshwater/marine habitat and habitat usage.

Terrestrial Habitat

Traditional Land Use

Minor modifications to the evaluation matrix prepared by the DND/NTI Environmental Working Group (EWG 1998) will be used for the assessment of potential environmental risk (Annex A). These modifications included:

- Addressing remedial requirements for dump sites and debris areas (generally smaller in size than landfills)
- Modifying contaminant characterization to include leachate migration and the presence of contaminants as one category.
- Including consideration of snow pack as well as annual precipitation.

Additional detail regarding the evaluation of WDAs is provided in Annex A.

4.4 Surface Debris

Surface debris is present on many of the sites, and may consist of a variety of waste materials including:

- Scrap metal and wood wastes (painted/unpainted);
- Barrels, potentially containing product; and
- Asbestos, batteries, and electrical equipment.

All areas of debris shall be inventoried to the extent possible to provide volume estimates and characterization of waste materials. Site debris shall be classified as inert, non-hazardous wastes or hazardous wastes in accordance with the following Acts and Regulations.

- Federal Transportation of Dangerous Goods Act and Regulations
- The Canadian Environmental Protection Act
- The Nunavut or Northwest Territories Environmental Protection Act

The number of barrels containing product shall be inventoried where it is safe to do so. However, it is impractical to sample and analyse contents of all barrels on site during the assessment phase. To provide information required for the Remedial Action Plan, a statistically relevant number of barrels shall be sampled and analysed. The actual number of barrels sampled will depend on the total number of barrels at the site, and should be determined using professional judgement. Samples will be analysed for parameters in accordance with the barrel protocol, and as summarized below:

Organic Phase: Total Chlorine, PCBs, Cadmium, Chromium, Lead

Aqueous Phase: % Alcohols and Glycols, Total Chlorine, Cadmium, Chromium, Lead

If the aqueous phase is less than 2% alcohols or glycols, water shall be analysed in accordance with waste water discharge criteria. Annex B provides further information on the Barrel Protocol.

4.5 Submerged Debris

Debris may be present in the near shore marine environment and/or lakes that are present on the site. Observations of debris in water shall be recorded to the extent possible and supplemented with local and anecdotal knowledge. Previous studies have confirmed that such debris is primarily a risk to navigation in shallow waters (AMSRP Volume 2 (INAC 2009)).

4.6 Buildings/Structure Inventory

Existing buildings and infrastructure at a site will be demolished down to their foundations as part of the cleanup. To assist in the development of the RAP, an inventory of building contents, foundation construction materials and details, and building/structure construction materials and dimensions are required. Building contents, where present, shall be inventoried and classified as non-hazardous or hazardous wastes. Hazardous building materials may include, but not be limited to: PCB and lead-amended paint, asbestos containing materials (ACMs), fluorescent lights, and mercury containing switches.

Painted building materials shall be tested for total lead and PCBs, and leachable lead and PCBs in order to determine disposal requirements. The thickness and density of the paint and substrate material shall be recorded as it may be required to calculate total PCB concentrations. Samples of concrete, excluding paint, shall be collected and analysed for PCBs. The locations and number of samples are to be determined in the field. Samples should be collected from both stained and non-stained areas on concrete on surface and at depth. Over-sampling and iterative analyses is recommended. As part of the assessment, a detailed waste inventory shall be prepared that includes: dimensions, building materials, foundation materials (concrete slab, timber piles, timber crib), estimated volume and mass of wastes, and the basis of any assumptions used in the estimate. Painted materials must be specifically identified and the extent of paint coverage and adherence quantified.

4.7 Geotechnical Requirements

4.7.1 Potential Development Areas

New engineered landfills and hydrocarbon treatment areas may be required during cleanup. Potential locations shall be identified and surveyed during the site assessment phase. Guidelines for the siting of potential development areas include:

- Avoidance of permafrost sensitive areas, vegetated areas and archaeological features.
- Avoidance of contaminated areas.
- Maintain a distance of 300 m or more from downgradient permanent water features.
- Locate at elevations greater than 2 metres above sea level or storm surge level
- Ground surface topography with grades of 6% or less.
- Proximity to borrow sources, waste materials.

The INAC sites are all located within the zone of continuous permafrost. The sensitivity of permafrost to climate warming consists of two components, the thermal response to warming and the impact of thaw (physical response) (Smith, Burgess, 2004) as cited in AMSRP Volume 2 (INAC 2009). The physical response of the terrain to permafrost degradation is mainly dependent on the ice content of the frozen material (Dyke et al., 1997). Warming of ice-rich perennially frozen ground would eventually lead to its thawing and the resultant thaw settlement, slope instability, thaw slumping, thermokarst, and other permafrost degradation-related processes. Excess ground ice can be identified by landforms at surface, such as patterned ground. An evaluation of the potential for impacts due to climate change is provided in AMSRP Volume 2 (INAC 2009).

Potential development areas shall be surveyed to provide detailed topographic information to allow generation of ground contours. A buffer zone of a minimum of 50 m should be surveyed around all proposed development areas. In previously disturbed areas, soil sampling and analyses shall be carried out to confirm or disprove the presence of any historic contamination using a targeted approach. Additional sampling should be carried out over a grid with spacing of approximately 50 m x 50 m.

4.7.2 Borrow Sources

During cleanup, borrow material is required for construction of new landfills, development of treatment areas, backfilling of contaminated soil excavation, closure of existing landfills, general regrading and for road construction/maintenance.

Available existing sources of borrow material should be exhausted before exploiting new areas. Areas of excess ground ice or of biophysical significance (denning/nesting areas) are to be avoided. Use of abandoned gravel pads and road infrastructure as granular source material is preferable, wherever possible. Existing gravel pads shall be screened for the presence of contaminants during the assessment phase.

Borrow sources shall be identified and characterized and estimated quantities developed. Test-pits shall be excavated to confirm subsurface stratigraphy, seepage, depth to permafrost table or bedrock, and ground ice conditions. Select soil samples shall be retained for geotechnical laboratory testing to assist in the development of Specifications. Testing shall include, but not be limited to: water content, grain size distribution, and moisture density relationships. At sites where background inorganic element concentrations are elevated, additional samples shall be collected for geo-chemical characterization of the borrow material.

4.7.3 Site Access

Access to the sites is typically by barge/ship and aircraft and on site by existing access roads. A limited number of sites are land-locked. Use of the airstrip is essential to mobilize materials and equipment required for site activities. An inspection and sampling of the airstrip fill materials shall be completed during the assessment phase to determine the load capacity to support a variety of aircraft. Drainage and erosion features shall be documented in order to assess the useable length, and/or upgrading requirements.

Investigation of potential CAT Train and/or other equipment mobilization options shall be investigated for the mobilization of heavy equipment. Construction records for Short Range Radar (SRR) sites located in the vicinity may be available as reference. Suitability of the beach for barge landing/sea lift access shall also be assessed. Local knowledge and Traditional Knowledge (TK) may prove useful in evaluating potential CAT train routes as well as suitable barge landing sites.

Helicopter landing pads, associated with Short Range Radar sites, are within the DND reserve. Only a non-intrusive visual inspection should be carried out to document the physical status of these areas.

4.7.4 Siting of Camp Facilities and Temporary Storage areas.

Laydown areas are required for temporary camp structures, equipment and storage during the cleanup. Potential locations shall be identified during the site assessment phase. Where possible, these will be located in previously disturbed areas such as borrow or storage areas, to minimize any new disturbances.

4.8 Potable Water Supply

A suitable drinking water supply shall be identified during the site assessment phase. A qualitative assessment of the flow rates (as applicable) shall be made at the time of the site assessment, as flow will vary throughout the season, with higher flows typically in spring run-off. Identifying the high water mark, and estimating depth of the stream/lake, as applicable, will aid in this evaluation. The Contractor will be advised that water withdrawal rates may not exceed 10% of the flow volume or 10% of the water volume in a lake, and to modify consumption as appropriate. Water samples shall be collected and analysed for criteria in accordance with the latest edition of the CCME Guidelines for Drinking Water Quality.

4.9 Natural Environment Assessment

A thorough assessment of the natural environment of the site and surrounding area shall be conducted as part of the detailed environmental site assessment. This assessment shall be carried out mainly by a biologist with input from a local community representative, where appropriate. This study shall consist of describing the regional and local setting, local ecosystems, species assemblage as well as potential impacts to vegetation and wildlife from cleanup activities and proposed mitigation measures. Additional information requirements are outlined in the following subsections.

4.9.1 Regional and Local Setting

The report should address the following information requirements.

- Location (site coordinates, main natural and man-made features present);
- Ecosetting (ecozones and ecoregions);
- Climate (mean temperature and precipitation data);
- Vegetation;
- Landforms and soils (main land features, soil types, general topography); and
- Human usage and disturbance (TK input will be valuable to assess human usage of the area).

4.9.2 Local Ecosystems

This subsection should describe 1) the various inland ecosystems; 2) the ecosystems present in the former operational areas (*i.e.*, disturbed areas and areas with infrastructure); as well as, if applicable, 3) the shore/coastline ecosystem; and the 4) open ocean ecosystem.

Each identified ecosystem should be described in terms of the various terrestrial and freshwater habitats, the vegetation and wildlife species present in those habitats, as well as past and current impacts and disturbances to habitats. Local and traditional knowledge from people who use these areas for hunting and fishing may provide useful information on plant and wildlife species present as well as ecosystem health.

4.9.3 Species Assemblage

This subsection should describe the various species at risk (*i.e.*, extirpated, endangered, threatened, or special concern) according to the Species at Risk Act (SARA) that occur in the general vicinity of the site, as well as any migratory species that known to breed or nest in the area (Migratory Birds Convention Act).

All species (*i.e.*, birds, mammals, fish, and plants) observed or known to use the site and surrounding areas should be documented. Observations should be described in terms of numbers and behaviour during sighting (*e.g.*, migrating, nesting/breeding, feeding, etc.). Species not observed on site but known to use the area may be documented by consulting local community representatives as well as various studies and reports.

4.9.4 Impacts and Mitigation

Potential impacts to vegetation and wildlife from site investigation and remediation activities should be clearly identified. Proposed constraints and other recommendations should also be presented as part of the Natural Environment Assessment, in order to incorporate these requirements into the Environmental Protection Plan.

4.10 Traditional Knowledge Surveys/Assessment

Traditional Knowledge (TK) forms an integral part of the development of the RAP. Incorporating TK during the assessment phase can provide guidance on targeting specific areas of concern to local residents. Qualitative knowledge provided by local residents can be used to complement and enhance the largely quantitative information provided by the physical studies completed.

TK can be efficiently obtained through a local community representative (*i.e.*, local TK consultant) who can liaise between the Consultant and various TK holders in the community. The local TK consultant may either be an Elder or someone else who knows the site well (*e.g.*, hunter, ranger). The ideal local TK consultant possesses some TK, but more importantly knows who to consult in the community to obtain relevant site information and TK.

4.10.1 Typical TK and Local Knowledge

TK may be grouped into four main categories:

1. Historical and Archaeological Features
2. Wildlife Use
3. Land Use
4. Site Specific Information

Historical and archaeological features provide information on traditional land use of the area. These features, often hidden from the untrained eye, will be identified by local TK holders as to their use and relative age, and can complement the work of the archaeological assessment.

Wildlife use of the land in and around the site includes migration routes, mating and calving grounds, as well as summer and winter-feeding areas of large land mammals. Nesting, moulting, and summer feeding grounds of migratory birds such as geese and ducks, as well as migration routes and feeding areas of sea mammals must also be identified.

Land use relates to traditional usage of the land and sea for hunting, fishing, camping, and harvesting products on land (*e.g.*, berries, eggs, medicine, tea, drinking water), and harvesting of sea products (*e.g.*, clams, kelp).

Site-specific information about the military site while it was under construction or in operation, including events (spills, accidents), waste management practices (storage, dumping), as well as natural occurrences, should also be documented.

4.11 Archaeological Assessment

The overall purpose of the archaeological assessment is to obtain the necessary archaeological regulatory approval at the assessment stage as required to implement the remediation program. The scope of the archaeological assessment shall include:

- Preparation and submission of permit applications to the Department of Culture, Language, Elders and Youth (Nunavut) or the Prince of Wales Northern Heritage Centre (NWT).
- Completion of an Overview for each site, which would include file searches to determine the number, nature and terrain associations of previously recorded sites.
- Completion of a field inventory and assessment of each site;
- Completion of a heritage features or structures evaluation for consideration of heritage value;
- Provision of a heritage resource impact assessment for each site
- Implementation of more detailed investigations at key sites and appropriate mitigation at significant sites affected by proposed projects (if required); and
- Preparation of a final permit report for each site and, if required, provides a summary of these results suitable for inclusion in a screening document.

Areas of high and moderate archaeological potential for containing cultural material will require detailed examination during the assessment phase, to ensure the protection and if required, development of mitigation measures to be implemented prior to or during cleanup.

5 REMEDIATION PROTOCOL

The elements of the remediation protocol have been developed through the review of previous work at related sites by DND and INAC, and take into consideration information of particular relevance to the unique character of the INAC sites.

The primary components of cleanup on the INAC abandoned military sites include:

- Treatment/Disposal of Contaminated Soil
- Disposal of Debris/Demolition Waste
- Closure of Existing Solid Waste Disposal Areas
- Construction of New Landfills
- Development of Borrow Sources and Site Grading Activities

The goals of a RAP are to provide the foundation for development of a cleanup design that will reduce the environmental liabilities present at the site, maximize benefits to local communities and provide good value to the Crown. More specifically, the RAP is to identify and evaluate options applicable to the treatment and/or disposal of waste materials present at a site. These waste materials typically include:

- Soil contaminated with inorganic elements, PCBs and/or petroleum hydrocarbons;
- Non-hazardous and hazardous wastes associated with building/facility demolition;
- Visible/accessible debris including barrel contents; and
- Buried debris/landfills as identified by geophysical surveys

The estimated volume of waste materials in each stream shall be determined and options evaluated on the basis of effectiveness to reduce and/or mitigate environmental risks in the short and long term, long term liability or residual risks, relative costs, monitoring costs and community acceptance. The costs associated with implementing remedial solutions include, but are not limited to: resources, such as materials, equipment, and personnel, and site logistics. Mobilization and site access constitute a significant cost for remote site cleanups, and can have significant impact on selection of the preferred remedial option. The evaluations shall be summarized and preferred remedial options identified for each waste stream. Options shall be integrated to finalize the recommended approach for site remediation.

During remediation planning public community consultations are conducted in surrounding communities to obtain feedback on the draft RAP.

5.1 Contaminated Soils

Contaminated soils are considered in three primary categories: soils that are regulated; soils classified as hazardous; and, soils classified as contaminated but not hazardous waste. Contaminated soils that are regulated shall be remediated and/or disposed of in compliance with the applicable regulations. Hazardous contaminated soils are defined as those that exceed criteria as provided in the Transportation of Dangerous Goods Act and Regulations. Contaminated soils that are not regulated or hazardous shall be excavated to the depth and extent to meet the DCC (see section 4.2.1) or PHC remedial targets (Section 4.2.2).

Three primary contaminated soil types have been identified; inorganic element contaminated soil, PCB contaminated soil and hydrocarbon contaminated soil. Where multiple contaminants are present in the soils, the most conservative remedial option that addresses all contaminant types shall be applied. A summary of remedial options for contaminated soils is presented in Table 5.1.

Table 5.1 Summary of Remedial Options – Contaminated Soil

Contaminated Soil	Remedial Options
DCC Tier I	▪ Excavate and place in an on-site engineered landfill or ▪ Cap in place under 0.3 m of clean fill if in a stable location
DCC Tier II	• Excavate and dispose of in an on-site Tier II facility or • Containerize for off-site disposal[1]
Inorganic Elements Leaching	• Transport in accordance with the TDGA for disposal at an off-site facility
PCB Contaminated Soil in excess of CEPA	• Store in accordance with PCB Regulations pending a decision regarding disposal
Type A TPH (Non-Mobile Hydrocarbon Contaminated Soil)	• Excavate and place in an on-site engineered landfill or • Scarify surficial stains that meet PHC criteria.
DCC Tier I -Type A TPH	• Excavate and place in an on-site engineered landfill or • Cap in place under 0.3 m of clean fill if in a stable location
DCC Tier II -Type A TPH	• Excavate and place in an on-site Tier II disposal facility or • Containerize for off-site disposal[1]
Type B TPH (Mobile Hydrocarbon Contaminated Soil)	• *In-situ* or *ex-situ* treatment to reduce environmental risk to meet guidelines
DCC Tier I -Type B TPH	• Ex-situ treatment to meet guidelines and place in an on-site engineered landfill or cap under 0.3 m of clean fill in a stable location after treatment. • Small areas of contamination may be excavated and disposed of in a Tier II disposal facility
DCC Tier II -Type B TPH	• Excavate and place in an on-site Tier II Facility or • Containerize for off-site disposal[1]
Hazardous Soil	• Dispose in compliance with applicable regulations

[1] Decision of whether to dispose of on or off-site is based on cost –benefit analyses (see Section 5.4.2).

5.2 Debris – Site Debris and Demolition Wastes

Site debris shall be collected and segregated into hazardous and non-hazardous waste streams for disposal:

Non hazardous waste: The volume of the non-hazardous materials shall be minimized through crushing, shredding, or incineration, prior to placement in an on-site engineered landfill. If there is no existing landfill on-site, and no suitable location for a new engineered landfill, non-hazardous materials shall be disposed of off-site; and

Hazardous waste: These materials shall be disposed of off-site, in accordance with the current regulations governing the handling and disposal of hazardous materials.

Hazardous materials referred to in this section are defined as any materials, which are, designated "hazardous" or "dangerous goods" under Territorial or Federal legislation. Generally, all hazardous materials identified at the site shall be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act (TC 2002), to a licensed hazardous waste disposal facility.

Hazardous materials that are typical of abandoned military sites and require special consideration include the following:

PCB Contaminated Concrete: Concrete (excluding paint) with PCB concentrations in excess of 50 ppm is regulated under the CEPA, and shall be collected and transported off-site, in accordance with the Transportation of Dangerous Goods Act and CEPA to a licensed hazardous waste disposal facility.

PCB Paint on Building Components: PCB paint and PCB painted components that are regulated under the CEPA, shall be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act and CEPA, to a licensed hazardous waste disposal facility. The thickness and density of the paint and substrate material shall be recorded as it may be required to calculate total PCB concentrations. Loose paint materials/paint chips are regulated under CEPA when PCB concentrations in the paint are greater than 50 ppm.

Lead-Based Paint on Building Components: Lead-based painted components that are classified as hazardous material shall be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act to a licensed hazardous waste disposal facility. Painted components that exceed the relevant federal or Territorial criteria but are not considered hazardous shall be collected and disposed in an on-site engineered landfill. Lead-based painted materials are considered hazardous when the lead leachate concentrations from a test of the component (paint and substrate) exceed 5 mg/L or the concentration as provided in the latest schedule of the TDGA. Additional discussion related to the classification of painted material is provided in AMSRP Volume 2, (INAC 2009).

There are also a few exceptions, which are described below:

Asbestos: Asbestos waste shall be collected, double bagged and disposed of in an on-site engineered landfill, in accordance with the appropriate legislation. Where no on-site facility is available, asbestos waste shall be shipped off-site for disposal. Where asbestos materials are painted, disposal requirements are based on paint analyses.

Petroleum Products: Petroleum products, such as gasoline or diesel, which do not contain other hazardous products (chlorine, PCB, metals, etc.) will be incinerated on-site under appropriate emissions controls. Heavier petroleum products such as lubricating oil will be disposed of off-site or mixed with lighter petroleum products and incinerated on-site under appropriate emissions controls in accordance with the Barrel Protocol provided in Annex B.

Compressed Gas Cylinders: Compressed gas cylinders with known contents shall be vented. Once empty, the metal cylinder shall be disposed on-site in an engineered landfill. Where no on-site facility is available, compressed gas cylinders shall be shipped off-site for disposal.

Creosote Treated Timbers: Timbers shall be wrapped in polyethylene sheets and disposed on-site in an engineered landfill. Where no on-site facility is available, creosote treated timbers shall be shipped off-site for disposal.

5.2.1 Submerged Debris

Submerged debris shall be removed from the near-shore environment to a depth of 2 metres or 30 metres off-shore, whichever is encountered first. Work in marine and freshwater environments shall be in accordance with all stipulations as provided by the Department of Fisheries and Oceans. Debris, once removed, shall be classified as hazardous or non-hazardous and disposed of as indicated in the previous sub-section.

5.2.2 Barrels

Barrels shall be handled according to the Barrel Protocol (Annex B) and as outlined below:

Empty Barrels: Empty barrels shall be crushed and disposed in an on-site engineered landfill;

Filled or Partially Filled Barrels: Barrel contents shall be inspected and tested if necessary and disposed of appropriately (off-site or incinerated). The empty barrel shall be rinsed, crushed and disposed on-site in an engineered landfill. The spent rinse liquid shall be tested and disposed of appropriately. Absorbent materials used as part of this process shall be incinerated if incineration criteria are met, or disposed of as hazardous material, as required; and

Buried Empty Barrels: Areas containing buried empty barrels will be inspected to determine if any of the barrels contain material and characterized through a geophysical survey. If the barrels are found to be empty, the area will be stabilized through compaction to crush any corroded barrels, if the area is deemed suitable from a geotechnical perspective. A cover of borrow material shall be placed over the area and compacted.

The criteria used to determine the acceptability of product for on-site incineration are summarized in Table 5.2 as follows:

Table 5.2 Barrel Protocol Criteria and Disposal Summary

Phase	% Alcohol or Glycols	PCBs	Chlorine ppm	Cadmium ppm	Chromium ppm	Lead ppm	Disposal
Organic		<2	<1000	<2	<10	<100	On-Site Incineration
Organic		>2	>1000	>2	>10	>100	Ship South
Aqueous	>2		>1000	>2	>10	>100	Ship South
Aqueous	>2		<1000	<2	<10	<100	On-Site Incineration
Aqueous	<2						Discard in accordance with wastewater discharge criteria

Wastewater generated during barrel cleaning shall be treated to meet discharge criteria in accordance with permits and licences issued for cleanup activities.

5.2.3 Buildings and Infrastructure

Existing buildings and infrastructure shall be demolished to concrete foundations. Above-grade timber foundations shall be removed. Where concrete foundations are above grade, the area will be re-graded with the placement of additional granular fill to match surrounding topography. Exposed timber piles shall be removed to a minimum of 0.3 m below ground surface. All hazardous materials shall be segregated prior to or during demolition. Non-hazardous demolition materials and asbestos shall be collected and disposed in an on-site engineered landfill. If there is no existing landfill on site and no suitable location for a new engineered landfill, the non-hazardous materials shall be disposed of off-site. Hazardous demolition materials shall be disposed off-site.

PCB amended painted material shall be containerized in accordance with the Transportation of Dangerous Goods Act, and transported off-site to a licensed treatment disposal facility.

Only in exceptional circumstances will existing buildings remain intact on site following the remediation program. These structures may remain as emergency shelters only once clear transfer of ownership has been established.

5.3 Solid Waste Disposal Area (WDA) Closure

The following section applies to landfills, dumps and debris areas, collectively referred to as WDA.Using the WDA evaluation matrix (Annex A), WDA can be classified into one of three broad categories. Actions associated with each category of WDA have been identified. Where a WDA exists on INAC abandoned military sites, the condition of the WDA shall be evaluated to determine the most appropriate action;

Class A: If the WDA is located in an unstable, high erosion location, it shall be relocated to a properly engineered landfill. A WDA located at an elevation of less than two metres above mean sea level will be removed. During the relocation process, any identified hazardous materials shall be segregated for off-site disposal.

Class B: If the WDA is located in a suitable, stable location, but there is evidence of contaminant migration, potential remedial solutions include excavation or provision of a suitably engineered containment system. Permafrost containment shall be designed in accordance with the geothermal requirements outlined in Section 5.4.2. The remedial solution selected shall be based on a cost-benefit analyses that includes consideration of construction costs and long-term monitoring costs.

Class C: If the WDA is located in a suitable, stable location, with no evidence of contaminant migration, it may be left in place. If required, additional granular fill shall be placed to ensure erosion protection and proper drainage. Consideration must be given to surrounding topography (to blend into existing terrain) and long term monitoring costs.

Additional information related to landfill design and closure is provided in AMSRP Volume 2, (INAC 2009).

5.4 Landfill Development

New engineered landfills may be required for the disposal of non-regulated contaminated soils and non-hazardous debris collected or generated during cleanup. Two classes of landfills are provided:

- Non-Hazardous Waste (NHW) Landfill
- Tier II Contaminated Soil Landfill

5.4.1 Non-Hazardous Waste Landfill

A NHW Landfill is a new landfill constructed for the disposal of non-hazardous debris and building demolition waste. Tier I contaminated soils and Type A PHC soil may also be disposed of in these landfills. Landfills constructed to date at DND DEW sites are predominately above ground facilities. These landfills do not rely on permafrost for containment nor do they include a geosynthetic liner.

The general design parameters include a perimeter berm and landfill cover constructed of a well graded sand and gravel. Clay is generally not available at the abandoned military sites. The sand and gravel should have a minimum of 8% fines (<0.08 mm) and be compacted to a minimum of 95% maximum dry density (ASTM D698). The landfill should have a maximum debris thickness of 3 m and minimum cover thickness of 1.0 m.

To reduce settlement and ground subsidence, debris should be placed in maximum 0.5 m thick lifts with granular fill placed over each lift of debris to fill the voids (intermediate fill). Intermediate fill should be a minimum of 0.15 m thick and worked into the underlying debris. The final landfill surface must be graded such that water ponding does not occur. Ponding and infiltration could increase the seasonal thaw depth or contribute to leachate generation. The landfill surface must not be so steep that it promotes erosion of the cover materials, which could expose debris.

Fill material for the landfill cap should be a well-graded material that is relatively erosion resistant and will have moderate water infiltration. Alternative designs or surface treatments, such as imported coarser gravels and cobbles, vegetation covers at sites where it is possible to vegetate the sites, roller compacted concrete or other synthetic surfaces, are required if erosion resistant materials are not present on site.

Final landfill design parameters including granular fill specifications, side slopes, cover thickness, and maximum height of landfill are dependent on site specific ground conditions and borrow availability. Designs must be reviewed by a geotechnical engineer with permafrost experience.

5.4.2 Tier II Contaminated Soil Landfill

The decision as to whether to construct a Tier II Contaminated Soil Landfill on site is based on a number of factors, including but not limited to those summarized in Table 5.3. These criteria were based on generic designs and relative cost estimates and may not accurately reflect site-specific conditions. These are provided as a guideline only.

Table 5.3 Decision Criteria Tier II Contaminated Soil Landfill

Is the site landlocked?	For landlocked sites, off-site transport costs increase significantly. Consideration should be given to on-site disposal facility.
Is landfill excavation required.	Landfill excavations pose contracting risks due to unknown quantities of waste material. To mitigate risks, an on-site Tier II disposal facility should be considered.
Are known contaminated soil volumes less than 300 to 500 m^3.	If yes, evaluate contingency factors and potential over-runs. If significant risk of quantity overrun is present, construct landfill on-site. If volume of contaminated soil estimated to be below these values, ship off-site for disposal.
Are known volumes of contaminated soil between 500 and 1000 m^3	Evaluate site specific conditions, and develop preliminary design and cost estimate for an on-site disposal facility using site specific information. Confirm availability and quality of borrow material.
Are known volumes of contaminated soil greater than 1000 m^3.	If yes, confirm availability and quality of granular borrow. If granular borrow sufficient, develop preliminary design and cost estimate for an on-site disposal facility, using site specific conditions. Re-evaluate on-site disposal costs versus off-site disposal and confirm cost-benefit.

The Tier II Contaminated Soil Landfill design is based on the containment of contaminated soil in a landfill provided with a geo-synthetic liner and a granular fill cover of sufficient thickness to maintain the contaminated soil in a frozen condition. The required fill thickness is a function of the climatic conditions selected as the design criteria.

Geothermal analyses are required to substantiate the use of permafrost as a means of containment for the landfills. Analyses are carried out to predict the short-term and long-term ground temperatures for the Tier II Contaminated Soil Landfill to determine:

- Length of time for landfill freezeback;
- Short-term and long-term thermal regime in the landfill; and
- Depth of annual thaw (active layer) in the cover material.

Geothermal analyses should be carried out for the landfills using two-dimensional finite element computer models. The models simulate transient, two-dimensional heat conduction with a change of phase for a variety of boundary conditions. Heat exchange at the ground surface should be modeled with an energy balance equation that considers air temperatures, wind velocity, snow depth, and solar radiation. The models should include the temperature phase change relationships for saline soils, such that freezing depression and unfrozen water content variations can be explicitly modeled.

Soil thermal properties required to carry out geothermal analyses include: porewater composition, latent heat, specific heat (frozen and unfrozen), and thermal conductivity (frozen and unfrozen). These properties are determined indirectly from well-established correlations with soil index properties, moisture content, grain size distribution, bulk density, salinity, etc. (Farouki, 1986; Johnston, 1981). Soil index properties are based on information collected during the site investigations.

Climatic data required for the thermal model include monthly mean air temperature, wind speed, solar radiation, and snow cover. The thermal analysis should be calibrated to measured temperatures and/or observed active layers thicknesses. The landfill designs include analyses for mean temperature conditions, warm conditions and long-term climate change. Statistical analyses are carried out to determine mean monthly temperatures representative of a 1 in 100 warm year. The freezing index and thawing index for each year are calculated from the recorded air temperature data. The index for each year is ranked in ascending order and plotted. A “best-fit” line is drawn through the set of points to estimate the 1 in 100 warm year index. Mean monthly air temperatures are increased by the ratio of the 1 in 100 warm year freezing or thawing index to the mean year freezing or thawing index to estimate the mean monthly temperatures of a 1 in 100 warm year. The influence of climate change should be evaluated by similar methods presented in ACIA (2005). This includes the average estimated seasonal temperature changes by various Global Circulation Models (GCMs).

Given the uncertainties in climate change and the cost of returning to a site at a future date, it is recommended that the Soil Disposal Facility be designed for 100 years of long-term climate warming (average of four GCMs) as a minimum. With this design condition, the active layer could penetrate the contaminated soil if a warm year occurred. Containment during this condition would be provided by the thick soil cover and the geomembrane liner. Additional factors of safety can also be applied to account for uncertainties in the geothermal model, soil input parameters, and climate input parameters, or the facilities can be designed for climate change plus one 1 in 100 warm year.

5.5 Borrow Source Development

Granular borrow material will be required for the development of new landfills and general site grading purposes.

5.5.1 Site Grading

Grading operations generally consist of the shaping and regrading of disturbed areas to blend in with the natural contours, in accordance with all applicable licenses. Disturbed areas may include:

- contaminated soil excavation areas,
- existing and new landfill areas,
- debris areas,
- areas disturbed during demolition activities,
- granular borrow areas, and
- any area disturbed during establishment and operation of the camp, equipment storage and maintenance activities.

5.6 Contractor Support Activities

For implementation of remedial activities, a Contractor will establish a camp and storage areas on-site, where required. Where possible, these will be located in previously disturbed areas such as borrow or storage areas, to minimize any new disturbances in accordance with all applicable licenses.

Domestic refuse generated by the camp shall be incinerated and disposed of on-site in an engineered landfill. Sewage shall be handled by an appropriately sized sewage treatment system, in accordance with applicable legislation and all applicable licenses.

Wastewater generated by the Contractor, shall be treated to meet discharge criteria as stipulated in permits and licenses issued for the project.

Potable water supplies at the site will be tested and used, only if they meet the Canadian Drinking Water Quality Standards (CCME 2002) or the latest edition thereof, in accordance with all applicable licenses.

Fuel required for the operation of the camp will be stored on-site in accordance with applicable legislation and licenses.

All hazardous materials shall be segregated prior to or during demolition. Non-hazardous demolition materials and asbestos shall be collected and disposed in an on-site engineered landfill. Hazardous demolition materials shall be disposed off-site.

Only in exceptional circumstances shall existing buildings remain intact on site following the remediation program. These structures may remain as emergency shelters once clear transfer of ownership has been established.

6 CONSTRUCTION RELATED IMPLEMENTATION REQUIREMENTS

Consistent with Step 9 of the Federal Contaminated Sites Action Plan, confirmation that the objectives of the RAP have been met is required. Based on the issues typically associated with the remediation of INAC sites, confirmatory testing encompasses a wider range of activities. These include, but are not necessarily limited to:

- Confirmatory testing of contaminated soils;
- Quality Assurance testing of earthworks associated with the remediation and construction of landfills;
- Testing as required for waste manifesting to allow for shipment and disposal of materials off-site; and
- Testing as required to meet the requirements of Land Use Permits, and/or other Licences/Permits issued for the cleanup program.

The requirements and/or guidelines for these testing programs are outlined in the following sub-sections.

6.1 Confirmatory Testing Contaminated Soils

Following excavation of contaminated material confirmatory samples shall be collected and analyzed to ensure that cleanup objectives have been met. Sampling will be conducted by a third party qualified to carry out such work. A detailed sampling plan shall be developed for each area of concern identified for excavation in the RAP, and must include the following information:

- Description of the objective for each potential area of concern
- Sampling locations
- Sampling methodology
- Proposed number of samples and media
- Parameters for analyses
- Analytical requirements, and Quality Assurance/Quality Control measures.

6.1.1 Tier I contaminated soils

Tier I criteria were developed to address aerial transport of contaminants; excavation and backfilling precludes this pathway. If, during the site assessment, sufficient evidence has been collected to demonstrate that soils at depths of greater than 0.3 m below surface do not exceed Tier II levels for inorganic elements or PCBs, confirmatory sampling will not be required.

6.1.2 Tier II contaminated soils

Confirmatory sampling shall be carried out using a systematic grid sampling design following the DND DLCU Confirmatory Sampling Protocol as summarized in Table 6.1. This design provides a practical and simple method for designating sample locations and ensures uniform coverage of a site. Discrete samples should be collected at every point on the grid. For small areas, all samples shall be analyzed, whereas for larger areas only a fraction of the interior grid samples shall be analyzed. When choosing sample locations for analysis, consideration shall be given to areas of previously high concentrations. No single sample result or the mean of a duplicate/replicate sample shall exceed the cleanup objectives. In cases where field analytical methodology is used, 10-20% of the samples analyzed in the field should also be analyzed in the laboratory for quality control purposes.

Table 6.1 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%

6.1.3 Hazardous Soils

Confirmatory sampling following excavation of soils considered hazardous according to CEPA (PCBs >50 ppm) or the TDGA may require a more closely spaced grid than outlined in Table 6.1 to minimize the overall volume of materials requiring off-site disposal.

6.1.4 Type B TPH (Fractions F1 to F3)

Confirmatory sampling following excavation of petroleum hydrocarbon impacted soils within 30 m of a water body supporting aquatic life will follow the confirmatory sampling protocol outlined in section 6.1.2. The remedial solution for petroleum hydrocarbon impacted soils further removed from surface water bodies involves excavation of source areas. In cases where field analytical methodology is used, 10-20% of the samples analyzed in the field should also be analyzed in the laboratory for quality control purposes. For comparison purposes, total petroleum hydrocarbons (TPH) data obtained by hexane extraction can be compared to data generated using the CCME analytical procedure for PHC in soils by summing fractions F1 to F3. The presence of residual petroleum hydrocarbon contamination is expected following excavation to design limits as outlined in the RAP. Representative samples from the base of the excavation will be collected and analyzed for record keeping purposes using the CCME analytical procedure for PHC in soils.

6.1.5 Ex-situ Confirmatory Sampling

Soils excavated from landfills and dumps will be classified ex-situ. Excavated soils will be placed in windrows or stockpiles with a maximum stockpile size of 20 m^3 (B.C. Environment, 1995). Debris is separated from the soil and sorted as potentially hazardous and non-hazardous under the supervision of the Hazardous Materials Specialist. Stained soil and soil associated with potentially contaminated debris such as battery waste or barrels must be stockpiled separately from other soil to prevent dilution and facilitate disposal.

As part of the sampling protocol, two types of soil samples shall be collected from stockpiles: discrete and composite. Sample locations are selected at various surface and depth locations in each stockpile to obtain samples that are representative of the entire pile. Five discrete samples are collected and analyzed for the first 20 stockpiles and every 20^{th} stockpile thereafter. Composite samples shall be collected and analyzed at all stockpiles. Composite samples consist of approximately equal volumes of soil collected from five discrete sample locations.

The standard deviation for each stockpile shall be calculated based on discrete sample results. These standard deviations are then used to calculate the average standard error for all stockpiles (Equation 1). Twice the average standard error is added to the analytical result for the composite sample to provide a 95% upper confidence limit (Equation 2).

$$SE_{avg} = \frac{\sum_{1}^{m}\left(\frac{SD}{\sqrt{n}}\right)}{m} \qquad \textbf{(Equation 1)}$$

$$UCL = \left[Composite_{x}\right] + 2\left(SE_{avg}\right) \qquad \textbf{(Equation 2)}$$

n = number of sample values,

SE_{avg} = average standard error,

SD = standard deviation of the sample values,

m = number of stockpiles,

UCL = upper confidence limit and

x = the stockpile number.

Classification of stockpiles for disposal is based on a comparison of the 95% upper confidence limit values and the relevant clean up objectives. The first 20 stockpiles shall be analyzed for the eight inorganic elements for which the DCC criteria are applicable and PCBs. Selection of samples for analysis for petroleum hydrocarbon will be based on visual and/or olfactory evidence. This process shall be repeated for every 20th stockpile thereafter. All the remaining stockpiles will be tested for copper, lead and zinc and any other analyte that exceeded the DCC criterion previously until it is no longer present (Table 6.2). Field analysis can provide adequate detection limits for statistical classification of certain contaminants (PCBs and PHC), while others (inorganic elements) must be analyzed in CAEAL accredited laboratories for more precise results.

Table 6.2 Analytical Requirements for Stockpile Sampling

Stockpile No.	Samples Collected	Analytical Suite	Samples for Analyses
1 through 20	**5 discrete** 1 composite	**PCBs, Cu, Ni, Co, Cd, Pb, Zn, Cr, As** PHC and Hg where evident	All discrete and all composite samples are analyzed for first 20 stockpiles
Every 20th thereafter	**5 discrete** 1 composite	**PCBs, Cu, Ni, Co, Cd, Pb, Zn, Cr, As** PHC and Hg where evident	All discrete and all composite samples are analyzed
Remaining stockpiles	**1 composite**	**PCBs, Cu, Pb, Zn** PHC, Hg and other inorganic elements where evident	Every composite sample is analysed.

Once the excavation is complete, the base of the landfill excavation must be sampled in accordance with confirmatory sampling protocol for Tier II soils.

6.1.6 Confirmatory Sampling of Material Processing Areas

Residual contamination may be present at barrel processing areas, hazardous materials processing areas, and stockpile lay down areas after clean up activities are complete. Once an area is no longer in use, a detailed inspection for evidence of staining and other indicators of contamination such as visible debris or paint flakes shall be carried out. Samples must be collected in these areas in a grid pattern based on the size of the area (see Table 6.1). In cases where field analytical methodology is used, 10-20% of the samples analyzed in the field should also be analyzed in the laboratory for quality control purposes.

6.2 Quality Assurance Testing of Earthworks

At most sites, earthworks will be carried out as part of the construction of new landfills, remediation of existing landfills, and/or development of hydrocarbon contaminated soil treatment areas. Contract Specifications developed for the project will identify specific requirements for fill gradation and compaction standards. As part of the testing to be carried out during cleanup, quality assurance (QA) testing is required to confirm that the earthworks are in conformance with the Specifications. The number and type of testing will be dependent on the volume of fill to be placed and the number of different material types employed in the cleanup. A QA program shall be developed in conjunction with the design engineer to determine the optimal number of tests required.

6.3 Testing Related to Permits/Regulatory Requirements

The Owner representative and the Contractor will be required to carry out testing to confirm that the requirements of the Land Use Permits and Water Licenses issued for the project are met.

This testing typically includes:

- Effluent testing for waste water generated from camp operations.
- Testing to confirm potability of drinking water supplies
- Testing of waste water generated from cleanup operations.

7 POST-CONSTRUCTION MONITORING

7.1 Introduction

A post-construction landfill monitoring program was developed by DND in conjunction with the Inuvialuit in the Western Arctic and the Inuit in Nunavut for landfills remediated and/or constructed during the cleanup of DEW Line sites. DND initiated cleanup of their DEW Line sites in 1996 and have collected a significant volume of landfill monitoring data since that time. Indian and Northern Affairs Canada, INAC, have initiated cleanup of abandoned military sites under their jurisdiction, and will implement a site monitoring program following remedial construction activities.

This section describes the recommended monitoring plan. It has been based on the DND landfill monitoring program and on landfill monitoring data collected at DND and INAC DEW Line sites to date. Additional monitoring requirements related to the natural environment and traditional knowledge have been added to the program.

A detailed description of the post-construction monitoring program is provided in AMSRP Volume 2 (INAC 2009).

7.2 Monitoring Program

The recommended monitoring program for abandoned military sites consists of:

- Baseline Geo-chemical Monitoring.
- Natural Environment Monitoring.
- Landfill Monitoring.

These are briefly described in the following subsections.

7.2.1 Baseline Geo-Chemical Monitoring

Geochemical Characterization of Soil Conditions

In all proposed development areas, and existing landfill areas (with the exception of existing landfills to be excavated), it is recommended that geochemical characterization of soil conditions be carried out during the assessment or remediation phase. For proposed development areas, sampling should be carried out on a grid spacing of approximately 50 m by 50 m. For existing landfills, testpits should be excavated at a minimum spacing of 50 m of landfill perimeter with a minimum of five testpits per area. Soil stratigraphy is to be logged in accordance with the Unified Soil Classification System, and evidence of

seepage and or soil staining recorded. Soil samples should be collected at surface and at 50 cm intervals to the maximum depth of the active layer, and analysed for the following parameters:

- PCBs (polychlorinated biphenyls);
- Hydrocarbon Fractions, F1, F2, F3 and F4; and
- Inorganic elements: arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc.

These data supplement information collected during the assessment phase of a site.

Geochemical Characterization of Groundwater Quality

In proposed landfill development areas or at landfills requiring leachate containment, it is recommended that a detailed characterization of groundwater quality be carried out. A minimum of three wells per area is recommended; however, this may be increased if the size of the landfill warrants increased coverage. The locations of monitoring wells should be selected based on the potential for groundwater (based on the testpit program for soil characterization), and to be representative of both up and downgradient areas. The depth of the monitoring well will be based on anticipated maximum depth of thaw. The monitoring wells should be located no further than 10 m beyond the final construction perimeter as defined by the design.

For baseline water quality, water samples should be collected at minimum monthly for one full season to allow assessment of changes in water quality as the active layer deepens. The wells for baseline sampling are typically installed in the final construction season. This minimizes the potential for damage during construction.

Recommended analytical requirements are outlined below:

- Petroleum Hydrocarbon Fractions, F1 and F2
- Total and dissolved metals.
- Major ions, hardness, total dissolved solids, total suspended solids.
- pH and conductivity.

Given the low solubility of PCBs, analyses of PCBs may be limited to once over the season, near the time of maximum thaw.

For each monitoring event, water level, pH, conductivity, and turbidity should be measured.

If significant variability is observed in groundwater monitoring data, a second season of baseline monitoring should be carried out following remedial activities.

Typically, only dissolved metals are measured in groundwater monitoring programs; however, previous concerns existed with respect to transport of contaminants with colloidal material. The requirement for total metal analyses should be reviewed at the completion of baseline monitoring, and eliminated if concentrations can be correlated with Total Suspended Solids (TSS) concentrations.

7.2.2 Natural Environment Monitoring

A natural environment assessment (NEA) conducted during the ESA phase of site remediation will serve as a reference for post-construction site monitoring. Local and traditional knowledge will be obtained from a local community representative familiar with the site (ideally the same person who assisted with the NEA). Natural environment data will be collected during the site visit as well as during community meetings with people who use or visit the site/area frequently (*i.e.*, year-round). The purpose of collecting this new data is not to find correlations with landfill monitoring data but rather to provide anecdotal data related to the presence of wildlife and changes over time.

Site specific data to be collected during the site visit should try to include as many of the following items:

- Wildlife sightings (species, number, gender, juveniles)
- Other evidence of recent presence of wildlife (droppings, tracks, feathers/fur, carcass remains, etc.)
- Wildlife activity (summering/nesting/denning, migratory/passing through)
- Qualitative assessment of relative numbers versus previous years (more, same, less)
- Revegetation of disturbed areas versus previous years (more, same, less)

Regional information to be collected during visits to the area throughout the year should include as many of the following items as possible:

- Use by people for traditional activities
- Season(s)
- Activities (hunting, fishing, trapping, camping, other harvesting)
- Relative frequency versus previous years (more, same, less)
- Wildlife species present (sightings or evidence)
- Wildlife presence versus previous years (more, same, less)
- Health of wildlife observed or harvested (good, average, poor)

- Relative health of wildlife versus previous years (better, same, worse)

7.2.3 Landfill Monitoring

In general, 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.

Based on site conditions at INAC's abandoned military sites, it is considered unlikely that leachate containment would be considered; however, it is included for consistency with previous monitoring plans at military sites. A summary of requirements is provided in Table 7.1.

Table 7.1 Summary of Landfill Monitoring Requirements

	Monitoring Requirements				
Landfill Type	**Baseline Monitoring** S- Soil GW - groundwater	**Visual Inspection**	**Soil Sampling**	**GW Sampling**	**Thermal Monitoring**
New Non-Hazardous Waste (NHW) Landfill (LF)	S, GW	✓	as required[a]	✓	
Regraded LF (low potential risk)	S	✓	as required[a]		
Leachate Contained LF (moderate potential risk)	S, GW	✓	as required[a]	✓	✓
New Tier II Soil Facility	S, GW	✓	as required[a]	✓	✓

[a] Refer to Section 7.3.4 for details.

Baseline monitoring requirements were described in Section 7.2.1. The details of the other four landfill monitoring elements are described in the following subsections.

7.3 Specific Monitoring Requirements

7.3.1 Visual Inspection

The physical integrity of the landfill should be inspected and reported using photographs (from the air, when possible, as well as ground level) and hand drawn sketches. Documented observations should at minimum include the items identified in Table 7.2. It is recommended that Table 7.2 be adapted for use as a field checklist to facilitate this data collection.

Table 7.2 Visual Inspection Requirements - Landfills

Item	**Presence/ Absence**	**Extent**	**Description Photographic Reference**
Settlement Erosion Frost Action Animal Burrows Vegetation Staining Vegetation Stress Seepage Points Exposed Debris Condition of Monitoring Instruments Other features of note	Yes or No	Provide dimensions, as applicable of: Length Width Depth	Features of note, photographic reference with scale, view point and direction

7.3.2 Groundwater Sampling

Results of analyses of groundwater samples from landfills should be compared to the baseline and background samples as this is indicative of changing environmental conditions at the site. In general, a

minimum of three to four groundwater monitoring wells will be associated with Non-Hazardous Waste Landfills, Tier II landfills and Existing Landfills – Leachate Containment.

Consistent with the baseline analyses, groundwater samples should be tested for:

- Petroleum Hydrocarbon Fractions, F1 and F2
- Total and dissolved metals.
- Major ions, hardness, total dissolved solids, total suspended solids.
- pH and conductivity.
- PCBs

For each monitoring event, water level, pH, conductivity, and turbidity should be measured in-situ. The evaluation of whether both total and dissolved metals are required will be evaluated after baseline monitoring.

Given the low solubility of PCBs in water, analyses of PCBs may be discontinued if not detected in the first five years of monitoring.

7.3.3 Thermal Monitoring

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 is placed; this is evaluated on a landfill-specific basis. Thermistor installation follows standard engineering practice.

7.3.4 Soil Sampling

As previously indicated, soil sampling and analyses provide limited information with respect to the performance of a landfill. Soil sampling will be limited to locations where seepage or staining has been identified as part of the visual inspection. Analytical requirements include:

- Petroleum Hydrocarbon Fractions, F1 to F4
- Arsenic, Cadmium, Cobalt, Copper, Chromium, Lead, Nickel, and Zinc
- PCBs
- Soil samples should be collected over the interval of 0 to 0.15 m, and 0.35 to 0.50 m depth.

7.4 Monitoring Frequency

Conceptually, three phases have been identified for landfill monitoring as described in the following sub-sections. Natural environment monitoring may be conducted according to the same schedule.

Phase I: Monitoring of conditions to confirm that thermal equilibrium and physical stability criterion are achieved.

During Phase I, monitoring would take place in years 1, 3, 5. 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.

Visual and thermal monitoring should be carried out on Tier II soil facilities and leachate contained landfills.

Visual inspections of the constructed and remediated landfills would also be carried out. It is anticipated that, if there is settlement or erosion within the initial years following remediation, it is likely attributable to construction quality. Changes after the first three years are more likely attributable to changes in the site conditions (i.e. warmer temperatures, changes in surface water drainage patterns).

It is recommended that groundwater monitoring take place in Years 3 and 5. The timing of the groundwater sampling event should consider the variability of water quality measured during the baseline monitoring.

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

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

At the completion of Phase I monitoring and review of the results, the Phase II monitoring frequency may be modified or downgraded. If no significant issues are identified for landfills of low potential environmental risk (as defined by the landfill evaluation matrix), monitoring may be discontinued at the conclusion of Phase I. If additional monitoring is warranted based on the thermal, groundwater or physical inspection, it is recommended that the monitoring frequency in Phase II 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.

Physical inspections of all landfills would be carried out at each monitoring event. The requirement for continued thermal monitoring would be based on Phase I results, or if significant climate changes had been recorded in the region.

Groundwater monitoring would be carried out at each monitoring event. The optimal time period for sampling would be based on the results obtained during baseline and Phase I monitoring.

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 re-evaluation of the monitoring program should 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 monitoring requirements.

7.5 Interpreting Monitoring Results

Landfill monitoring results (thermal, chemical and visual) have to be interpreted in concert with one another as described in AMSRP Volume 2 (INAC 2009).

7.6 Reporting Format

To provide a basis for comparison between monitoring events, it is recommended that a consistent format be used in reporting.

An outline is provided as follows:

1 Introduction. The introduction should provide an outline of the work elements, the timing of and weather conditions during field work, and describe the scope of the document.

For each individual landfill, the following information is to be provided.

2a. Landfill Summary: For each landfill, a summary should be prepared that describes the monitoring carried out, any notable groundwater analytical results, and any associated staining, seepage, exposed

debris, and/or evidence of vandalism. In addition, visual inspection issues identified as significant or unacceptable should be identified. The overall performance rating of the landfill should be provided.

2b. Completed Visual Inspection Report.

2c. A preliminary stability assessment, as described in Section 4.

2d. Annotated drawings on a tabloid paper, indicating all visual inspection features.

2e. Completed thermistor inspection reports, where appropriate.

2f. Photographic records.

2g. Thermal monitoring data, where appropriate.

2h Groundwater analytical data.

2i. Monitoring well sampling logs.

In Annexes to the report, the following information is to be provided.

- Formal laboratory results.
- QA/QC evaluation of the analytical results.
- Handwritten field notes.

Example field note templates are provided in AMSRP Volume 2 (INAC 2009).

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TC 2002: *Transport Canada*, Transportation of Dangerous Goods Regulations: Clear Language. Transportation of Dangerous Goods Act *1992*.

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Annex A – Dump site, landfill and debris area (waste disposal area – WDA) evaluation

SUMMARY

In 1997, the DEW Line Cleanup Environmental Working Group (EWG), comprised of members representing Nunavut Tungaavik Inc. (NTI) and the Department of National Defence (DND) / Defence Construction Canada (DCC), was formed to address environmental issues associated with the DEW Line sites under the jurisdiction of DND. One of their tasks was the development of a matrix to assess potential environmental risk associated with existing landfills at the DEW Line sites. The evaluation matrix considered three primary categories, contaminant source, exposure pathways and potential receptors. In the development of the matrix, landfills typical of the DND DEW Line sites were considered. The DND DEW Line sites were in operation for nearly 40 years, and landfill activity was generally extensive.

By comparison, most INAC Abandoned Military Sites were generally only operational for a much shorter period of time, approximately five to six years. Accordingly, waste disposal practices were different. At many sites, waste materials were not consolidated in a single area, and dump sites and/or isolated areas of partially buried debris are common. These areas are collectively referred to as Waste Disposal Areas (WDA).

This current document presents an Evaluation Matrix for WDAs that considers conditions more specific to INAC Abandoned Military sites.

1 INTRODUCTION

To address the varied nature of landfills at abandoned military sites, a consistent method for the assessment of their potential risk to the arctic environment, in the form of a risk evaluation matrix, was developed by the DND/NTI EWG in 1997 (EWG 1998). Since that time, the matrix has been utilized to develop recommendations for landfill remediation at DND DEW Line sites. This document provides a modified evaluation matrix to address the dump sites, landfills and buried debris areas more typical of the abandoned military sites under the jurisdiction of INAC. As a whole, these are referred to as Waste Disposal Areas (WDAs).

The DND/NTI evaluation matrix was based on the CCME National Classification System for Contaminated Sites, and adapted to address the particular concerns of the Arctic environment. This revised version also references the Federal Contaminated Site Action Plan (FCSAP) Contaminated Site Classification Guidance Document. 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 intended purpose of the matrix is to evaluate the potential environmental risk posed by WDAs in their current condition.

Two conservative assumptions are made during the evaluation of all WDAs

- The contents of WDAs are generally unknown and all potential contaminants may be present.
- If contaminants come into contact with receptors, they could have adverse effects on the receptors.

2 MATRIX FACTORS

2.1 Contaminant Source – Category A

Four factors were considered under Contaminant Source to describe specific disposal areas as follows:

A.1 Areal extent of waste disposal.

A.2 Estimated depth of buried debris

A.3 Contaminant Characteristics – combined presence of leachate and surface contaminated soil.

A.4 Presence of Surface Debris

Contaminant characteristics were assigned the greatest weighting in this category as it is a strong indicator of potential environmental risk associated with the WDAs. The volume of a WDA is considered to be related to its potential to be contaminated – the greater the volume, the greater the risk that contaminants are present. The volume of the waste disposal area is divided into two parameters, area and depth. The area is relatively easy to measure; the estimated depth of the buried waste is given less weight in the matrix as it is difficult to measure using non-intrusive techniques.

A.1 Areal Extent of Waste Disposal

The larger the area impacted by waste disposal, the greater the potential for contaminants to be present exists. The areal extent of dump sites can be easily surveyed based on the presence of surface wastes. Landfill or buried debris areas are based on the results of geotechnical/geophysical site surveys and visual observations. A value of 10 000 m^2 is used as the basis for comparison. All WDAs greater than 10 000 m^2 are awarded the maximum points for this category. Scoring for all other WDAs is prorated relative to 10 000 m^2. WDAs less than 1000 m^2 are referred to as debris areas.

Scores are provided for all WDAs following the detailed field investigations that are carried out prior to cleanup/construction. The objectives of these investigations are to delineate the extent of known contamination, and confirm existing site and WDA conditions.

A.2 Estimated Depth

The depth of landfills and debris areas can be estimated by visual inspection of surrounding topographic features. The average depth of the active layer is 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 and buried debris with estimated depths of greater than 1.5 meters were scored higher than those with estimated depths of less than 1.5 meters. For the majority sites, it is anticipated that the depth of buried waste is 1.5 metres or less. Exceptions to this may include dumping within ravine areas or other natural depressions. A minimum score of 2 is allotted to all WDAs in the absence of specific data.

A.3 Contaminant Characteristics

Contamination associated with WDAs may be elevated with respect to background concentrations, but less than applicable criteria. In this case, elevated concentrations may be indicative of chronic low levels of contaminants leaching from the WDA, as a result of infiltration and percolation of surface water, or flow of active layer groundwater through areas of buried debris. In some cases, contamination on the surface may exceed applicable criteria as a result of direct spills or leaking containers.

With consideration of the FSCAP Hazard Ranking of contaminants and the DCC Criteria, all contaminants included in the DCC are considered high concern, with the exception of Petroleum Hydrocarbon Fractions F3 and F4. The F3 and F4 fractions are considered essentially insoluble and are therefore immobile. In the scoring of this category, four categories are provided:

- Concentrations not elevated with respect to background; however, the potential for contamination is considered possible.
- Concentrations elevated with respect to background; but less than DCC criteria. Elevated with respect to background refers to a concentration in excess of the three times the mean background concentration. With respect to organic contaminants, such as hydrocarbons and PCBs, the method detection limit is assumed to represent background concentrations.
- Concentrations in excess of DCC Tier I guidelines.
- Concentrations in excess of DCC Tier II guidelines.

A.4 Presence of surface debris

At some WDAs, in particular dump sites, 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 WDA that has surface debris covering more than 50% of its surface receives a full score. Debris areas, and dump sites as implied by the designation, generally receive full score for this category.

2.2 Pathways – Category B

The primary transport mechanisms for contaminants at these sites are considered to be:

B.1 Aerial transport of fine particles; and

B.2 Dissolved phase and/or colloidal transport in water, 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 impacted soils imply the potential for aerial transport. This factor is given a low weight because the quantity of contaminated soil on the surface 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

Dissolved phase and/or colloidal transport in water includes 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 generally subject to the same driving forces or gradients as surface water. The intent of this sub-category is to examine factors that affect migration away from the WDA – slope, runoff, extent and type of cover on below grade disposal areas, annual precipitation and distance to surface water. Among these factors, topography, runoff potential and proximity to surface water are given the greatest weight.

B.2.1 Topography

The degree of the slope on which the WDA is located is one of the major factors contributing to transport of contaminants. Scoring is carried out on a progressive scale. In cases where there are different slopes in the area, a weighted average is used.

B.2.2 Cover Material – Depth

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

B.2.3 Cover Material – Type

The erosion potential of a WDA is partly based on the type of cover material. Erosion can eventually lead to the exposure of the waste. 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 WDA, 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 in the area.

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, and potentially erosion. The majority of the abandoned military sites receive less than 500 mm of precipitation annually, with the exception of sites on the lower east coast of Baffin Island. Typically, the amount of precipitation at any site is relatively low. Any given rainfall event is unlikely to generate major run-off; however, spring thaw and corresponding run-off may be significant at some sites. Detailed precipitation data is not available for the INAC sites; therefore data was interpolated from the Hydrological Atlas of Canada Maps [accessed on line: http://atlas.nrcan.gc.ca/site/english/maps/archives/5thedition] as summarized below for various areas. For sites not listed below, the aforementioned maps should be consulted.

Sites	Annual Precipitation (mm)	Annual Snowfall (cm)	Average Maximum Snow Pack depth (cm)
Clifton Point	100-200	100	30
Bernard Harbour east to Matheson Point	100-200	80	30
Simpson Lake to Sarcpa Lake	150-200	100	50
Bray Island, Rowley Island	150-200	100	60
Nadlaurdjuk Lake	200-300	100	60
Ekalugad Fiord	200-300	200	70
Kivitoo	350	240	100
Durban Island	+400	240	100

As spring run-off likely represents the maximum precipitation event, scoring is provided relative to the maximum snow pack depth, with a score of 4 allotted to snow pack depth of 100 cm. If site specific factors, such as drifting in the WDA are present, the score may be increased to 5, the maximum allotted to this category.

B.2.6 Distance to Down-gradient 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 WDA, or streams and lakes downgradient from the WDA, 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 elevation difference. 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 away from the WDA.

2.3 Receptors – Category C

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

Selection of the water body in this category is based on potential effects on the receiving habitat. Consideration must be given to the regional drainage patterns. For example, where the drainage from a WDA is overland (i.e. there is no direct connection between the WDA and the downgradient water body), water bodies beyond two 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 WDA 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 a significant body of water near the limit of the WDA where contaminants are likely to have an impact. 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 limit of the WDA toe. The objective is to select a habitat that supports receptors rather than identify the closest body of water. It is assumed that only habitat downgradient from the WDA is to be considered (given that aerial transport of contaminants to habitat upgradient from the WDA will be addressed by the remediation of contaminated soil).

C.1.2 Estimated Habitat Usage – Freshwater/Marine

The score within this category is based on the frequency of usage within the selected receiving environment and considers the level of biodiversity and the occurrence of calving/spawning grounds. Freshwater and/or marine wildlife are potentially more at risk compared with terrestrial wildlife or avifauna, the latter of which are exposed through water ingestion. Thus, when terrestrial wildlife or avifauna are 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

The extent of vegetation considers the area within 300 metres downgradient of the WDA. Within this distance, vegetation is expected to be most susceptible to uptake of contaminants if they are leaching from the WDA. However, topography and the potential for run-off must be considered and a greater or lesser distance could be considered.

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 are 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 surface is not frozen. Within this factor, the scoring takes into account the likelihood and the duration of contact. Using this method, 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 Table 1 below. Unmanned Short Range Radar (SRR) sites, part of the North Warning System, are co-located at some of the former abandoned military sites, and periodic maintenance of these facilities is carried out. As a

conservative approach, it may be considered that maintenance workers may have a low likelihood of contact and low duration of contact.

Table 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

Different areas on a site may need to be considered individually.

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 WDA is to be considered in this factor.

C.3.3 Food Consumption

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

Sedentary organisms are more susceptible to local inputs as their exposure is greater if they are downgradient from the WDA. 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 sites do not have elevated levels of contaminants, as 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 abandoned military 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 site has the potential to pose a higher risk than a low consumption, although in general the risk remains low.

2.4 Special Considerations

As indicated in the introduction to the matrix, 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 their 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 that are not general to all of the abandoned military 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 a WDA, 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

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 WDA.

Example 2. Proximity to a community

In the WDA risk evaluation matrix, human exposure to a WDA is measured in the following way: people can spend time at the WDA (potential dermal exposure), they can drink water from an area near the WDA (potential ingestion), they could live very close to the WDA (potential exposure through aerial transport) or they could eat animals that feed near the WDA (potential ingestion). These considerations form section C.3 of the risk evaluation matrix. If a WDA is located near a community, there is a greater likelihood that people will spend time at the site than there is for areas far from a community. It is not necessarily the case, however, that WDAs near communities receive frequent visits; therefore, instead of creating a special section addressing proximity to a community, the risk of human exposure (see Table 1-1) is more accurately evaluated by measuring time spent at a WDA. In these cases, however, "special considerations" points may be added to the receptors category to address a community's specific concerns, such as the physical hazards associated with an exposed dump site.

2.5 Traditional Knowledge

The matrix for the evaluation of potential environmental risk was developed recognizing that local input would be relied upon in the scoring of WDAs. Additional guidance on the collection of Traditional Knowledge is provided in Section 4.10 of the protocol.

3 INTERPRETATION OF SCORES

The score obtained through the application of the matrix is intended to represent the potential environmental risk posed by a given WDA in its current state. The objective of remediation is to mitigate the risk associated with a WDA by preventing the migration of contaminants that may be present in the landfill, and by removing physical hazards.

During the development of the matrix by the EWG, WDAs at four different sites were evaluated by environmental scientists and engineers to assess the applicability of the matrix and to determine cut-off values between categories. WDA scoring 105 points or more is classified as potentially high risk (Class A) and require excavation. The high score accorded to these WDAs is generally a result of the ecological sensitivity of the area and the geometry and surrounding topography of the landfill, which precludes the development of a cost-effective and long-term design solution such as pathway intervention and/or stabilization of the landfill. WDAs with a score of 100-104 points must be considered on a case by case basis – some may require complete excavation while others may be considered Class B landfills. WDAs that score less than 105 require excavation/removal if one or more of the following conditions are met:

- The WDA is located at an elevation of less than 2 m higher than an ocean.
- The WDA consists of unconsolidated wastes at surface. Debris should be removed, classified, and sorted, and non-hazardous contents placed in an engineered landfill.
- WDA, with areal extent of less than 1000 m^2 and scoring a total of 89 points or more are classified as potentially high risk and require excavation to the full extent/depth of the debris. In addition, if these WDAs score greater than 23 points in the contaminant source category, complete excavation of the area is recommended.

A WDA with a score in the range 75 to 99 points is classified as moderate potential environmental risk (Class B). An engineered leachate containment system will be provided for these WDAs to mitigate against potential environmental risks. In specific cases where an engineered leachate containment system cannot be constructed, an evaluation of excavation will be carried out with the objective of determining whether complete excavation or partial excavation with a leachate containment system is required.

For WDAs of less than 1000 m^2, it is considered unlikely that leachate containment will be cost-effective when compared to excavation and removal of debris. Consideration must therefore be given to the level of contamination present. If contaminants are present in excess of criteria, it is recommended that the debris area be excavated to its full extent. If contamination does not exceed criteria, debris should be cut-off and removed within the upper 0.5 metres of the ground surface. The area should then be regraded to match surrounding topography.

A WDA with a score of 75 or less is classified as low potential environmental risk (Class C). In general, the remediation approach for these areas includes placement of an engineered cover, following collection, sorting, and appropriate disposal of debris from the surface, and excavation and disposal of any surface contaminated soils from the area. Some of the factors to be considered in the design of the cover include: thickness and type of the existing cover materials; slopes on the landfill; surrounding topography and available granular fill. The cover is designed to promote surface water run-off (i.e. no areas of standing water), prevent erosion, and mitigate against settlement. Where required, the slope of the WDA may be modified and/or geotextiles may be incorporated into the granular cover to provide a long-term solution. Generally, the final thickness of cover material is approximately 0.75 metres, and may be greater, dependent on site specific conditions. The granular cover material is to be placed in layers and compacted before the placement of the next layer of granular fill, until the design thickness is reached.

Overall, it is to be stressed that the matrix is to be used in the assessment of potential environmental risks associated with a specific WDA. It is not intended to be used as the sole criterion in determining the remediation solution for a WDA. The results of the matrix, both total score and the score from each major category, are to be considered in conjunction with the engineering evaluation of site conditions, to determine appropriate design solutions. Review of the individual category scores relative to the total score will highlight particular areas of concern that are to be addressed during the design process.

The potential impacts of climate change are also to be considered in evaluating remedial solutions.

It should be emphasized that the total score has an error associated with it of approximately 5 points; there is inevitable subjectivity in the scoring process and scores that fall near decision points should be considered on a case by case basis.

4 REFERENCES

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ATTACHMENT 1

WASTE DISPOSAL AREA

EVALUATION MATRIX

	ENVIRONMENTAL RISK EVALUATION MATRIX WASTE DISPOSAL AREAS - ABANDONED MILITARY SITES	Maximum Score
A. **A.1**	**CONTAMINANT SOURCE** **AREAL EXTENT OF WASTE DISPOSAL AREA**	
	>10,000 m2	10
	For areas less than 10,000 = Area of Waste Disposal Area X 10 / 10 000	2-9
	Minimum Score	1
A.2	**ESTIMATED DEPTH OF BURIED WASTES**	
	greater than 1.5 m	5
	less than 1.5 m	2-4
A.3	**CONTAMINANT CHARACTERIZATION**	
	Concentrations in excess of DCC Tier II Criteria	25
	Concentrations in excess of DCC Tier I Criteria	20
	Concentrations elevated relative to background	10
	Potential Contamination	5
A.5	**PRESENCE OF SURFACE DEBRIS**	
	>50% of surface area	10
	<50% of surface area, pro-rated	1-9
	No debris observed	0
	SPECIAL CONSIDERATIONS	+/- 5
	TOTAL SCORE - CONTAMINANT SOURCE	

	ENVIRONMENTAL RISK EVALUATION MATRIX WASTE DISPOSAL AREAS - ABANDONED MILITARY SITES	Maximum Score
B.	**PATHWAY/TRANSPORT MECHANISMS**	
B.1	**AERIAL TRANSPORT OF CONTAMINANTS**	
	All Waste Disposal Areas Scored as 2, if surface sol contamination (A.4) or leachate (A.3) has been identified.	
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
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
B.2.3	**COVER MATERIAL – TYPE**	
	No cover	5
	Silty/Sandy Material	4
	Sandy/Gravel Material	3
	Gravel Material	1-2

B.	**PATHWAY/TRANSPORT MECHANISMS continued**	
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
B.2.5	**PRECIPITATION**	
	> 100 cm snow pack	4
	< 100 cm snowpack (pro-rated)	1-4
	Snow Drifting	1
B.2.6	**DISTANCE TO DOWNGRADIENT PERENNIAL SURFACE WATER/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
	SPECIAL CONSIDERATIONS	+/- 5
	TOTAL SCORE – PATHWAYS	

	ENVIRONMENTAL RISK EVALUATION MATRIX WASTE DISPOSAL AREAS - ABANDONED MILITARY SITES	Maximum Score
C.	**RECEPTORS**	
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
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
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
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

C.	**RECEPTORS continued.**	
C.3	**POTENTIAL HUMAN EXPOSURE THROUGH LAND USE**	
C.3.1	**Presence/Occupation**	
	Duration of Contact /Likelihood of Contact	7-8
	see chart and provide rationale for scoring	4-6
		1-3
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
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
	High quantity of migratory organisms	2
	Moderate quantity of migratory organisms	1
	Low quantity of migratory organisms	0.5
	No consumption	0
	SPECIAL CONSIDERATIONS ***TOTAL SCORE – RECEPTORS***	+/-5
	TOTAL SCORE	

Annex B – Barrel Protocol

1 INTRODUCTION

In order to determine the correct disposal method for barrels and their contents, the contents must first be identified. All barrel contents should be sampled and analyzed according to DND DEW Line Cleanup standard procedures, as described in this section.

Analytical data obtained for the samples collected from barrels located at the site should 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. The flash point of organic waste and aqueous waste (> 2% glycols/alcohols) must also be determined. Uncontaminated aqueous phases can be disposed of on the land according to the discharge criteria; 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.

During the delineation phase of the site investigation, an inventory of the number and locations of barrels at the site is to be compiled. This inventory should include buried or partially buried barrels that will be taken out of the landfills during excavation. Where significant numbers of barrels are present on a site, and if safe to do so, representative samples shall be collected to provide a preliminary indication of whether on-site incineration is a viable alternative. Otherwise, barrels are only sampled during the cleanup phase and as such, the handling, transportation and opening of barrels is the responsibility of the site Contractor.

Other waste fuels and oils are also sampled according to this protocol. These may come from a variety of sources including, but not necessarily limited to, old generators, fuel tanks and pipelines, and transformers.

2 INSPECTION

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

- 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.
- 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.
- Signs of deterioration or damage such as corrosion, rust, or leaks at seams, rims, and V grooves, or signs that the barrel is under pressure such as bulging and swelling.
- Spillage or discoloration on the top and sides of the barrel.

3 SAMPLING

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.

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.

Barrels should only be opened according to accepted procedures and under qualified supervision, preferably using remotely operated, non-sparking equipment.

Once open, barrels will be sampled by personnel wearing proper personal protective equipment as described below. Samples of the contents of all barrels shall be extracted using a drum thief and placed into a pre-labelled glass vial. The number and type of liquid phases, and their respective thickness, and the size of each barrel are to be recorded.

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.

All barrels shall be clearly numbered using spray paint or other suitable paint marker. The number on this label should be the only sample coding provided to the laboratory.

The barrel locations and barrel sample descriptions should be recorded.

Samples should be kept at ambient temperatures and shipped by guaranteed freight to laboratories where they should be kept cold pending analysis.

4 TESTING

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.

The contents of barrels containing organic materials, including aqueous samples which contain more than 2% glycols or alcohols, shall be tested for flash point, PCBs, total chlorine, cadmium, chromium and lead following the targeted barrel testing approach presented in Figure 1. Analyses will be conducted on a rush basis where indicated. In addition, major organic components should be identified e.g. fuel oil, lubricating oil.

If on site incineration of waste is not planned, waste samples need only be tested for flash point, PCB, and pH (at regular turnaround time) in order to classify the waste for transport and disposal options.

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 provided in the protocol.

5 DISPOSAL OF BARREL CONTENTS

Barrels containing only rust and sediment shall be treated as empty barrels.

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 shall be tested prior to discharge in accordance with wastewater discharge criteria. Where water meets criteria, it may be discharged to the ground a minimum of 30 meters distance from natural drainage courses. Used oil absorbent material shall be treated as described in the following subsection.

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, 100 ppm lead, and that have a flash point between 25°C and 225°C, 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 not be leachable shall be disposed of as DCC Tier II contaminated soil. Leachable material shall be treated as hazardous waste and disposed of off-site at a licensed disposal facility.

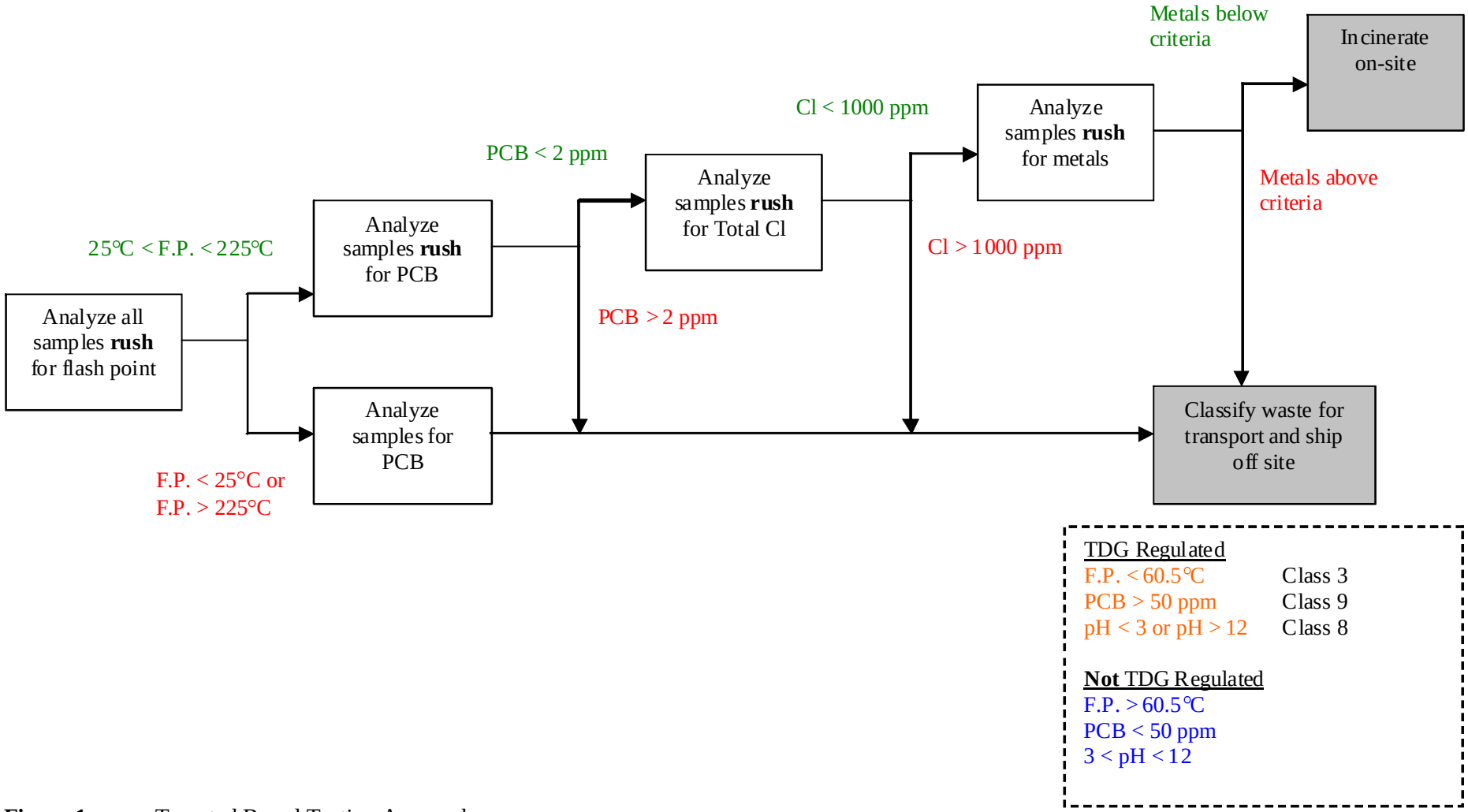

Figure 1 Targeted Barrel Testing Approach

Barrel contents, which contain greater than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium or 100 ppm lead, or that have a flash point below 25°C or greater than 225°C shall be disposed of off-site at a licensed disposal facility. Contents may be combined with compatible materials for shipping purposes.

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.

6 DISPOSAL OF BARRELS

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.

7 PERSONNEL PROTECTIVE EQUIPMENT

Safety equipment required includes a respirator with organic vapour cartridges, safety glasses, a hard hat, rubber safety boots, double gloves (chemically resistant on the outside, and latex or vinyl on the inside) and disposable Syranex-coated coveralls.

A decontamination procedure should be established at the barrel sampling area(s) to prevent tracking potentially contaminated liquids outside of the sampling area(s).

It is advisable to have one person outside of the sampling area to observe the sampler(s) in case of unexpected hazards, and also to record the samplers' observations.

Appendix F

Golder Archaeological Impact Assessment Report

FINAL REPORT

ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF THE FORMER USAF PADLOPING ISLAND WEATHER STATION, PADLOPING, NUNAVUT

Submitted to:

The Department of Culture, Language, Elders and Youth (CLEY), Nunavut
Nunavut Permit No. 2010-016A

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EXECUTIVE SUMMARY

During August of 2010, Golder Associates Ltd. conducted an Archaeological Impact Assessment (AIA) of the former United States Air Force (USAF) Padloping Island Weather Station on Padloping Island, Nunavut on behalf of AECOM working for Public Works and Government Services Canada (PWGSC) and Indian and Northern Affairs Canada (INAC). This AIA was carried out in conjunction with the Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation and Remedial Action Plan. All required fieldwork was completed under an Archaeological Permit (2010-016A) issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut to Brent Murphy of Golder.

The former USAF Padloping Island Weather Station is located on Padloping Island, approximately 80 km southeast of Qikiqtarjuaq, Nunavut. Low-level aerial reconnaissance of the site area was conducted in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential. The site area is characterized by natural springs and is poorly drained. During the study three heritage resource sites were newly recorded including the weather station, Inuit settlement and cemetery were identified and documented as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003).

PWGSC has fulfilled the requirements to identify the potential for impact to heritage resources during the proposed remediation/reclamation of the former USAF Padloping Island Weather Station on Padloping Island. The AIA included the participation of Losie Audiakiak and Johnny Kooneeliusie from the local community of Qikiqtarjuaq, who acted as bear monitors and participated in the identification and recording of heritage resource sites.

During the investigation a former weather station, an Inuit settlement and cemetery were recorded as heritage resource sites and assigned Borden site numbers: MgBu 5, MgBu 6 and MgBu 7. It is recommended that PWGSC and INAC have met their obligations to assess the potential for impact to heritage resources during the proposed Remedial Action Plan. It is also recommended that the newly identified site MgBu 7 be avoided during reclamation activities, none of the structures from MgBu 6 be removed during

remediation, and that any material that is removed from MgBu 5 such as fuel barrels, metal debris, and wood debris, be hand picked. Further, that none of the recorded features associated with MgBu 5 be disturbed by borrow sources, landfills or heavy vehicle traffic.

It is also recommended that any information on the sites be recorded during public consultation and used to assess the potential for impact during the development of the Remedial Action Plan of the USAF Padloping Weather Station.

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1. INTRODUCTION

During August of 2010, Golder Associates Ltd. (Golder) conducted an Archaeological Impact Assessment (AIA) of the former United States Air Force Padloping Island Weather Station, Padloping Island in conjunction with the Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation, Remedial Action Plan on behalf of AECOM and Public Works and Government Services Canada (PWGSC). All required fieldwork was completed under an Archaeological Permit (2010-016A) issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut to Brent Murphy of Golder.

Low-level aerial reconnaissance of the site area was initially flown in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential. The AIA was intended to identify any artifacts or heritage resource areas that might be impacted by a remediation program and, as such, only those areas of previous and potential disturbance were assessed. The intent of this program was not to conduct a full AIA of the entire Padloping Island. However, during traverses of the former weather station some lands outside of proposed impacts were surveyed (Figure 1).

As requested, areas that will not be impacted during remediation were not fully examined. As a result of the survey three new heritage resources sites, MgBu 5, MgBu 6, and MgBu 7 were recorded by the author during the program, which were documented as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003).

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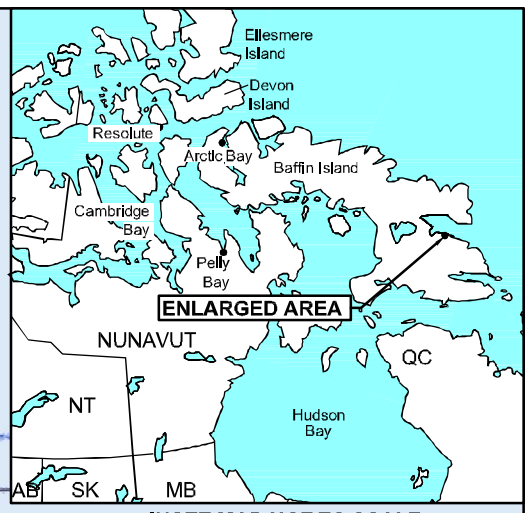

INSET MAP NOT TO SCALE

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Qaqaluit Island

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Padloping Island (site)

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SCALE KILOMETRES

LEGEND

STUDY AREA

REFERENCE

TOPOGRAPHIC MAP 16M & 16N 3rd EDITION OBTAINED FROM Canmatrix.© 1994 HER MAJESTY THE QUEEN IN RIGHT OF CANADA, DEPARTMENT OF NATURAL RESOURCES : TRANSVERSE MERCATOR DATUM : NAD83 COORDINATE SYSTEM : UTM ZONE 20W.

PROJECT

PADLOPING ISLAND USAF WEATHER STATION

TITLE

STUDY AREA

Golder Associates
Calgary, Alberta

PROJECT 10.1333.0025.8470			FILE No. 10133300258470A001	
DESIGN	BM	14/10/10	SCALE AS SHOWN	REV. 0
CADD	KJM	14/10/10		
CHECK	BM	19/10/10		
REVIEW	DB	19/10/10		

FIGURE: 1

2. LOCATION, POTENTIAL IMPACTS, AND OBJECTIVES

2.1 Location

The former USAF Padloping Island Weather Station, codenamed Crystal III is located on Padloping Island 80 km southwest of Qikiqtarjuaq, Nunavut. Padloping Island is off the northeast coast of Baffin Island on the Hudson Strait. The abandoned weather station was built and operated by the United States Air Force from 1943 until the end of the Second World War when it was taken over by the Canadian Department of Transport who operated the station until 1956. The abandoned weather station is located on a coastal plain approximately 400 m from the bay bordered by a steep cliff, two shallow lakes to the west and undulating hills to the east. (Plates 1 and 2) The site includes the remains of several buildings and large amount of debris including fuel barrels and abandoned vehicles.

Plate 1 Aerial photo of the Project area, view southwest showing building remains.

Plate 2 Aerial photo of the beach landing area with main site in the background. Barrel dumps can be seen on shore and a sunken barge is seen off the beach.

2.2 Potential Impacts

The potential impacts to heritage resources around the former weather station on Padloping Island are dependent upon the proximity of those resources to the remediation activities that will be conducted to remove the remnants of the former weather station. Heritage resource sites are non-renewable resources that may be located at or near ground level or may be deeply buried. Prehistoric or precontact archaeological sites are those sites which contain features, artifacts or ecofacts reflecting the use of a given land base by people prior to European influences and technologies. Features are non-portable articles that indicate a human modification of the local environment such as hearths, pits, tent rings, stone cairns and Inuksuk. Artifacts are portable items that have been modified

by people at some time in the past. These include such items as projectile points, stone flaking debris, and cut and modified bone. Ecofacts are naturally occurring items such as preserved plant remains or pollen that can aid in the interpretation of archaeological sites. Historic archaeological sites include the features, artifacts and ecofacts relating to the past few hundred years of human occupation. These sites are typically identified by the presence of buildings or structural remains, but may include any site that has evidence of historic use of the landscape.

Alteration of the landscape can result in the damage or complete destruction of all or portions of historic resource sites. These alterations often involve the displacement of artifacts resulting in the loss of valuable contextual information or may involve the destruction of the artifacts and features themselves resulting in complete information loss. These losses are permanent and irreversible. Primary, secondary and tertiary impacts are possible with any new development. Remediation can be considered a new development in this context if it impacts previously undisturbed areas during operation.

Primary impacts include those disturbances resulting immediately from a project. The primary impact zone is the area within the remediation footprint including access roads, temporary work zones, borrow pits and dumps. Individual sites are likely to be affected to varying degrees if they are located within the development area. Artifact context is fundamental to interpretation of archaeological sites. By disturbing the context in which artifacts and features are recovered, interpretations of heritage resources sites and, ultimately, past lifeways are affected negatively.

Secondary impacts can occur when the support services or additional access required by development adversely affects heritage resources outside the primary target areas. The remediation project should have no secondary effect on heritage resources.

Tertiary impacts are the results of project induced changes in demography and land use patterns. Increased rates of intentional and unintentional impacts can be expected as a result of increased visitation to an area if the project were large enough to affect regional

population bases. Tertiary impacts are anticipated to be very low for this project, especially because changes to the site through remediation will probably only negatively affect the visitation rates.

The study detailed in this report is intended to identify areas of possible impact and to determine whether the current proposed project will disturb those heritage resources located in proximity to the development.

2.3 Project Objectives

The objective of the 2010 study at the former USAF Padloping Island Weather Station located on Padloping Island is to ensure that heritage resources are not inadvertently impacted by the proposed clean-up and remediation project. The purpose of this AIA is to:

- conduct a pre-impact assessment of the proposed remediation areas;
- identify any archaeological sites within those areas (if present);
- make recommendations to CLEY, AECOM and PWGSC to mitigate or avoid those sites;
- make recommendations on surveillance and monitoring;
- provide a cost estimate on implementing the recommendations during the construction phase; and
- prepare a draft Final Report to be reviewed by AECOM and PWGSC, followed by a Final Report for distribution as required and submission to CLEY.

3. PHYSICAL AND CULTURAL SETTING

3.1 Environmental Context

An understanding of past environmental conditions and the environmental factors that shape human approaches to subsistence and settlement patterns enable archaeologists to not only locate sites, but also to provide more accurate interpretations of individual sites. The physical aspects of the environs (topography, drainage, climate and soils) as well as resource availability (flora, fauna, lithic materials and water) are prime criteria for the identification of site location and function. Assessments of the universal cultural activities of site location, travel within and through the area, and resource exploitation are key components of any archaeological site analysis.

The anthropological theory of environmental determinism suggests that, to a great extent, environmental factors condition human behavioural and cultural adaptations, or patterns of behaviour. The environment has likely influenced many of the activities that contribute to the character of the regional prehistoric record. All available environmental variables must be considered as indicators of prehistoric use of the landscape.

The regional environment influences where specific activities and occupation are located in a pattern of seasonal movements according to the availability of resources: a seasonal round. The variables of archaeological site distribution can be identified and combined into useful criteria for suggesting the potential of an environment to hold heritage resources that includes a wide variety of landforms frequently associated with coastlines and lake shores, river banks, eskers and kames, and bedrock knolls in Arctic environs. Distribution patterns partially reflect environmental opportunities presented to human groups as well as cultural preferences demonstrated by site location. Topography influences much human activity including travel, communication, resource catchments, dwelling locations and eventually constrains human activity areas to defined localities. Based on existing heritage resources, the environment is a key factor in human settlement patterns.

3.2 Regional Environment

Prior to contact with Europeans, the environment in which the people of North America lived strongly influenced their culture and economy. The people who inhabited the North took advantage of the seasons and all the resources that were available.

Baffin Island is part of the Canadian Shield, an old erosion surface of Precambrian rocks. Specifically, the northeast coast is mountainous and framed by numerous fjords, inlets, cliffs, eroded sandstone valleys and intricate alpine glaciers flowing to the sea (Collignon 2005). Hundreds of small islands surround the coast. The vegetation is diverse by sparse and dwarfed with sedges, saxifrage, dryas, Arctic willows, cottongrass, broad-leafed willows, herbs and Arctic poppies being the most common plants of the 350 species recorded on the island. Caribou, wolf, Arctic fox, lemming, Arctic hare, and polar bears are the most common land mammals on the island while sea mammals include walrus and several species of seals and whales are found in coastal waters.

The abandoned weather station is located on a coastal plain approximately 400 m from the bay bordered by a steep cliff two shallow lakes to the west and undulating hills to the east. The main site is connected to the beach landing area and fresh water lake by roads. During the study wildlife that was observed near the station area included a polar bear, numerous seals and whales. The site area is wet, boggy and heavily vegetated with sedges, willows and many flowering plants, grasses and rushes (Plate 3).

Plate 3 View south along road with the main station to the right of the photo showing typical vegetation.

3.3 Heritage Resources

Archaeology is the study of human history through the material remains of culture, now known as heritage resources. The ultimate goal in archaeology is to describe the cultures and events responsible for the creation and deposition of the remains at a given archaeological site. As such, archaeologists use material remains to determine the nature and age of cultural occupations at a site. Artifacts, ecofacts and features deposited into the natural environment, along with their inter-relationships, are the integral parts that make up an archaeological site. The *Nunavut Archaeological and Palaeontological Sites Regulations* (2003) define heritage resources as: “but not limited to, archaeological and historical sites, burial grounds, palaeontological sites, historical buildings and cairns.”

Predating the arrival of Europeans, precontact archaeological sites are comprised of artifacts, features and residues of native origin typically characterized by modified bone and stone, and stone structures. Historic sites are those structures, features, and objects of European influence that date back to contact with the Europeans but can also represent more recent activity of more than 50 years. Depending on the context, sites less than 50 years old may be considered to represent traditional land use and are identified to document continued use and occupation of an area to the present time. A key component of the historic period record are the sites, artifacts and affiliated resources relating to post-contact Aboriginal people's use of the landscape. These include both archaeological sites and objects such as standing and collapsed cabins, campsites, graves, and traditional sites and resources, such as special places, hunting and plant collecting areas, traplines and their associated remains, oral traditions and various documents. These latter resources are usually identified through consultation procedures such as Traditional Use Studies (TUS) or community consultations.

Additionally, heritage resources include, as well as the sites where events took place in the past, all of the objects that they contain and any of the contextual information that may be associated with them and will aid in their interpretation, including natural specimens and documents or verbal accounts.

Heritage resources are non-renewable and are susceptible to alteration, damage, and destruction by construction and development activities. The value of heritage resources cannot be measured in terms of individual artifacts or biological specimens, rather the value of these resources lies in the integrated information which is derived from the relationship of the individual artifacts and fossil specimens, associated features, spatial relationships (distribution), and contextual situations. Interpretation of heritage resource materials, and the ability to interpret the significance of particular sites in a landscape, is based on an understanding of the nature of the relationship between individual archaeological and palaeontological materials as well as the sediments and strata within which they are contained. As such, removal or mixing of cultural or fossil bearing

sediments results in the permanent loss of information basic to the understanding of these resources. As a result, heritage resources are increasingly susceptible to destruction and depletion through disturbance.

Similarly, tundra areas north of the tree line are characterized by extremely slow rates of soil development and sediment accumulation. Accordingly, at repeatedly occupied sites, there is little chance of distinguishing occupations relating to different periods within the 5,000-year record of human occupation in the region without recovering a diagnostic indicator. Some areas of high sediment deposition rates are present within the study area, but these are not the typical scenario.

The lack of temporally diagnostic artifacts, the absence of materials suitable for radiocarbon dating, and the natural mixing of shallow archaeological deposits serve to limit the definition of the recognized prehistory for the region. In contrast, extant documents, records, and oral testimony provide a firmer basis for understanding the historic period of the region.

3.3.1 Cultural Chronology

Many of the archaeological materials in the project area represent human activity after the ice sheet receded from Baffin Island about 5,000 years ago. Soon afterward the island was colonized by Paleo-Eskimos with Southwestern Baffin Island, Melville Peninsula, Southhampton Island and the north of Quebec being considered to be part of the core area of Pre-Dorset and Dorset Culture Development.

3.3.1.1 Arctic Small Tool Tadition (4200 B.P. to 2800 B.P.)

There is presently little evidence to link Palaeo-Arctic tradition occupations to the Arctic Small Tool tradition (ASTt) occupations that succeed them. The ASTt represents a widespread cultural manifestation that covers all of the Canadian Arctic as well as parts of Alaska and Greenland. The ASTt is typically thought to date between approximately

4,200 and 2,800 B.P. (McGhee 1990). It includes the Denbigh Flint complex in northern Alaska, the Independence I culture of the Canadian High Arctic, the Inuvik Phase and the Pre-Dorset culture in Arctic Canada, and the Sarqaq culture in Greenland. It is thought that the ASTt relates to a separate migration of peoples from Siberia and does not appear to be related to the preceding Palaeo-Arctic tradition. As the name implies, the toolkit of the ASTt is comprised of lithic artifacts that are finely made and smaller than tools of similar function and age from elsewhere in North America. These include microblades and microcores, burins, gravers, small side and end scrapers, side and end blades, and bipointed (arrow) and triangular (harpoon) projectile points (Wright 1995). In Alaska it appears to have developed into the cultures of the Norton tradition while in Canada it developed into the Dorset culture.

3.3.1.2 Dorset Culture (2,500 B.P. to 1,000 B.P.)

The Dorset culture occupied the Canadian Arctic from 2,500 B.P. until at least 1,000 B.P. (McGhee 1990). Best known for miniature carvings, Dorset appears to have been a more successful adaptation to the conditions of the north than the preceding ASTt cultures from which it developed. This is demonstrated by the huge area occupied by Dorset groups and by evidence that they had perfected winter hunting on the sea ice. Cooler conditions in the northern hemisphere around 3,000 years ago resulted in expansion of the sea ice and a shift away from terrestrial hunting of caribou and hunting of sea mammals from boats in open water to a procurement of sea mammals from coastal edges and sea ice. This is evidenced in the archaeological record with a shift away from bow hunting to harpoon and spear hunting (McGhee 1990). Artifacts recovered from sites representing this period are more diverse and “reflect a richer and more secure way of life than that of earlier Palaeo-Eskimos.” including the establishment of permanent winter villages (McGhee 1990).

However, when the people of the Thule culture arrived in the Canadian Arctic approximately 1,000 years ago, the Dorset culture had largely or entirely disappeared for reasons that are not well understood (McGhee 2001; Wright 1999).

3.3.1.3 Thule (1,000 B.P. to 400 B.P.)

The Thule tradition dates from approximately 1,000 to 400 B.P. and is derived from the Norton tradition in northern Alaska. More specifically, Thule grows out of the Old Bering Sea and Punuk traditions, which have numerous similarities to Thule cultural assemblages. These assemblages suggest subsistence based on maritime resources such as seals and whales that were hunted from kayaks or umiaks as identified by harpoon floats. Thule represented a new kind of adaptation to the Arctic environment, based on the hunting of large sea mammals in open water through the use of drag floats attached to the harpoon line. Large skin boats and the use of dogs to pull large sleds were other Thule innovations. Winters were spent in sometimes large communities of semi-subterranean houses, subsisting on a stored surplus obtained most typically by hunting bowhead whales. The introduction of Thule into the Canadian Arctic is noted by a distinct change in a number of cultural markers from the Dorset culture. The earliest Thule occupations currently recognized are on islands in the Bering Strait and exhibit an almost complete reliance on maritime resources; however, later sites demonstrate that both maritime and terrestrial resources were utilized (McGhee 1990). Climatic changes following the thirteenth century likely caused the Thule to modify their way of life into that of the various historic Inuit groups.

3.3.2 Historic Inhabitants

Historic use of the project area is identified with the ‘Baffin Eskimo’. This group inhabited the southern two-thirds of Baffin Island and some of the nearby islands off its shores (Kemp 1984:464). The remaining northern region of the Island is inhabited by the Iglulik (Kemp 1984:464). The island region that is inhabited by the Baffin Eskimo is characterized by freshwater systems located in the central interior and mountainous areas in the northeast and southwest (Kemp 1984:464). The region was first inhabited by the Pre-Dorset approximately 4,200 years ago, supported by archaeological sites identified at Lake Harbour, Frobisher Bay, and Pond Inlet (Desrosiers 2005:193). Prior to this inhabitation, a large ice sheet had covered the island until its melting 5,000 years ago

(Desrosiers 2005:193). Dorset groups are identified in the archaeological record following this, between 2,500 and 600 years ago. The regions of southwestern Baffin Island, Melville Peninsula, Southampton Island, and northern Quebec are considered the central regions of Pre-Dorset and Dorset cultural development (Desrosiers 2005:193). Thule groups entered the area during the final 200 years of the Dorset occupation of the area. These two archaeologically distinct cultures coexisted in the region, but the character of this relationship is unclear. Much of the information known of the historic Thule, or Baffin Eskimo, is based on the ethnographic recordings of Franz Boas from the late 1800's. At this time, Boas recognized seven distinct regional populations within the Baffin Eskimo area (Kemp 1984:464). These populations were "linked together by [bilateral] kinship and the mutual use of hunting and territory, to form larger territorial and social groupings...bands" (Kemp 1984:464). Importantly, by the time of Boas' ethnography the Baffin Eskimo possessed many European goods, which influenced and altered the traditional life-ways of the local groups.

European contact with the Baffin Eskimo populations began in the 16th Century with the Frobisher Expedition (Kemp 1984:467), whose task it was to find the North West Passage (Desrosiers 2005:193). However, previously Baffin Bay had been explored by the Norse (Heinrichs 2005:191). During the 10th Century these Norseman built settlements on Greenland and perhaps Newfoundland but little evidence remains of where and how far they had actually travelled as these same settlements collapsed during the 13th Century. Baffin Bay was next explored and recorded by John Davis in 1587. European interaction gradually increased with the rise of European whale hunting; whaling stations began operating throughout the eastern arctic in the 1880's (Kemp 1984:466). Such whaling activities around Davis Strait originated in the 1700's, but it was not until the 1850's that all the inhabitants of the Cumberland Sound and Davis Strait regions were in contact with whalers (Kemp 1984:466). The whaling industry was eventually eclipsed by fur trapping in 1910 (Kemp 1984:474). Also at this time Anglican missionaries entered the region (Kemp 1984:474).

The Baffin Eskimo have historically utilized a vast array of subsistence resources, including marine, terrestrial, avian, and freshwater game; however, the wolf was sought but not utilized for subsistence (Kemp 1984:467). A vast array of tools was used for hunting, such as plugs to stop the bleeding of seals that made it easier for their transport. Bird nets were also constructed and used to ensnarl various avian species (Kemp 1984:468). Hunting weapons included breathing-hole harpoons that had compound elements, and single-curve bows (Kemp 1984:69). Metal, along with driftwood, antler, bone, and stone, were used in the construction of these implements. In addition, Baffin Eskimo technology allowed for water transportation via kayaks and umiaks, or women's boats (Kemp 1984:469); the form of the kayaks was not consistent throughout the Baffin Eskimo area. Dog sleds were used as well. These sleds were the dominant method of transportation until the 1960's when snowmobiles were introduced (Kemp 1984:469). With these forms of transportation, the Baffin Eskimo interacted with neighbouring groups such as those from northern Quebec (Kemp 1984:465). However, this interaction did not occur regularly.

Different subsistence resources were procured based on the season. For instance, seals (particularly ringed seal) were hunted along the floe-edge during the spring months, and caribou herds were hunted during the fall in the interior and coastal regions (sometimes with the aid of drives) (Kemp 1984:467-468). As this instance suggests, Baffin Eskimo mobility was seasonal and influenced by the location of what game they were pursuing. As a rule, Baffin Eskimo groups resided primarily in the coastal regions. It was the caribou that pulled groups into the interior, whereby three particular lakes were favoured as hunting locals: Nettling, Amadjuak, and Sylvia Grinnel Lakes (Kemp 1984:468). During these interior hunts, if excess caribou meat was produced, then it would be cached at these interior locations and retrieved at times of food stress during the winter months (Kemp 1984:468). In addition to there being differences in subsistence procurement based on seasonality, there were also differences in dwellings. Winter dwellings were commonly snow houses, although occasionally early and abandoned Thule houses were reused through the addition of roofs (Kemp 1984:470). In contrast to the winter, skin tents were utilized during the warmer months. These tents varied in form and size

depending on how far they were to be transported and their use (Kemp 1984:470). A further seasonal distinction is found in Baffin Eskimo clothing; only caribou skin was used for winter clothing, and seal skin was used in addition to caribou for summer clothes (Kemp 1984:470).

3.3.3 Heritage Studies

A search of the Canadian Museum of Civilization database identified five previously recorded sites on Padloping Island with an additional three sites recorded on the neighbouring Qaqaluit, Paugnang and Block Islands. However, none of the previously recorded sites are located within the study area and therefore were not revisited.

Prior to the current study of the USAF Padloping Island Weather Station on Padloping Island, a total of five archaeological sites were recorded on the island. These sites included: MgBu 1, MgBu 3, MgBu 4, MgBt 3, and MhBt 2. The first of these sites, MgBu 1, was classed as a prehistoric lithic scatter, though bone and ivory artifacts were also recovered. Identified in 1963 by Father Guy Mary-Rousseliere (1913-1994), the site possibly relates to the Pre-Dorset or Thule. The second site previously recorded on Padloping Island was MhBt 2. This site was identified by D. Clark in 1964 as a cairn of undetermined age. The other three sites previously recorded on Padloping island (MgBu 3, MgBu 4, and MgBt 3) are all listed as Sabo sites, named after George Sabo who identified them in 1975; individually these are Sabo sites JJ, KK, and II. Located by local informants, MgBu 4 was a prehistoric Thule campsite with multiple structures, two of which were found eroding from a terrace edge. In total, six Thule semi-subterranean sod and stone dwellings, and two sod and stone qarmats were recorded. Four of these Thule dwellings were bilobate. Besides the multiple features, one harpoon ice pick was also recovered. MgBt 3 had both prehistoric and indigenous historic associations (Thule and Inuit). This site consisted of two areas, the first area held the remains of a qarmat, a tent ring, and a cache; the qarmat was badly disturbed. Qarmats are rectangular structures that were built on the surface or in a shallow pit with interiors that were arranged in a way that was identical to semi-subterranean houses, in terms of sleeping

plarforms, and were often be made of snow or ice walls with caribou or muskox hide roofs. The cache and tent ring were actually a single feature as the ring had been transformed into a cache. The second area was to the east and consisted of multiple rectangular tent rings, associated with recent debris. These rings were situated on higher ground than the first area. The third Sabo site was MgBu 3, which was an undisturbed indigenous historic site. It was classed as a campsite with a qarmat, tent ring, and cache. The caches from MgBt 3 and MgBu 3 were not elaborated upon.

Three islands, situated in close proximity to Padloping Island hold three additional previously identified archaeological sites. These islands have one previously recorded site each and are called: Qaqaluit Island, Paugnang Island, and Block Island. The MhBt 1 was also known as the Cape Searle site, located on the north shore of Qaqaluit Island. The site was recorded by D. Clark in 1964 as a stone cairn with undetermined temporal and cultural associations. The second site, MgBt 2, was a prehistoric site located on a rocky ledge along the south shore of Paugnang Island. George Sabo in 1975 recorded this (and MgBt 1) site while conducting the Thule Archaeology Conservation Project. There were a total of three structures identified, two of which were looted. The other structure was eroding but did not indicate looting. These three structures were associated with the late Thule. The third and final site, MgBt 1, was located on the south shore of Block Island. The site was identified as 4 closely placed villages. The first was an Inuit village comprised of numerous wood platformed qarmats. The second, a Thule village, was also comprised of qarmats (n=2) but were made of stone and one had a stone cairn built within. The third village, associated with the Thule, had 3 stone houses. One of these structures had a recent cache placed within it and two burial cairns placed behind the structure's back walls. Nearby to this structure were 2 kayak rests, a number of tent rings, and additional caches. Approximately 105 metres to the north of these three villages was the forth and final grouping of structures. These structures (n=3) were associated with the Thule.

4. METHODOLOGY

4.1 Field Inventory and Assessment

All field work was conducted under a valid Class II Archaeological Permit issued by CLEY. The field program focused on assessment of all areas of high and moderate archaeological potential within the abandoned weather station, and the proposed borrow source and landfill locations. The purpose of the field investigation was to identify archaeological materials, document location and content and provide data to be used in the development of recommendations for future remediation programs. Inventory and assessment techniques followed established practices and consisted of the following:

- visual examination of the identified areas to determine the presence of such surficial features such as standing or collapsed buildings, dumps, cache pits, cabin foundations, etc. and exposed precontact cultural materials such as stone tool making debris and tools;
- visual examination of the identified areas to determine the presence of items of historical military interest;
- excavation of shovel tests (ca. 40 x 40 cm) to varying depths to determine the potential for subsurface precontact cultural remains if deposition is present;
- visual examination of bedrock exposures (if any) or gravels for precontact quarrying activity;
- excavation of either additional shovel tests or 1 x 1 m units for the purpose of identifying the distribution, density, and nature of cultural remains associated with sites identified through inventory procedures;
- documentation of the location (GPS coordinates), nature, size, and complexity of each identified site; and
- documentation of individual site features to record content, context, potential identity, and to provide information required to develop a mitigation program.

These results, along with updates and recommendations will be included in written submissions to CLEY as required by the Permit to conduct the AIA, and discussed with the Chief Archaeologist of Nunavut.

4.2 Heritage Feature / Structure Evaluation

Evaluations of heritage features and standing structures were to be completed for features/structures that are observed during the investigations. These evaluations would consider perceived heritage resource value and community cultural value as well as the predicted impact from the proposed program. In general, disturbed sites with limited cultural remains would be assigned lower archaeological resource values than undisturbed sites, large sites with large amounts of cultural material, complex sites, and multicomponent sites. Undisturbed multicomponent sites would generally be assigned the highest heritage resource value.

Community input will play a role in the evaluation of site value, and the inclusion of members of the local community on the field crew aided in the in-field discussions regarding site significance.

4.3 Detailed Archaeological Site Investigations / Mitigation

If required, mitigation of significant heritage resources sites may include a number of different options. Prior to evaluation of these mitigative options, the perceived value of the identified archaeological sites will be discussed with the AECOM Project team to determine the feasibility of avoiding important sites. If site avoidance is not possible, other mitigative measures such as collection and documentation, and controlled mapping/excavation be considered and discussed with CLEY. In areas of no sediment deposition surface collection and mapping of artifacts and features may satisfy regulatory requirements for mitigation. Recommendations for excavation may include a controlled excavation mitigative plan and will specify the number of square metres and suggest locations for excavation units/blocks.

Overall mitigative options may be summarized by:

- collection and documentation undertaken at the time of the field assessment at all sites with low archaeological resource value;
- avoidance if feasible at all sites assigned high archaeological resource value;
- mitigative excavations which will be recommended at those sites assigned high archaeological resource value that could not be avoided by borrow source relocation; and
- a management plan for required mitigation relative to the proposed construction schedule to be discussed with the site project team and CLEY.

4.4 Reporting

Analysis of collected artifacts includes cleaning, cataloguing, identification, inventory, and description of each individual piece for inclusion in the final report. GPS site information is provided for mapping relative to the former site structures at the site and to CLEY, but not included in the final versions of this report. Archaeological site maps, photographs, and artifact scans are prepared as digital files.

5. RESULTS

Upon completion of the field component and the artifact curation, a draft report was prepared. This final permit report on the archaeological studies will be forwarded to AECOM for review and then submitted to CLEY for review. This report includes a project description, the environmental setting, the historical and archaeological context for the project area, field methodology, and the results of the field reconnaissance. The report includes descriptive data on the sites, artifacts, and features identified, as well as detailed information on the nature, content, and significance of the artifacts and features identified. Cultural material that was recovered was inventoried, described, and discussed within the report text to aid in evaluation of scientific and interpretive value. All identified sites have been documented on appropriate site inventory forms.

If required, a summary of the findings will be prepared for inclusion in a screening document.

The following workplan was followed:

- avoidance has been recommended where feasible at all sites assigned high archaeological resource value (this to include all constructed features: burials, tent rings, caches, hunting blinds, hearths);
- collection and documentation has been undertaken as a mitigative option of sites with low archaeological resource value and as a method of protecting the heritage resource from future undocumented impacts due to increased personnel activity in the vicinity; and
- acceptable methods of mitigation were discussed with CLEY and the Territorial Archaeologist, and may lead to a recommendation for detailed mapping, collection and/or test excavations at those sites assigned high archaeological resource value that cannot be avoided by reclamation project.

A management plan for required mitigation, monitoring or surveillance relative to the proposed remediation will be developed as part of the contracted services deliverable to PWGSC. This includes site mitigation, additional survey of any project re-locates required due to site avoidance, and verification of those heritage sites located outside the proposed development activity area that should remain outside re-located areas.

A search of the Canadian Museum of Civilization database identified five previously recorded sites on Padloping Island with an additional three sites having been recorded on the neighbouring Qaqaluit, Paugnang and Block Islands. However none of the previously recorded sites are located within the study area and were therefore not revisited.

5.1 Community Consultation

Consultation regarding the USAF Padloping Island Weather Station Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation, Remedial Action Plan is ongoing.

5.2 Field Results

The AIA assessment included all of the areas of moderate to high archaeological potential that have been disturbed by the weather station as well as areas identified as having potential for future borrow sources or dumps. The disturbed areas that were surveyed included the main site (Plate 4), original site (Plate 5) access roads, beach landing area (Plate 6), barrel dumps, metal dumps (Plate 7) and anywhere there was evidence of a bull dozer push or any other disturbance. Previously undisturbed areas that were examined included the periphery of all the impacted areas as well as several areas that were identified as potential borrow areas, landfills and landfarms for remediation activities (Plate 8).

During the investigation the former weather station, Inuit Settlement and cemetery were recorded as heritage resource sites. This was due to the fact that all of these sites were more than 50 years old, as per the *Nunavut Archaeological and Palaeontological Sites*

Regulations (2003). The weather station includes the original site, main station, roads and numerous barrel and metals dumps. The Inuit Settlement is made up of the remains of at least 22 houses that were determined from stone outlines and constructions materials, and the Inuit graveyard is located adjacent to the study area and consists of 20 graves. All three sites are described in more detail below.

Plate 4 View east of the remains of the maintenance garage.

Plate 5 View southwest of original warehouse.

Plate 6 View west of beach landing area with crushed barrels and sunken barge.

Plate 7 View west of metal dump area.

Plate 8 View south of potential borrow source between salt water and fresh water lakes.

In addition to the heritage sites, modern land use sites consisting of modern tent rings and Inuksuit were observed. There are two rather large Inuksuit at the beach landing area of the site, both have dates engraved or written on them from 1999 and 2003, respectively (Plate 9 and 10). There are also at least 11 modern tent rings along the beach landing area and along the access road from the beach to the station (Plate 11). Recent plastic and aluminum debris around the beach landing area further attests to the continued use of the island. The community of Qikiqtarjuaq initiated a clean up of the Padloping Island site in 1993, crushing approximately 3,000 fuel barrels (INAC 2008) which can be seen in the background of Plate 6.

Plate 9 Photo of modern Inuksuk dated August 7, 1999.

Plate 10 Photo of modern Inuksuk dated 2003.

Plate 11 Modern tent ring with wooden floor, a second tent ring can be seen in the background.

5.3 Newly Recorded Heritage Resource Sites

5.3.1 MgBu 5

MgBu 5 is an abandoned weather station that was built and operated by the United States Air Force from 1943 until the end of the Second World War when it was taken over by the Canadian Department of Transport who operated the station until 1956. The abandoned weather station is located on a coastal plain approximately 400 m from the bay bordered by a steep cliff, two shallow lakes to the west and undulating hills to the east (Figure 1).

The abandoned weather station consists of two localities, the original site and the main site (Figure 2). The original site includes two warehouses (Plate 12) and a powerhouse (Plate 13) as well as metal debris, wooden power poles, electrical wire, fuel barrels and dimensional lumber. All that remains of one of the warehouses is structural steel and metal sheeting with several US Army canon heaters (Plate 12). The remains of the powerhouse consist of two generators that are on their side with some of the wooden floor remaining. There is also a stove between the warehouse and generators with a manufacture date of June 19, 1942.

The main site consists of a maintenance shed, supply depot, boiler/incinerator, library, maintenance garage, washrooms, accommodations, kitchen/mess hall, weather station and several barrel and metal dumps. Structural remains consists of the metal frame of the maintenance garage (Plate 4), cement and brick foundation of the boiler/incinerator (Plate 14), cement foundation of the library building and two generators from the Generator Building (Plate 15). There is also a lot of miscellaneous metal and wood debris, wooden power poles and an army truck. The main metal dump is south of the main site. Fuel barrels, construction material, food cans and abandoned vehicles were all observed there (Plate 7 and Plate 16). The area has several roads going from the main site to both the

beach landing area and to the freshwater lake to the west of the site area (Plate 3). At the beach landing area there are two sunken barges, only one of which is visible above the water; crushed oil barrels and miscellaneous metal debris litter the area (Plate 6).

North of the main site on a gravel ridge is an open grave that once contained an American serviceman (Plate 17). The grave consists of a broken wooden cross and portions of a picket fence. The body has since been repatriated. No further information is available on the grave.

All of the remains of the USAF Padloping Weather Station will be removed during the planned remediation of the site by PWGSC. The site was recorded as a heritage site as it is more than 50 years old the as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003). No further work is recommended as the recording of the site is thought to be sufficient mitigation.

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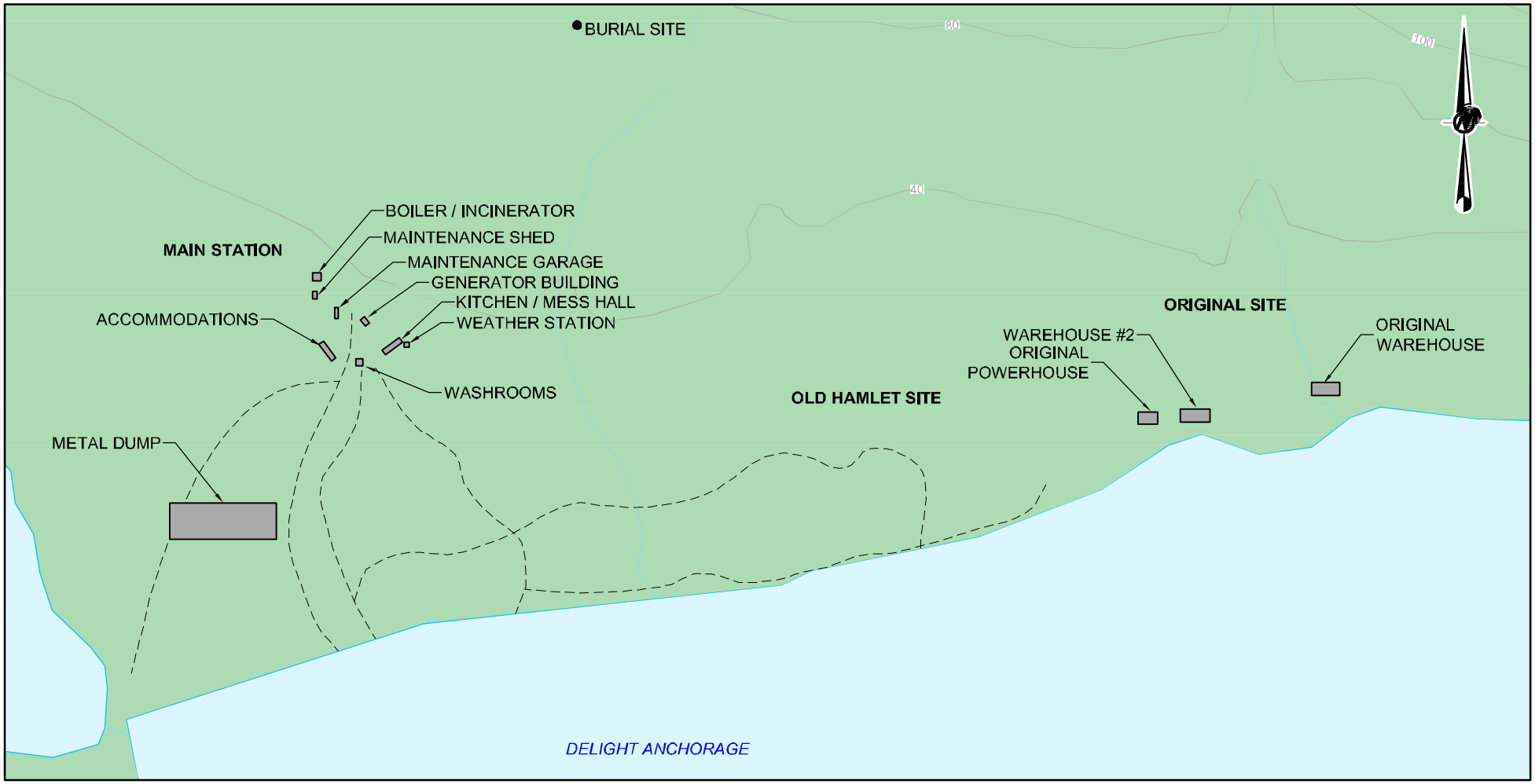


200 0 200
SCALE METRES

LEGEND

- CONTOUR (METRES)
- TRAIL
- WATERCOURSE
- WATERBODY

REFERENCE

ALBERTA NTDB DIGITAL DATA OBTAINED FROM GEOMATICS CANADA, AUGUST 2001. MAPSHEET 16M AND 16N DATUM: NAD83 PROJECTION: UTM ZONE 20

PROJECT

PADLOPING ISLAND USAF WEATHER STATION

TITLE

SITE LOCATION
MgBu 5

Golder Associates
Calgary, Alberta

PROJECT	10.1333.0025.8470		FILE No.	10133300258470A002	
DESIGN	BM	14/10/10	SCALE	AS SHOWN	REV. 0
CADD	KJM	19/10/10			
CHECK	BM	19/10/10			
REVIEW	DB	19/10/10			

FIGURE: 2

Plate 12 View east of warehouse #2 showing structural remains and US Army canon heaters.

Plate 13 Photo of generators at the original site, MgBu 5.

Plate 14 View northwest of the remains of the boiler/incinerator.

Plate 15 Photo of generators at the main site, MgBu 5.

Plate 16 View south of metal dump.

Plate 17 View north of grave.

5.3.2 MgBu 6

Site MgBu 6 is the Padloping Island Inuit Settlement that extends along the beach south and east of the USAF Weather Station. Historic reports indicate that the settlement was mentioned as early at 1884 with seven remaining families being resettled to Broughton Island (now Qikiqtarjuaq) in 1968 so that their children could attend school. The Padloping Island Settlement, along with the settlement at Kivitoo, were the larger centers of Inuit occupation in the region prior to the establishment of the DEW Line site at Broughton Island (Qikiqtani Truth Commission (QTC) 2010). There is also a graveyard that is associated with the settlement to the west of a salt water lake that was recorded as MgBu 7 and reported on below.

Approximately 22 Inuit houses are located at MgBu 6, as they are scattered along the upper beach terrace for 1,100 m. The house remains are quite diverse consisting of stone outlines (Plate 18), wooded floors (Plate 19) as well as areas that appear to have had structures at one time (Plate 20) (Table 1). The site extends southeast of the main station of the USAF Padloping Weather Station on both sides of the Original Site of the weather station.

Table 1 Feature metrics, MgBu 6

Feature	Size (m)	Orientation	Shape	Feature	Size (m)	Orientation	Shape
1	4.5 X 9.5	NW/SE	Rectangular	12	4 X 5	N/S	Rectangular
2	7 X 5.4	NE/SW	Rectangular	13	5 X 5		Square
3	5 X 5		Circular	14	5 X 7	N/S	Rectangular
4	5.5 X 5	NW/SE	Rectangular	15	4		Circular
5	3.5 X 2.5	E/W	Rectangular	16	5 X 3	N/S	Rectangular
6	5 X 7	N/S	Rectangular	17	5		Circular
7	7 X 7	NE/SW	Rectangular	18	5 X 3	N/S	Rectangular
8	8 X 8	N/S	Rectangular	19	5 X 7	N/S	Rectangular
9	6 X 6		Square	20	4 X 4		Circular
10	7 X 6	NW/SE	Rectangular	21	5 X 7	N/S	Rectangular
11	5 X 5		Circular	22	5 X 7	E/W	Rectangular

The debris around the houses consists of both domestic material such as books, clothing, eating utensils, bed frames, pots, lanterns, two rifles, women's figure skates, a snowmobile and a sewing machine and material from the weather station. The debris from the weather station includes bricks (stamped "SEABOARD PENN MADE IN U.S.A."), miscellaneous pieces of metal, stove parts, electronic parts, electrical wire, as well as fuel barrels. Around the house remains there are also several areas where debris has been burned. The amount of debris around the house features are not evenly distributed with the western feature, close to the weather station main site, having much more debris than the features that were recorded on the east side of the site. East of the recorded site there are also several recent stone tent rings and it was thought that the site continues to the east but was not surveyed during the current program as it was not within the study area.

During the recording of MgBu 6, there was no cultural material observed that indicated any occupation prior to the construction of the weather station. This may be because earlier sites are to the east of MgBu 6 or because the site has been occupied since at least 1884 and earlier features and material culture are now mixed in or covered by the more modern debris.

Site MgBu 6 is considered to be significant in terms of its place in the 20th Century Inuit history. It is recommended that none of the house foundations, stone tent rings and wooden flooring be removed during the remediation of the site and that any material that is removed, fuel barrels, metal debris, wood debris be hand picked and that none of the recorded features associated with the site be disturbed by borrow sources, landfills or by heavy vehicle traffic. It is also recommended that during public consultation for the remediation of the USAF Padloping Weather Station any information on the site be recorded.

Plate 18 View south of Feature 19, MgBu 6.

Plate 19 View southeast of Feature 2, MgBu 6, with wooden floor and the remains of walls.

Plate 20 View northeast of Feature 5, MgBu 6, showing the former location of a house.

5.3.3 MgBu 7

Site MgBu 7 is an Inuit graveyard that is associated with the Padloping Island Settlement located to the west of the settlement on a ridge at the base of a cliff on the other side of a salt water lake. The lake is easily accessible in low tide when the mouth of the lake can be traversed as water is draining out of the lake into the ocean. The graveyard consists of twenty grave sites placed side by side oriented east to west (Plate 21 and 22). Of the twenty graves all but five have wooded crosses with names, in syllabics, and dates. The graves date from 1948 to 1967 and with the exception of a single grave with a collapsed top are in good shape. According to the dates and judging by the size of the graves most are those of children.

Site MgBu 7 is considered to be significant in terms of its place in the 20th Century Inuit history. It is recommended that this site be avoided during the planned remediation

activities and that any information on the cemetery that is brought up during public consultation for the remediation of the USAF Padloping Weather Station be recorded.

Plate 21 View east of graveyard with Padloping Settlement and weather station in the background.

Plate 22 View west of the graveyard, MgBu 7.

6. SUMMARY AND RECOMMENDATIONS

The AIA of the USAF Padloping Weather Station conducted under Nunavut Permit 2010-016A produced the results discussed in Section 5 and outlined in Table 2. As requested, areas which will not be impacted during remediation were not fully examined. During the study three sites, the weather station, Padloping Island Inuit Settlement and Inuit Graveyard, were recorded as per the *Guidelines for Applicants and Holders of Nunavut Territory Archaeology and Palaeontology Permits* (Government of Nunavut 2003).

Table 2 Heritage Site Recommendations

Site	Type	Significance	Recommendations
MgBu 5	Weather Station	Limited	No further work is recommended
MgBu 6	Inuit Settlement	High	Avoidance is recommended
MgBu 7	Graveyard	High	Avoidance is recommended

PWGSC has fulfilled the requirements to indentify the potential for impact to heritage resources during the proposed remediation/reclamation of the USAF Padloping Island Weather Station on Padloping Island. The AIA of the Padloping Island weather station included the participation of Losie Audiakiak and Johnny Kooneeliusie from the local community of Qikiqtarjuaq, who acted as bear monitors and participated in the identification and recording of the heritage resource sites.

During the investigation the former weather station, the Inuit Settlement and cemetery were recorded as heritage resource sites and were assigned Borden site numbers Mgbu 5, MgBu 6, and MgBu 7. All of the remains of the USAF Padloping Weather Station will be removed during the planned remediation of the site by PWGSC. The site was recorded as a heritage site as it is more than 50 years old as per the *Nunavut Archaeological and Palaeontological Sites Regulations*. No further work is recommended as the recording of the site is thought to provide sufficient mitigation.

Site MgBu 6 is considered to be significant in terms of its place in 20th Century Inuit history. It is recommended that none of the house foundations, stone tent rings and wooden flooring be removed during the remediation of the site and that any material that is removed (fuel barrels, metal debris, wood debris) be hand picked and that none of the recorded features associated with the site be disturbed by borrow sources, landfills or by heavy vehicle traffic. It is also recommended that any information on the site be recorded during public consultation and used to assess the potential for impact during the development of the Remedial Action Plan of the USAF Padloping Weather Station.

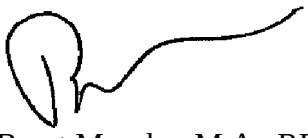
Site MgBu 7 is considered to be significant in terms of its place in the 20th Century Inuit history. It is recommended that this site be avoided during the planned remediation activities and that any information on the cemetery be recorded during public consultation and used to assess the potential for impact during the development of the Remedial Action Plan of the USAF Padloping Weather Station

7. CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

GOLDER ASSOCIATES LTD.

Report prepared by:



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APPENDIX I

PHOTOGRAPH LOG

Padloping Island AIA Photo Log

Number	Borden Number (if applicable)	Comment
10-016Aphoto1		View north of metal dump from the air
10-016Aphoto2		View north of metal dump from the air
10-016Aphoto3		View northwest of the metal dump from the air
10-016Aphoto4		View west of quad trail with metal dump in the background
10-016Aphoto5		View southwest of metal dump from the air
10-016Aphoto6		View southwest of metal dump from the air
10-016Aphoto7		Rifle
10-016Aphoto8		View south across Hudson Strait from the site
10-016Aphoto9		View south across Hudson Strait from the site
10-016Aphoto10		View southeast across Hudson Strait from the site
10-016Aphoto11		View east across hamlet
10-016Aphoto12	MgBu-5	View northwest of tent ring, Feature 1, MgBu-5
10-016Aphoto13	MgBu-5	View west of tent ring, Feature 1, MgBu-5
10-016Aphoto14	MgBu-5	View south of tent ring , Feature 1, MgBu-5
10-016Aphoto15	MgBu-5	View west of tent ring, Feature 1, MgBu-5
10-016Aphoto16	MgBu-5	View southwest of Feature 1, MgBu-5
10-016Aphoto17	MgBu-5	Detail of wood along the outer ring of site, Feature 1, MgBu-5
10-016Aphoto18	MgBu-5	Photo of metal debris close to Feature 1 at MgBu-5
10-016Aphoto19	MgBu-5	Photo of sewing machine close to Feature 1, MgBu-5
10-016Aphoto20	MgBu-5	View west of garbage that has been burned
10-016Aphoto21	MgBu-5	View west of garbage that has been burned
10-016Aphoto22	MgBu-5	View north from the beach area of burned material
10-016Aphoto23	MgBu-5	View north of another area with burned garbage
10-016Aphoto24	MgBu-5	View west of second area with burned garbage
10-016Aphoto25	MgBu-5	View north of Feature 2, MgBu-5
10-016Aphoto26	MgBu-5	View west of Feature 2, MgBu-5
10-016Aphoto27	MgBu-5	Detail of cultural material at Feature 2, MgBu-5
10-016Aphoto28	MgBu-5	View south of Feature 2, MgBu-5
10-016Aphoto29	MgBu-5	Detail of coal at Feature 2, MgBu-5
10-016Aphoto30	MgBu-5	View southeast of Feature 2, MgBu-5
10-016Aphoto31	MgBu-5	View southeast of Feature 2, MgBu-5
10-016Aphoto32	MgBu-5	View south from Feature 2, MgBu-5
10-016Aphoto33	MgBu-5	Detail of metal stove/furnace at Feature 2, MgBu-5
10-016Aphoto34	MgBu-5	Detail of brick
10-016Aphoto35	MgBu-5	Detail of clothing at Feature 2, MgBu-5
10-016Aphoto36	MgBu-5	Detail of wood debris, including 'ribs' from a Quonset type hut, Feature 2, MgBu-5
10-016Aphoto37	MgBu-5	marker
10-016Aphoto38	MgBu-5	View northwest of Feature 3, MgBu-5

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto39	MgBu-5	View northwest of Feature 3, MgBu-5
10-016Aphoto40	MgBu-5	Detail of Feature 3, MgBu-5
10-016Aphoto41	MgBu-5	Detail of Feature 3, MgBu-5
10-016Aphoto42	MgBu-5	Detail of Feature 3, MgBu-5
10-016Aphoto43	MgBu-5	View southeast of Feature 3, MgBu-5
10-016Aphoto44	MgBu-5	Book at Feature 3, MgBu-5
10-016Aphoto45	MgBu-5	Book at Feature 3, MgBu-5
10-016Aphoto46	MgBu-5	Book at Feature 3, MgBu-5
10-016Aphoto47	MgBu-5	Snow machine west of Feature 3, MgBu-5
10-016Aphoto48	MgBu-5	Ceramic insulator
10-016Aphoto49	MgBu-5	View northwest of Feature 4, MgBu-5
10-016Aphoto50	MgBu-5	View northwest of Feature 4, MgBu-5
10-016Aphoto51	MgBu-5	View west of Feature 4, MgBu-5
10-016Aphoto52	MgBu-5	View southwest of Feature 4, MgBu-5
10-016Aphoto53	MgBu-5	View southeast of Feature 4, MgBu-5
10-016Aphoto54	MgBu-5	Detail of domestic artifacts, Feature 4, MgBu-5
10-016Aphoto55	MgBu-5	Women's figure skate, Feature 4, MgBu-5
10-016Aphoto56	MgBu-5	Electric light fixture, MgBu-5
10-016Aphoto57	MgBu-5	Toy snow machine, MgBu-5
10-016Aphoto58	MgBu-5	Toy snow machine, MgBu-5
10-016Aphoto59	MgBu-5	Toy snow machine, MgBu-5
10-016Aphoto60	MgBu-5	Tape player, MgBu-5
10-016Aphoto61	MgBu-5	View northeast of Feature 5, MgBu-5
10-016Aphoto62	MgBu-5	View southeast of Feature 5, MgBu-5
10-016Aphoto63	MgBu-5	View south of Feature 5, MgBu-5
10-016Aphoto64	MgBu-5	View east across the site from Feature 5, MgBu-5
10-016Aphoto65	MgBu-5	View south of Feature 5, MgBu-5
10-016Aphoto66	MgBu-5	View south of Feature 6, MgBu-5
10-016Aphoto67	MgBu-5	View west of Feature 6, MgBu-5
10-016Aphoto68	MgBu-5	View north of Feature 6, MgBu-5
10-016Aphoto69	MgBu-5	View southeast across MgBu-5 from Feature 6
10-016Aphoto70	MgBu-5	View northwest of Feature 7, MgBu-5
10-016Aphoto71	MgBu-5	View northwest of Feature 7, MgBu-5
10-016Aphoto72	MgBu-5	View southwest of Feature 7, MgBu-5
10-016Aphoto73	MgBu-5	Misc debris around Feature 7, MgBu-5
10-016Aphoto74	MgBu-5	Detail of wood stuck in the ground, Feature 7, MgBu-5
10-016Aphoto75	MgBu-5	Misc debris around Feature 7, MgBu-5
10-016Aphoto76	MgBu-5	View south of MgBu-5 from Feature 7
10-016Aphoto77	MgBu-5	View northeast of Feature 8, MgBu-5

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto78	MgBu-5	View west of Feature 8, MgBu-5
10-016Aphoto79	MgBu-5	View south of Feature 8, MgBu-5
10-016Aphoto80	MgBu-5	View east of Feature 8, MgBu-5
10-016Aphoto81	MgBu-5	View north of Feature 9, MgBu-5
10-016Aphoto82	MgBu-5	View west of Feature 9, MgBu-5
10-016Aphoto83	MgBu-5	View south of Feature 9, MgBu-5
10-016Aphoto84	MgBu-5	Detail of electronics at Feature 9, MgBu-5
10-016Aphoto85	MgBu-5	Detail of cultural material at Feature 9, MgBu-5
10-016Aphoto86	MgBu-5	View southwest of Feature 10, MgBu-5
10-016Aphoto87	MgBu-5	View southeast of Feature 10, MgBu-5
10-016Aphoto88	MgBu-5	View north of Feature 10, MgBu-5
10-016Aphoto89	MgBu-5	Detail of burned area, Feature 10, MgBu-5
10-016Aphoto90	MgBu-5	View west of Feature 10,MgBu-5
10-016Aphoto91	MgBu-5	Warehouse at main station, view east
10-016Aphoto92	MgBu-5	View northeast across main station
10-016Aphoto93	MgBu-5	View south of metal dump
10-016Aphoto94	MgBu-5	View southeast across site from the air
10-016Aphoto95	MgBu-5	View southwest of main station form the air
10-016Aphoto96	MgBu-5	View southwest of main station form the air
10-016Aphoto97	MgBu-5	View northwest of site from the air
10-016Aphoto98	MgBu-5	View south of original warehouse
10-016Aphoto99	MgBu-5	View south of original warehouse
10-016Aphoto100	MgBu-5	View southwest of original warehouse
10-016Aphoto101	MgBu-5	View southwest across original site with warehouse in the background
10-016Aphoto102	MgBu-6	View north of Feature 20, MgBu-6
10-016Aphoto103	MgBu-6	View southwest of Feature 20, MgBu-6
10-016Aphoto104	MgBu-6	Detail of electronic equipment near Feature 20, MgBu-6
10-016Aphoto105	MgBu-6	View northeast of Feature 21, MgBu-6
10-016Aphoto106	MgBu-6	View north of Feature 21, MgBu-6
10-016Aphoto107	MgBu-6	Detail of floor and debris, Feature 21, MgBu-6
10-016Aphoto108	MgBu-6	View south off Feature 21, MgBu-6
10-016Aphoto109	MgBu-6	View northwest of Feature 22, MgBu-6
10-016Aphoto110	MgBu-6	View northwest of Feature 22, MgBu-6
10-016Aphoto111	MgBu-6	View south of Feature 22, MgBu-6
10-016Aphoto112	MgBu-6	View southwest of modern rings east of MgBu-6
10-016Aphoto113	MgBu-6	View south of modern rings east of MgBu-6
10-016Aphoto114	MgBu-6	View southwest of modern rings east of MgBu-6
10-016Aphoto115	MgBu-6	View south of modern rings east of MgBu-6

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto116		View west along beach on the east end of the study area
10-016Aphoto117		View west along beach on the east end of the study area
10-016Aphoto118	MgBu-6	View south of Feature 19,MgBu-6
10-016Aphoto119	MgBu-6	View north of Feature 19, MgBu-6
10-016Aphoto120	MgBu-6	View north of Feature 14, MgBu-6
10-016Aphoto121	MgBu-6	View southeast of Feature 14, MgBu-6
10-016Aphoto122	MgBu-6	View southwest of Feature 14, MgBu-6
10-016Aphoto123	MgBu-6	View east of Feature 14, MgBu-6
10-016Aphoto124	MgBu-6	View south of Feature 15, MgBu-6 with original warehouse in the background
10-016Aphoto125	MgBu-6	View east of Feature 15, MgBu-6
10-016Aphoto126	MgBu-5	View southeast of original warehouse with heaters
10-016Aphoto127	MgBu-5	detail of a heater
10-016Aphoto128	MgBu-5	Stove at original weather station site
10-016Aphoto129	MgBu-5	Detail of stove at original station site
10-016Aphoto130	MgBu-5	Diesel genset at the original site
10-016Aphoto131	MgBu-5	View east across original site
10-016Aphoto132	MgBu-6	View north of Feature 18, MgBu-6
10-016Aphoto133	MgBu-6	View east of Feature 18, MgBu-6
10-016Aphoto134	MgBu-6	View south of Feature 18, MgBu-6
10-016Aphoto135	MgBu-6	Detail of telephone pole beside Feature 18, MgBu-6
10-016Aphoto136	MgBu-6	View north of Feature 17, MgBu-6
10-016Aphoto137	MgBu-6	View northeast of Feature 17, MgBu-6
10-016Aphoto138	MgBu-6	View north of Feature 16, MgBu-6
10-016Aphoto139	MgBu-6	View northeast of Feature 16, MgBu-6
10-016Aphoto140	MgBu-6	View north of Feature 11,MgBu-6
10-016Aphoto141	MgBu-6	View west of Feature 11, MgBu-6
10-016Aphoto142	MgBu-6	Gun beside Feature 11, MgBu-6
10-016Aphoto143	MgBu-6	Polar bear skull near Feature 11, MgBu-6
10-016Aphoto144	MgBu-6	View north of Feature 12, MgBu-6
10-016Aphoto145	MgBu-6	View east of Feature 12, MgBu-6
10-016Aphoto146		View north of modern tent rings
10-016Aphoto147		View west of modern tent ring with wooden floor
10-016Aphoto148		View southwest of modern tent ring with wooden floor
10-016Aphoto149	MgBu-5	View west of barrels and sunken barge at beach
10-016Aphoto150		Modern Inuksuk
10-016Aphoto151		Detail of modern Inuksuk
10-016Aphoto152		Detail of modern Inuksuk
10-016Aphoto153		Detail of modern Inuksuk

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto154	MgBu-5	Photo of crushed army jeep and cat
10-016Aphoto155	MgBu-5	Photo of amphibious vehicle
10-016Aphoto156	MgBu-5	Detail of amphibious vehicle
10-016Aphoto157	MgBu-5	Photo of truck and amphibious vehicle
10-016Aphoto158	MgBu-5	Photo of amphibious vehicle
10-016Aphoto159	MgBu-7	View east of Inuit grave yard
10-016Aphoto160	MgBu-7	Detail of grave marker
10-016Aphoto161	MgBu-7	Detail of grave marker
10-016Aphoto162	MgBu-7	Detail of grave marker
10-016Aphoto163	MgBu-7	Detail of grave marker
10-016Aphoto164	MgBu-7	Detail of grave marker
10-016Aphoto165	MgBu-7	Detail of grave marker
10-016Aphoto166	MgBu-7	Detail of grave marker
10-016Aphoto167	MgBu-7	Detail of grave marker
10-016Aphoto168	MgBu-7	Detail of grave marker
10-016Aphoto169	MgBu-7	Detail of grave marker
10-016Aphoto170	MgBu-7	Detail of grave marker
10-016Aphoto171	MgBu-7	Detail of grave marker
10-016Aphoto172	MgBu-7	Detail of grave marker
10-016Aphoto173	MgBu-7	View east of Inuit grave yard
10-016Aphoto174	MgBu-7	View east of Inuit grave yard
10-016Aphoto175	MgBu-7	Detail of grave with collapsed lid
10-016Aphoto176	MgBu-7	View west of Inuit grave yard
10-016Aphoto177	MgBu-7	View east of site from the Inuit grave yard
10-016Aphoto178	MgBu-7	View west of Inuit grave yard
10-016Aphoto179	MgBu-7	View west of Inuit grave yard
10-016Aphoto180		Modern Inuksuk
10-016Aphoto181		Detail of walrus skull on Inuksuk
10-016Aphoto182		Modern Inuksuk
10-016Aphoto183		View south of site from outcrop to the north of site
10-016Aphoto184		View south of site from outcrop to the north of site
10-016Aphoto185		View south east of site from proposed borrow near freshwater lake
10-016Aphoto186		View southwest of proposed borrow between lakes
10-016Aphoto187		View southwest of proposed borrow between lakes
10-016Aphoto188		View south of outcrop that may be borrow near fresh water lake
10-016Aphoto189		View east across proposed borrow of freshwater lake and outcrop
10-016Aphoto190	MgBu-5	View east of American grave
10-016Aphoto191	MgBu-5	View northwest of American grave
10-016Aphoto192	MgBu-5	Detail of American grave

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto193		View northwest of proposed gravel borrow
10-016Aphoto194		View south of site from proposed borrow
10-016Aphoto195	MgBu-5	View south of site from road
10-016Aphoto196		View south west of site from road
10-016Aphoto197		View south west of site from road
10-016Aphoto198	MgBu-5	Photo of genset at main site
10-016Aphoto199	MgBu-5	Photo of a truck
10-016Aphoto200	MgBu-5	Photo of the warehouse
10-016Aphoto201	MgBu-5	Photo of building remains

Water Licence Application

Durban and Padloping Islands

Remediation Project

Appendix 5

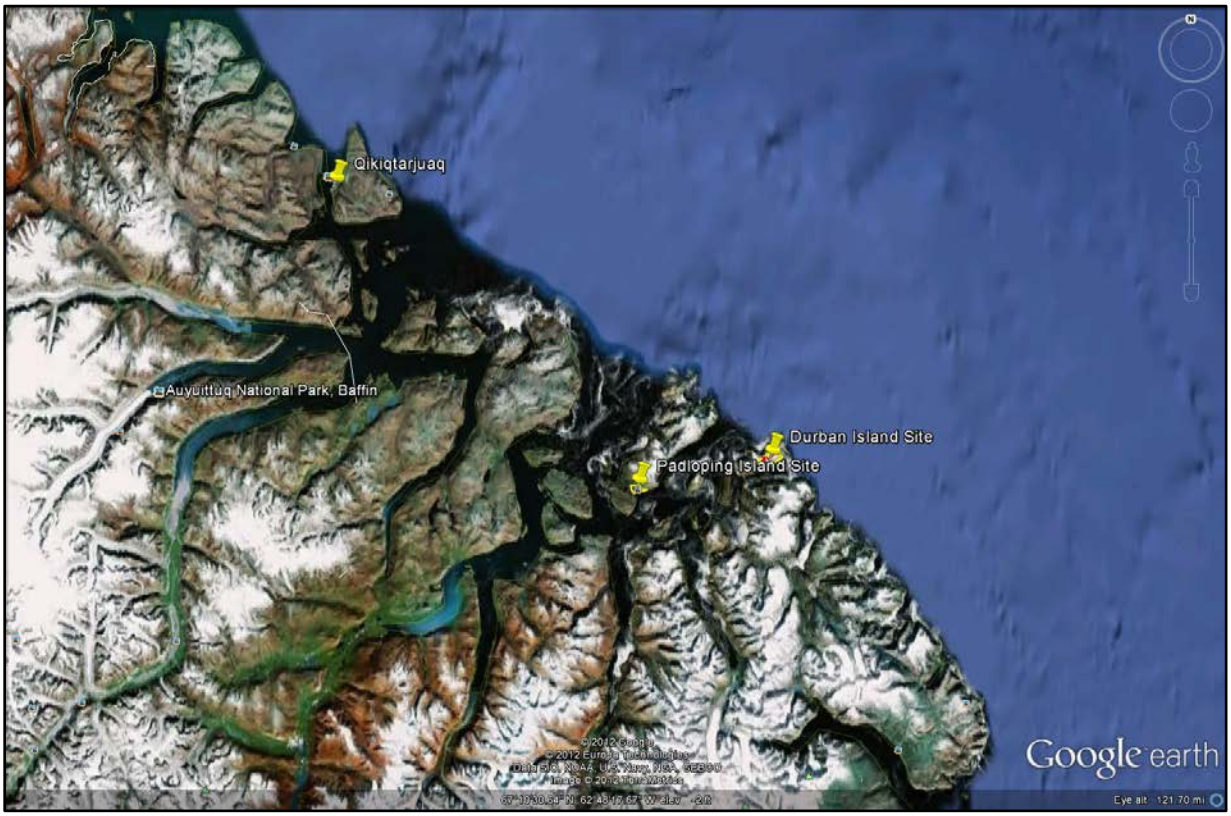
Site Drawings and Maps

1. General Location
2. Qikiqtarjuaq, Padloping and Durban Islands
3. Padloping and Durban Islands Site Areas
4. Durban Island – Beach and Old Construction Camp Areas
5. Padloping Island Beach Areas, Freshwater Lake
6. Durban Island: Streams and Blast Hole Locations

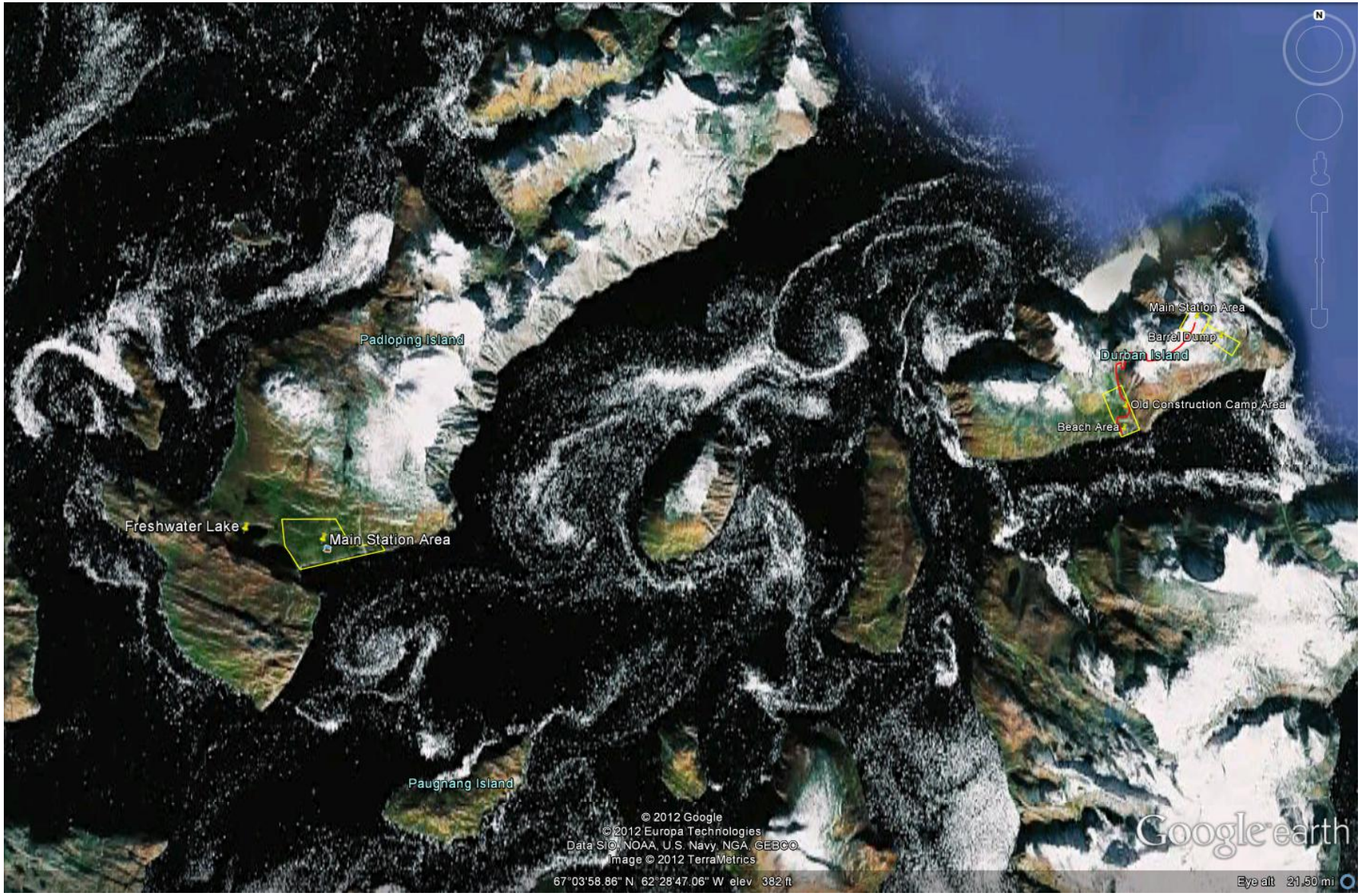
16M/1 Block Island
16 M/2 Delight Anchorage

Durban Island: Issued for Tender Drawings
Padloping Islands: Issued for Tender Drawings

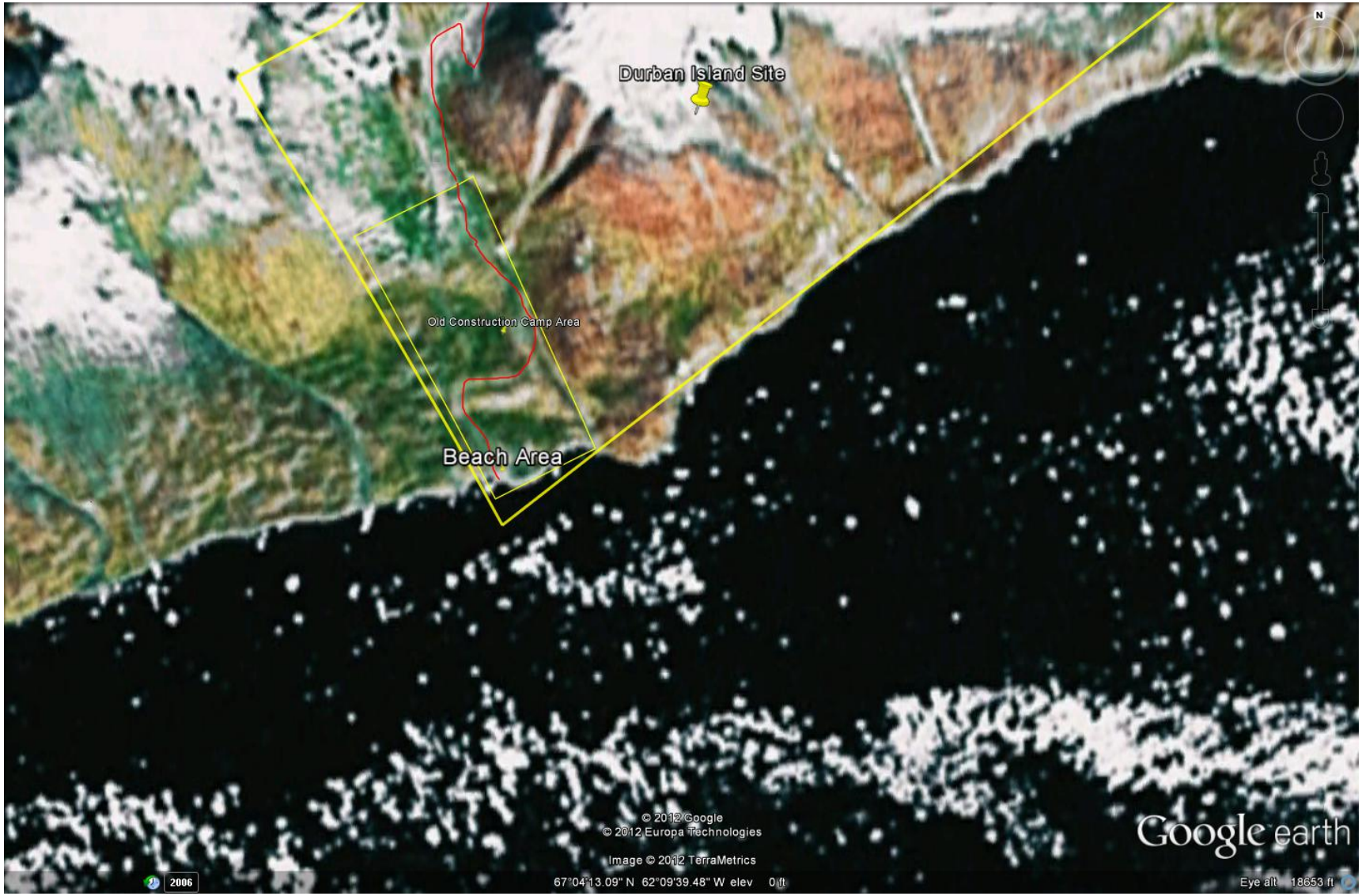
1. General Location



2. Qikiqtarjuaq, Padloping Island and Durban Island

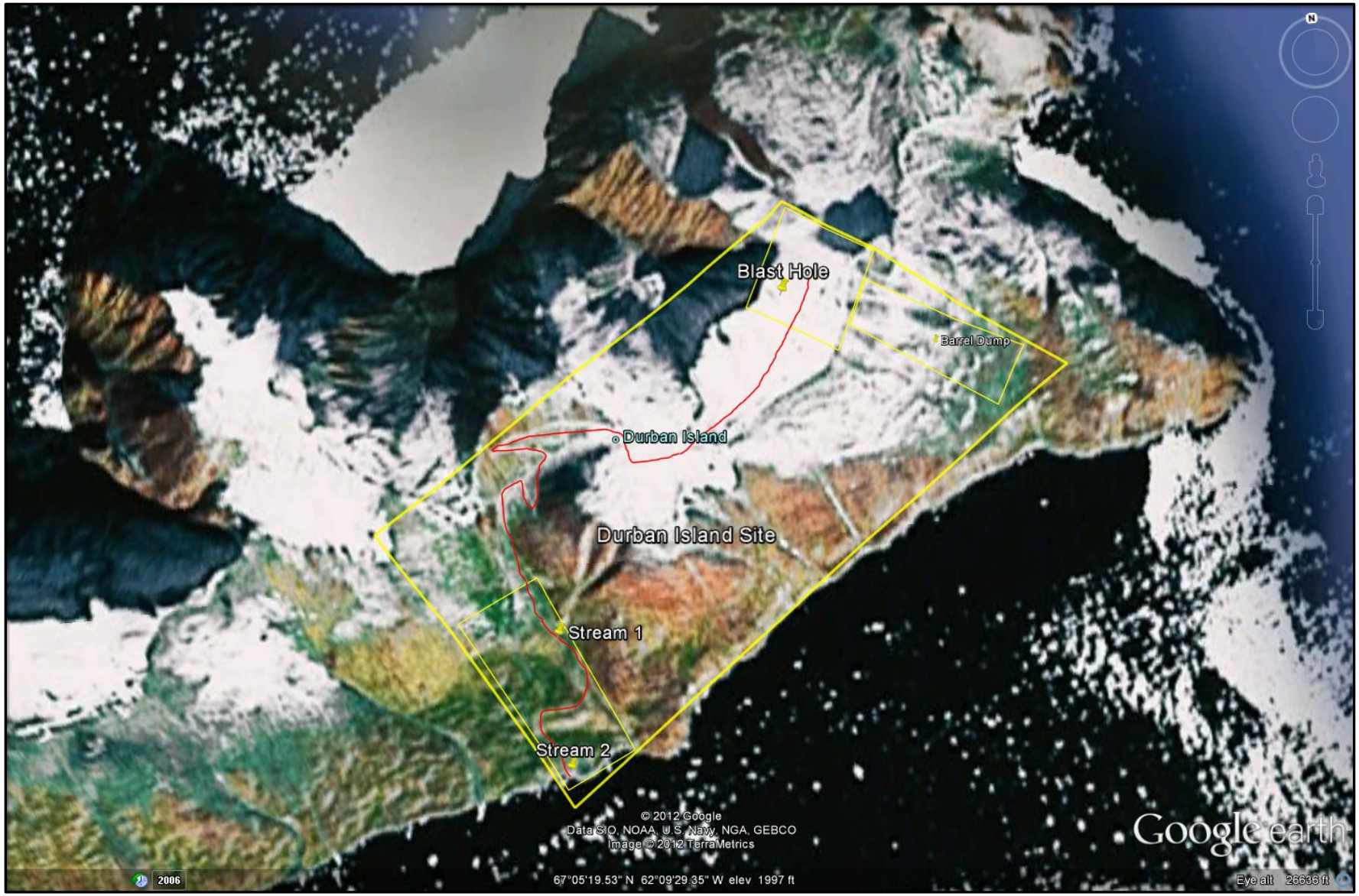


3. Padloping and Durban Islands Site Areas



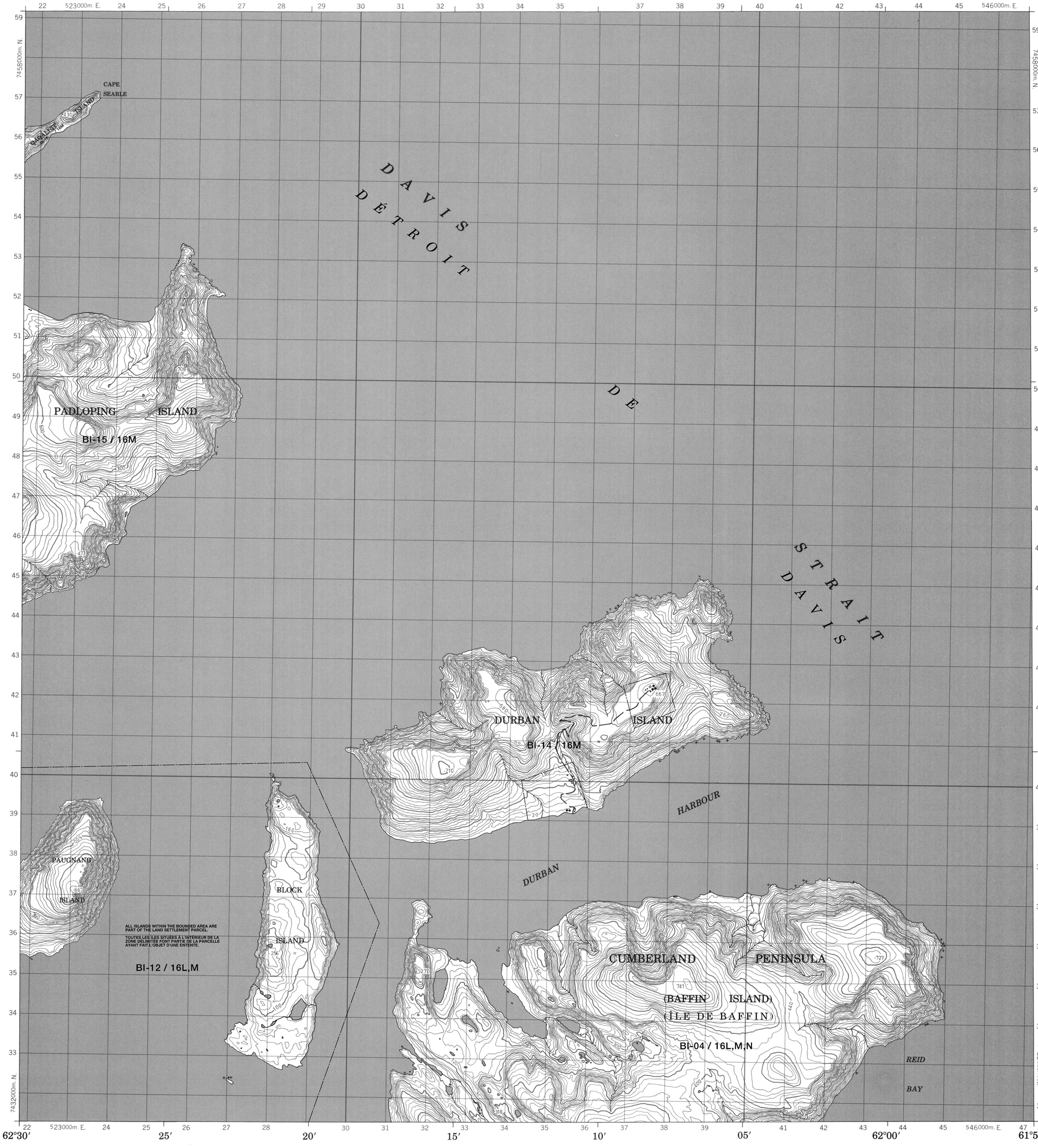
4. Durban Island – Beach and Old Construction Camp Areas

5. Padloping Island Beach Areas, Freshwater Lake



6. Durban Island: Streams and Blast Hole Locations

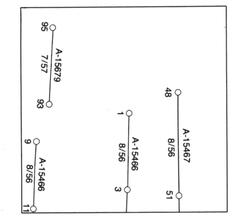
Military users, refer to this map as: / Référence de cette carte pour usage militaire: SERIES A 701 / MAP 16 M/1 & 16 N/4 / EDITION 2 MCE — SÉRIE / CARTE / ÉDITION



LEGEND - LÉGENDE

- ROAD, HARD SURFACE, ALL WEATHER ..... ROUTE, SURFACE DURCIE, TOUTES SAISONS
- ROAD, LOOSE SURFACE ..... ROUTE, SURFACE DE GRAVIER
- CART TRACK, WINTER ROAD ..... CHEMIN DE CHARROI, ROUTE D'HIVER
- TRAIL, CUT LINE, PORTAGE ..... SENTIER, PERCÉE OU PORTAGE
- BUILT-UP AREA ..... AGGLOMÉRATION
- RAILWAY: SIDING; STATION; STOP ..... CHEMIN DE FER: VOIE D'ÉVITEMENT; STATION; ARRÊT
- BRIDGE ..... PONT
- SEAPLANE BASE; SEAPLANE ANCHORAGE ..... BASE D'HYDRAVIONS; ANCRAGE D'HYDRAVIONS
- HOUSE; BARN ..... MAISON; GRANGE
- CHURCH; SCHOOL; POST OFFICE ..... ÉGLISE; ÉCOLE; BUREAU DE POSTE
- TOWER: FIRE, COMMUNICATION ..... TOUR: FEU, COMMUNICATION
- WELL: OIL, GAS; TANK: WATER ..... PUITS: PÉTROLE, GAZ; RÉSERVOIR: EAU
- POWER TRANSMISSION LINE ..... LIGNE DE TRANSPORT D'ÉNERGIE
- MINE; GRAVEL PIT ..... MINE; CARRIÈRE DE GRAVIER
- CUTTING; EMBANKMENT ..... DÉBLAI; REMBLAI
- INTERNATIONAL, PROVINCIAL BOUNDARY WITH MONUMENT ..... FRONTIÈRE INTERNATIONALE, LIMITE PROVINCIALE AVEC BORNE
- PROVINCIAL BOUNDARY, UNSURVEYED ..... FRONTIÈRE PROVINCIALE, NON ARPENTÉE
- COUNTY, DISTRICT BOUNDARY ..... LIMITE DE COMTÉ OU DE DISTRICT
- TOWNSHIP, PARISH BOUNDARY ..... LIMITE DE CANTON, DE PAROISSE
- MUNICIPALITY BOUNDARY ..... LIMITE DE MUNICIPALITÉ
- RESERVE, SANCTUARY, PARK, ETC. BOUNDARY ..... LIMITE DE RÉSERVE, SANCTUAIRES, PARCS, ETC.
- OUTLINED LANDMARK AREA,BOUNDARY APPROXIMATE, ETC. ..... LIMITE DE SURFACE REPÈRE, LIMITE APPROXIMATIVE, ETC.
- D.L.S. TOWNSHIP CORNER: SURVEYED; UNSURVEYED ..... COIN DE CANTON (A.T.C.): ARPENTÉ; NON ARPENTÉ
- D.L.S. SECTION CORNERS ..... COINS DE SECTION (A.T.C.)
- HORIZONTAL CONTROL POINT ..... POINT DE CONTRÔLE PLANIMÉTRIQUE
- BENCH MARK WITH ELEVATION (365 →) ..... REPÈRE DE NIVELLEMENT AVEC COTE
- SPOT ELEVATION, PRECISE (397) ..... POINT COTÉ, PRÉCIS
- STREAM OR SHORELINE; INDEFINITE ..... COURS D'EAU OU RIVE; IMPRÉCIS
- LAKE; INTERMITTENT LAKES ..... LAC; LACS INTERMITTENTS
- FLOODED LAND ..... TERRAIN INONDÉ
- MARSH; SWAMP (WOODED); STRING BOG ..... MARAIS; BOISÉ MARÉCAGEUX; FONDRIÈRE À FILAMENTS
- DRY RIVER BED WITH CHANNELS ..... LIT DE RIVIÈRE ASSÉCHÉ AVEC CHENAUX
- RAPIDS; FALLS; RAPIDS ..... RAPIDES; CHUTES; RAPIDES
- FORESHORE FLATS, SAND IN WATER; ROCKS ..... ESTRANS, SABLE SOUS L'EAU; ROCHES
- TUNDRA: LAKES IN TUNDRA; POLYGONS (LT, PG) ..... TOUNDRA: LACS EN TOUNDRA; POLYGONES DE TOUNDRA
- PALSA BOG (PA) ..... FONDRIÈRE DE PALSE
- DAM; WHARF ..... BARRAGE; QUAI
- ICEFIELD (GLACIER); MORAINE (GL, M) ..... CHAMP DE GLACE (GLACIER); MORAINE
- PINGO ..... PINGO
- DITCH ..... FOSSÉ
- CONTOURS (400) ..... COURBES DE NIVEAU
- APPROXIMATE CONTOURS ..... COURBES DE NIVEAU APPROXIMATIVES
- DEPRESSION CONTOUR ..... COURBE DE CUVETTE
- CLIFF ..... FALAISE
- SPOT ELEVATION, APPROXIMATE: LAND; WATER (965 ... 590±) ..... POINT COTÉ, APPROXIMATIF: SUR TERRE ;SUR L'EAU
- ESKER ..... ESKER
- SAND, SAND DUNES, RAISED BEACHES ..... SABLE, DUNES DE SABLE ; PLAGES SURÉLEVÉES
- HISTORIC SITE ..... LIEU HISTORIQUE
- WOODED AREA, FOREST; CLEARED AREA (F, C) ..... SURFACE BOISÉE, FORÊT; ESPACE DÉNUDÉ, CLAIRIÈRE

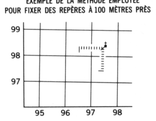
PHOTOGRAPHY PHOTOGRAPHIE
COMPILATION RESTITUTION



GRID ZONE DESIGNATION: DÉSIGNATION DE LA ZONE DU QUADRILLAGE: 20W

100 000 m SQUARE IDENTIFICATION / IDENTIFICATION DU CARRÉ DE 100 000 m: NK

EXAMPLE OF METHOD USED TO GIVE A REFERENCE TO NEAREST 100 METRES
EXEMPLE DE LA MÉTHODE EMPLOYÉE POUR FIXER DES REPÈRES À 100 MÈTRES PRÈS



REFERENCE POINT / POINT DE REPÈRE	CHURCH - ÉGLISE	(as above) (ci-dessus)
EASTING: Read number on grid line immediately to left of point: ABSCISSE: Noter le chiffre de la ligne du quadrillage immédiatement à gauche du repère:	97	
Estimate tenths of a square from this line eastward to point: Estimer le nombre de dixièmes du carré entre cette ligne et le repère en direction est:	5	975
NORTHING: Read number on grid line immediately below point: ORDONNÉE: Noter le chiffre de la ligne du quadrillage immédiatement en dessous du repère:	98	
Estimate tenths of a square from this line northward to point: Estimer le nombre de dixièmes du carré entre cette ligne et le repère en direction nord:	4	984
GRID REFERENCE: / RÉFÉRENCE AU QUADRILLAGE:		975984

Nearest similar grid reference 100 000 metres
La prochaine référence similaire est à 100 000 mètres

Coordinate Conversion NAD27 to NAD83 (WGS 84)
Mean Value for this Map

Geographic:	Latitude-	add	1.2"
	Longitude-	subtract	6.0"
Grid:	Northing-	add	224 m
	Easting-	add	68 m

Conversion des coordonnées NAD 27 à NAD 83 (WGS 84)
Valeurs moyennes pour cette carte

Coordonnées géographiques	Latitude-	additionner	1,2"
	Longitude-	soustraire	6,0"
Quadrillage :	Ordonnée (N)-	additionner	224 m
	Abcisse (E)-	additionner	68 m

ONE THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 20
QUADRILLAGE DE MILLE MÈTRES
TRANSVERSE UNIVERSEL DE MERCATOR

16 M/7		
16 M/2	16 M/1 & 16 N/4	
16 L/15	16 L/16	16 K/13

The 2003 MAGNETIC BEARING is 41°19′ (734 mils) WEST of GRID NORTH.
ANNUAL CHANGE DECREASING 27.0′
GRID NORTH is 1°39′ (29 mils) EAST of TRUE NORTH for centre of map.

Le REPÈRE MAGNÉTIQUE en 2003 est à 41°19′ (734 mils) à l'OUEST du NORD DU QUADRILLAGE.
VARIATION ANNUELLE DÉCROISSANTE 27.0′
Le NORD DU QUADRILLAGE est à 1°39′ (29 mils) à l'EST du NORD GÉOGRAPHIQUE au centre de la carte.

Boundaries of Inuit Owned Lands are approximate and not to be used for legal purposes.
Les limites des terres Inuit sont approximatives et ne doivent pas être utilisées à des fins légales.

CONVERSION SCALE FOR ELEVATIONS
ÉCHELLE DE CONVERSION DES ALTITUDES

Metres 30 20 10 0 50 100 150 200 250 300 Mètres
Feet 100 50 0 100 200 300 400 500 600 700 800 900 1000 Pieds

PRODUCED BY THE CENTRE FOR TOPOGRAPHIC INFORMATION, NATURAL RESOURCES CANADA. FEATURES VISIBLE ON SATELLITE IMAGERY CURRENT AS OF 1999. PUBLISHED IN 2003.

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ELEVATIONS IN METRES ABOVE MEAN SEA LEVEL
CONTOUR INTERVAL ..... 20 METRES

NORTH AMERICAN DATUM 1927
TRANSVERSE MERCATOR PROJECTION

INFORMATION CONCERNING BENCH MARKS AND HORIZONTAL SURVEY MONUMENTS CAN BE OBTAINED FROM GEODETIC SURVEY, SURVEYS AND MAPPING BRANCH, OTTAWA.

NO FOREST AREA ON THIS MAP.

BLOCK ISLAND

NUNAVUT

Scale 1:50 000 Échelle

Miles 1 0 1 2 3 Milles
Metres 1000 0 1000 2000 3000 4000 Mètres

ALTITUDES EN MÈTRES
ÉQUIDISTANCE DES COURBES ..... 20 MÈTRES

SYSTÈME DE RÉFÉRENCE GÉODÉSIQUE NORD-AMÉRICAIN 1927
PROJECTION TRANSVERSE DE MERCATOR

POUR TOUT RENSEIGNEMENT CONCERNANT LES REPÈRES ET BORNES ALTIMÉTRIQUES, S'ADRESSER AUX LEVÉS GÉODÉSIQUES, DIRECTION DES LEVÉS ET DE LA CARTOGRAPHIE, OTTAWA.

AUCUNE ZONE FORESTIÈRE SUR CETTE CARTE.

ÉTABLIE PAR LE CENTRE D'INFORMATION TOPOGRAPHIQUE, RESSOURCES NATURELLES CANADA. ÉLÉMENTS VISIBLES SUR L'IMAGERIE SATELLITAIRE À JOUR EN 1999. PUBLIÉE EN 2003.

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PROVISIONAL PRINT
IMPRESSION PROVISOIRE

BLOCK ISLAND
16 M/1 & 16 N/4
EDITION 2 ÉDITION

Natural Resources Canada / Ressources naturelles Canada

METRIC/MÉTRIQUE

Military users, refer to this map as: / Référence de cette carte pour usage militaire:	SERIES A 701 SÉRIE MAP 16 M/2 CARTE EDITION 1 MCE ÉDITION

501000m. E. 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 19 20 521000m. E.

67°15′

7458000m. N.

CUMBERLAND PENINSULA (BAFFIN ISLAND)

QAQALUIT ISLAND

M E R C H A N T S B A Y

P A D L O P I N G I S L A N D

PAUGNANG ISLAND

DELIGHT ANCHORAGE

10′

05′

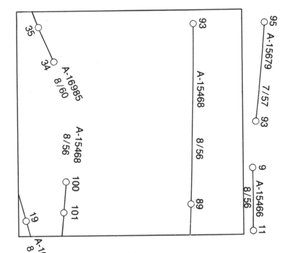
7432000m. N.

63°00′ 55′ 50′ 45′ 40′ 35′ 62°30′ 67°00′

LEGEND - LÉGENDE

- ROAD, HARD SURFACE, ALL WEATHER — ROUTE, SURFACE DURCIE, TOUTES SAISONS
- ROAD, LOOSE SURFACE — ROUTE, SURFACE DE GRAVIER
- CART TRACK, WINTER ROAD — CHEMIN DE CHARROI, ROUTE D'HIVER
- TRAIL, CUT LINE, PORTAGE — SENTIER, PERCÉE OU PORTAGE
- BUILT-UP AREA — AGGLOMÉRATION
- RAILWAY: SIDING; STATION; STOP — CHEMIN DE FER: VOIE D'ÉVITEMENT; STATION; ARRÊT
- BRIDGE — PONT
- SEAPLANE BASE; SEAPLANE ANCHORAGE — BASE D'HYDRAVIONS; ANCRAGE D'HYDRAVIONS
- HOUSE; BARN — MAISON; GRANGE
- CHURCH; SCHOOL; POST OFFICE — ÉGLISE; ÉCOLE; BUREAU DE POSTE
- TOWER: FIRE, COMMUNICATION — TOUR: FEU, COMMUNICATION
- WELL: OIL, GAS; TANK: WATER — PUITS: PÉTROLE, GAZ; RÉSERVOIR: EAU
- POWER TRANSMISSION LINE — LIGNE DE TRANSPORT D'ÉNERGIE
- MINE; GRAVEL PIT — MINE; CARRIÈRE DE GRAVIER
- CUTTING; EMBANKMENT — DÉBLAI; REMBLAI
- INTERNATIONAL, PROVINCIAL BOUNDARY WITH MONUMENT — FRONTIÈRE INTERNATIONALE, LIMITE PROVINCIALE AVEC BORNE
- PROVINCIAL BOUNDARY, UNSURVEYED — FRONTIÈRE PROVINCIALE, NON ARPENTÉE
- COUNTY, DISTRICT BOUNDARY — LIMITE DE COMTÉ OU DE DISTRICT
- TOWNSHIP, PARISH BOUNDARY — LIMITE DE CANTON, DE PAROISSE
- MUNICIPALITY BOUNDARY — LIMITE DE MUNICIPALITÉ
- RESERVE, SANCTUARY, PARK, ETC. BOUNDARY — LIMITE DE RÉSERVE, SANCTUAIRES, PARCS, ETC.
- OUTLINED LANDMARK AREA,BOUNDARY APPROXIMATE, ETC — LIMITE DE SURFACE REPÈRE, LIMITE APPROXIMATIVE, ETC.
- D.L.S. TOWNSHIP CORNER: SURVEYED; UNSURVEYED — COIN DE CANTON (A.T.C.): ARPENTÉ; NON ARPENTÉ
- D.L.S. SECTION CORNERS — COINS DE SECTION (A.T.C.)
- HORIZONTAL CONTROL POINT — POINT DE CONTRÔLE PLANIMÉTRIQUE
- BENCH MARK WITH ELEVATION — 365 → REPÈRE DE NIVELLEMENT AVEC COTE
- SPOT ELEVATION, PRECISE — 397 POINT COTÉ, PRÉCIS
- STREAM OR SHORELINE; INDEFINITE — COURS D'EAU OU RIVE; IMPRÉCIS
- LAKE; INTERMITTENT LAKES — LAC; LACS INTERMITTENTS
- FLOODED LAND — TERRAIN INONDÉ
- MARSH; SWAMP (WOODED); STRING BOG — MARAIS; BOISÉ MARÉCAGEUX; FONDRIÈRE À FILAMENTS
- DRY RIVER BED WITH CHANNELS — LIT DE RIVIÈRE ASSÉCHÉ AVEC CHENAUX
- RAPIDS; FALLS; RAPIDS — RAPIDES; CHUTES; RAPIDES
- FORESHORE FLATS, SAND IN WATER; ROCKS — ESTRANS, SABLE SOUS L'EAU; ROCHES
- TUNDRA: LAKES IN TUNDRA; POLYGONS — LT PG TOUNDRA: LACS EN TOUNDRA; POLYGONES DE TOUNDRA
- PALSA BOG — PA FONDRIÈRE DE PALSE
- DAM; WHARF — BARRAGE; QUAI
- ICEFIELD (GLACIER); MORAINE — GL M CHAMP DE GLACE (GLACIER); MORAINE
- PINGO — PINGO
- DITCH — FOSSÉ
- CONTOURS — 400 COURBES DE NIVEAU
- APPROXIMATE CONTOURS — COURBES DE NIVEAU APPROXIMATIVES
- DEPRESSION CONTOUR — COURBE DE CUVETTE
- CLIFF — FALAISE
- SPOT ELEVATION, APPROXIMATE: LAND; WATER — 965 590± POINT COTÉ, APPROXIMATIF: SUR TERRE ;SUR L'EAU
- ESKER — ESKER
- SAND, SAND DUNES, RAISED BEACHES — SABLE, DUNES DE SABLE ; PLAGES SURÉLEVÉES
- HISTORIC SITE — LIEU HISTORIQUE
- WOODED AREA, FOREST; CLEARED AREA — F C SURFACE BOISÉE, FORÊT; ESPACE DÉNUDÉ, CLAIRIÈRE

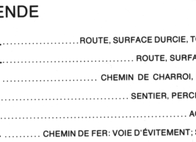
PHOTOGRAPHY PHOTOGRAPHIE
COMPILATION RESTITUTION



REVISION RÉVISION

GRID ZONE DESIGNATION: DÉSIGNATION DE LA ZONE DU QUADRILLAGE:	100 000 m SQUARE IDENTIFICATION IDENTIFICATION DU CARRÉ DE 100 000 m
20W	NK

EXAMPLE OF METHOD USED TO GIVE A REFERENCE TO NEAREST 100 METRES
EXEMPLE DE LA MÉTHODE EMPLOYÉE POUR FIXER DES REPÈRES À 100 MÈTRES PRÈS



REFERENCE POINT / POINT DE REPÈRE	CHURCH - ÉGLISE	(as above) (ci-dessus)
EASTING: Read number on grid line immediately to left of point. ABSCISSE: Noter le chiffre de la ligne du quadrillage immédiatement à gauche du repère:		97
Estimate tenths of a square from this line eastward to point. Estimer le nombre de dixièmes du carré entre cette ligne et le repère en direction est:		5
		975
NORTHING: Read number on grid line immediately below point. ORDONNÉE: Noter le chiffre de la ligne du quadrillage immédiatement en dessous du repère:		98
Estimate tenths of a square from this line northward to point. Estimer le nombre de dixièmes du carré entre cette ligne et le repère en direction nord:		4
GRID REFERENCE: RÉFÉRENCE AU QUADRILLAGE:		984 975984

Nearest similar grid reference 100 000 metres
La prochaine référence similaire est à 100 000 mètres

ONE THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 20
QUADRILLAGE DE MILLE MÈTRES
TRANSVERSE UNIVERSEL DE MERCATOR

16 M/6	16 M/7	
16 M/3	16 M/2	16 M/1 & 16 N/4
16 L/14	16 L/15	16 L/16

The 1984 MAGNETIC BEARING is 47°09′ (838 mils) WEST of GRID NORTH.

ANNUAL CHANGE DECREASING 23.9′

GRID NORTH is 0°14′ (4 mils) EAST of TRUE NORTH for centre of map.

Le REPÈRE MAGNÉTIQUE en 1984 est à 47°09′ (838 mils) à l'OUEST du NORD DU QUADRILLAGE.

VARIATION ANNUELLE DÉCROISSANTE 23,9′

Le NORD DU QUADRILLAGE est à 0°14′ (4 mils) à l'EST du NORD GÉOGRAPHIQUE au centre de la carte.

CONVERSION SCALE FOR ELEVATIONS
ÉCHELLE DE CONVERSION DES ALTITUDES

Metres 30 20 10 0 — 50 100 150 200 250 300 Mètres
Feet 100 50 0 — 100 200 300 400 500 600 700 800 900 1000 Pieds

PRODUCED BY THE SURVEYS AND MAPPING BRANCH, DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA. PUBLISHED IN 1984.
COMPILED BY THE MAPPING AND CHARTING ESTABLISHMENT, DEPARTMENT OF NATIONAL DEFENCE 1984.

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ELEVATIONS IN METRES ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL ..... 40 METRES

NORTH AMERICAN DATUM 1927

TRANSVERSE MERCATOR PROJECTION

INFORMATION CONCERNING BENCH MARKS AND HORIZONTAL SURVEY MONUMENTS CAN BE OBTAINED FROM GEODETIC SURVEY, SURVEYS AND MAPPING BRANCH, OTTAWA.

NO FOREST AREA ON THIS MAP

DELIGHT ANCHORAGE

DISTRICT OF FRANKLIN DISTRICT DE FRANKLIN
NORTHWEST TERRITORIES TERRITOIRES DU NORD-OUEST

Scale 1:50 000 Échelle

Miles 1 — 0 — 1 — 2 — 3 Milles
Metres 1000 — 0 — 1000 — 2000 — 3000 — 4000 Mètres

ALTITUDES EN MÈTRES

ÉQUIDISTANCE DES COURBES ..... 40 MÈTRES

SYSTÈME DE RÉFÉRENCE GÉODÉSIQUE NORD-AMÉRICAIN 1927

PROJECTION TRANSVERSE DE MERCATOR

POUR TOUT RENSEIGNEMENT CONCERNANT LES REPÈRES ET BORNES ALTIMÉTRIQUES, S'ADRESSER AUX LEVÉS GÉODÉSIQUES, DIRECTION DES LEVÉS ET DE LA CARTOGRAPHIE, OTTAWA.

AUCUNE ZONE FORESTIÈRE SUR CETTE CARTE.

ÉTABLIE PAR LA DIRECTION DES LEVÉS ET DE LA CARTOGRAPHIE MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES, OTTAWA. PUBLIÉE EN 1984.

RECUEILLIE PAR LE SERVICE DE LA CARTOGRAPHIE, MINISTÈRE DE LA DÉFENSE NATIONAL, 1984.

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PROVISIONAL PRINT
IMPRESSION PROVISOIRE

DELIGHT ANCHORAGE
16 M/2
EDITION 1 ÉDITION

Energy, Mines and Resources Canada — Énergie, Mines et Ressources Canada

METRIC/MÉTRIQUE

METRIC/MÉTRIQUE

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Travaux publics et Services gouvernementaux Canada

Indian and Northern Affairs Canada

Affaires indiennes et du Nord Canada

REAL PROPERTY SERVICES
Western Region

Canada

REMEDIATION PROJECT

DRAWING INDEX			
SHEET NO.	TITLE	SHEET NO.	TITLE
CIVIL		STRUCTURAL	
R.048967.001 C00	COVER SHEET	R.048967.001 S01	STATION AREA DEMOLITION SITE PLAN
R.048967.001 C01	LOCATION PLAN	R.048967.001 S02	BEACH LANDING AREA DEMOLITION SITE PLAN
R.048967.001 C02	PROJECT AREA PLAN	R.048967.001 S03	GARAGE FLOOR PLAN, ELEVATION AND SECTION
R.048967.001 C03	OVERALL SITE PLAN	R.048967.001 S04	WAREHOUSE FLOOR PLAN, ELEVATION AND SECTION
R.048967.001 C04	STATION AREA SITE PLAN	R.048967.001 S05	MODULE TRAIN PLAN AND ELEVATION
R.048967.001 C05	SOUTH OF STATION AREA SITE PLAN	R.048967.001 S06	WATER RESERVOIR/PUMPHOUSE PLAN AND ELEVATION
R.048967.001 C06	MIDDLE SITE AREA SITE PLAN	R.048967.001 S07	POL PUMPHOUSE/TANK PLANS AND ELEVATIONS
R.048967.001 C07	OLD CONSTRUCTION CAMP AREA SITE PLAN		
R.048967.001 C08	BEACH LANDING AREA SITE PLAN		
R.048967.001 C09	DUMP A PLAN AND PROFILE		

FOX-E DURBAN ISLAND, NUNAVUT
ISSUED FOR TENDER
JULY, 2011

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SCALE 1:50000

0 500 1000 1500 m

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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2. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.

LEGEND:

SITE GRID (5000m INTERVAL)

Professional Seals / Sceaux

DO NOT SCALE DRAWINGS

Revision/ Revision	Description/Description	Date/Date
C	ISSUED FOR TENDER	11/07/20
B	ISSUED FOR 99% REVIEW	11/07/05
A	ISSUED FOR 75% REVIEW	11/06/06

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

Approved by/Approuve par
B. FEDORAK

Designed by/Concept par
C. CORRIGAN

Drawn by/Dessine par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

LOCATION PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	C01 OF 09	C

Sheet Size: B1 (1000mm x 707mm)
Saved by: De Leon, Adrian
Plotted on: July 18, 2011
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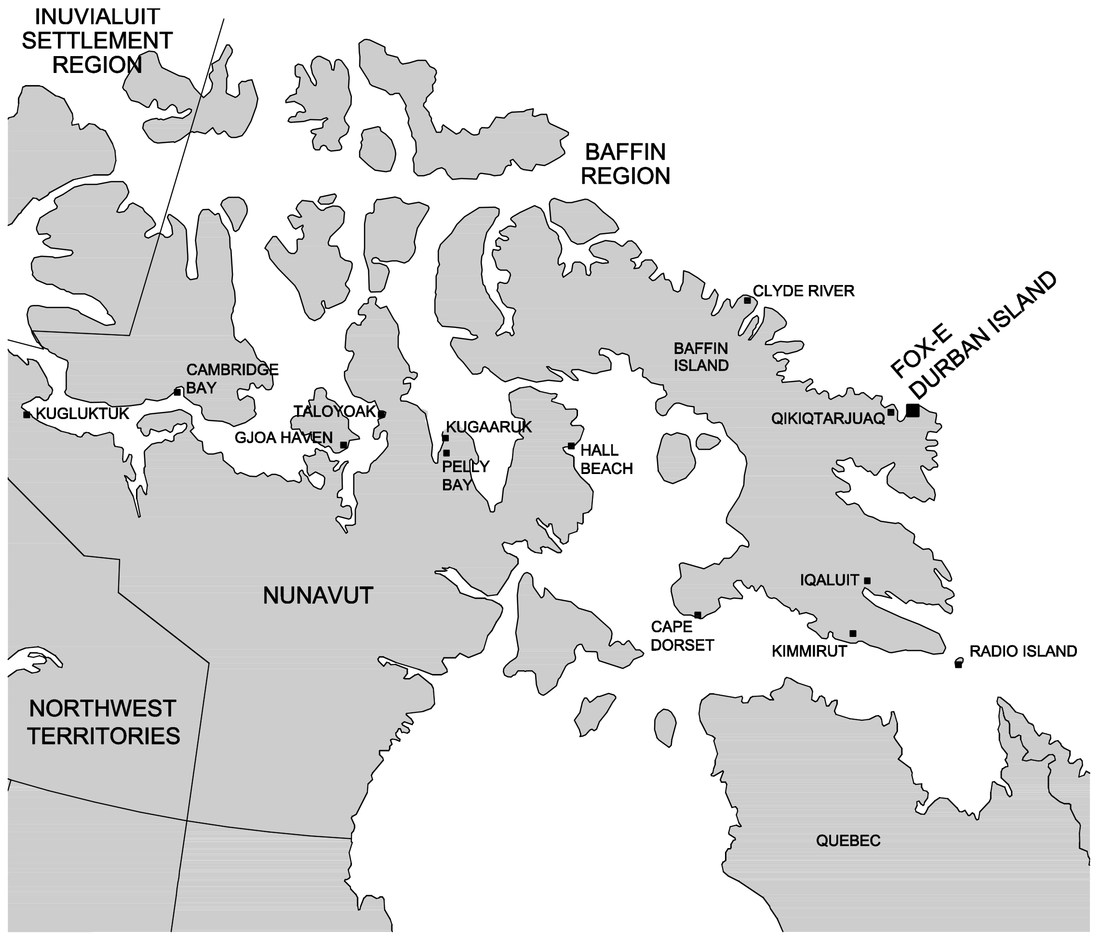


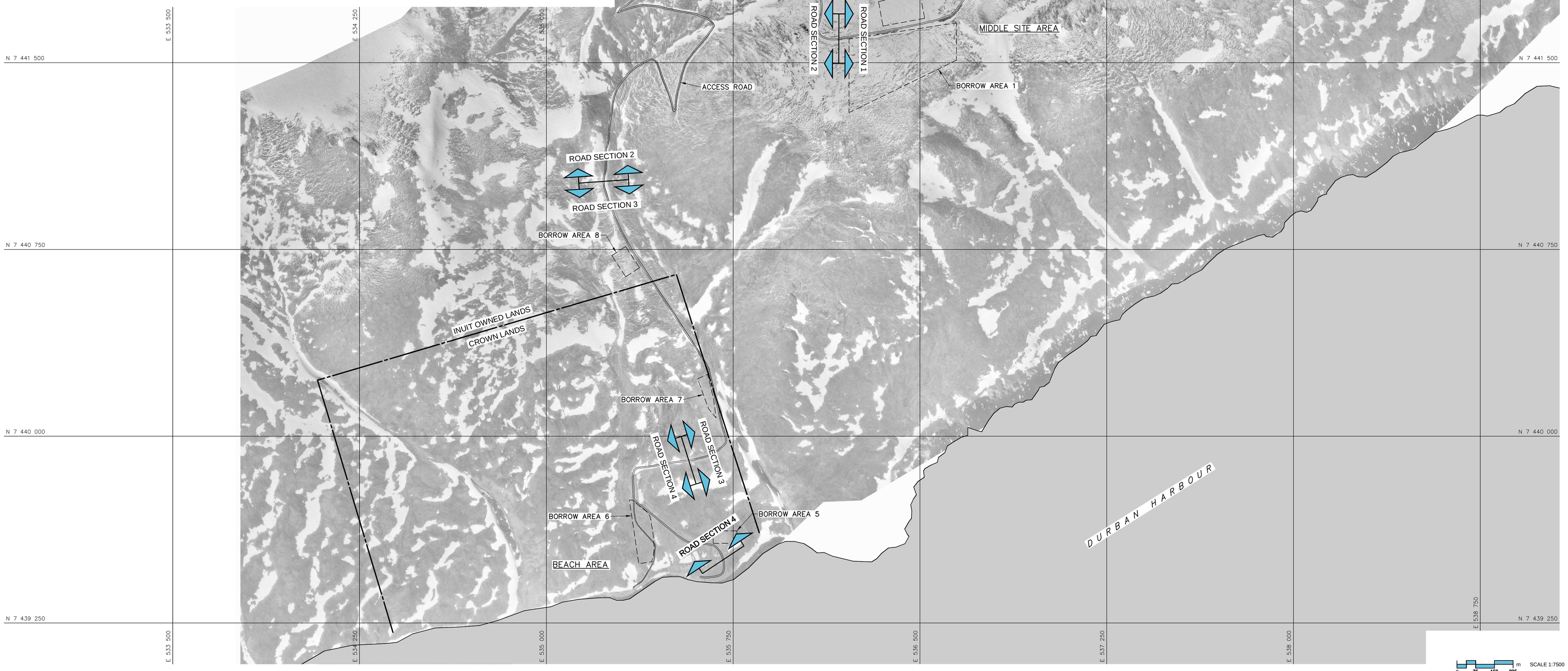
LOCATION OF DURBAN ISLAND WITHIN NUNAVUT TERRITORY

SCALE: NTS

POTENTIAL SOURCE FOR GRANULAR MATERIAL			
BORROW AREA	GRANULAR TYPE (SECTION 31 05 17 IN SPECIFICATION)		
	TYPE 1	TYPE 2	TYPE 3
1 *	✔	✔	✔
2 *			✔
3		✔	✔
4	✔		✔
5 **			
6			✔
7		✔	✔
8 *		✔	✔

* BORROW AREA 1, 2 AND 8 ARE WITHIN INUIT OWNED LANDS.

** BORROW AREA 5 DOES NOT HAVE SUITABLE GRANULAR MATERIAL AVAILABLE.



Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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LEGEND:

- BODY OF WATER
- SITE GRID (750m INTERVAL)
- APPROXIMATE LOCATION OF PROPERTY BOUNDARIES
- APPROXIMATE EXTENT OF BORROW AREA

Professional Seals / Sceaux

DO NOT SCALE DRAWINGS

Revision/ Revision	Description/Description	Date/Date
C	ISSUED FOR TENDER	11/07/20
B	ISSUED FOR 99% REVIEW	11/07/05
A	ISSUED FOR 75% REVIEW	11/06/06

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

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FOX-E DURBAN ISLAND REMEDIATION PROJECT

Approved by/Approuve par
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Designed by/Concept par
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Drawn by/Dessine par
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PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

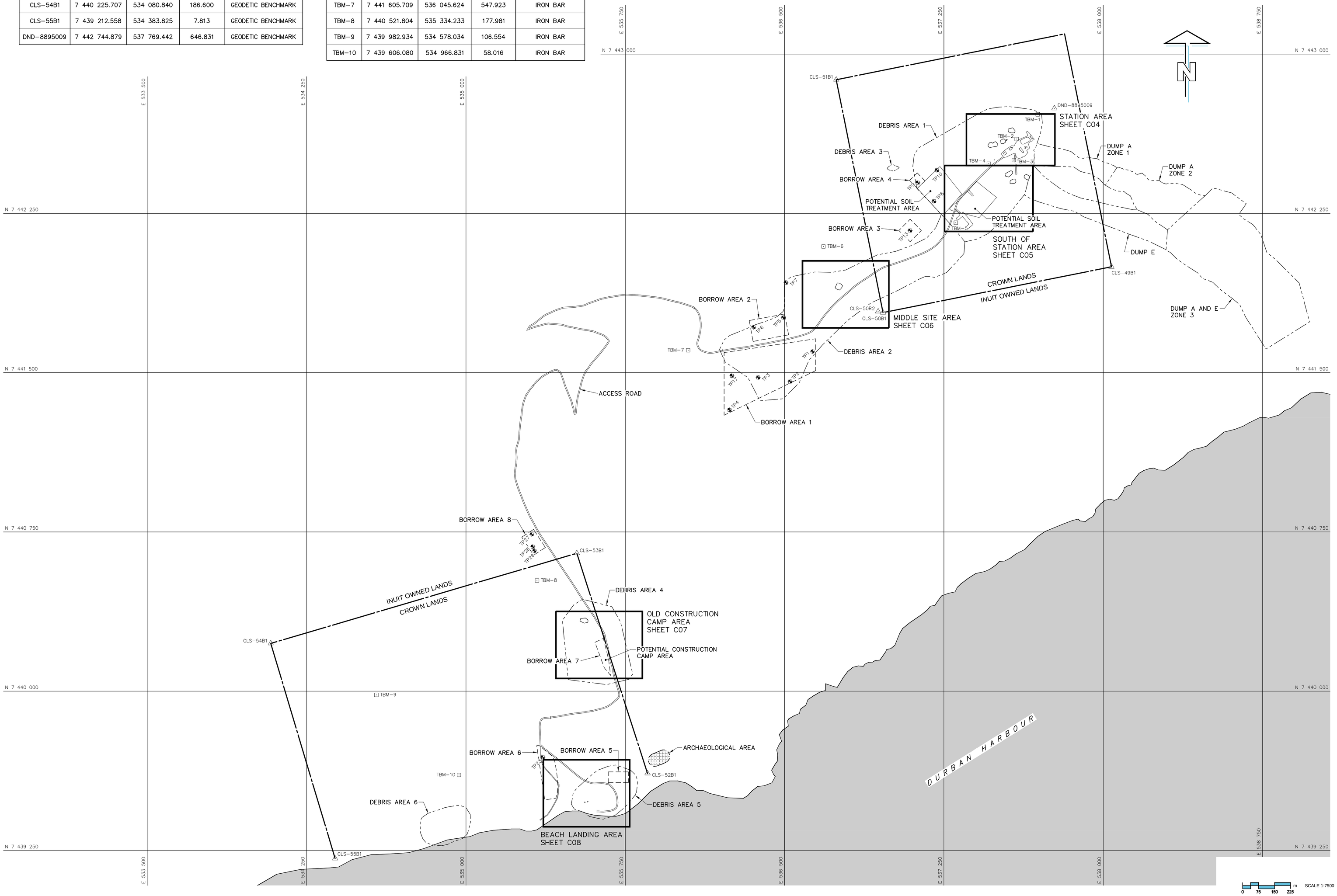
Drawing title/Titre du dessin

PROJECT AREA PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	C02 OF 09	C

SURVEY CONTROL MONUMENTS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
CLS–49B1	7 441 998.977	538 038.315	365.584	GEODETIC BENCHMARK
CLS–50B1	7 441 783.201	536 963.236	627.623	GEODETIC BENCHMARK
CLS–50R2	7 441 788.653	536 939.994	632.268	GEODETIC BENCHMARK
CLS–51B1	7 442 879.899	536 742.842	325.653	GEODETIC BENCHMARK
CLS–52B1	7 439 613.322	535 854.448	18.937	GEODETIC BENCHMARK
CLS–53B1	7 440 649.967	535 521.637	172.137	GEODETIC BENCHMARK
CLS–54B1	7 440 225.707	534 080.840	186.600	GEODETIC BENCHMARK
CLS–55B1	7 439 212.558	534 383.825	7.813	GEODETIC BENCHMARK
DND–8895009	7 442 744.879	537 769.442	646.831	GEODETIC BENCHMARK

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
TBM–1	7 442 716.385	537 690.972	649.102	IRON BAR
TBM–2	7 442 600.431	537 591.744	656.484	NAIL
TBM–3	7 442 501.332	537 578.770	656.975	NAIL
TBM–4	7 442 484.249	537 460.881	654.506	IRON BAR
TBM–5	7 442 206.657	537 305.400	636.792	IRON BAR
TBM–6	7 442 094.624	536 682.565	636.122	IRON BAR
TBM–7	7 441 605.709	536 045.624	547.923	IRON BAR
TBM–8	7 440 521.804	535 334.233	177.981	IRON BAR
TBM–9	7 439 982.934	534 578.034	106.554	IRON BAR
TBM–10	7 439 606.080	534 966.831	58.016	IRON BAR



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REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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2. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. CULVERTS TO BE REMOVED AND CULVERT AREA TO BE GRADED TO DRAIN PRIOR TO PROJECT COMPLETION.

LEGEND:

- BODY OF WATER
- SITE GRID (750m INTERVAL)
- APPROXIMATE LOCATION OF PROPERTY BOUNDARIES
- APPROXIMATE EXTENT OF BORROW AREA
- APPROXIMATE EXTENT OF DEBRIS AREA
- ARCHAEOLOGICAL AREA
- SURVEY CONTROL MONUMENT
- TEMPORARY BENCHMARK
- TESTPIT LOCATION

Professional Seals / Sceaux

DO NOT SCALE DRAWINGS

Revision/ Revision	Description/Description	Date/Date
C	ISSUED FOR TENDER	11/07/20
B	ISSUED FOR 99% REVIEW	11/07/05
A	ISSUED FOR 75% REVIEW	11/06/06

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

Approved by/Approuvé par
B. FEDORAK

Designed by/Concept par
C. CORRIGAN

Drawn by/Dessiné par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

OVERALL SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	C03 OF 09	C

R.048967.001-C03.dwg

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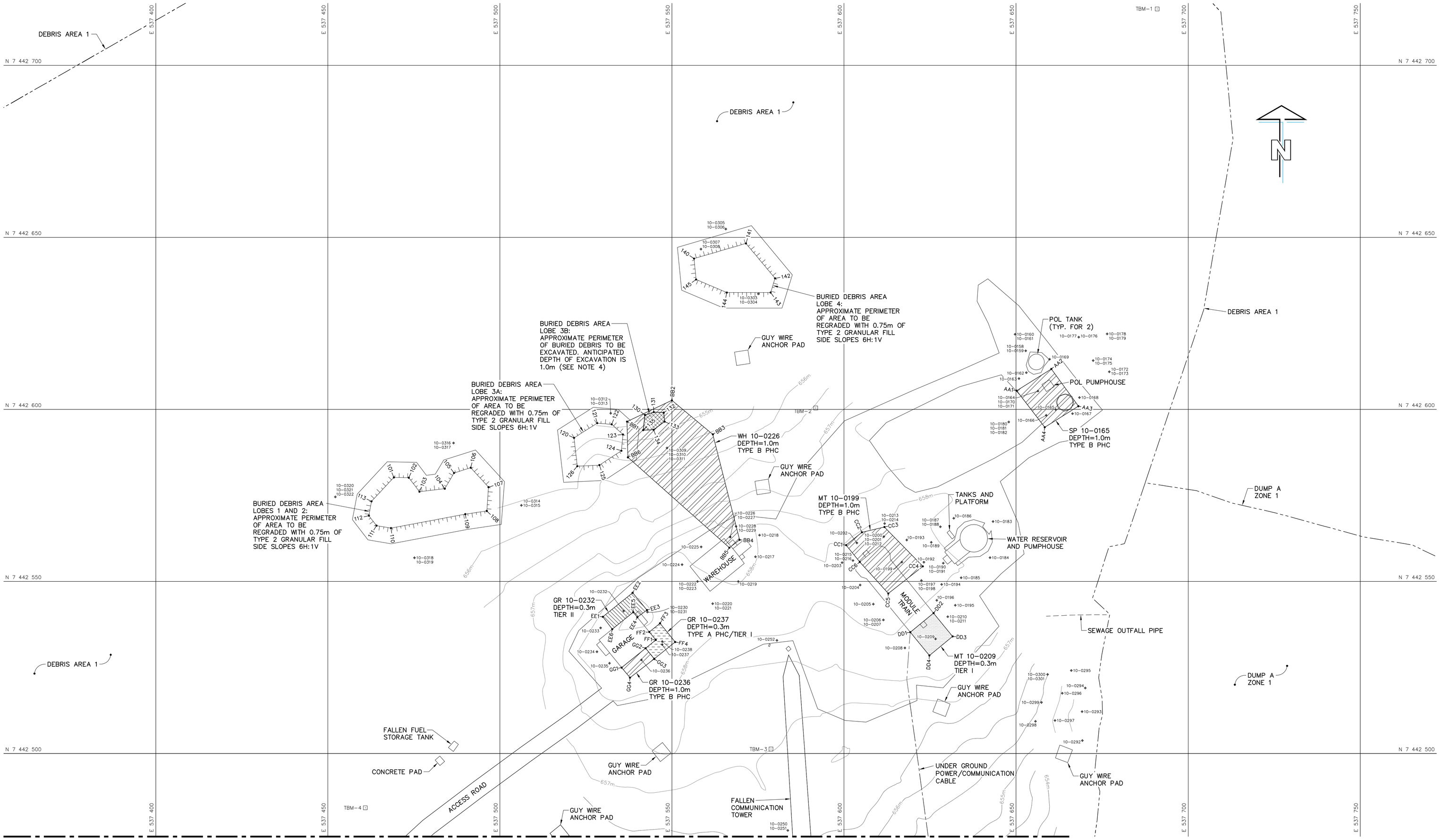

MATCH LINE

SEE SHEET C05

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
TBM–1	7 442 716.385	537 690.972	649.102	IRON BAR
TBM–2	7 442 600.431	537 591.744	656.484	NAIL
TBM–3	7 442 501.332	537 578.770	656.975	NAIL
TBM–4	7 442 484.249	537 460.881	654.506	IRON BAR

CONTAMINATED SOIL TO BE EXCAVATED							
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	CONTAINMENT CLASSIFICATION	COMMENTS	REFERENCE POINTS	
						NORTHING	EASTING
GR 10–0232	57	0.3	19	TIER II	OFF SITE DISPOSAL	7 442 541	537 536
GR 10–0236	35	1.0	43	TYPE B PHC	ON SITE TREATMENT	7 442 526	537 540
GR 10–0237	43	0.3	14	TYPE A PHC/TIER I	OFF SITE DISPOSAL	7 442 533	537 547
MT 10–0199	223	1.0	253	TYPE B PHC	ON SITE TREATMENT	7 442 557	537 612
MT 10–0209	77	0.3	26	TIER I	OFF SITE DISPOSAL	7 442 535	537 626
SP 10–0165	156	1.0	182	TYPE B PHC	ON SITE TREATMENT	7 442 603	537 659
WH 10–0226	682	1.0	740	TYPE B PHC	ON SITE TREATMENT	7 442 583	537 555

BURIED DEBRIS AREA LOBES 1 AND 2 REGRADE					
NO.	COORDINATES		NO.	COORDINATES	
	NORTHING	EASTING		NORTHING	EASTING
101	7 442 580.3	537 469.2	108	7 442 570.5	537 496.2
102	7 442 580.2	537 473.5	109	7 442 569.6	537 489.9
103	7 442 576.1	537 476.6	110	7 442 565.5	537 468.3
104	7 442 577.0	537 484.0	111	7 442 566.2	537 464.1
105	7 442 581.5	537 486.7	112	7 442 569.1	537 461.9
106	7 442 583.1	537 491.5	113	7 442 573.3	537 462.7
107	7 442 577.4	537 496.7			

BURIED DEBRIS AREA LOBE 3A REGRADE		
NO.	COORDINATES	
	NORTHING	EASTING
120	7 442 591.8	537 521.5
121	7 442 596.0	537 528.3
122	7 442 595.7	537 532.5
123	7 442 592.7	537 535.7
124	7 442 588.0	537 535.3
125	7 442 583.8	537 528.9
126	7 442 583.5	537 522.5

BURIED DEBRIS AREA LOBE 3B EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
130	7 442 598.4	537 542.1
131	7 442 599.3	537 544.7
132	7 442 599.1	537 547.6
133	7 442 596.5	537 547.8
134	7 442 594.1	537 544.6
135	7 442 594.0	537 541.6

BURIED DEBRIS AREA LOBE 4 REGRADE		
NO.	COORDINATES	
	NORTHING	EASTING
140	7 442 643.9	537 556.4
141	7 442 648.3	537 571.5
142	7 442 638.1	537 579.9
143	7 442 634.0	537 578.7
144	7 442 634.0	537 565.9
145	7 442 637.8	537 557.0

TYPE B PHC CONTAMINATED SOIL EXCAVATION (SP 10–0165)		
NO.	COORDINATES	
	NORTHING	EASTING
AA1	7 442 605.5	537 650.1
AA2	7 442 611.8	537 660.2
AA3	7 442 601.0	537 668.1
AA4	7 442 594.8	537 658.3

TYPE B PHC CONTAMINATED SOIL EXCAVATION (WH 10–0226)		
NO.	COORDINATES	
	NORTHING	EASTING
BB1	7 442 596.5	537 536.9
BB2	7 442 602.7	537 550.0
BB3	7 442 592.8	537 561.9
BB4	7 442 562.1	537 569.6
BB5	7 442 559.8	537 566.7
BB6	7 442 586.1	537 537.2

TYPE B PHC CONTAMINATED SOIL EXCAVATION (MT 10–0199)		
NO.	COORDINATES	
	NORTHING	EASTING
CC1	7 442 560.6	537 600.6
CC2	7 442 564.3	537 605.2
CC3	7 442 565.8	537 611.7
CC4	7 442 554.4	537 622.9
CC5	7 442 546.5	537 612.8
CC6	7 442 555.7	537 604.6

TIER I CONTAMINATED SOIL EXCAVATION (MT 10–0209)		
NO.	COORDINATES	
	NORTHING	EASTING
DD1	7 442 535.3	537 619.2
DD2	7 442 540.8	537 626.0
DD3	7 442 534.1	537 631.5
DD4	7 442 528.5	537 624.8

TIER II CONTAMINATED SOIL EXCAVATION (GR 10–0232)		
NO.	COORDINATES	
	NORTHING	EASTING
EE1	7 442 539.8	537 529.9
EE2	7 442 546.7	537 538.5
EE3	7 442 541.7	537 542.7
EE4	7 442 539.6	537 539.9
EE5	7 442 541.1	537 538.7
EE6	7 442 536.2	537 532.6

TYPE A PHC / TIER I CONTAMINATED SOIL EXCAVATION (GR 10–0237)		
NO.	COORDINATES	
	NORTHING	EASTING
FF1	7 442 533.0	537 545.3
FF2	7 442 535.3	537 543.4
FF3	7 442 537.9	537 546.5
FF4	7 442 532.4	537 550.9

TYPE B PHC CONTAMINATED SOIL EXCAVATION (GR 10–0236)		
NO.	COORDINATES	
	NORTHING	EASTING
GG1	7 442 525.0	537 535.4
GG2	7 442 530.6	537 542.3
GG3	7 442 527.5	537 544.8
GG4	7 442 522.1	537 537.8

SCALE 1:500

0 5 10 15 m

0 10 20 30 40 50 60 70 80 90 100 mm

B1 – 1000 x 707

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
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3. ALL SURFACE DEBRIS IS TO BE REMOVED FROM ALL CONTAMINATED SOIL AREAS AND EXISTING BURIED DEBRIS AREAS PRIOR TO FILL PLACEMENT OR EXCAVATION TAKING PLACE.
4. REPLACE CLEAN BURIED DEBRIS EXCAVATION SOILS FROM THE EXCAVATION OF LOBE 3B AS BACKFILL. CAP AREA WITH 0.3m OF TYPE 3 GRANULAR FILL OVER THE CLEAN BACKFILL TO PREVENT PONDING.

LEGEND:

- SITE GRID (50m INTERVAL)
- APPROXIMATE EXTENT OF DEBRIS AREA
- TEMPORARY BENCHMARK
- 10–0174 SAMPLE LOCATION
- BURIED DEBRIS EXCAVATION
- TIER I CONTAMINATED SOIL
- TIER II CONTAMINATED SOIL
- TYPE A PHC / TIER I CONTAMINATED SOIL
- TYPE B PHC CONTAMINATED SOIL

Professional Seals / Sceaux

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Revision/ Revision	Description/Description	Date/Date
C	ISSUED FOR TENDER	11/07/20
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Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

Approved by/Approuvé par
B. FEDORAK

Designed by/Concept par
C. CORRIGAN

Drawn by/Dessiné par
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PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

STATION AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
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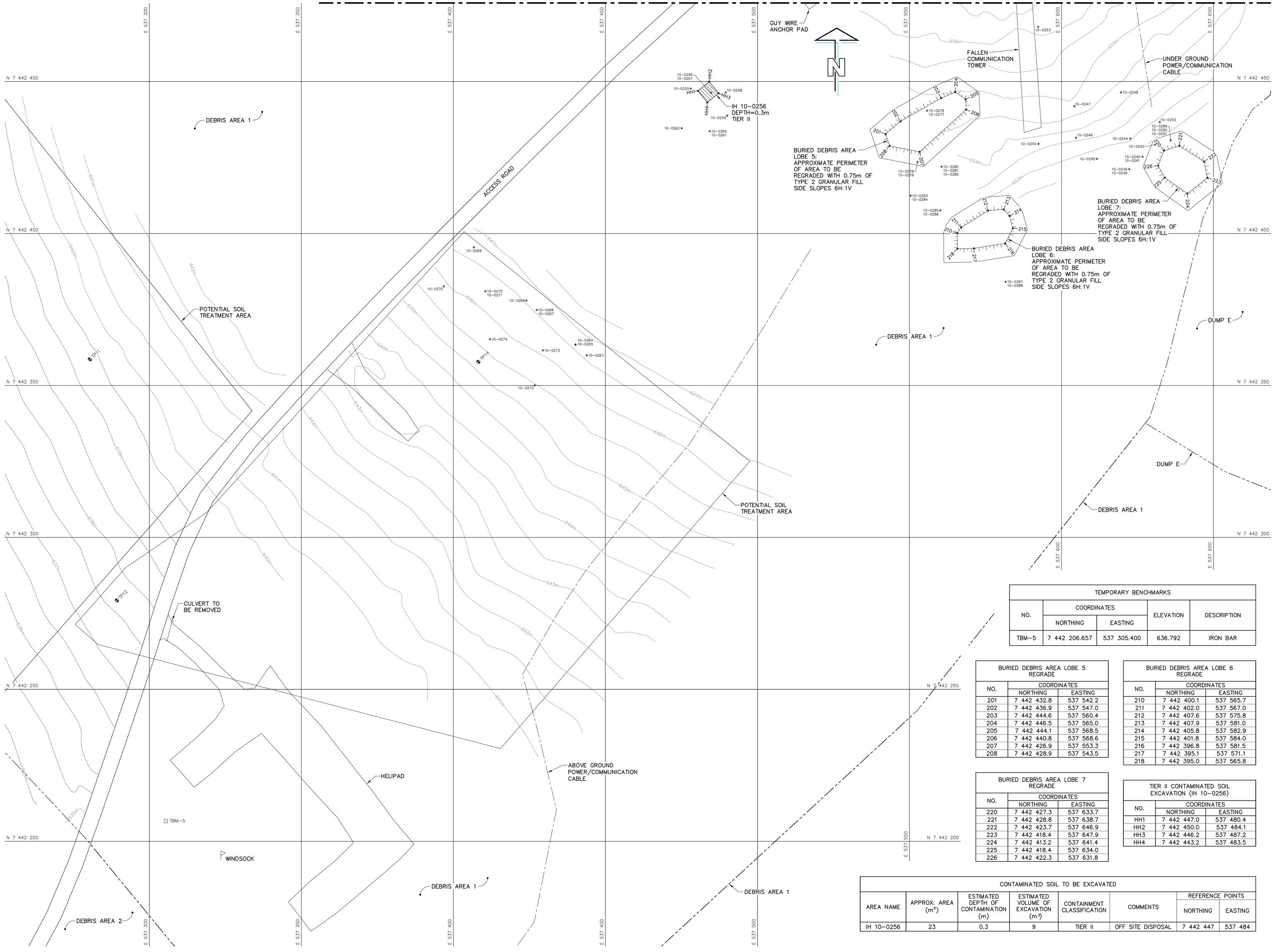

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LEGEND:

- SITE GRID (50m INTERVAL)
- APPROXIMATE EXTENT OF DEBRIS AREA
- TEMPORARY BENCHMARK
- TESTPIT LOCATION
- 10-0280 SAMPLE LOCATION
- TIER II CONTAMINATED SOIL

Professional Seals / Sceaux

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B	ISSUED FOR 99% REVIEW	11/07/05
A	ISSUED FOR 75% REVIEW	11/06/06
Revision/ Revision	Description/Description	Date/Date

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

Approved by/Approuvé par
B. FEDORAK

Designed by/Concept par
C. CORRIGAN

Drawn by/Dessiné par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

SOUTH OF STATION AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	C05 OF 09	C

TEMPORARY BENCHMARKS

NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
TBM-5	7 442 206.657	537 305.400	636.792	IRON BAR

BURIED DEBRIS AREA LOBE 5 REGRADE

NO.	COORDINATES	
	NORTHING	EASTING
201	7 442 432.8	537 542.2
202	7 442 436.9	537 547.0
203	7 442 444.6	537 560.4
204	7 442 446.5	537 565.0
205	7 442 444.1	537 568.5
206	7 442 440.8	537 568.6
207	7 442 426.9	537 553.3
208	7 442 428.9	537 543.5

BURIED DEBRIS AREA LOBE 6 REGRADE

NO.	COORDINATES	
	NORTHING	EASTING
210	7 442 400.1	537 565.7
211	7 442 402.0	537 567.0
212	7 442 407.6	537 575.8
213	7 442 407.9	537 581.0
214	7 442 405.8	537 582.9
215	7 442 401.8	537 584.0
216	7 442 396.8	537 581.5
217	7 442 395.1	537 571.1
218	7 442 395.0	537 565.8

BURIED DEBRIS AREA LOBE 7 REGRADE

NO.	COORDINATES	
	NORTHING	EASTING
220	7 442 427.3	537 633.7
221	7 442 428.8	537 638.7
222	7 442 423.7	537 646.9
223	7 442 418.4	537 647.9
224	7 442 413.2	537 641.4
225	7 442 418.4	537 634.0
226	7 442 422.3	537 631.8

TIER II CONTAMINATED SOIL EXCAVATION (IH 10-0256)

NO.	COORDINATES	
	NORTHING	EASTING
HH1	7 442 447.0	537 480.4
HH2	7 442 450.0	537 484.1
HH3	7 442 446.2	537 487.2
HH4	7 442 443.2	537 483.5

CONTAMINATED SOIL TO BE EXCAVATED

AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	CONTAINMENT CLASSIFICATION	COMMENTS	REFERENCE POINTS	
						NORTHING	EASTING
IH 10-0256	23	0.3	9	TIER II	OFF SITE DISPOSAL	7 442 447	537 484

0 5 10 15 m SCALE 1:500

0 10 20 30 40 50 60 70 80 90 100 mm

B1 – 1000 x 707

R.048967.001-C05.dwg

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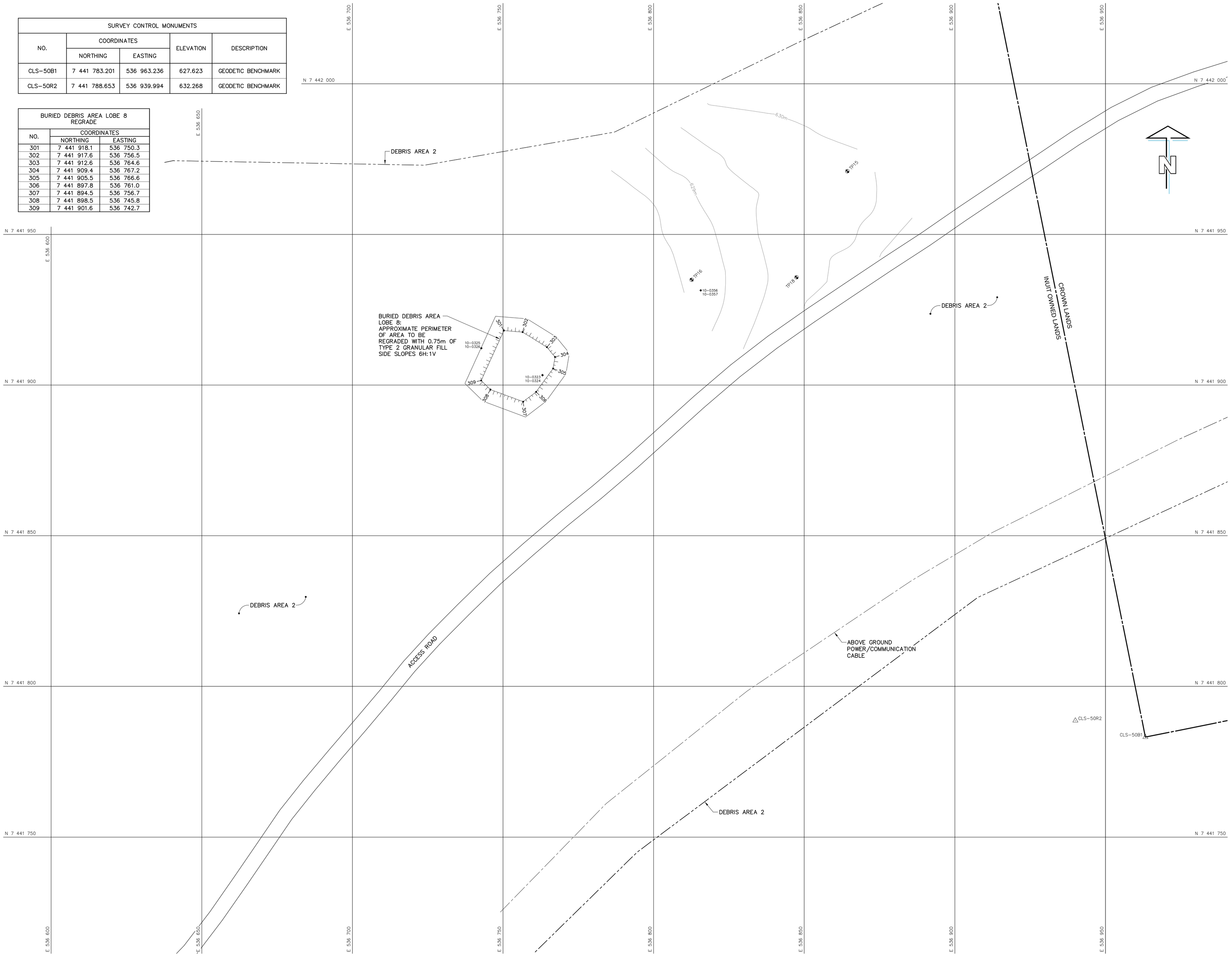
SURVEY CONTROL MONUMENTS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
CLS-50B1	7 441 783.201	536 963.236	627.623	GEODETIC BENCHMARK
CLS-50R2	7 441 788.653	536 939.994	632.268	GEODETIC BENCHMARK

BURIED DEBRIS AREA LOBE 8 REGRADE		
NO.	COORDINATES	
	NORTHING	EASTING
301	7 441 918.1	536 750.3
302	7 441 917.6	536 756.5
303	7 441 912.6	536 764.6
304	7 441 909.4	536 767.2
305	7 441 905.5	536 766.6
306	7 441 897.8	536 761.0
307	7 441 894.5	536 756.7
308	7 441 898.5	536 745.8
309	7 441 901.6	536 742.7



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Western Region
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LEGEND:

- SITE GRID (50m INTERVAL)
- APPROXIMATE LOCATION OF PROPERTY BOUNDARIES
- APPROXIMATE EXTENT OF DEBRIS AREA
- △ SURVEY CONTROL MONUMENT
- TESTPIT LOCATION
- ⌖ 10-0356 SAMPLE LOCATION

Professional Seals / Sceaux

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Revision/ Revision	Description/Description	Date/Date
C	ISSUED FOR TENDER	11/07/20
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Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

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Designed by/Concept par
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Drawn by/Dessine par
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PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

MIDDLE SITE AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	C06 OF 09	C

B1 – 1000 x 707

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E 535 450 | E 535 500 | E 535 550 | E 535 600 | E 535 650 | E 535 700 | E 535 750 | E 535 800

N 7 440 350 | N 7 440 300 | N 7 440 250 | N 7 440 200 | N 7 440 150 | N 7 440 100

DEBRIS AREA 4

10-0358
10-0359

401 402 403 404 405 406

10-0360
10-0361
10-0362

BURIED DEBRIS AREA LOBE 9: APPROXIMATE PERIMETER OF AREA TO BE REGRADED WITH 0.75m OF TYPE 2 GRANULAR FILL SIDE SLOPES 6H:1V

INUIT OWNED LANDS
CROWN LANDS

DEBRIS AREA 4

BURIED DEBRIS AREA LOBE 9 REGRADE		
NO.	COORDINATES	
	NORTHING	EASTING
401	7 440 338.7	535 543.6
402	7 440 340.1	535 561.1
403	7 440 334.1	535 569.8
404	7 440 328.3	535 569.4
405	7 440 325.8	535 557.1
406	7 440 333.2	535 541.6

TP25

116m
115m
114m
113m
112m
111m
110m
109m
108m
107m

BORROW AREA 7

POTENTIAL CONSTRUCTION CAMP AREA

TP24

ACCESS ROAD

DEBRIS AREA 4

DEBRIS AREA 4

SCALE 1:500
0 5 10 15 m

B1 – 1000 x 707
0 10 20 30 40 50 60 70 80 90 100 mm

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REAL PROPERTY SERVICES
Western Region
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LEGEND:

- SITE GRID (50m INTERVAL)
- APPROXIMATE LOCATION OF PROPERTY BOUNDARIES
- APPROXIMATE EXTENT OF BORROW AREA
- APPROXIMATE EXTENT OF DEBRIS AREA
- TESTPIT LOCATION
- 10-0358 SAMPLE LOCATION

Professional Seals / Sceaux

DO NOT SCALE DRAWINGS

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Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

OLD CONSTRUCTION CAMP AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ Le Révison no.
R.048967.001	C07 OF 09	C

R.048967.001-C07.dwg

Sheet Size: B1 (1000mm x 707mm)
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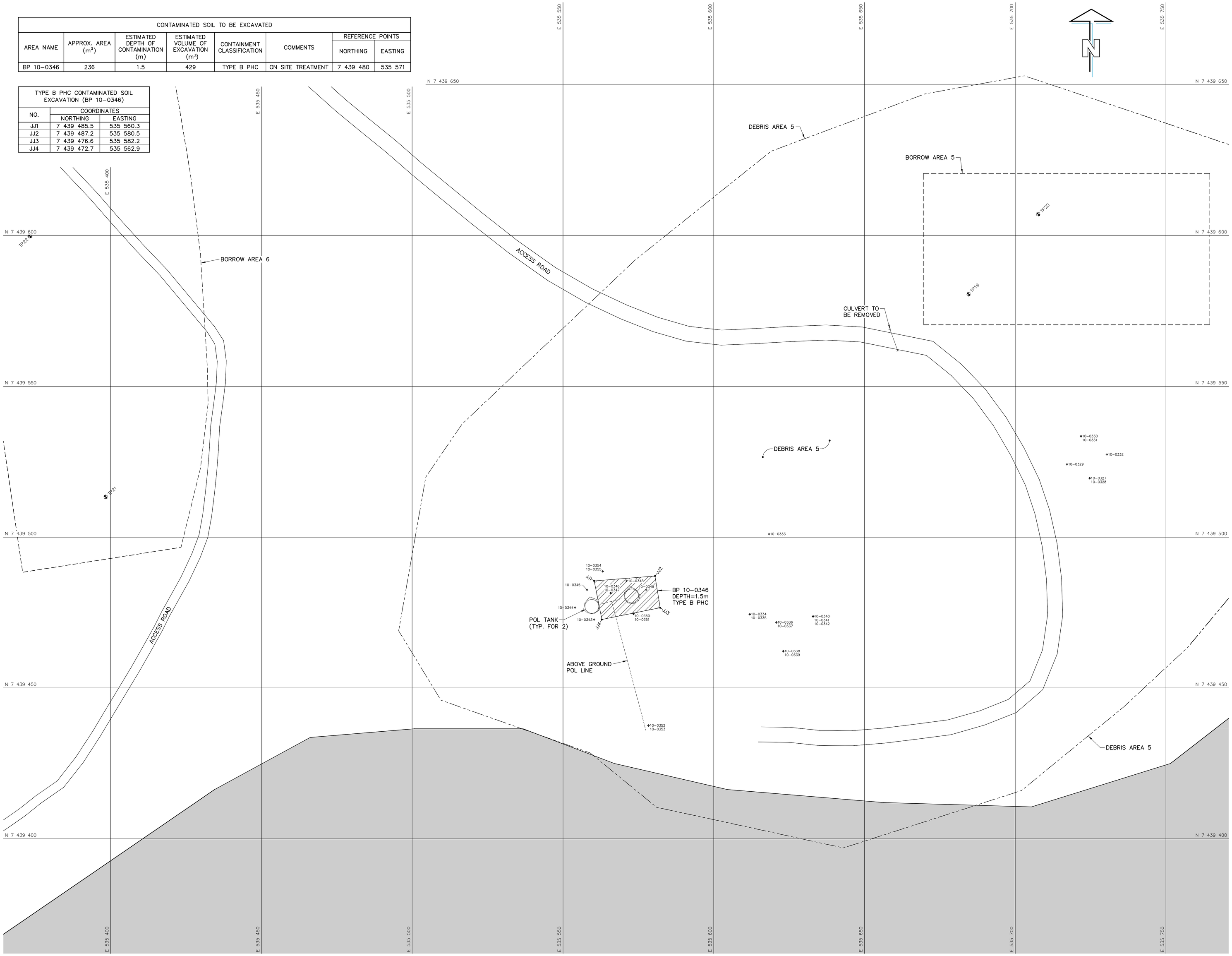
CONTAMINATED SOIL TO BE EXCAVATED							
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	CONTAINMENT CLASSIFICATION	COMMENTS	REFERENCE POINTS	
						NORTHING	EASTING
BP 10-0346	236	1.5	429	TYPE B PHC	ON SITE TREATMENT	7 439 480	535 571

TYPE B PHC CONTAMINATED SOIL EXCAVATION (BP 10-0346)		
NO.	COORDINATES	
	NORTHING	EASTING
JJ1	7 439 485.5	535 560.3
JJ2	7 439 487.2	535 580.5
JJ3	7 439 476.6	535 582.2
JJ4	7 439 472.7	535 562.9



Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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2. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. ALL SURFACE DEBRIS IS TO BE REMOVED FROM ALL CONTAMINATED SOIL AREAS AND EXISTING BURIED DEBRIS AREAS PRIOR TO FILL PLACEMENT OR EXCAVATION TAKING PLACE.

LEGEND:

- BODY OF WATER
- SITE GRID (50m INTERVAL)
- APPROXIMATE EXTENT OF BORROW AREA
- APPROXIMATE EXTENT OF DEBRIS AREA
- TESTPIT LOCATION
- 10-0334 SAMPLE LOCATION
- TYPE B PHC CONTAMINATED SOIL

Professional Seals / Sceaux

DO NOT SCALE DRAWINGS

Revision/ Revision	Description/Description	Date/Date
C	ISSUED FOR TENDER	11/07/20
B	ISSUED FOR 99% REVIEW	11/07/05
A	ISSUED FOR 75% REVIEW	11/06/06

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

Approved by/Approuve par
B. FEDORAK

Designed by/Concept par
C. CORRIGAN

Drawn by/Dessine par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Ressources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

BEACH LANDING AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	C08 OF 09	C

Sheet Size: B1 (1000mm x 707mm)
Saved by: Cech, Ione
Plotted on: July 18, 2011
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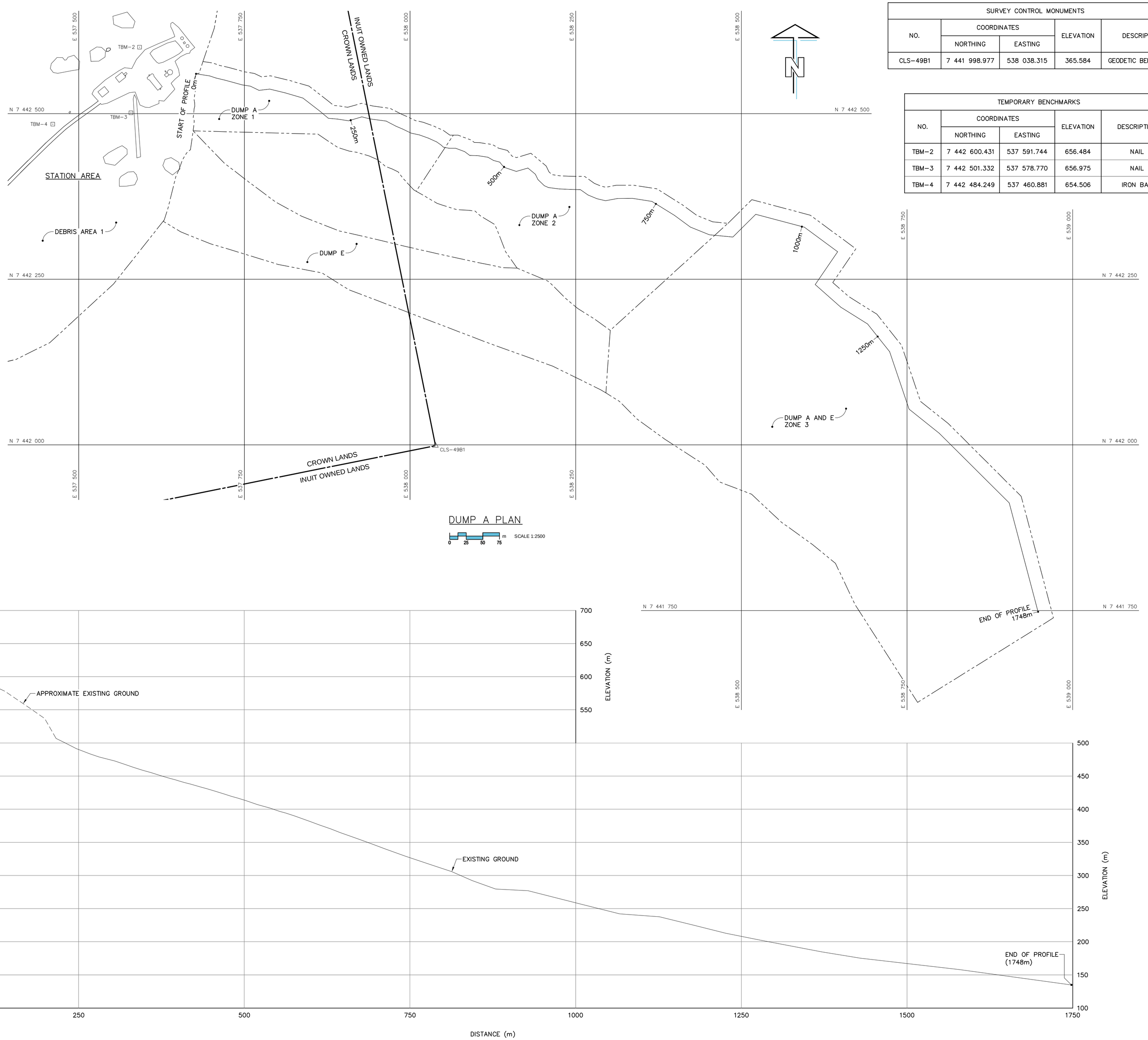
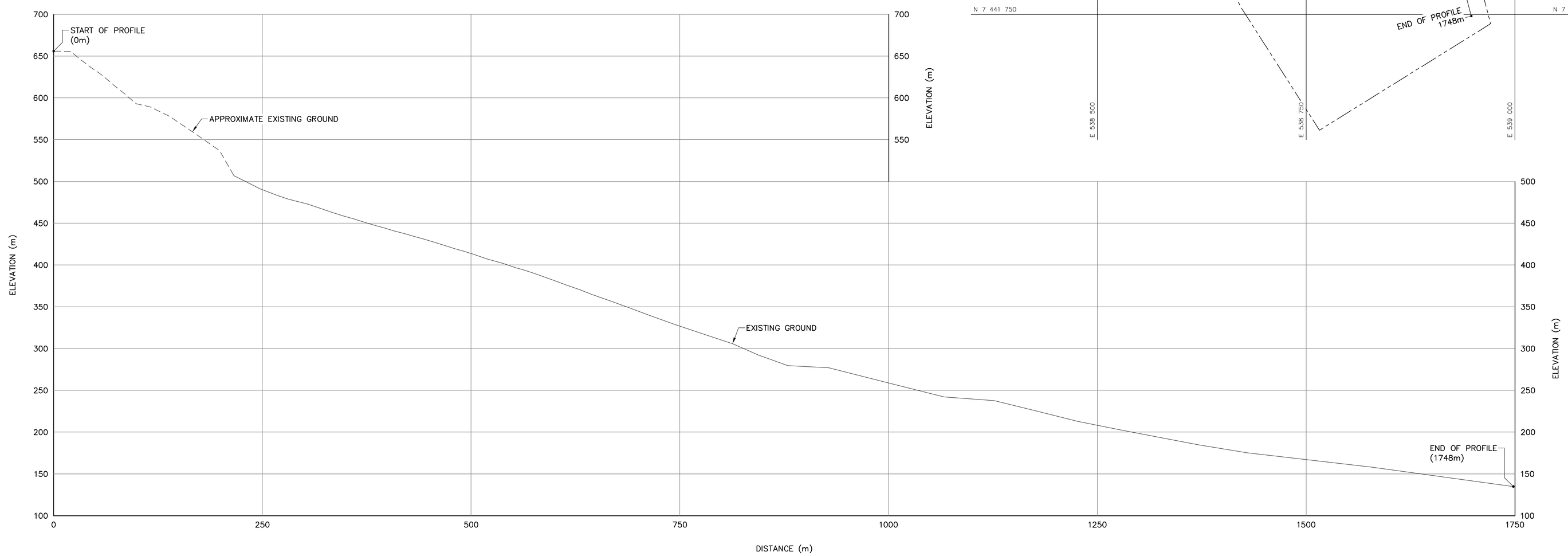


DUMP A PLAN

0 25 50 75 m SCALE 1:2500



DUMP A PROFILE

0 25 50 75 m SCALE 1:2500

SURVEY CONTROL MONUMENTS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
CLS-49B1	7 441 998.977	538 038.315	365.584	GEODETIC BENCHMARK

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
TBM-2	7 442 600.431	537 591.744	656.484	NAIL
TBM-3	7 442 501.332	537 578.770	656.975	NAIL
TBM-4	7 442 484.249	537 460.881	654.506	IRON BAR

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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LEGEND:

- SITE GRID (250m INTERVAL)
- APPROXIMATE LOCATION OF PROPERTY BOUNDARIES
- APPROXIMATE EXTENT OF DEBRIS AREA
- SURVEY CONTROL MONUMENT
- TEMPORARY BENCHMARK

Professional Seals / Sceaux

DO NOT SCALE DRAWINGS

Revision/ Revision	Description/Description	Date/Date
A	ISSUED FOR TENDER	11/07/20

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

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B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

DUMP A PLAN AND PROFILE

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	C09 OF 09	A

Sheet Size: B1 (1000mm x 707mm)
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E 537 400 | E 537 450 | E 537 500 | E 537 550 | E 537 600 | E 537 650 | E 537 700 | E 537 750

N 7 442 600 | N 7 442 550 | N 7 442 500 | N 7 442 450 | N 7 442 400 | N 7 442 350

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
TBM–2	7 442 600.431	537 591.744	656.484	NAIL
TBM–3	7 442 501.332	537 578.770	656.975	NAIL
TBM–4	7 442 484.249	537 460.881	654.506	IRON BAR

GUY WIRE ANCHOR PAD (SEE NOTE 4)
CONCRETE FOUNDATION (SEE NOTE 4)
POL TANK (TYP. FOR 2, SEE SHEET S07)
POL PUMPHOUSE (SEE SHEET S07)
CONCRETE FOUNDATION (SEE NOTE 4)
TBM–2
GUY WIRE ANCHOR PAD (SEE NOTE 4)
CONCRETE PAD TO BE REMOVED
WAREHOUSE (SEE SHEET S04)
CONCRETE FOUNDATION (SEE NOTE 4)
TANKS AND PLATFORM TO BE REMOVED
WATER RESERVOIR AND PUMPHOUSE (SEE SHEET S06)
GARAGE (SEE SHEET S03)
CONCRETE RAMP TO BE REMOVED (TYP. FOR 2)
MODULE TRAIN (SEE SHEET S05)
SEWAGE OUTFALL PIPE TO BE REMOVED
CONCRETE FOUNDATIONS (SEE NOTE 4)
GUY WIRE ANCHOR PAD (SEE NOTE 4)
FALLEN FUEL STORAGE TANK TO BE REMOVED
CONCRETE PAD (SEE NOTE 4)
GUY WIRE ANCHOR PAD (SEE NOTE 4)
TBM–3
GUY WIRE ANCHOR PAD (SEE NOTE 4)
TBM–4
GUY WIRE ANCHOR PAD (SEE NOTE 4)
FALLEN COMMUNICATION TOWER TO BE REMOVED
ACCESS ROAD
ABOVE GROUND POWER/COMMUNICATION CABLE TO BE REMOVED

0 5 10 15 m SCALE 1:500

B1 – 1000 x 707

0 10 20 30 40 50 60 70 80 90 100 mm

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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4. PROVIDE REGRADING AROUND ALL CONCRETE PADS AS PER TYPICAL DETAIL ON SHEET S02, THAT ARE DESIGNATED TO REMAIN.
5. PORTIONS OF THE POL LINES AND POWER/ COMMUNICATION CABLES MAY BE PARTIALLY BURIED.
6. CULVERTS TO BE REMOVED AND CULVERT AREA TO BE GRADED TO DRAIN PRIOR TO PROJECT COMPLETION.

LEGEND:

SITE GRID (50m INTERVALS)
STRUCTURE TO BE DEMOLISHED
SURVEY CONTROL MONUMENT

Professional Seals / Sceaux

DO NOT SCALE DRAWINGS

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C	ISSUED FOR TENDER	11/07/20
B	ISSUED FOR 99% REVIEW	11/07/05
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Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

Approved by/Approuve par
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Designed by/Concept par
C. CORRIGAN

Drawn by/Dessine par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

STATION AREA DEMOLITION SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	S01 OF 07	C

R.048967.001-S01.dwg

Sheet Size: B1 (1000mm x 707mm)
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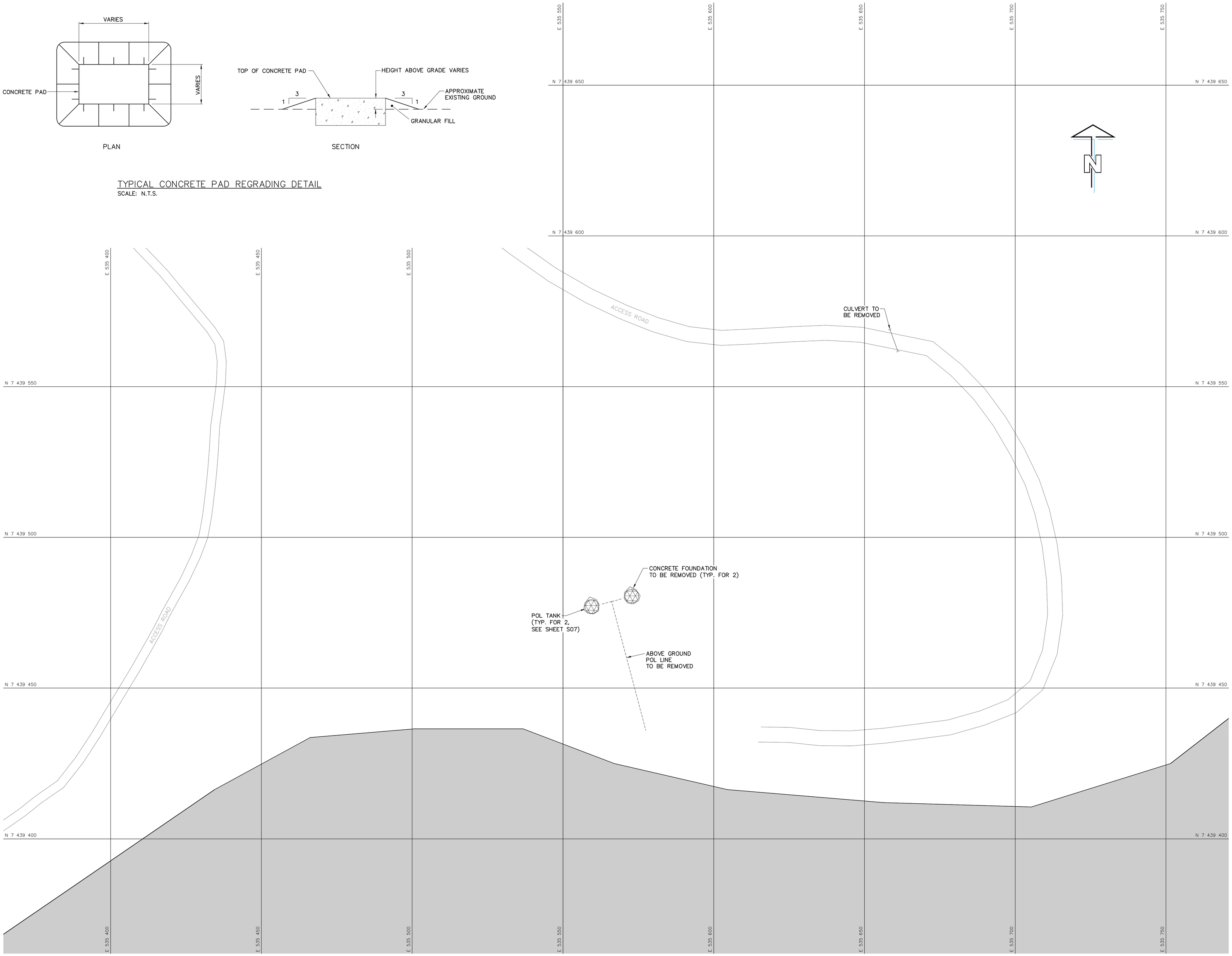
TYPICAL CONCRETE PAD REGRADING DETAIL
SCALE: N.T.S.



Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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4. PROVIDE REGRADING AROUND ALL CONCRETE PADS AS PER TYPICAL DETAIL ON THIS SHEET, THAT ARE DESIGNATED TO REMAIN.
5. PORTIONS OF THE POL LINES AND POWER/ COMMUNICATION CABLES MAY BE PARTIALLY BURIED.
6. CULVERTS TO BE REMOVED AND CULVERT AREA TO BE GRADED TO DRAIN PRIOR TO PROJECT COMPLETION.

LEGEND:

BODY OF WATER
SITE GRID (50m INTERVALS)
STRUCTURE TO BE DEMOLISHED

Professional Seals / Sceaux

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Revision/ Revision	Description/Description	Date/Date
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Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

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Designed by/Concept par
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Drawn by/Dessine par
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B. THOMPSON

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Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

BEACH LANDING AREA DEMOLITION SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ Le Révision no.
R.048967.001	S02 OF 07	C

B1 – 1000 x 707

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R.048967.001-S02.dwg

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Plotted on: July 18, 2011
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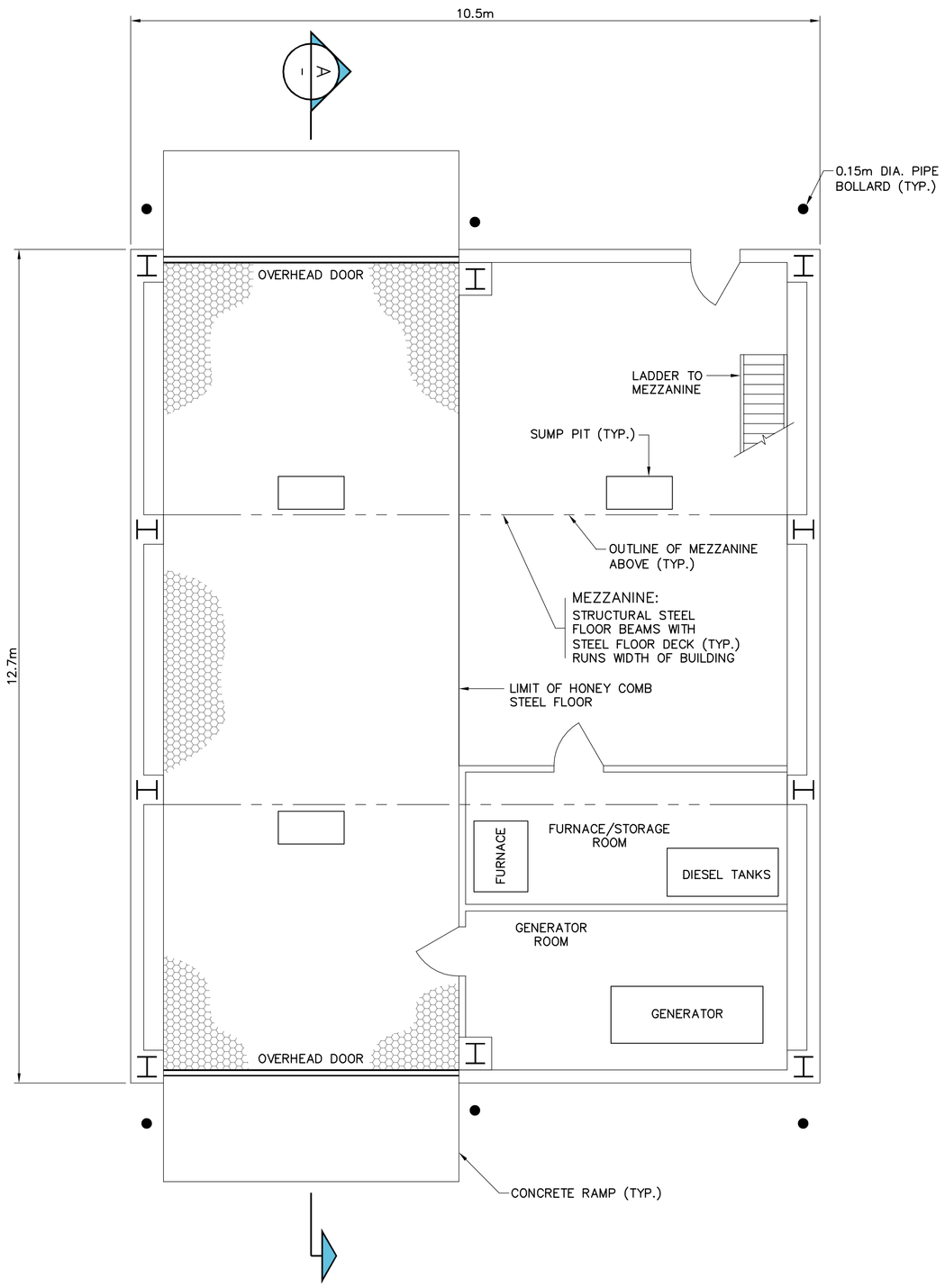
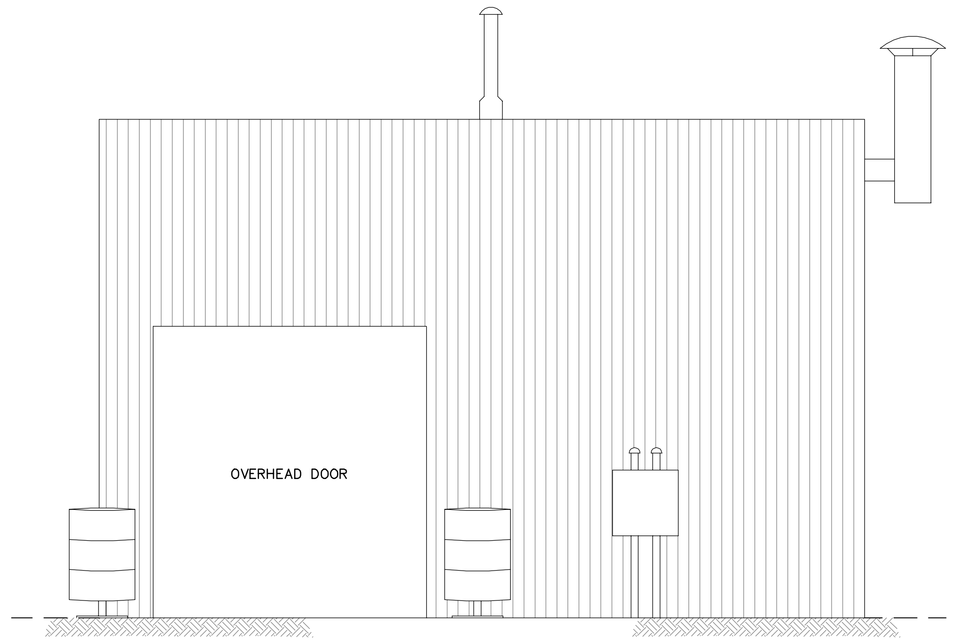
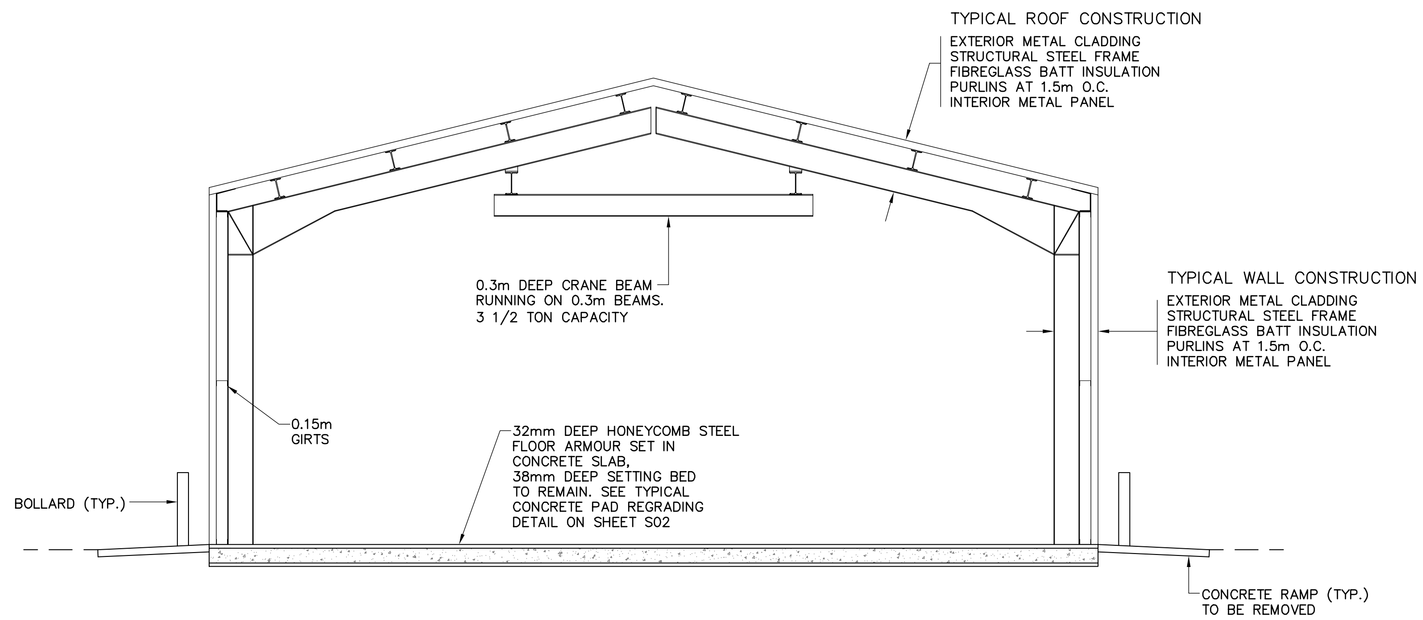


FLOOR PLAN



ELEVATION



SECTION A –

SCALE 1:50

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

Approved by/Approuve par
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Designed by/Concept par
C. CORRIGAN

Drawn by/Dessine par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

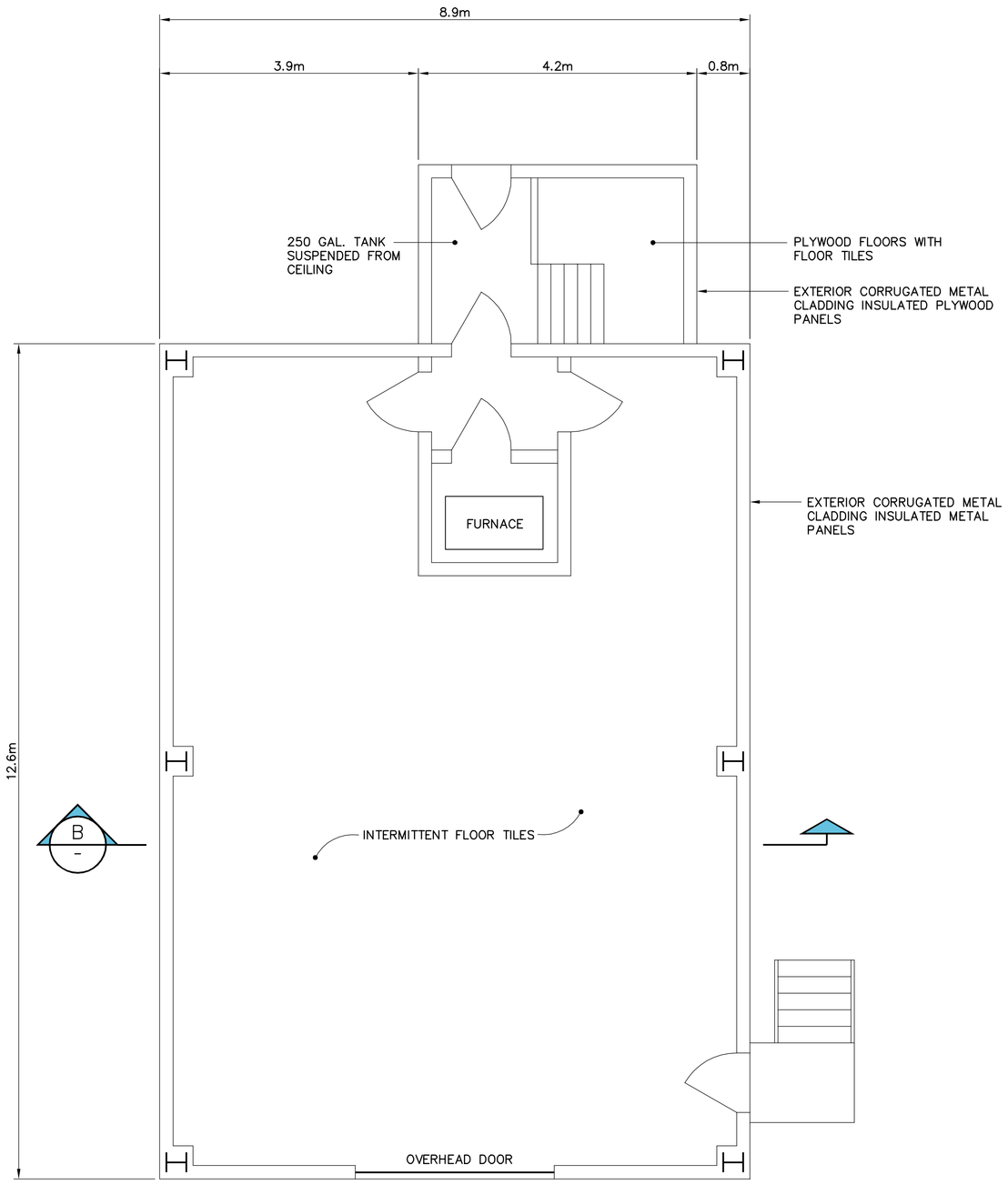
Drawing title/Titre du dessin

GARAGE FLOOR PLAN, ELEVATION AND SECTION

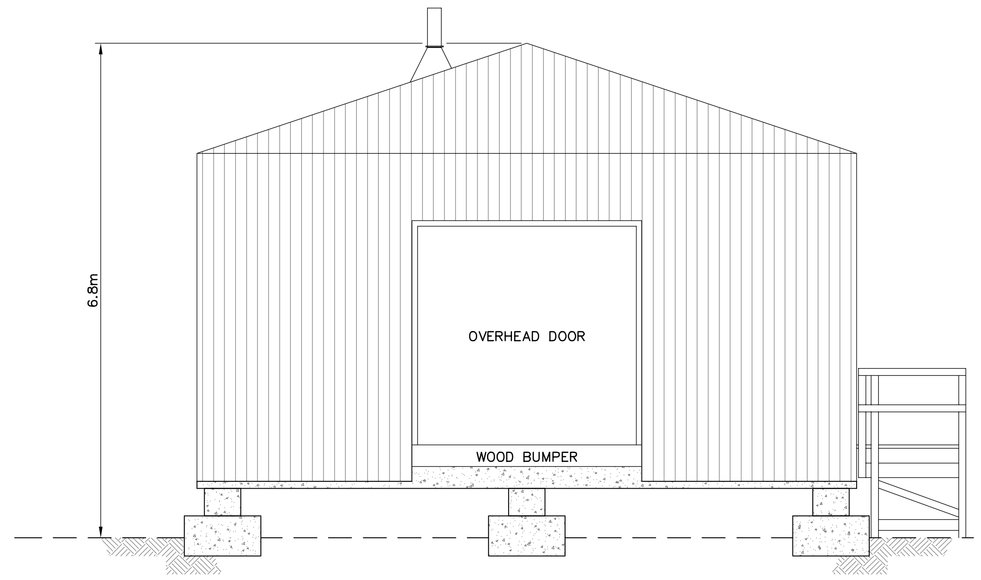
Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	S03 OF 07	C

R.048967.001-S03.dwg

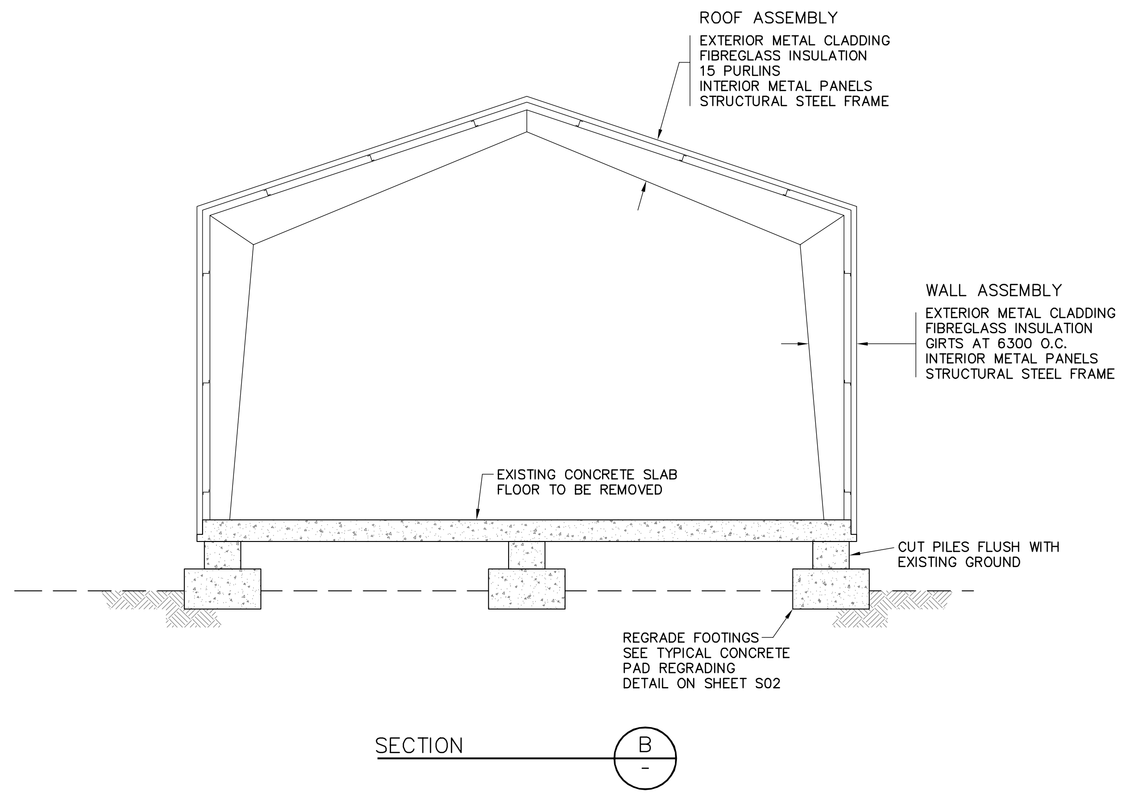
B1 – 1000 x 707



FLOOR PLAN



ELEVATION



SECTION B

m 0 0.5 1 1.5 SCALE 1:50

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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Client/client

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B. THOMPSON

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Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

WAREHOUSE FLOOR PLAN, ELEVATION AND SECTION

Project No./No. du projet	Sheet/Feuille	Revision no./ Le Révision no.
R.048967.001	S04 OF 07	C

R.048967.001-S04.dwg

Sheet Size: B1 (1000mm x 707mm) Saved by: Cech, Ione Plotted on: July 18, 2011
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B1 – 1000 x 707

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Plotted on: July 18, 2011
Saved by: Cech, Ione
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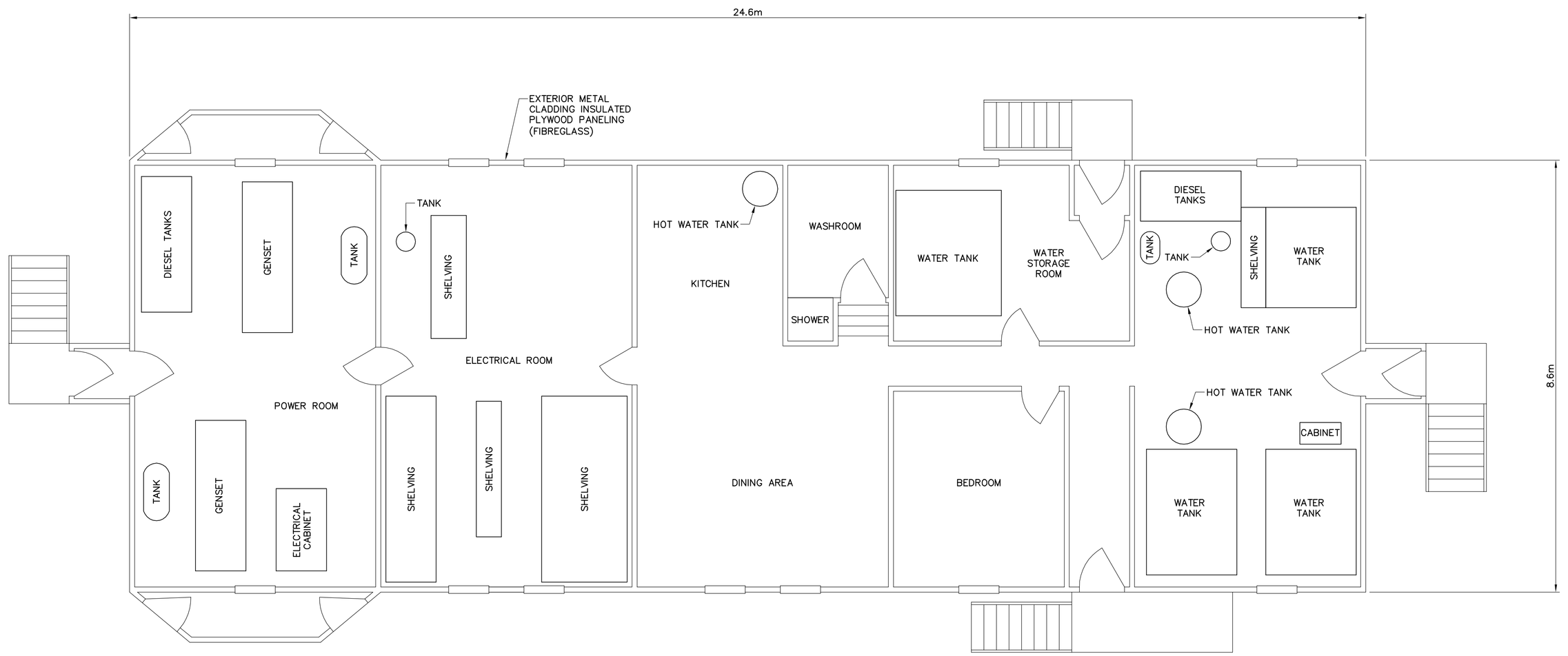
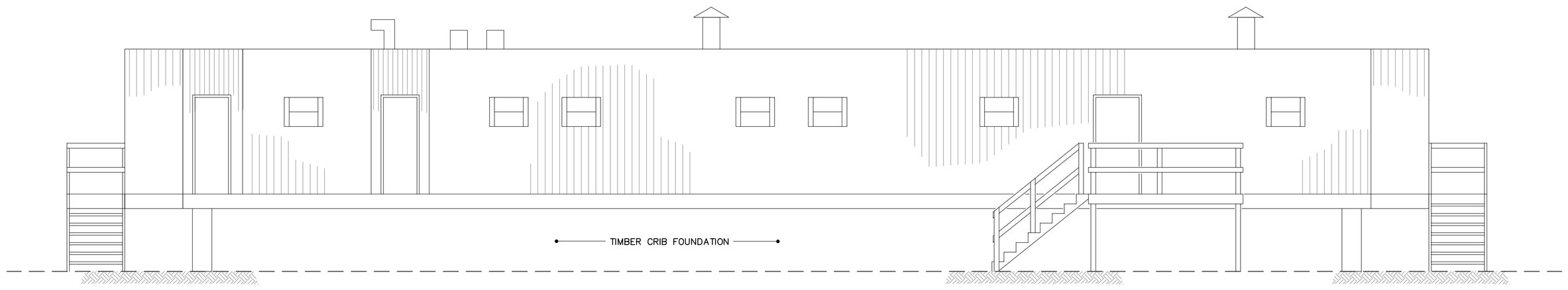


PLAN



ELEVATION

0 0.5 1 1.5 m SCALE 1:50

0 10 20 30 40 50 60 70 80 90 100 mm

B1 – 1000 x 707

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

MODULE TRAIN PLAN AND ELEVATION

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	S05 OF 07	C

R.048967.001-S05.dwg

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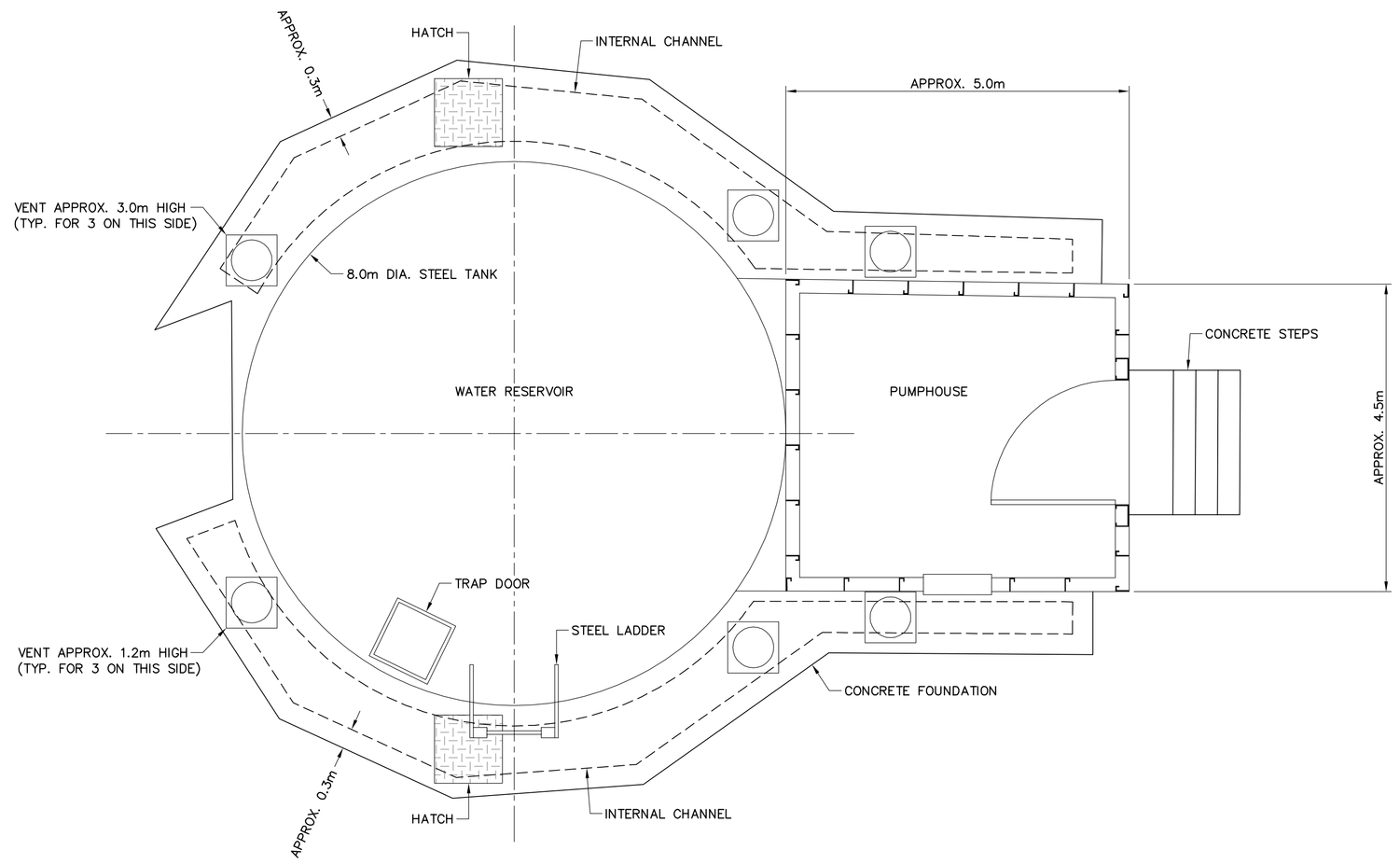
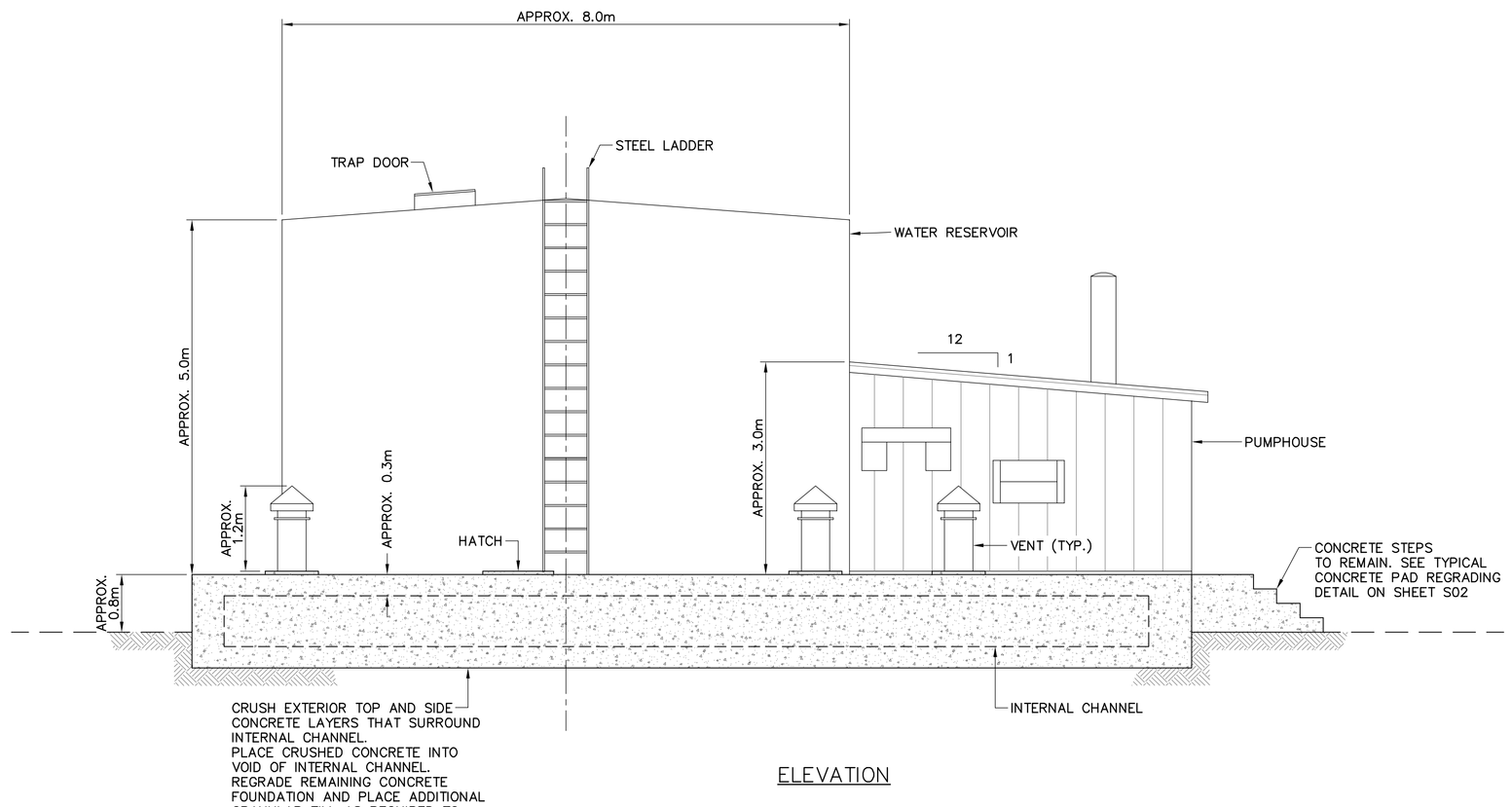


PLAN



ELEVATION

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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C	ISSUED FOR TENDER	11/07/20
B	ISSUED FOR 99% REVIEW	11/07/05
A	ISSUED FOR 75% REVIEW	11/06/06

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

FOX-E DURBAN ISLAND REMEDIATION PROJECT

Approved by/Approuve par
B. FEDORAK

Designed by/Concept par
C. CORRIGAN

Drawn by/Dessine par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

WATER RESERVOIR / PUMPHOUSE PLAN AND ELEVATION

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	S06 OF 07	C

0 0.5 1 1.5 m SCALE 1:50

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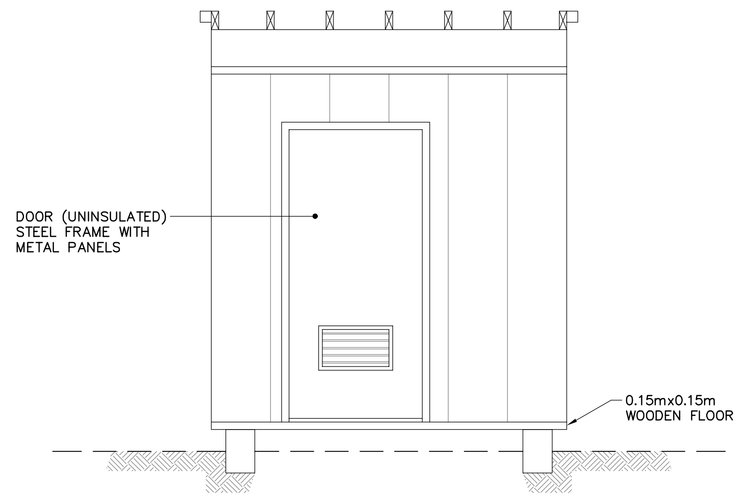
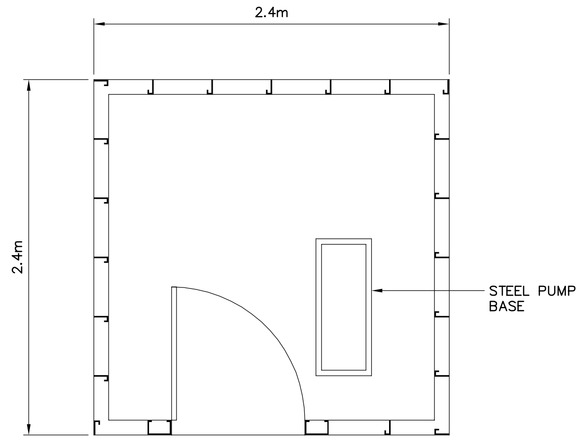
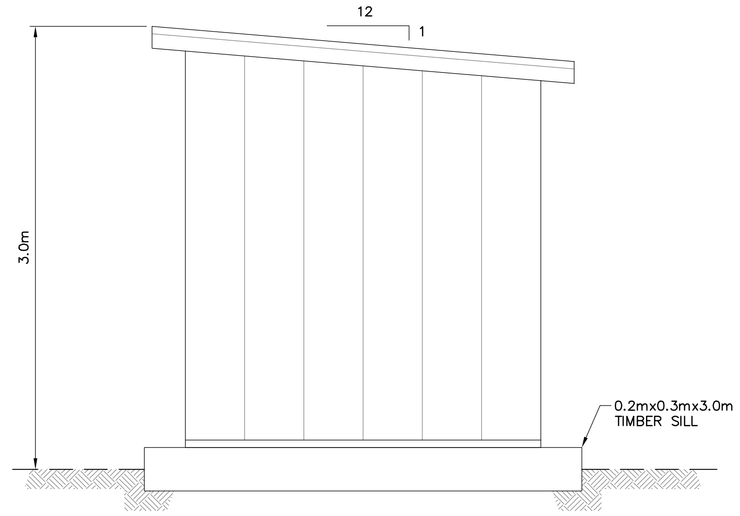


FRONT ELEVATION

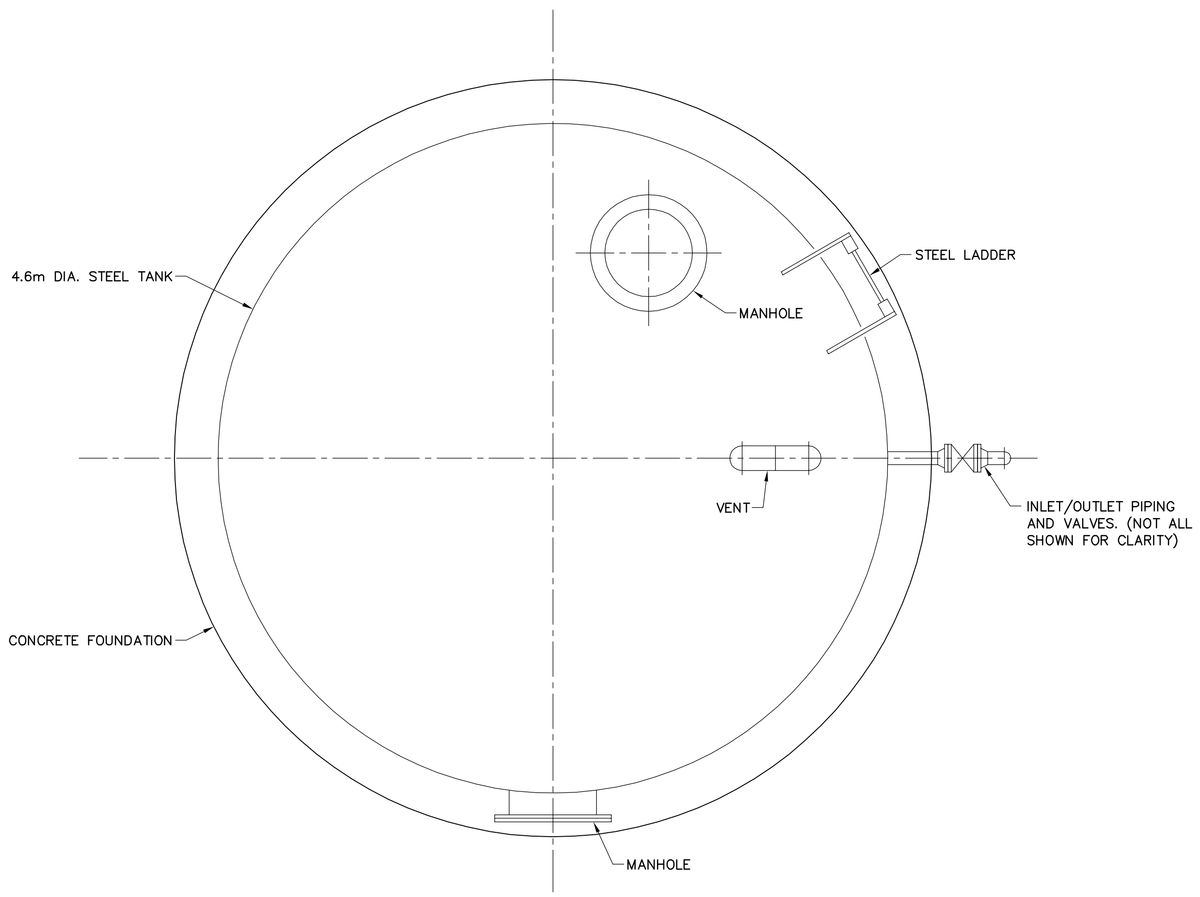


FLOOR PLAN

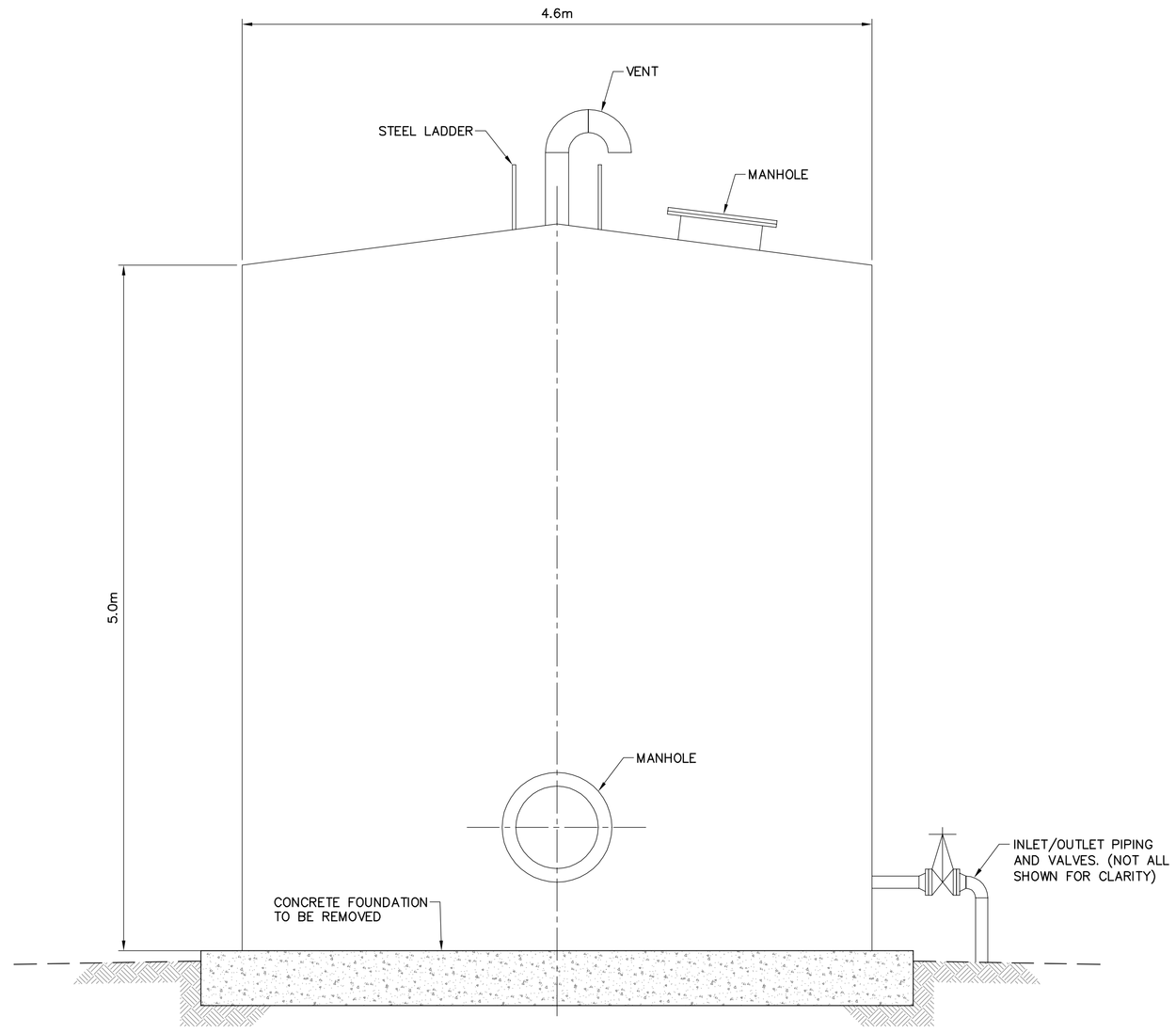


SIDE ELEVATION

POL PUMPHOUSE



PLAN



ELEVATION

FUEL TANK

SCALE 1:25

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
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Approved by/Approuve par
B. FEDORAK

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C. CORRIGAN

Drawn by/Dessine par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

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PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

POL PUMPHOUSE / TANK PLANS AND ELEVATIONS

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.001	S07 OF 07	C

Public Works and Government Services Canada

Travaux publics et Services gouvernementaux Canada

Indian and Northern Affairs Canada

Affaires indiennes et du Nord Canada

REAL PROPERTY SERVICES
Western Region

Canada

REMEDIATION PROJECT

DRAWING INDEX			
SHEET NO.	TITLE	SHEET NO.	TITLE
CIVIL		CIVIL	
R.048967.032 C50	COVER SHEET	R.048967.032 C55	STATION AREA SITE PLAN
R.048967.032 C51	LOCATION PLAN	R.048967.032 C56	SOUTH OF STATION AREA SITE PLAN
R.048967.032 C52	PROJECT AREA PLAN	R.048967.032 C57	WEST BEACH AREA SITE PLAN
R.048967.032 C53	OVERALL SITE PLAN	R.048967.032 C58	OLD HAMLET AREA SITE PLAN
R.048967.032 C54	POND AREA SITE PLAN	R.048967.032 C59	EAST BEACH AREA SITE PLAN

PADLOPING ISLAND, NUNAVUT
ISSUED FOR TENDER
JULY, 2011

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CANADIAN TOPOGRAPHIC MAPS (16-M/1 AND 16-M/2)
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SCALE 1:50000

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LEGEND:

SITE GRID (5000m INTERVAL)

Professional Seals / Sceaux

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LOCATION PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.032	C51 OF 59	C

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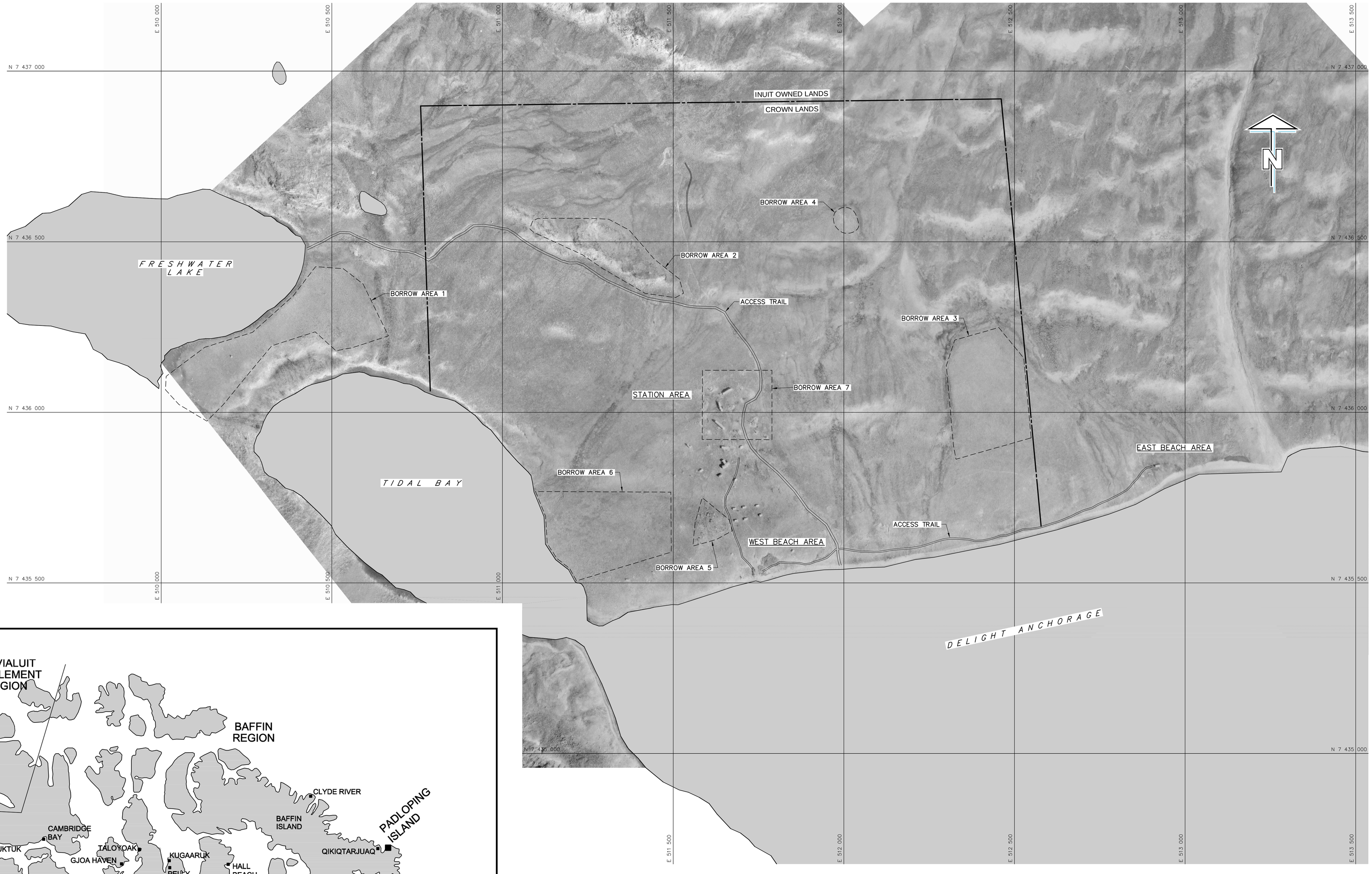

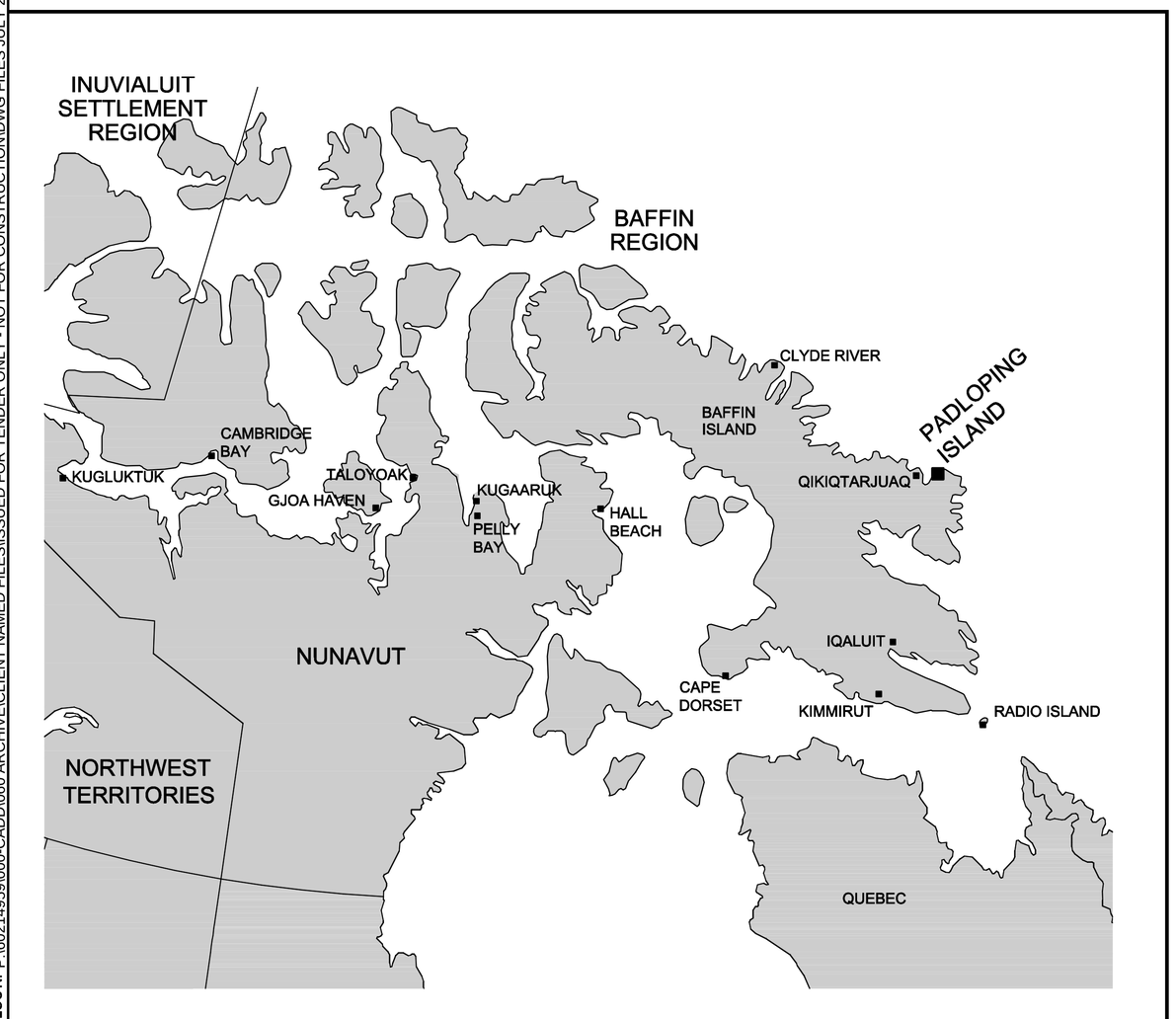

LOCATION OF PADLOPING ISLAND WITHIN NUNAVUT TERRITORY
SCALE: NTS

POTENTIAL SOURCE FOR GRANULAR MATERIAL			
BORROW AREA	GRANULAR TYPE (SECTION 31 05 17 IN SPECIFICATION)		
	TYPE 1	TYPE 2	TYPE 3
1 *			✔
2	✔	✔	✔
3 **			✔
4			✔
5			✔
6			✔
7			✔

* BORROW AREA 1 IS WITHIN INUIT OWNED LANDS.
** BORROW AREA 3 LIMITS HAVE BEEN ADJUSTED TO AVOID INUIT OWNED LANDS.

0 50 100 150 m SCALE 1:5000

B1 – 1000 x 707

0 10 20 30 40 50 60 70 80 90 100 mm

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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LEGEND:

- BODY OF WATER
- SITE GRID (500m INTERVAL)
- APPROXIMATE LOCATION OF PROPERTY BOUNDARIES
- APPROXIMATE EXTENT OF BORROW AREA

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PROJECT AREA PLAN

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R.048967.032-C52.dwg

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SURVEY CONTROL MONUMENTS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
CLS-44B1	7 435 666.199	512 578.053	3.282	GEODETIC BENCHMARK
CLS-44R2	7 435 676.708	512 599.590	3.629	GEODETIC BENCHMARK
CLS-45B1	7 436 918.700	512 460.947	121.486	GEODETIC BENCHMARK
CLS-46B1	7 436 898.384	510 759.874	41.698	GEODETIC BENCHMARK
CLS-47B1	7 436 062.869	510 788.024	0.968	GEODETIC BENCHMARK
CLS-47R2	7 436 065.106	510 812.126	2.859	GEODETIC BENCHMARK

TEMPORARY BENCHMARKS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
TBM-50	7 436 899.748	512 354.187	117.025	IRON BAR
TBM-51	7 436 593.998	512 401.215	83.342	IRON BAR
TBM-52	7 436 269.693	511 467.328	39.254	IRON BAR
TBM-53	7 435 871.749	511 360.908	24.465	IRON BAR

0 50 100 150 m SCALE 1:5000

0 10 20 30 40 50 60 70 80 90 100 mm

B1 – 1000 x 707

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3. CULVERTS TO BE REMOVED AND CULVERT AREA TO BE GRADED TO DRAIN PRIOR TO PROJECT COMPLETION.

LEGEND:

- BODY OF WATER
- SITE GRID (500m INTERVAL)
- APPROXIMATE LOCATION OF PROPERTY BOUNDARIES
- APPROXIMATE EXTENT OF BORROW AREA
- APPROXIMATE EXTENT OF DEBRIS AREA
- ARCHAEOLOGICAL AREA
- ARCHAEOLOGICAL FEATURE
- SURVEY CONTROL MONUMENT
- TEMPORARY BENCHMARK
- TESTPIT LOCATION

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OVERALL SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.032	C53 OF 59	C

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E 511 250 · E 511 300 · E 511 350 · E 511 400 · E 511 450 · E 511 500 · E 511 550 · E 511 600

N 7 436 800 · N 7 436 750 · N 7 436 700 · N 7 436 650 · N 7 436 600 · N 7 436 550

BURIED DEBRIS AREA LOBE E EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
501	7 436 756.4	511 491.0
502	7 436 758.0	511 492.2
503	7 436 758.2	511 493.5
504	7 436 757.6	511 495.6
505	7 436 756.5	511 496.8
506	7 436 754.2	511 496.4
507	7 436 753.3	511 494.1
508	7 436 753.2	511 492.3
509	7 436 754.0	511 491.0

BURIED DEBRIS AREA LOBE F EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
510	7 436 760.6	511 520.6
511	7 436 761.5	511 521.4
512	7 436 762.0	511 524.8
513	7 436 761.2	511 526.3
514	7 436 760.0	511 526.4
515	7 436 759.0	511 526.0
516	7 436 757.4	511 523.3
517	7 436 757.7	511 521.1

BURIED DEBRIS AREA LOBE G EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
520	7 436 729.3	511 495.0
521	7 436 731.8	511 498.7
522	7 436 729.3	511 505.6
523	7 436 719.2	511 505.8
524	7 436 718.5	511 498.8
525	7 436 723.4	511 498.2
526	7 436 726.6	511 494.9

BURIED DEBRIS AREA LOBE E: APPROXIMATE PERIMETER OF BURIED DEBRIS TO BE EXCAVATED. ANTICIPATED DEPTH OF EXCAVATION IS 0.6m (SEE NOTE 4)

BURIED DEBRIS AREA LOBE F: APPROXIMATE PERIMETER OF BURIED DEBRIS TO BE EXCAVATED. ANTICIPATED DEPTH OF EXCAVATION IS 0.6m (SEE NOTE 4)

BURIED DEBRIS AREA LOBE G: APPROXIMATE PERIMETER OF BURIED DEBRIS TO BE EXCAVATED. ANTICIPATED DEPTH OF EXCAVATION IS 0.7m (SEE NOTE 4)

DEBRIS AREA 6

DEBRIS AREA 6

DEBRIS AREA 6

ACCESS TRAIL

BORROW AREA 2

TP5

0 5 10 15 m SCALE 1:500

0 10 20 30 40 50 60 70 80 90 100 mm

B1 – 1000 x 707

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
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3. ALL SURFACE DEBRIS IS TO BE REMOVED FROM ALL CONTAMINATED SOIL AREAS AND EXISTING BURIED DEBRIS AREAS PRIOR TO EXCAVATION TAKING PLACE.
4. REPLACE CLEAN BURIED DEBRIS EXCAVATION SOILS FROM THE EXCAVATION OF LOBES E, F AND G AS BACKFILL. CAP AREAS WITH 0.3m OF TYPE 3 GRANULAR FILL OVER THE CLEAN BACKFILL TO PREVENT PONDING.

LEGEND:

- SITE GRID (50m INTERVAL)
- APPROXIMATE EXTENT OF BORROW AREA
- APPROXIMATE EXTENT OF DEBRIS AREA
- TESTPIT LOCATION
- BURIED DEBRIS EXCAVATION

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Project title/Titre du projet

PADLOPING ISLAND REMEDIATION PROJECT

Approved by/Approuve par: **B. FEDORAK**

Designed by/Concept par: **C. CORRIGAN**

Drawn by/Dessine par: **I. CECH**

PWGSC Project Manager/Administrateur de Projets TPSGC: **B. THOMPSON**

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client: **PUBLIC WORKS AND GOVERNMENT SERVICES CANADA**

Drawing title/Titre du dessin

POND AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.032	C54 OF 59	C

R.048967.032-C54.dwg

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Sheet Size B1 (1000mm x 707mm)

B1 – 1000 x 707

0 10 20 30 40 50 60 70 80 90 100 mm

R.048967.032-C55.dwg

Project No./No. du projet	Sheet/Feuille	Revision no./Le Révision no.
R.048967.032	C55 OF 59	C

0 5 10 15 m SCALE 1:500

TYPE A PHC CONTAMINATED SOIL
EXCAVATION (GB 10-0049)

NO.	COORDINATES	
	NORTHING	EASTING
H1	7 436 017.9	511 675.7
H2	7 436 007.7	511 688.2
H3	7 435 992.4	511 677.1
H4	7 435 997.1	511 671.3
H5	7 435 999.2	511 672.8
H6	7 436 006.2	511 665.5

TIER II CONTAMINATED SOIL
EXCAVATION (MG 7519)

NO.	COORDINATES	
	NORTHING	EASTING
J1	7 436 016.1	511 632.3
J2	7 436 017.1	511 635.9
J3	7 436 013.1	511 637.0
J4	7 436 012.1	511 633.3

TIER I CONTAMINATED SOIL
EXCAVATION (MG 7521)

NO.	COORDINATES	
	NORTHING	EASTING
K1	7 435 996.7	511 642.6
K2	7 435 997.6	511 645.5
K3	7 435 994.6	511 646.4
K4	7 435 994.0	511 643.5

TIER II CONTAMINATED SOIL
EXCAVATION (KMH 10-0033)

NO.	COORDINATES	
	NORTHING	EASTING
L1	7 435 978.6	511 748.7
L2	7 435 981.6	511 751.5
L3	7 435 978.7	511 754.6
L4	7 435 975.6	511 751.9

BURIED DEBRIS AREA LOBE H
EXCAVATION

NO.	COORDINATES	
	NORTHING	EASTING
601	7 435 944.7	511 759.5
602	7 435 946.1	511 761.1
603	7 435 943.2	511 767.0
604	7 435 941.0	511 768.1
605	7 435 937.5	511 768.1
606	7 435 936.4	511 764.8
607	7 435 933.5	511 765.1
608	7 435 931.1	511 763.5
609	7 435 927.4	511 763.1
610	7 435 927.7	511 761.5
611	7 435 933.5	511 762.4
612	7 435 935.0	511 762.3
613	7 435 936.4	511 765.6
614	7 435 940.2	511 764.3
615	7 435 941.9	511 760.5

TIER II CONTAMINATED SOIL
EXCAVATION (GB 10-0053)

NO.	COORDINATES	
	NORTHING	EASTING
616	7 436 031.4	511 686.1
617	7 436 021.5	511 689.3
618	7 436 023.9	511 693.3
619	7 436 020.6	511 686.2

TYPE A PHC CONTAMINATED SOIL
EXCAVATION (GB 10-0047)

NO.	COORDINATES	
	NORTHING	EASTING
620	7 435 919.7	511 766.2
621	7 435 920.9	511 768.3
622	7 435 920.9	511 770.0
623	7 435 919.8	511 771.3
624	7 435 918.8	511 771.5
625	7 435 917.7	511 771.2
626	7 435 916.7	511 769.1
627	7 435 916.7	511 766.9
628	7 435 917.2	511 766.1
629	7 435 918.8	511 766.0

BURIED DEBRIS AREA LOBE I
EXCAVATION

NO.	COORDINATES	
	NORTHING	EASTING
630	7 435 923.2	511 773.1
631	7 435 923.2	511 774.8
632	7 435 921.8	511 775.1
633	7 435 920.4	511 774.8
634	7 435 920.4	511 773.1
635	7 435 921.8	511 771.4

TIER II CONTAMINATED SOIL
EXCAVATION (MS 10-0069)

NO.	COORDINATES	
	NORTHING	EASTING
C1	7 436 029.8	511 598.2
C2	7 436 031.5	511 601.5
C3	7 436 028.1	511 603.4
C4	7 436 026.3	511 600.1

TYPE B PHC CONTAMINATED SOIL
EXCAVATION (MS 10-0072)

NO.	COORDINATES	
	NORTHING	EASTING
B1	7 436 036.3	511 596.7
B2	7 436 038.4	511 601.7
B3	7 436 035.4	511 603.8
B4	7 436 031.4	511 598.8

TYPE B PHC CONTAMINATED SOIL
EXCAVATION (BI 10-0082)

NO.	COORDINATES	
	NORTHING	EASTING
A1	7 436 057.2	511 614.5
A2	7 436 059.6	511 617.6
A3	7 436 055.4	511 621.3
A4	7 436 052.8	511 618.2

TIER II CONTAMINATED SOIL
EXCAVATION (MW 10-0004)

NO.	COORDINATES	
	NORTHING	EASTING
E1	7 436 061.9	511 731.2
E2	7 436 053.9	511 747.7
E3	7 436 032.7	511 736.5
E4	7 436 040.6	511 720.9

TYPE A PHC CONTAMINATED SOIL
EXCAVATION (FA P48)

NO.	COORDINATES	
	NORTHING	EASTING
D1	7 436 080.9	511 702.6
D2	7 436 073.9	511 713.1
D3	7 436 058.9	511 703.3
D4	7 436 067.4	511 691.5

TYPE B PHC/TIER II CONTAMINATED SOIL
EXCAVATION (SW 10-0043)

NO.	COORDINATES	
	NORTHING	EASTING
N1	7 435 964.6	511 739.7
N2	7 435 964.0	511 740.4
N3	7 435 957.2	511 734.5
N4	7 435 957.9	511 733.5

TYPE B PHC/TIER II CONTAMINATED SOIL
EXCAVATION (KMH 10-0024)

NO.	COORDINATES	
	NORTHING	EASTING
M1	7 435 973.1	511 754.4
M2	7 435 973.3	511 748.0
M3	7 435 966.3	511 747.7
M4	7 435 959.3	511 743.2
M5	7 435 957.1	511 732.0
M6	7 435 954.9	511 727.9
M7	7 435 962.7	511 735.8

TIER II CONTAMINATED SOIL
EXCAVATION (KMH 10-0025)

NO.	COORDINATES	
	NORTHING	EASTING
N5	7 435 962.2	511 702.3
P1	7 435 942.8	511 697.4
P2	7 435 937.8	511 697.5
P3	7 435 938.2	511 699.9

TIER II CONTAMINATED SOIL (SW P02)

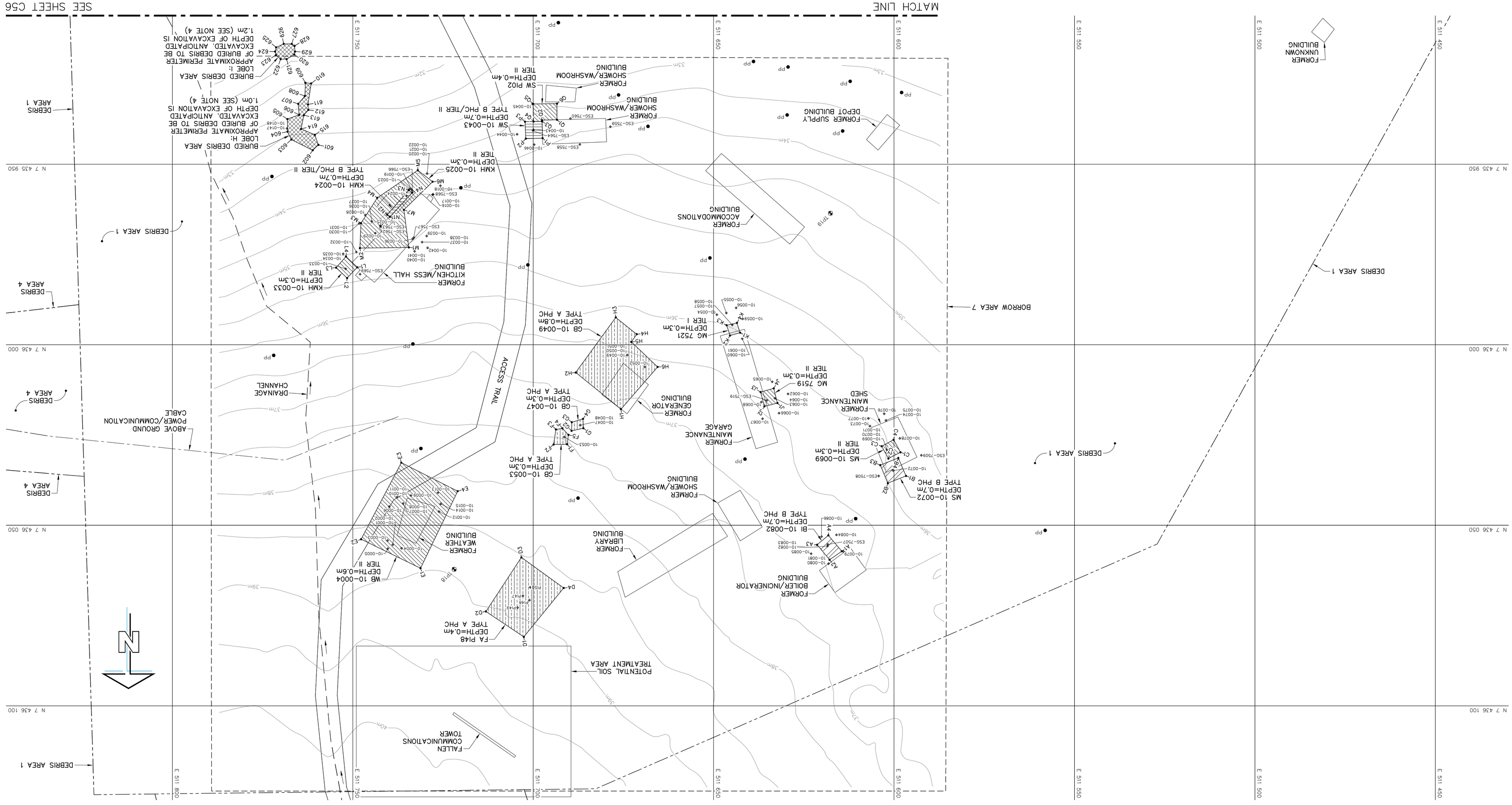
NO.	COORDINATES	
	NORTHING	EASTING
Q1	7 435 937.7	511 693.4
Q2	7 435 933.3	511 697.5
Q3	7 435 938.2	511 697.5
Q4	7 435 933.3	511 699.9
Q5	7 435 933.3	511 700.0
Q6	7 435 933.3	511 693.4

TYPE A PHC CONTAMINATED SOIL
EXCAVATION (GB 10-0049)

NO.	COORDINATES	
	NORTHING	EASTING
H1	7 436 017.9	511 675.7
H2	7 436 007.7	511 688.2
H3	7 435 992.4	511 677.1
H4	7 435 997.1	511 671.3
H5	7 435 999.2	511 672.8
H6	7 436 006.2	511 665.5

CONTAMINATED SOIL TO BE EXCAVATED

AREA NAME	APPROX. AREA (m²)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m³)	CONTAINMENT CLASSIFICATION	COMMENTS	REFERENCE POINTS	
						NORTHING	EASTING
BI 10-0082	23	0.7	21	ON SITE TREATMENT	7 436 056	511 618	
FA P48	240	0.4	102	OFF SITE DISPOSAL	7 436 070	511 702	
GB 10-0047	8	0.3	3	TYPE A PHC	OFF SITE DISPOSAL	7 436 022	511 688
GB 10-0049	289	0.8	254	TYPE A PHC	OFF SITE DISPOSAL	7 436 006	511 677
GB 10-0053	15	0.3	6	TYPE A PHC	OFF SITE DISPOSAL	7 436 026	511 692
KMH 10-0024	10	0.7	12	TYPE B PHC/TIER II	OFF SITE DISPOSAL	7 435 961	511 737
KMH 10-0025	211	0.3	66	TIER II	OFF SITE DISPOSAL	7 435 962	511 741
MG 7519	16	0.3	6	TIER II	OFF SITE DISPOSAL	7 436 014	511 635
MG 7521	9	0.3	4	TIER I	OFF SITE DISPOSAL	7 435 996	511 644
MS 10-0069	15	0.3	6	TIER II	OFF SITE DISPOSAL	7 436 029	511 601
MS 10-0072	29	0.7	26	TYPE B PHC	ON SITE TREATMENT	7 436 035	511 600
MS 10-0043	22	0.7	20	TYPE B PHC/TIER II	OFF SITE DISPOSAL	7 435 941	511 700
SW P02	30	0.4	14	TIER II	OFF SITE DISPOSAL	7 435 936	511 697
WB 10-0004	426	0.6	271	TIER II	OFF SITE DISPOSAL	7 436 048	511 734



LEGEND:

- SITE GRID (50m INTERVAL)
- APPROXIMATE EXTENT OF BORROW AREA
- APPROXIMATE EXTENT OF DEBRIS AREA
- TESTPIT LOCATION
- SAMPLE LOCATION
- UTILITY POLE
- BURIED DEBRIS EXCAVATION
- TIER I CONTAMINATED SOIL
- TIER II CONTAMINATED SOIL
- TYPE A PHC CONTAMINATED SOIL
- TYPE B PHC CONTAMINATED SOIL
- TYPE B PHC / TIER II CONTAMINATED SOIL

GENERAL NOTES:

1. ALL COORDINATES ARE REFERENCED TO NAD83 (CSRS), UTM ZONE 20W. ALL ELEVATIONS REFER TO GEODETIC DATUM.
2. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. ALL SURFACE DEBRIS IS TO BE REMOVED FROM ALL CONTAMINATED SOIL AREAS AND EXISTING BURIED DEBRIS AREAS PRIOR TO EXCAVATION TAKING PLACE.
4. REPLACE CLEAN BURIED DEBRIS EXCAVATION SOILS FROM THE EXCAVATION OF LOBES H AND I AS BACKFILL. CAP AREAS WITH 0.3m OF TYPE 3 GRANULAR FILL OVER THE CLEAN BACKFILL TO PREVENT PONDING.

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Revision/ Révision	Description/Description	Date/Date
C	ISSUED FOR TENDER	11/07/20
B	ISSUED FOR 99% REVIEW	11/07/05
A	ISSUED FOR 75% REVIEW	11/06/06

Client/Client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

PADLOPING ISLAND REMEDIATION PROJECT

Approved by/Approuvé par
B. FEDORAK

Designed by/Concept par
C. CORRIGAN

Drawn by/Dessiné par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC Architectural and Engineering Resources Manager/ Ressources Architectural et de Génieur d'ingénieur, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin
STATION AREA SITE PLAN

PRELIMINARY NOT FOR CONSTRUCTION

AECOM

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'Ouest

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

Sheet Size: B1 (1000mm x 707mm)
Saved by: Cech, Ione
Plotted on: July 18, 2011
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CONTAMINATED SOIL TO BE EXCAVATED							
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	CONTAINMENT CLASSIFICATION	COMMENTS	REFERENCE POINTS	
						NORTHING	EASTING
OGB 10-0087	12	0.7	12	TYPE B PHC	ON SITE TREATMENT	7 435 895	511 647
OGB 10-0093	5	0.4	3	TYPE A PHC	OFF SITE DISPOSAL	7 435 890	511 646
OGB 10-0094	9	0.4	5	TYPE A PHC	OFF SITE DISPOSAL	7 435 885	511 649
WTB 7596	8	0.3	4	TIER II	OFF SITE DISPOSAL	7 435 852	511 647

TYPE B PHC CONTAMINATED SOIL EXCAVATION (OGB 10-0087)		
NO.	COORDINATES	
	NORTHING	EASTING
R1	7 435 897.7	511 645.8
R2	7 435 897.5	511 648.3
R3	7 435 892.7	511 647.7
R4	7 435 893.0	511 645.3

TYPE A PHC CONTAMINATED SOIL EXCAVATION (OGB 10-0093)		
NO.	COORDINATES	
	NORTHING	EASTING
S1	7 435 891.6	511 645.5
S2	7 435 891.6	511 647.5
S3	7 435 889.3	511 647.5
S4	7 435 889.3	511 645.5

TYPE A PHC CONTAMINATED SOIL EXCAVATION (OGB 10-0094)		
NO.	COORDINATES	
	NORTHING	EASTING
T1	7 435 886.1	511 647.1
T2	7 435 886.1	511 649.8
T3	7 435 882.8	511 651.1
T4	7 435 883.4	511 647.4

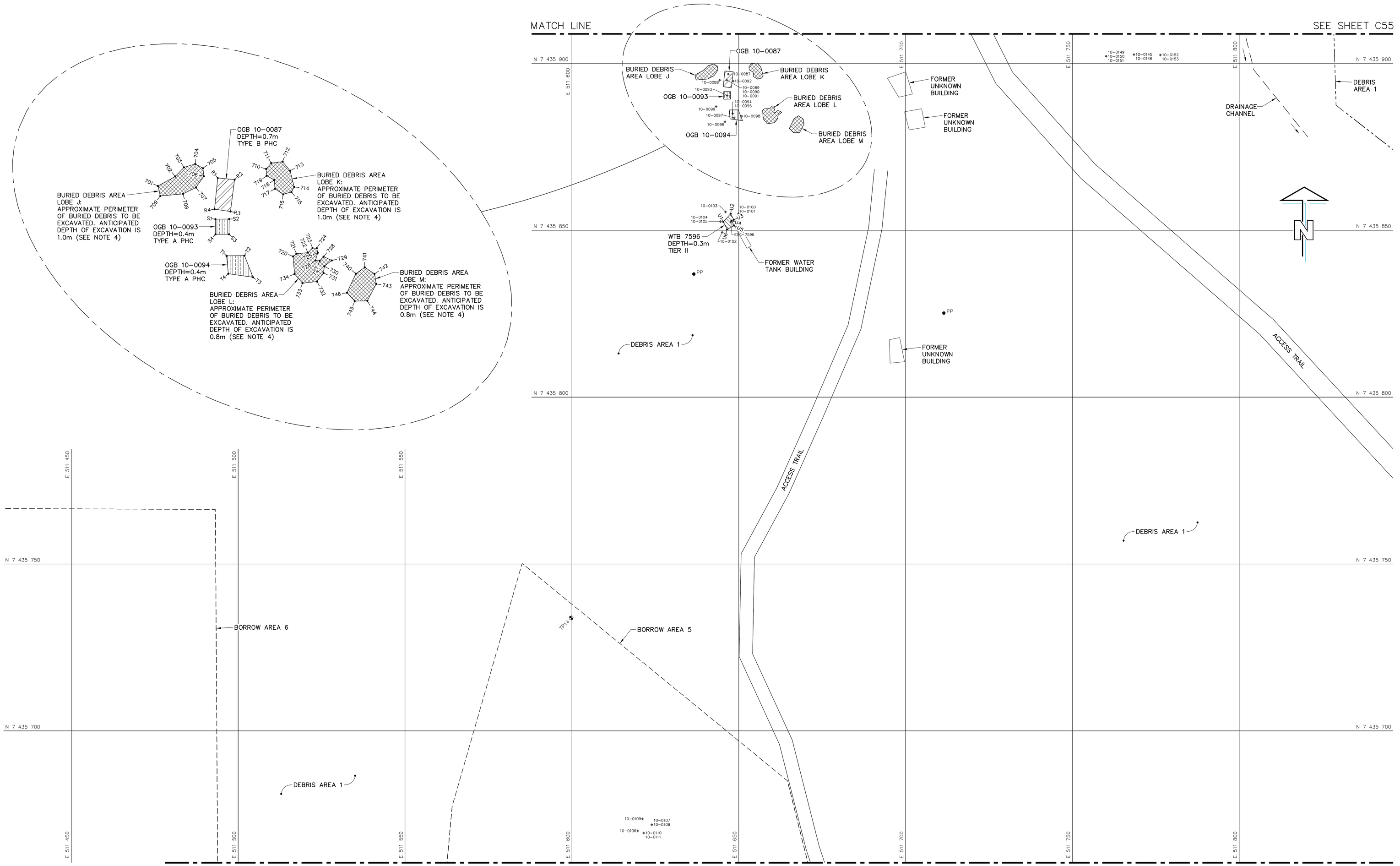
TIER II CONTAMINATED SOIL EXCAVATION (WTB 7596)		
NO.	COORDINATES	
	NORTHING	EASTING
U1	7 435 852.5	511 645.4
U2	7 435 855.0	511 647.6
U3	7 435 853.1	511 648.5
U4	7 435 852.8	511 647.8
U5	7 435 851.4	511 648.6
U6	7 435 850.2	511 646.5

BURIED DEBRIS AREA LOBE J EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
701	7 435 896.5	511 636.9
702	7 435 897.9	511 639.4
703	7 435 899.3	511 640.8
704	7 435 899.8	511 642.5
705	7 435 899.2	511 643.6
706	7 435 898.0	511 643.7
707	7 435 896.3	511 642.6
708	7 435 895.3	511 640.6
709	7 435 895.0	511 637.2

BURIED DEBRIS AREA LOBE K EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
710	7 435 899.1	511 653.1
711	7 435 900.0	511 653.8
712	7 435 900.2	511 655.5
713	7 435 898.8	511 656.7
714	7 435 896.4	511 657.3
715	7 435 895.6	511 656.9
716	7 435 895.3	511 655.6
717	7 435 896.1	511 654.4
718	7 435 897.4	511 654.3
719	7 435 898.1	511 653.2

BURIED DEBRIS AREA LOBE L EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
720	7 435 886.0	511 657.1
721	7 435 886.4	511 657.6
722	7 435 886.5	511 659.3
723	7 435 887.2	511 660.0
724	7 435 887.2	511 660.7
725	7 435 886.5	511 660.8
726	7 435 885.4	511 660.5
727	7 435 885.3	511 661.1
728	7 435 885.9	511 661.7
729	7 435 885.4	511 662.9
730	7 435 884.5	511 661.8
731	7 435 883.5	511 661.7
732	7 435 882.2	511 660.7
733	7 435 882.0	511 658.5
734	7 435 883.3	511 657.3

BURIED DEBRIS AREA LOBE M EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
740	7 435 883.4	511 666.5
741	7 435 884.3	511 667.8
742	7 435 883.4	511 669.3
743	7 435 881.9	511 669.6
744	7 435 879.3	511 668.2
745	7 435 879.3	511 666.3
746	7 435 880.5	511 665.2



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4. REPLACE CLEAN BURIED DEBRIS EXCAVATION SOILS FROM THE EXCAVATION OF LOBES J, K, L AND M AS BACKFILL. CAP AREAS WITH 0.3m OF TYPE 3 GRANULAR FILL OVER THE CLEAN BACKFILL TO PREVENT PONDING.

LEGEND:

- SITE GRID (50m INTERVAL)
- APPROXIMATE EXTENT OF BORROW AREA
- APPROXIMATE EXTENT OF DEBRIS AREA
- TESTPIT LOCATION
- SAMPLE LOCATION
- UTILITY POLE
- BURIED DEBRIS EXCAVATION
- TIER II CONTAMINATED SOIL
- TYPE A PHC CONTAMINATED SOIL
- TYPE B PHC CONTAMINATED SOIL

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REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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Revision/ Revision	Description/Description	Date/Date
C	ISSUED FOR TENDER	11/07/20
B	ISSUED FOR 99% REVIEW	11/07/05
A	ISSUED FOR 75% REVIEW	11/06/06

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

PADLOPING ISLAND REMEDIATION PROJECT

Approved by/Approuvé par
B. FEDORAK

Designed by/Concept par
C. CORRIGAN

Drawn by/Dessiné par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

Client/client
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

SOUTH OF STATION AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.032	C56 OF 59	C

B1 – 1000 x 707

R.048967.032-C56.dwg

Sheet Size: B1 (1000mm x 707mm)
Saved by: Cech, Ione
Plotted on: July 18, 2011
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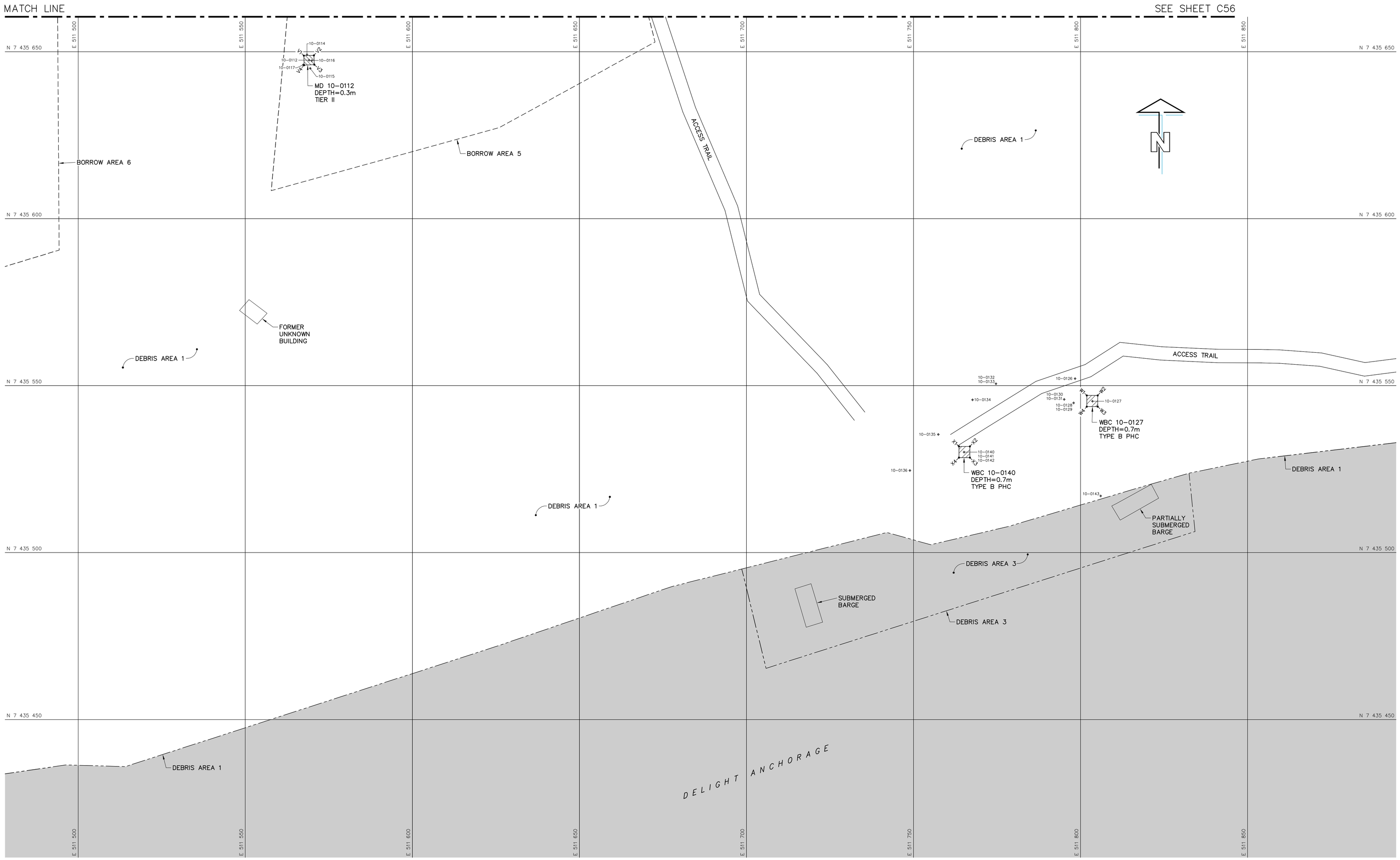
CONTAMINATED SOIL TO BE EXCAVATED							
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	CONTAINMENT CLASSIFICATION	COMMENTS	REFERENCE POINTS	
						NORTHING	EASTING
MD 10-0112	9	0.3	4	TIER II	OFF SITE DISPOSAL	7 435 647	511 569
WBC 10-0127	11	0.7	11	TYPE B PHC	ON SITE TREATMENT	7 435 545	511 804
WBC 10-0140	11	0.7	11	TYPE B PHC	ON SITE TREATMENT	7 435 530	511 765

TIER II CONTAMINATED SOIL EXCAVATION (10-0112)		
NO.	COORDINATES	
	NORTHING	EASTING
V1	7 435 648.8	511 567.5
V2	7 435 648.9	511 570.5
V3	7 435 646.1	511 570.6
V4	7 435 646.0	511 567.6

TYPE B PHC CONTAMINATED SOIL EXCAVATION (WBC 10-0127)		
NO.	COORDINATES	
	NORTHING	EASTING
W1	7 435 547.1	511 801.9
W2	7 435 547.1	511 805.1
W3	7 435 543.7	511 805.1
W4	7 435 543.7	511 801.9

TYPE B PHC CONTAMINATED SOIL EXCAVATION (WBC 10-0140)		
NO.	COORDINATES	
	NORTHING	EASTING
X1	7 435 531.8	511 763.6
X2	7 435 531.8	511 766.9
X3	7 435 528.5	511 766.9
X4	7 435 528.5	511 763.6



Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

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LEGEND:

- BODY OF WATER
- SITE GRID (50m INTERVAL)
- APPROXIMATE EXTENT OF BORROW AREA
- APPROXIMATE EXTENT OF DEBRIS AREA
- 10-0114 SAMPLE LOCATION
- TIER II CONTAMINATED SOIL
- TYPE B PHC CONTAMINATED SOIL

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Revision/ Revision	Description/Description	Date/Date
C	ISSUED FOR TENDER	11/07/20
B	ISSUED FOR 99% REVIEW	11/07/05
A	ISSUED FOR 75% REVIEW	11/06/06

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

PADLOPING ISLAND REMEDIATION PROJECT

Approved by/Approuvé par: **B. FEDORAK**
Designed by/Concept par: **C. CORRIGAN**
Drawn by/Dessiné par: **I. CECH**
PWGSC Project Manager/Administrateur de Projets TPSGC: **B. THOMPSON**
PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC
Client/client: **PUBLIC WORKS AND GOVERNMENT SERVICES CANADA**

Drawing title/Titre du dessin

WEST BEACH AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.032	C57 OF 59	C

CADD FILE LOCN: P:\60214959\000\CADD\060 ARCHIVE\CLIENT NAMED FILES\ISSUED FOR TENDER ONLY - NOT FOR CONSTRUCTION\DWG FILES JULY 20 2011\R.048967.032-C58.DWG
Plotted on: July 18, 2011
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Sheet Size: B1 (1000mm x 707mm)

B1 – 1000 x 707

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SCALE 1:500

0 5 10 15 m

MATCH LINE

SEE SHEET C59

DELIGHT ANCHORAGE

E 512 750
E 512 700
E 512 650
E 512 600
E 512 550
E 512 500
E 512 450
E 512 400

N 7 435 900
N 7 435 850
N 7 435 800
N 7 435 750
N 7 435 700
N 7 435 650

ACCESS TRAIL

INUIT OWNED LANDS
CROWN LANDS

DEBRIS AREA 2

BURIED DEBRIS AREA LOBE D: APPROXIMATE PERIMETER OF BURIED DEBRIS TO BE EXCAVATED. ANTICIPATED DEPTH OF EXCAVATION IS 0.6m (SEE NOTE 4)

801
802
803
804

BORROW AREA 3

10-0139
10-0156
10-0157
10-0154
10-0155

TP10
TP11
TP15

16m
17m
18m
19m
20m
21m
22m
23m
24m
25m
26m

BURIED DEBRIS AREA LOBE D EXCAVATION			
NO.	COORDINATES		
	EASTING	NORTHING	
801	512 491.1	7 435 688.2	
802	512 493.8	7 435 688.5	
803	512 496.1	7 435 686.1	
804	512 493.7	7 435 683.3	

SURVEY CONTROL MONUMENTS				
NO.	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
CLS-44B1	7 435 666.199	512 578.053	3.282	GEODETIC BENCHMARK
CLS-44R2	7 435 676.708	512 599.590	3.629	GEODETIC BENCHMARK

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4. REPLACE CLEAN BURIED DEBRIS EXCAVATION SOILS FROM THE EXCAVATION OF LOBE D AS BACKFILL. CAP AREA WITH 0.3m OF TYPE 3 GRANULAR FILL OVER THE CLEAN BACKFILL TO PREVENT PONDING.

LEGEND:

- BODY OF WATER
- SITE GRID (50m INTERVAL)
- APPROXIMATE PERIMETER OF PROPERTY BOUNDARIES
- APPROXIMATE EXTENT OF BORROW AREA
- APPROXIMATE EXTENT OF DEBRIS AREA
- ARCHAEOLOGICAL FEATURE
- SURVEY CONTROL MONUMENT
- TESTPIT LOCATION
- 10-0154 SAMPLE LOCATION
- BURIED DEBRIS EXCAVATION

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C	ISSUED FOR TENDER	11/07/20

Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project title/Titre du projet

PADLOPING ISLAND REMEDIATION PROJECT

Approved by/approuvé par
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Designed by/Conçu par
C. CORRIGAN

Drawn by/Dessiné par
I. CECH

PWGSC Project Manager/Administrateur de Projets TPSGC
B. THOMPSON

PWGSC Architectural and Engineering Resources Manager/ Ressources Architectural et de Génieur d'ingénierie, TPSGC

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PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin
OLD HAMLET AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ Le Révision no.
R.048967.032	C58 OF 59	C

R.048967.032-C58.dwg

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CONTAMINATED SOIL TO BE EXCAVATED							
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	CONTAINMENT CLASSIFICATION	COMMENTS	REFERENCE POINTS	
						NORTHING	EASTING
OP 10-0118	43	0.3	14	TIER II	OFF SITE DISPOSAL	7 435 807	512 869
OP 10-0121	54	0.7	45	HAZARDOUS	OFF SITE DISPOSAL	7 435 804	512 873

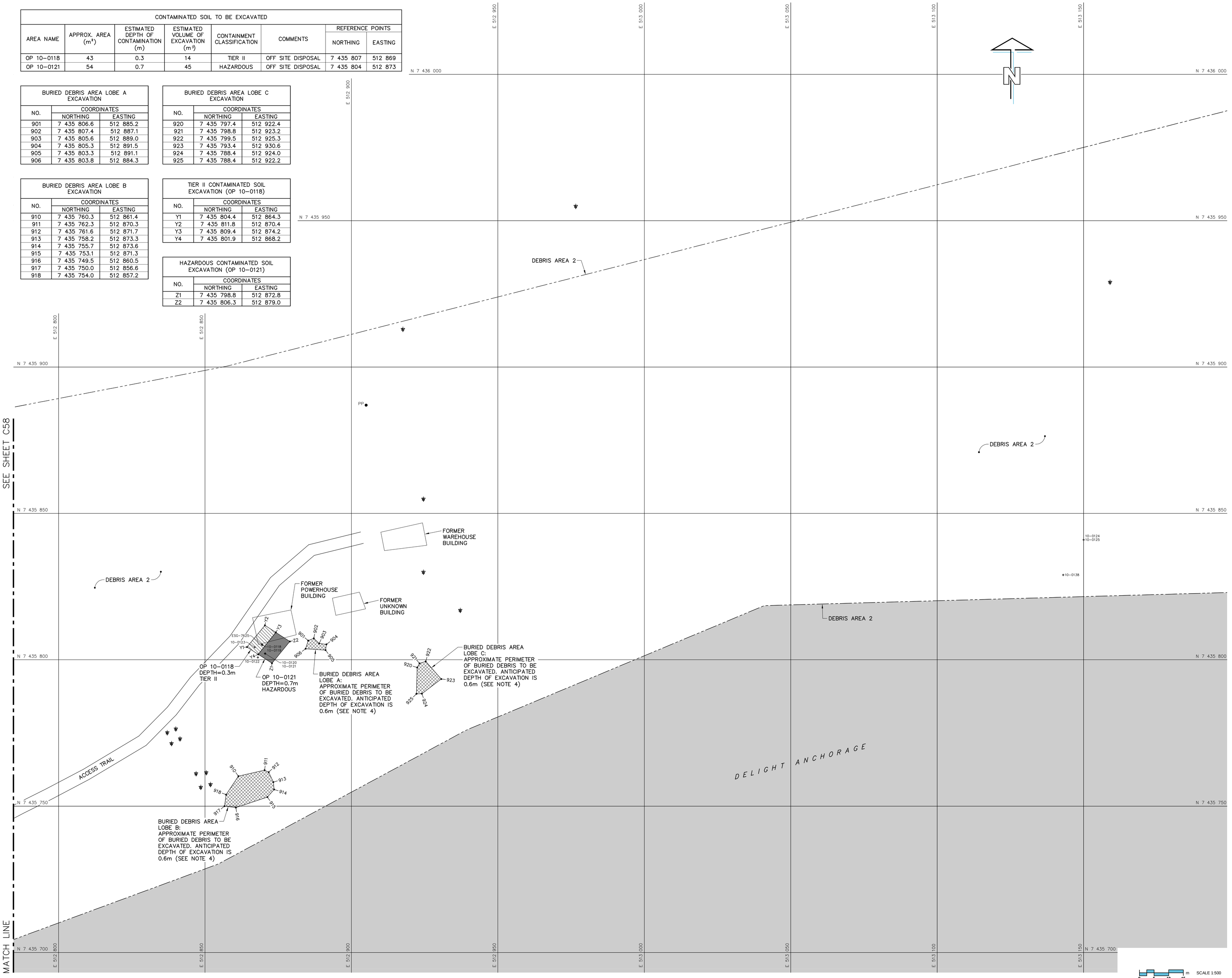
BURIED DEBRIS AREA LOBE A EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
901	7 435 806.6	512 885.2
902	7 435 807.4	512 887.1
903	7 435 805.6	512 889.0
904	7 435 805.3	512 891.5
905	7 435 803.3	512 891.1
906	7 435 803.8	512 884.3

BURIED DEBRIS AREA LOBE C EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
920	7 435 797.4	512 922.4
921	7 435 798.8	512 923.2
922	7 435 799.5	512 925.3
923	7 435 793.4	512 930.6
924	7 435 788.4	512 924.0
925	7 435 788.4	512 922.2

BURIED DEBRIS AREA LOBE B EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
910	7 435 760.3	512 861.4
911	7 435 762.3	512 870.3
912	7 435 761.6	512 871.7
913	7 435 758.2	512 873.3
914	7 435 755.7	512 873.6
915	7 435 753.1	512 871.3
916	7 435 749.5	512 860.5
917	7 435 750.0	512 856.6
918	7 435 754.0	512 857.2

TIER II CONTAMINATED SOIL EXCAVATION (OP 10-0118)		
NO.	COORDINATES	
	NORTHING	EASTING
Y1	7 435 804.4	512 864.3
Y2	7 435 811.8	512 870.4
Y3	7 435 809.4	512 874.2
Y4	7 435 801.9	512 868.2

HAZARDOUS CONTAMINATED SOIL EXCAVATION (OP 10-0121)		
NO.	COORDINATES	
	NORTHING	EASTING
Z1	7 435 798.8	512 872.8
Z2	7 435 806.3	512 879.0



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LEGEND:

- BODY OF WATER
- SITE GRID (50m INTERVAL)
- APPROXIMATE EXTENT OF DEBRIS AREA
- ARCHAEOLOGICAL FEATURE
- 10-0122 SAMPLE LOCATION
- PP UTILITY POLE
- BURIED DEBRIS EXCAVATION
- TIER II CONTAMINATED SOIL
- HAZARDOUS CONTAMINATED SOIL

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Client/client

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

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PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

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EAST BEACH AREA SITE PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.048967.032	C59 OF 59	C

Water Licence Application

Durban and Padloping Islands

Remediation Project

Appendix 6

Environmental Impact Assessments

Durban Island FOX-E

Padloping Island

Environment

Public Works and Government Services Canada

Environmental Impact Assessment Durban Island (FOX-E) Intermediate DEW Line Site- FINAL

Prepared by:

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Project Number:

60158564

Date:

March, 2011

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March 31, 2011

Giselle Cotta, M.Eng, P.Eng.
Senior Environmental Engineer
Public Works and Government Services Canada
Northern Contaminated Sites
5th Floor, 10025 Jasper Avenue
Edmonton, AB T5J 1S6

Dear Ms. Cotta:

Project No: **60158564**

Regarding: **Environmental Impact Assessment**
Durban Island (FOX-E) Intermediate DEW Line Site

It is our pleasure to provide Public Works and Government Services Canada with the attached Environmental Impact Assessment report for the FOX-E, Durban Island Intermediate DEW Line site.

Please contact the undersigned at 780-486-7000 if you have any questions.

Sincerely,
AECOM Canada Ltd.

Nick Oke, M.Sc., P.Chem.
nick.oke@aecom.com

NO:slm

Distribution List

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	Eva Schulz	March 17, 2011	DRAFT
2	Jennie Turner	March 31, 2011	FINAL

AECOM Signatures

Report Prepared By:

Jennie Turner, EIT
Environmental Engineer

Report Reviewed By:

Eva Schulz, P.Ag.
Senior Environmental Scientist

Executive Summary

FOX-E Durban Island is located at 67°05' N, 62°07' W, on the eastern side of Durban Island, 2.3 km off the east coast of Baffin Island in Davis Strait. FOX-E is about 60 km northwest of the Cape Dyer DEW Line site (DYE-M) and 95 km southeast of the closest community, Qikiqtarjuaq on Broughton Island.

The site is scheduled for remediation according to the Indian and Northern Affairs Canada Abandoned Military Site Remediation Protocol (2009). Activities will include: dump remediation; debris removal; contaminated soil remediation; and containerization and off-site removal of hazardous wastes.

Based on the requirements of the Nunavut Land Claim Agreement (NLCA) through the Nunavut Impact Review Board (NIRB), the project specific information requirements regarding the proposed remediation activities are to be provided and are to undergo an environmental assessment.

The remediation of the site will follow the 2011 Remedial Action Plan (RAP) prepared by AECOM, and the proposed "Walkaway Solution", which allows for elimination of any new on-site disposal facilities and for the disposal of all site waste and contaminated soil to established southern disposal facilities. The following is the potential proposed schedule for the remediation of the Durban Island site according to the RAP and the "Walkaway Solution":

- Source borrow material;
- Construct the landfarm;
- Excavate contaminated soils and package appropriately for either off-site disposal (Tier I, Tier II and Type A) or send to the on-site landfarm for treatment (Type B);
- Excavate waste disposal areas (WDAs) scheduled for removal;
- Collect surface debris; and
- Regrade existing WDAs scheduled for regrading.

The following objectives are to be achieved as part of the remediation of Durban Island:

- To restore the site to meet the environmental objectives established for northern sites;
- To prevent migration of contaminants into the Arctic ecosystem;
- To remove physical hazards for the protection of human health and safety; and
- To implement a cost effective remediation solution.

The remediation of the Durban Island site will have a net positive effect on the environment through the removal of physical hazards such as the debris, the removal and disposal of Tier I and Tier II impacted soils, site surface and buried debris and hazardous materials, the treatment of hydrocarbon impacted soils, and grading of the site to match the existing terrain. Through the implementation of the proposed mitigation and monitoring plans and project design, potential adverse effects of the proposed project will be minimized and no significant adverse residual effects are expected to occur.

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Appendices

Appendix A. Drawings

1. Introduction

Public Works and Government Services Canada (PWGSC) requested that AECOM prepare the *Environmental Impact Assessment (EIA)* for the proposed remediation of the FOX-E, Durban Island Intermediate Distant Early Warning (DEW) Line Site. The EIA will be submitted with the applications to the Nunavut Impact Review Board (NIRB), Nunavut Water Board (NWB) and the federal regulators in Nunavut.

1.1 Location

FOX-E Durban Island is located at 67°05' N, 62°07' W, on the eastern side of Durban Island, 2.3 km off the east coast of Baffin Island in Davis Strait. FOX-E is about 60 km northwest of the Cape Dyer DEW Line site (DYE-M) and 95 km southeast of the closest community, Qikiqtarjuaq on Broughton Island.

The site does not have an airstrip and is only accessible by helicopter or by sea. The terrain at Durban Island is composed mainly of deep glacial valleys with associated cirques and high plateaus. The site consists of three main areas; the Station Area on a high plateau, the Old Construction Camp and the Beach Landing Area (refer to Figure 1.0).

1.2 History

FOX-E, Durban Island was constructed as an Intermediate DEW Line site in 1957 by the Department of National Defence (DND). The station was abandoned as part of the DEW Line system in 1963, and in 1965 responsibility for the land was assumed by INAC. Typical of Intermediate DEW Line sites, the FOX-E Station Area consisted of a Module Train, Warehouse, Garage, Inuit Huts, two petroleum, oil, and lubricants (POL) storage tanks and pumphouse and a felled Doppler antenna. Less typical of these sites, a large water reservoir tank and pump house is included in the Station Area infrastructure as there is no fresh water source at the Upper Site and there are no nearby freshwater lakes in vicinity of the Site. Station personnel historically obtained freshwater from the runoff collector stream, which runs beside the Old Construction Camp toward the Beach Landing Area, terminating at the ocean. In addition to the main site, a beach POL storage facility is located at the Beach Area and consists of two 75,700L POL tanks and ancillary piping from the tanks to the shoreline.

1.3 General Project Information

1.3.1 Purpose

The purpose of the project is to remediate the FOX-E Durban Island site in a manner consistent with the requirements of the INAC Abandoned Military Site Remediation Protocol (AMSRP) (INAC 2009). This protocol provides assessment and remedial guidelines for Waste Disposal Areas (WDAs), disposal of barrel contents and provides clean-up criteria for contaminated soil. There are no criteria for the classification of hazardous waste at federal sites, except for materials regulated under the Canadian Environmental Protection Act (CEPA), including the Inter-provincial Movement of Hazardous Waste Regulations. The classification and remedial recommendations for materials not covered under CEPA has been based on the Transportation of Dangerous Goods (TDG) Regulations and the Nunavut/NWT Guideline for the General Management of Hazardous Waste (1998), under the territorial Environmental Protection Act (R.S.N.W.T 1998 c.E-7). More detailed information related to remedial guidelines or requirements under the sources noted above is provided in the issue-specific sections below.

The ultimate goal is to create a positive environmental impact. The objectives are as follows:

- To restore sites to meet the environmental objectives established in the Abandoned Military Site Remediation Protocol (AMSRP);
- To prevent migration of contaminants into the Arctic ecosystem;

- To remove physical hazards for the protection of human health and safety; and
- To implement a cost effective remediation solution.

To accomplish these objectives, there will be four main areas of activity during the remediation of the FOX-E site. These activities include:

- Waste debris area remediation;
- Hazardous Waste Removal;
- Non-Hazardous Waste Disposal; and
- Contaminated Soil Remediation.

1.3.2 Project Alternatives

Due to the nature of the site and the location, the range of alternatives to the project is limited. Three alternatives to the remediation of FOX-E were identified, and include:

Do nothing (no clean up action): The first alternative involved examining the environmental impact of maintaining the status quo at the sites. It was quickly realized that failure to address the environmental problems identified during the site investigations could lead to the following:

- Placing the Arctic environment/food chain at risk;
- Possible future legal liabilities for the federal government; and
- Greater clean up costs in the future.

Walkaway Solution: The second solution would include application of remedial solutions to preclude the requirement for post construction monitoring, including provisions for the following:

- The elimination of any new on-site disposal facilities including a Non-Hazardous Waste Landfill (NHWL) and Secure Soil Disposal Facility.
- The off-site disposal of all site waste and contaminated soil to established southern disposal facilities.
- There is no long-term monitoring requirement for existing landfills less than 1,000 m^2 in area. For a "Walkaway Solution", all WDAs greater than 1,000 m^2 would have to be excavated with the resulting debris and contaminated soil disposed of at an established southern disposal facility. There are no existing WDAs with areas exceeding 1,000 m^2 at the Durban Island site.
- The landfarm treatment facility would proceed as planned as there is no monitoring required once the treatment soils are remediated.
- The "Walkaway Solution" could be applied to either an "Individual" or "Combined Contract" scenario for the Padloping and Durban Island Sites.

Combined Contract: The third alternative is to combine the FOX-E contract with the Padloping Island contract. The Padloping Island site is only 24 km away from the FOX-E site. A contractor may be able to share resources and realize cost savings if these two sites are tendered together. For this combined scenario, the contractor could procure remediation for the sites concurrently or consecutively with the mobilization of one camp and equipment fleet. Further cost savings could be realized if only one NHWL was built and the waste was consolidated to this location from the two sites.

1.3.3 Schedule

Based on the information provided in the Remedial Action Plan prepared by AECOM, it is anticipated that that construction activities can be completed within one clean up season, excluding mobilization.

In order to complete the clean-up of the FOX-E site in one full construction season, the anticipated schedule of activities would be as follows:

- Mobilization in the late July or August 2012 allowing for 4 to 6 weeks of construction following mobilization to source borrow material, perform any required major upgrades and to construct the Landfarm.
- Excavate landfills and contaminated soil, and demobilize from site in 2013.

1.3.4 Regulatory Overview

1.3.4.1 Lead Authorizing Agencies

The proponent for this project is Indian and Northern Affairs Canada (INAC). The management of this project is being provided by PWGSC. These agencies will be responsible for obtaining permits, except in those cases where the clean up contractor is required to do so by legislation or as part of their contract.

1.3.4.2 List of Approvals, Permits and Licenses Required

The following is a list of permits required for the clean-up of the FOX-E site:

Land Use Permit (Crown Land): As per the Territorial Land Use Act and Territorial Land Use Regulations, a Class A permit issued by Indian and Northern Affairs Canada (INAC) is required for the activities associated with the remediation of FOX-E. There is a permit currently in place, which will be amended to include the remediation activities. Contact: INAC Land Administration, Iqaluit, NU (Tel) 867-975-4283.

Land Use Permit (Inuit Owned Land): As per the Nunavut Land Claims Agreement, a License of Exemption may be required for the activities associated with the remediation of FOX-E. Contact: Qikiqtani Inuit Association, Iqaluit, NU (Tel) 1-800-667-2742.

Quarry Permit (Crown Land): As per the Territorial Land Use Act and Territorial Quarrying Regulations, a Quarry Permit(s) issued by INAC is required for the extraction of granular material required for remediation. Contact: INAC Land Administration, Iqaluit, NU (T) 867-975-4283.

Quarry Permit (Inuit Owned Land): As per the Nunavut Land Claims Agreement a Quarry Permit(s) is required for the extraction of granular material required for remediation. Contact: Qikiqtani Inuit Association, Iqaluit, NU (Tel) 1-800-667-2742

Water Use License: As per the Nunavut Land Claims Agreement Act, a water use license issued by the Nunavut Water Board is required for camp operations and construction activities associated with the remediation of FOX-E. There is a license currently in place, which will be amended to include the remediation activities. Contact: Nunavut Water Board, Gjoa Haven, NU (T) 867-360-6338.

In addition, the successful contractor may require a number of other permits or licenses. These permits or licenses pertain to the operation and maintenance of the contractors' camp or relate to his/her status as an employer. Examples of these permits include those related to the possession of firearms, day-to-day camp operation and federal/territorial labour codes. A list of these and other requirements is presented in Table 1.

Table 1. Other Authorizations

Authorization	Authority	Activity to Authorization Applies
Archaeological Research Permit	Department of Culture, Language, Elders and Youth, Gov't of Nunavut (Nunavut Land Claims Agreement Act)	Investigation of archaeological sites, mitigation, monitoring
Transportation Permits	Transport Canada (Transportation of Dangerous Goods Act)	Shipping
Transportation Permits	Transport Canada (International Air Transport Association Dangerous Goods Regulations)	Air transport
Fishing Licenses	Department of Fisheries and Oceans	Recreational fishing
Firearms Acquisition Certificates/ Firearms License (course required)	RCMP	Use and storage of firearms

1.3.4.3 Conformance to Legislation and Policy

The remediation of the site will comply with all applicable environmental laws, regulations and requirements of Federal, Territorial and other regional authorities, and any permits, approvals, and authorizations that may be required. The contractor is subject to and must comply with all permits and approvals obtained on behalf of and by INAC to conduct this work. Throughout all project phases, project personnel will work in close cooperation with regulatory authorities and compliance will be enforced.

Federal Acts, Regulations and Guidelines

Several Federal Acts, regulations and guidelines affect project activities across all Canadian jurisdictions. The most relevant to the remediation of FOX-E are outlined below:

The **Canadian Environmental Protection Act** regulates toxic substances from their production or import, to consumption, storage and disposal. This Act also incorporates, amongst others, the Storage Tank Regulations (SOR/2008-197) and the PCB Regulations (SOR 2008-273).

The **Transportation of Dangerous Goods Act and Regulations** promotes public safety in the transportation of dangerous goods. The Act applies to all handling, offering for transport and transporting of dangerous goods by any means of transport whether or not the goods originate from or are destined for any place or places in Canada.

The **Fisheries Act** protects fish and fish habitat from pollution, harmful alteration, disturbance and destruction, and impediments to fish movement.

The **Arctic Waters Pollution Prevention Act and Regulations** govern development and shipping activity in Arctic waters adjacent to the mainland islands of the Canadian Arctic to facilitate the continuing welfare of the residents of the areas, and to protect the ecological balance in water, ice and land areas.

The **Migratory Birds Convention Act** provides for the protection of designated migratory species, their habitats, and the regulated harvest of certain species.

The **Canada Wildlife Act** provides for the involvement of the Government of Canada in cooperative research and management programs involving wildlife species normally the responsibility of provinces or territories. This is particularly relevant to rare and endangered species or species such as the Peary caribou, which seasonally move across various regulatory boundaries.

The **Species at Risk Act** aims to protect wildlife from becoming extinct or lost from the wild, with the objective of helping the numbers recover. The act identifies all wildlife species listed as being at risk nationally and protects populations and their habitats.

The **Canada Shipping Act, 2001** regulates shipping activities under the jurisdiction of Canada. Regulations cover technical standards of operation safety and pollution aspects related to shipping activities in Canadian waters.

The **Navigable Waters Protection Act** pertains to the erection of structures or facilities used to support or impede navigation in waters under the jurisdiction of Canada.

The **Territorial Lands Act** provides the authority for administering and protecting lands under the direct control of the Minister of Indian and Northern Affairs Canada (INAC). The following regulations are pursuant to this Act:

- The **Territorial Lands Regulations** provide regulatory control for maintaining sound environmental practises for any land use activities on Territorial lands. These regulations require that land use permits be issued for such operations as work involving the use of heavy equipment, establishment of camps, use of explosives, and clearing of lines, trails and rights-of-way, including construction of access roads.
- The **Territorial Quarrying Regulations** establish the procedures for extracting Crown-owned limestone, granite, slate, marble, gypsum, loam, marl, gravel, sand, clay or stone from Territorial lands. The regulations specify permits, applications, staking and dimensions of quarries.

The **Nunavut Land Claim Agreement Act** provides for the use, management and conservation of land, water, and resources of Nunavut. It also identifies the need to complete an environmental impact assessment for specific projects.

The **Nunavut Waters and Surface Rights Tribunal Act** provides the Nunavut Water Board with the power to issue water use licenses. The NWB evaluates the potential for detrimental effects occurring because of the use of water or a deposit of waste in water on other users.

Canada Labour Code contains the labour code for all Federal employees or activities on Federal owned or controlled land. Private Provincial or Territorial employees are governed by the Provincial/Territorial Labour Acts, even when working on Federal lands or facilities. The Labour Acts control such things as statutory holidays, maximum work hours and minimum wages.

Atomic Energy Control Act and Regulations describe the packaging requirements and approvals needed for the transportation of radioactive materials.

National Fire Code (NFC) established the standard for fire prevention, fire fighting and life safety in buildings in use, including standards for the conduct of activities causing fire hazards, maintenance of sire safety equipment and egress facilities, standards for fire extinguishers, etc. In addition, the NFC established the standard for prevention, containment and fighting of fires originating outside buildings which may present a hazard to a nearby community, and sets the standards for the storage and handling of dangerous goods, flammable liquids and combustible liquids.

The following guidelines are identified as reference materials, and should be used where appropriate in the final design.

Freshwater Intake End-of-Pipe Fish Screen Guidelines (DFO) provide instructions for the protection of anadromous and resident fish where freshwater is extracted from fish-bearing waters.

National Guidelines for the Landfilling of Hazardous Waste (CCME) is to be used by regulators, designers, owners, and operators of hazardous waste facilities. They cover site selection, design, construction, closure and post-closure care, monitoring and operation. They are intended for new, not existing facilities.

Code of Good Practice for Used Oil Management in Canada (CCME) described environmentally sound options for the handling, storage, collection, transportation, recycling, reuse and disposal of used oils in Canada. It is intended to provide guidance for used oil generators and to regulatory authorities in the formulation of provincial or regional used oil management strategies.

Canadian Environmental Quality Criteria for Contaminated Sites (CCME) provide numerical limits for contaminants in soil and water intended to maintain, improve, or protect environmental quality and human health at contaminated sites. The criteria are intended to provide general technical and scientific guidance to provincial, federal, territorial and non-governmental agencies in the assessment and remediation of contaminated sites across Canada. They serve as benchmarks against which to assess the degree of contamination at a site.

Canadian Drinking Water Guidelines (Health Canada) provide criteria for water that are protective of human health and also meet aesthetic objectives.

The **Canada-Wide Standard for Mercury (CCME)** applies to incineration activities on site.

Nunavut and Northwest Territory Acts, Regulations and Guidelines

In addition to the Federal Acts and Regulations identified in Section 3.3.1, the remediation of the FOX-E site is governed by the following:

Guidelines for the Discharge of Domestic Wastewater in Nunavut, by the Nunavut Water Board, outlines the requirements for water quality effluent from facilities in Nunavut.

Environmental Guidelines for Industrial Waste Discharges establish standards that should be followed when discharging waste from an industrial operation on Commissioners Land or lands administered by municipal governments in Nunavut.

The **Explosives Use Act** provides controls for surface blasting other than for mining purposes.

The **Nunavut Wildlife Act** provides for the protection of wildlife and wildlife habitats as well as regulated harvest of selected species.

The **Nunavut Environmental Protection Act** provides for the protection of the environment from the discharge of contaminants, clean up of contaminants and unsightly premises. In addition, the powers of inspectors as well as offences and penalties are defined. The Act applies only to situations not authorized by other Canadian Acts in the Nunavut Territory. The following guidelines under the Nunavut Environmental Protection Act may be applicable to the clean up of the Durban Island site:

- Contingency Planning and Spill Reporting;
- Disposal Guidelines for Fluorescent Light Tubes;
- Guideline: Dust Suppression;
- Guidelines for the Management of Waste Asbestos;
- Guideline for the Management of Waste Antifreeze;
- Guideline for the Management of Waste Paint;
- Guideline for the Management of Waste Solvents; and
- Guidelines for the General Management of Hazardous Waste in Nunavut.

The **Nunavut Environmental Rights Act** provides the people of Nunavut the right to access information concerning the release or potential release of contaminants into the environment, and also the right to prevent the release or potential release of contaminants into the environment.

The **Spill Contingency Planning and Reporting Regulations** outline requirements for filing a contingency plan and for reporting spills.

The **Nunavut Fire Prevention Act and Regulations** provides for the regulation of the decommissioning of fuel lines and fuel tanks.

The **Pesticides Act and Regulations** specifies the requirements for use storage, handling and disposal of pesticides.

The **Nunavut Territorial Archaeological Sites Regulations**, pursuant to the Nunavut Act, protects archaeological sites in Nunavut from disturbance and prohibits the removal of archaeological specimens, except under permit.

The **Safety Act: Occupational Health Regulations** outline the health and safety standards to be maintained at workplaces to facilitate the health and safety of persons.

Guidelines for the Removal of Materials Containing Friable Asbestos outlines the procedures for the removal of friable asbestos.

1.4 DFO Operational Statement Conformity

Based on the work to be completed, there are no activities where a DFO Operation Statement would be applicable.

1.5 Transportation

Transportation associated with the movement of materials, equipment, and personnel to the site, as well as disposal of some waste materials off-site includes air, ground and barge transport. These activities are described as follows:

Air – transport of personnel to and from the site, and weekly domestic supplies (i.e., food) will be completed using charter helicopter. The helipad and windsock are located southwest of the Station Area at the Upper Site. It is assumed that aircraft access to the site will not be an issue, though limited to a helicopter, and the primary mobilization of the contractor's equipment will be via sea-lift.

Ground – existing roads will be used at FOX-E while on-site. Most of the gravel roads are in poor to fair condition and will require upgrades, especially to access the upper site. It is anticipated that the existing roadways would remain intact once the clean-up work is completed, with the exception of any culverts or other structures that may have been part of the former DEW Line maintenance program or those that may have been required during the remediation program, which will be removed.

Sea-Lift – the transport of the contractors' equipment and facilities will likely be by sea-lift in the summer. In addition, any waste materials to be transported off-site will be removed via sea-lift.

1.6 Camp Site

Two potential camp areas have been identified as suitable locations for the Construction camp and/or laydown areas, shown on Figures 2.0 and 4.0. The ultimate location for the camp is at the discretion of the contractor, and will not be finalized until the contract has been awarded.

The temporary camp structures will include accommodations for the construction staff, the owner and support staff as well as associated facilities, such as offices, latrines and kitchen facilities. The facilities will be installed during mobilization, and will be removed as part of the demobilization from the site. The facilities will be winterized between the construction seasons. The anticipated number of staff is approximately 50 people, from June 15 to September 15.

1.7 Equipment

The contract for this work has not yet been tendered or awarded; therefore, the exact types of equipment are not available. However, based on equipment used at other sites, the typical equipment can include, but is not limited to, the following:

- Rock truck;
- Loader;
- Excavator;
- Grader;
- Dozer;
- Fuel truck;
- Water truck;
- Mack truck;
- Passenger van;
- Pick-up trucks;
- Incinerator;
- Generator;
- Backhoe;
- Compactor;
- Drill;
- Landfiller; and
- Snowblower.

1.8 Water

There are three freshwater sources on site, including two streams and a blast hole. These sources could potentially be utilized for camp operations, including provision of drinking water. It is estimated that water use will be approximately 18 m^3 per day. No water will be returned to the source.

Water samples were collected at these three locations during the 2010 Environmental Site Investigation. No significant differences in analytical concentrations were observed between the three samples, and results indicated that the water met drinking water criteria. However, due to the seasonal nature of coliform concentrations in surface water bodies, no coliform samples were collected. If one of these locations is selected as a water source this water body is to be used during construction as the drinking water source, coliform testing will be required on a regular basis throughout the construction season. Analysis and confirmation of all drinking water parameters is recommended to be completed on, at minimum, a bi-weekly basis.

1.9 Waste Water

The ultimate location of the camp and associated sewage, grey water, and waste disposal will need to consider the requirements of the Water Use License and Land Use Permit. Typically, the permits require that all waste disposal locations, including sewage treatment systems and greywater discharge areas, and fuel storage areas be located a minimum of 31 m from the high water mark of any water body or drainage course. In addition, all effluent and wastewater must meet water quality requirements prior to discharge. Sewage lagoons are the typically utilized method for sewage disposal at such sites, and as such, it is expected that a sewage lagoon may be used during camp operation at the FOX-E, Durban Island site.

In terms of waste disposal, licenses typically require that camp solid wastes be incinerated on-site, in an approved incinerator facility, and that non-hazardous, non-combustible waste and the ash generated from incineration will likely be packaged and shipped off-site.

1.10 Fuel

It is anticipated that fuel used on-site will be comprised of diesel and gasoline. The exact quantity of fuel, details of the secondary containment, method of fuel transfer and spill control measures are to be provided by the contractor, once the contract has been awarded. However, as a minimum, they must meet the requirements as outlined in Section 4.3.2 Storage and Handling of Fuel and Other Hazardous Substances.

1.11 Chemicals and Hazardous Materials

All chemicals and hazardous materials will be dealt with according to Section 4.3.16 Handling of Dangerous Goods and Hazardous Waste Materials.

1.12 Workforce and Human Resources/Socio-Economic Impacts

It is anticipated that the majority of the workforce will come from the nearby communities of Qikiqtarjuaq, Pangnirtung and Clyde River. As part of the contract, the successful contractor is required to provide training programs for employees. Typical positions available are heavy equipment operators, cooks, bear monitors and labourers.

The construction season will be from approximately June 15 to September 15, except during the mobilization year, when the work will occur from the time of arrival of the sea-lift, likely sometime in mid to late August to the middle of September. The rotation schedule is decided by the contractor, but is required to comply with all applicable Government of Nunavut Labour Regulations.

1.13 Public Involvement

A community meeting for this work was completed in the last week of February (2011) in Qikiqtarjuaq. During the meeting, an outline of the proposed work was provided and any questions and comments regarding the work were addressed. The meeting was also intended to provide some information on the contracting process, so that people interested in working on the project are aware of when the positions will become available.

There were no significant issues identified regarding the FOX-E site during the meetings.

2. Project Specific Information - Site Clean-up/Remediation

2.1 Waste Debris Areas

The assessment of waste disposal areas (WDA or buried debris areas) at FOX-E was completed with the goal of classifying the WDAs according to the three categories specified under the INAC Abandoned Military Site Remediation Protocol, which are:

Class A: The WDA is located in an unstable, high erosion location. Remediation will involve relocation of buried debris to an engineered landfill. A WDA located at an elevation of less than two (2) metres above mean sea level will be removed.

Class B: The WDA is in a suitable, stable location, but there is evidence of contaminant migration. Remedial solutions include the installation of an engineered containment system, or relocation, whichever is deemed more cost effective.

Class C: The WDA is in a suitable, stable location, and there is no evidence of contaminant migration. In such cases, the debris may be left in place, with the placement of additional granular cover to facilitate erosion protection and proper drainage.

There are no WDAs identified at FOX-E that are considered to be high potential environmental risk, or any WDAs located in close proximity to water bodies at the FOX-E site. Therefore, no WDA excavations have been recommended. Section 2.2 describes the existing WDAs and the recommended remedial requirements.

2.2 Description of Existing Waste Debris Areas

There are 9 existing WDAs at FOX-E, including the following:

- Lobe 1 (Northwest of Garage);
- Lobe 2 (North of Garage);
- Lobe 3 (North of Warehouse);
- Lobe 4 (North of Water Reservoir and Pumphouse);
- Lobe 5 (West of Antenna);
- Lobe 6 (Southwest of Antenna);
- Lobe 7 (South of Inuit Huts (South of Station Area));
- Lobe 8 (Barrel Cache (West of Station Area)); and
- Lobe 9 (South of Dump C).

2.2.1 Lobe 1 (Northwest of Garage)

Lobe 1 is located at the Upper Site Station Area approximately 75 m northwest of the garage as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 122 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, wood and clothing. The terrain in the area of Lobe 1 is generally flat with a 5 to 6% slope to the northwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the gentle slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 1 scored as a low potential environmental risk or Class C buried debris area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial action includes the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

2.2.2 Lobe 2 (North of Garage)

Lobe 2 is located at the Upper Site Station Area approximately 60 m north of the garage and 30 m east of Lobe 1 as shown of Figure 2.0. The estimated areal extent and depth of the buried debris are 74 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, wood, painted wood, and glass. The terrain in the area of Lobe 2 is generally flat with a 5 to 6% slope to the northwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 2 scored as a low potential environmental risk or Class C buried debris area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial action includes the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

2.2.3 Lobe 3 (North of Warehouse)

Lobe 3 is located at the Upper Site Station Area approximately 50 m northwest of the garage and 30 m east of Lobe 2 as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 101 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal and crushed barrels. The terrain in the area of Lobe 3 is generally flat with a 5 to 6% slope to the northwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 3 scored as a low potential environmental risk or Class C buried debris area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial actions include the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris and excavation of the Type B hydrocarbon plume that extends over the eastern corner of the buried debris lobe.

2.2.4 Lobe 4 (North of Water Reservoir and Pumphouse)

Lobe 4 is located at the Upper Site Station Area approximately 80 m north of the warehouse and 40 m northeast of Lobe 3 as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 145 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, wood, and crushed barrels. The terrain in the area of Lobe 4 is generally flat with a 1 to 2% slope to the northwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 4 scored as a low potential environmental risk or Class C buried debris area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial actions include the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

2.2.5 Lobe 5 (West of Antenna)

Lobe 5 is located at the Upper Site Station Area approximately 90 m southeast of the garage as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 120 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, wood, and a fire extinguisher. The terrain in the area of Lobe 5 is generally flat with a 1 to 2% slope to the southwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 5 scored as a low potential environmental risk or Class C buried debris area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial action includes the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

2.2.6 Lobe 6 (Southwest of Antenna)

Lobe 6 is located at the Upper Site Station Area approximately 115 m southeast of the garage and 30 m south of Lobe 5 as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 50 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient and down-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. Minimal surface debris was noted at the surface of the lobe and consisted mainly of scrap metal, painted wood, and a tarp. The terrain in the area of Lobe 6 is generally flat with a 1 to 2% slope to the southwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 6 scored as a low potential environmental risk or Class C buried debris area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial action includes the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

2.2.7 Lobe 7 (South of Inuit Huts (South of Station Area))

Lobe 7 is located at the Upper Site Station Area approximately 15 m southeast of the Inuit huts and situated between the huts and the edge of the cliff as shown on Figure 2.0. The estimated areal extent and depth of the buried debris are 95 m^2 and 1.0 m, respectively. Based on visual observations and samples collected up-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. A down-gradient sample was not feasible since the southeast limit of the buried debris area is approximately 4m from the crest of the cliff. Minimal surface debris was noted at the surface of the lobe and consisted mainly of metal and wood. The terrain in the area of Lobe 7 is generally flat with a 5 to 6% slope to the southwest. Drainage runs from the station area pad, which is a relatively small drainage basin, along the slopes and eventually drains over the ridge. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 7 scored as a low potential environmental risk or Class C buried debris area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial action includes the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

2.2.8 Lobe 8 (Barrel Cache (West of Station Area))

Lobe 8 is located at the Upper Site Area southwest of the Station Area and is approximately 35 m north of the access road as shown of Figure 3.0. The estimated areal extent and depth of the buried debris are 117 m^2 and 0.5 m, respectively. Based on visual observations and samples collected up-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. A down-gradient sample was not feasible since the southeast limit of the buried debris area is approximately 4 m from the crest of the cliff. No surface debris was present over the limits of the buried debris area. The terrain in the area of Lobe 8 is generally flat with a 5 to 6% slope to the northwest. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 8 scored as a low potential environmental risk or Class C buried debris area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial action includes the placement of additional granular cover to a thickness of 0.75 m.

2.2.9 Lobe 9 (South of Dump C)

Lobe 9 is located at the Lower Site Area Old Construction Camp within Debris Area 12 and approximately 50 m west of the access road as shown on Figure 4.0. The estimated areal extent and depth of the buried debris are 132 m^2 and 1.5 m, respectively. Based on visual observations and samples collected up-gradient of the lobe at the time of the site investigation, there is no surface staining present and no evidence of contaminant migration. A down-gradient sample was not feasible since the southeast limit of the buried debris area is approximately 4 m from the crest of the cliff. Minimal surface debris was noted at the surface of the lobe and consisted mainly of wood pieces. The terrain in the area of Lobe 9 is generally flat with a 8 to 10% slope to the southeast. There is no evidence of erosion in the area.

Based on the landfill evaluation matrix, Lobe 9 scored as a low potential environmental risk or Class C buried debris area. The low score is due mainly to the lack of contamination, the stability of the lobe, lack of down-gradient receptors, and its small size. As a result, the remedial action includes the placement of additional granular cover to a thickness of 0.75 m, following the removal of surface debris.

Table 2 summarizes the anticipated remedial requirements for the existing buried debris areas at FOX-E.

Table 2. Summary of Recommended Buried Debris Remedial Requirements

Landfill	Area (m^2) & Depth (m)	Environmental Assessment	Landfill Evaluation	Recommended Remediation	Comments
Lobe 1	122 0.5	No evidence of contaminant migration, no potential for surface contaminated soil identified, no erosion noted. Sparse vegetation cover and minimal surface debris noted.	Class C Low Potential Environmental Risk.	Regrade and removal of surface debris.	Placement of additional granular cover to facilitate erosion protection and proper drainage.
Lobe 2	74 0.5	No evidence of contaminant migration, no potential for surface contaminated soil identified, no erosion noted. Sparse vegetation cover and minimal surface debris noted.	Class C Low Potential Environmental Risk.	Regrade and removal of surface debris.	Placement of additional granular cover to facilitate erosion protection and proper drainage..
Lobe 3	101 0.5	No evidence of contaminant migration, no potential for surface contaminated soil identified, no erosion noted. Sparse vegetation cover and minimal surface debris noted.	Class C Low Potential Environmental Risk.	Excavate, regrade, and removal of surface debris.	Following the removal of surface debris and excavation of the Type B hydrocarbon plume the placement of additional granular cover to a thickness of 0.75 m is recommended.

Landfill	Area (m^2) & Depth (m)	Environmental Assessment	Landfill Evaluation	Recommended Remediation	Comments
Lobe 4	145 0.5	No evidence of contaminant migration, no potential for surface contaminated soil identified, no erosion noted. Sparse vegetation cover and minimal surface debris noted.	Class C Low Potential Environmental Risk.	Regrade and removal of surface debris.	Placement of additional granular cover to facilitate erosion protection and proper drainage..
Lobe 5	120 0.5	No evidence of contaminant migration, no potential for surface contaminated soil identified, no erosion noted. Sparse vegetation cover and minimal surface debris noted.	Class C Low Potential Environmental Risk.	Regrade and removal of surface debris.	Placement of additional granular cover to facilitate erosion protection and proper drainage.
Lobe 6	50 0.5	No evidence of contaminant migration, no potential for surface contaminated soil identified, no erosion noted. Sparse vegetation cover and minimal surface debris noted.	Class C Low Potential Environmental Risk.	Regrade and removal of surface debris.	Placement of additional granular cover to facilitate erosion protection and proper drainage.
Lobe 7	95 1.0	No evidence of contaminant migration, no potential for surface contaminated soil identified, no erosion noted. Sparse vegetation cover and minimal surface debris noted.	Class C Low Potential Environmental Risk.	Regrade and removal of surface debris.	Placement of additional granular cover to facilitate erosion protection and proper drainage.
Lobe 8	117 0.5	No evidence of contaminant migration, no potential for surface contaminated soil identified, no erosion noted. Sparse vegetation cover and minimal surface debris noted.	Class C Low Potential Environmental Risk.	Regrade.	The debris may be left in place, with the placement of additional granular cover to facilitate erosion protection and proper drainage.
Lobe 9	132 1.5	No evidence of contaminant migration, no potential for surface contaminated soil identified, no erosion noted. Sparse vegetation cover and minimal surface debris noted.	Class C Low Potential Environmental Risk.	Regrade and removal of surface debris.	Placement of additional granular cover to facilitate erosion protection and proper drainage.

2.3 Contaminated Soil

Contaminated soil areas will be excavated, typically using a backhoe, and then backfilled with granular material. The excavated soils will be disposed of according to the contaminant type. The disposal requirements are presented below:

Table 3. Summary of Contaminated Soil Disposal Requirements

Contaminant Designation	Description	Estimated Soil Volume (m^3)	Disposal Requirement
Tier I Contaminated Soil	Soils containing concentrations of any or all contaminants listed as follows: Lead ..... 200 to 499 ppm PCBs..... 1 to <5 ppm	23	Off-site at licensed southern disposal facility
Tier II Contaminated Soil	Soils containing concentrations of any or all contaminants listed as follows: • Arsenic 31 ppm* • Cadmium 5 ppm • Chromium 343 ppm* • Cobalt 91 ppm* • Copper 159 ppm* • Lead 500 ppm • Mercury 2 ppm • Nickel 1,632 ppm* • Zinc 500 ppm • PCBs ≥5 ppm;<50 ppm *Site Specific Criteria	19	Transport off-site for disposal in engineered territorial or provincial Landfill.
TPH Type A Soils F3 and F4 Fractions	Soils contaminated with hydrocarbons consisting primarily of oil and grease at concentrations equal to or greater than: •TPH, Sum of F3 and F4 fractions….. 20,000 ppm	11 (Co-contaminated with Tier II levels)	Off-site at licensed southern disposal facility
TPH Type B Soils F1-F3 Fractions	Soils contaminated with hydrocarbons consisting primarily of fuel oil, and/or diesel, and/or gasoline, with concentrations equal to or greater than the following concentrations : Station Area and Beach POL Area: -Surface soils to 0.5 m depth…2,500 ppm (TPH, sum of F1 through F3 fractions) -Subsurface soils below 0.5 m depth…5,000 ppm (TPH, sum of F1 through F3 fractions)	378 (note: The Beach POL Area is greater than 30 m from the shore)	Landfarm
CEPA/ Hazardous Soil	Soils contaminated with PCBs ≥ 50 ppm or with leachate concentrations above criteria.		Off-site at licensed southern disposal facility

A description of the contaminated soil areas identified at FOX-E is presented below.

2.3.1 Tier I and Type A Soils

A small volume of Tier I soil was identified at the Module Train at the Station Area along with a small volume of co-contaminated Tier I/Type A PHC soil at the Garage. The total estimated volume of Tier I and co-contaminated Tier I/Type A soil is 34 m^3. The Tier I and Tier I/Type A PHC soil will be disposed at an off-site licensed facility.

2.3.2 Tier II Soils

The 2010 site investigation identified a small volume of Tier II levels of cadmium at the Garage to a depth of 0.3 m in depth and a small volume of Tier II levels of arsenic and copper at the Inuit House to a depth of 0.3 m in depth. The total volume of Tier II soil identified for remediation is 19 m^3 from delineated contaminated areas. It should be noted that none of the buried debris areas at FOX-E are identified for excavation and as a result it is not expected that the estimated Tier II soil volume will change substantially. Samples beneath the module train have not been collected, however, and there is a slight chance that additional Tier II soils will require excavation and disposal from this area. The footprint of the module train is approximately 227 m^2.

The decision criterion to determine if a Secure Soil Disposal Facility (SSDF) is required at a DEW Line Site is outlined in Table 5.3 of the INAC AMSRP. The FOX-E site is not landlocked and there is no Tier II soil volume from buried debris excavations that require disposal which for other sites generally accounts for a large unknown volume of Tier II soils. The estimated Tier II soil volume requiring excavation and disposal is 19 m^3, which is less than the decision criteria volume of 300 to 500 m^3 and the risk of overrun is considered to be very low. Therefore, the remedial option is to ship Tier II contaminated soil off-site.

2.3.3 Type B Soils

Six areas of Type B impacted soil requiring remedial action were identified as part of the 2010 investigation: the Station POL Tanks, the Module Train, the Warehouse, the Garage, the Lobe 3, and the Beach POL Tanks. The total volume of PHC Type B soil identified for remediation is 378 m^3.

Based on the applicability of the various treatment options at the FOX-E site, the recommended remedial option is on-site ex-situ treatment, i.e. landfarming. Based on the volume of impacted soil and moderate hydrocarbon concentrations observed during the 2010 investigation, it is anticipated that ex-situ biological treatment may be completed within a 1 year period provided site conditions are monitored and optimized where possible (i.e., moisture conditioning, nutrient amendment).

Soils contaminated with Type B fractions should be excavated and treated ex-situ by biological treatment methods in an on-site landfarm facility. Soils concentrations should be reduced, when required, to meet the 2009 INAC Criteria. The Type B soils identified at the Beach POL are subject to more stringent criteria than Type B soil from other locations, including the proposed landfarm sites, further away from water bodies.

2.4 Debris Areas

Twenty-one surface debris areas were identified during the 2010 ESA. In addition to the identified surface debris areas, all debris within 50 m of existing pads and roadways shall be picked up. All non-hazardous surface debris should be packaged with other non-hazardous waste for off-site disposal.

Other hazardous materials, including batteries and UXO will be containerized for off-site disposal, destroyed on-site, or recycled in accordance with TDGA requirements.

2.4.1 Summary of Surface Debris

Table 4 provides a summary of the debris areas inventoried at the FOX-E site. The total crushed volume of surface debris at FOX-E is estimated to be 695 m^3.

Table 4. Summary of Debris Areas Identified at FOX-E

Location	Description of Components	Comments
1-Southeast of Station POL Tanks	Tin cans, wood, electrical wire, fiberglass, rope	Sparsely scattered debris with higher concentrations of surface debris near the edge of the plateau.
2- Station Area including Inuit Huts and Inuit Building, not including the Antenna	Tin cans, wood (timbers, planking, post), fiberglass, glass, concrete, metal wire, metal pipes, scrap metal, components of a piece of construction equipment, electrical wire and conduit, 2 electrical panels, stoves, counter tops, plumbing, Asbestos floor tiles, clay ceramic with unknown white powder, fire extinguisher.	Sparsely scattered debris except at areas of concentrated debris at the Inuit Huts, Inuit Building, and push point for Dump E. The Inuit Huts are demolished with remnants of a wood raft floor and it appears the Inuit Huts had electrical and water services, likely buried. The Inuit Building is also demolished with the remnants of a wood floor on concrete pads and is partially burnt.
3 -North of Station Area	Wood (planking, timber piles, etc.), rubber, glass, plastic, corrugated sheet metal, scrap metal, heater unit, large gas tank for vehicles (0.6 m x 1.2 m), mostly wood	Sparsely scattered debris with higher concentrations of surface debris as you move towards the Station Area, especially around the Buried Debris Lobes. A large hole containing timber posts is present at WP956 that appears to have been blasted and may have been an attempt at a groundwater well. There are blast drill holes and detention cords in the area and there may be ordnance (blast caps) in the area. The timber posts within the large hole may have been a foundation to support a structure. There were no remnants of the structure nearby.
4 -West of Station Area	Scrap metal, timber pallets, acrylic looking substance	
5 -West of Station Area	Tin cans, scrap metal, wood, destroyed battery, metal wire, fabric, mostly metal	Sparsely scattered debris with two concentrated pockets of surface debris.
6 -Northwest of Station Area, along edge of plateau	Tin cans, scrap metal, wood, mostly metal	Concentrated debris area very close to the edge of the plateau (shear face)
7 -Southwest of Station Area, Former Barrel Storage Area	mostly wood, some scrap metal	Very sparsely scattered debris in a large area, mostly within disturbed area. There is some partially buried debris within Former Barrel Storage Area such wood planks, barrels, and tracks to an old piece of equipment.
8 - BA 1 - Old Borrow Area, South of Access Road	metal cables, scrap metal, wood, equipment track pads	Very sparsely scattered debris in a large area.
9 - BA 1 - Old Borrow Area, North of Access Road	scrap metal and mostly wood fragments	Very sparsely scattered debris in a large area.
10 - Off Drawings	mostly wood, some scrap metal and tin cans	Very sparsely scattered debris in a large area.
11 - Barrel Cache, west of Station Area	wood fragments	Very small volume of debris within barrel cache.
12 - Area around and including the Inuit Hut at the Beach Landing	wood, scrap metal, furnace, rubber equipment tracks, rope, canvas	Some of the debris has been partially buried caused by surface runoff depositing transported material in this area.
13 - Beach Landing east of road to Beach POL Tanks	wood, scrap metal, cables	Most of the debris has been partially buried caused by surface runoff depositing transported material in this area.
14 -In vicinity of Beach POL Tanks	wood, scrap metal, metal bed frames, metal cables, timber poles	Some of the debris has been partially buried caused by surface runoff depositing transported material in this area.
15 -South of Dump B, East of Dump D	wood, scrap metal, electrical cables, equipment track, wood weir, rubber	Wood Weir is located in runoff stream. May have been used to pond fresh water for potable water.
16 -Within 30 m of Access Road from Station Area to Beach Landing Area, excluding areas within other debris areas	mostly wood, scrap metal, a metal sled near Road Section #4	Refer to Figure 5.0
17 - South of Station, below plateau	Barrels, tin cans, wood, rubber tires, plumbing, metal pipe values (painted), batteries, fibreglass, fire extinguisher, glass, rubber equipment tracks, paint cans, oil filters, rubber, mercury lamps, electrical wires and switches, grinding wheels, small compressed gas cylinder (50mm diam.), metal sled, plastic, metal cables, Styrofoam, fabric, metal tanks of various sizes, demolished vehicles, fire repressing tank (with exposed white powder, 03m diam x 0.75m), pieces of machinery,	Figure 6.0 provides additional information such as the terrain profile, debris zones, photo location and orientation, locations of hazardous material.
18 -Old Construction Camp, East of Road	wood (beams, timbers), scrap metal, equipment tracks, machine parts, metal cables, electrical wire, metal hauling truck boxes	Most of the debris is located in a concentrated area around the metal hauling truck boxes, but some debris does extend into the steam east of the area.
19 - Near Old Construction Camp, West of Road	wood, scrap metal, tin cans, metal strapping	Some of the debris is partially buried and has been partially covered in vegetation.
20 -Southwest of Dump B at Old Construction Camp Area	Barrels, wood, scrap metal, rubber, electrical cable, rope, machine parts, seat cushions, wooden crates, metal cables, wooden tables, equipment tracks, metal garbage cans, wooden cable spoils, tin cans, compressed gas cylinder , plumbing, metal strapping, stoves	Some of the debris is partially buried.
21 - South of Station, below plateau west of Dump A	scrap metal, wood.	Lower portion of Dump E surface debris assessment incorporated into Dump A inventory as noted on Figure 6.0. The surface debris in the remaining area was estimated from a Helicopter fly by.

2.5 Proposed Construction

2.5.1 Potential Locations

Three potential landfarm locations (LF-1, LF-2 and LF-3) were identified and evaluated during the field program. These locations are shown on Figure 3.

Table 5. Summary of Proposed Landfarm Locations

Area	Location	Estimated Available Surface Area (m^2)	Environmental Considerations	Engineering Considerations
Proposed Area 1	West of the main station and north of an existing access road.	27,500	No contamination present.	The site is in a well drained, relatively flat area, gently sloping to the northwest. Silty sand to sand with some silt and variable amounts of gravel, cobbles and boulders. Seepage and sloughing below 0.55m below ground surface. Permafrost was not encountered due to sloughing and seepage.
Proposed Area 2	West of main station and north of an existing access road.	24,500	Some surface debris is present.	The site is a well drained, disturbed area with sporadic concentrations of wood and metal debris. Silty, bouldery sand to gravel with some cobbles. Oversize materials were observed in the area. Seepage and sloughing below 0.66m below ground surface. Permafrost was not encountered due to sloughing and seepage. Perimeter containment system requires keying in permafrost at a depth at least of 1.5m.
Proposed Area 3	West of main station and south of an existing access road.	6,000	No contamination present.	The site is an undisturbed, well drained, relatively flat area, gently sloping to the northwest. Variable proportions of silt, gravel and cobbles and oversized material was observed. Seepage and sloughing below 0.41m below ground surface. Permafrost was not encountered due to sloughing and seepage.

2.5.2 Recommended Location and Construction Details

2.5.2.1 Landfarm

The total volume of Type B soil identified for remediation is approximately 380 m^3, which will require an area approximately 3,000 m^2 for the construction of a landfarm. Potential Landfill Areas 1 and 2 are the preferred locations for a landfarm but can also be built at Potential Landfill Area 3 but it is situated on Inuit Owned Lands (Figure 3). This site is located at the Upper Site and is in close proximity to the station area where the majority of the Type B hydrocarbon soils are situated and provides a surface area of approximately 24,000 m^2. Following the treatment of the Type B hydrocarbon soils to below criteria the closure plan for the landfarm should include reshaping the berms to blend with the surrounding terrain. The treated soils should not be covered with granular material which will allow further remediation of the soils over time.

The construction of the landfarm is a priority, following the upgrading of the main access road, as the treatment of soil could potentially delay the contractor's demobilization from site. Considering the small volume of Type B soils and the short project duration, it is recommended to spread the soils within the landfarm to a depth of 0.3 m instead of 0.4 m in an effort to accelerate the remediation process and reduce risk of the soils not meeting criteria at the end of the main construction season. Preliminary sizing of the landfarm and associated granular volumes for the construction of the landfarm were based on the 0.3 m lift thickness of Type B soils. The final landfarm surface should be graded at 2 to 4% towards the outside edge(s) and uniformly compacted with the random action of tracked equipment.

2.6 Borrow Areas

Borrow quantities were investigated as part of the geotechnical field investigation completed by AECOM in 2010. Eleven borrow areas have been identified at FOX-E, including:

1. Borrow Area 1A
2. Borrow Area 1B
3. Borrow Area 1C
4. Borrow Area 1D
5. Borrow Area 2
6. Borrow Area 3
7. Borrow Area 4
8. Borrow Area 5
9. Borrow Area 6
10. Borrow Area 7
11. Borrow Area 8

Table 6 provides a summary of the granular material types and estimated volumes at each of the borrow areas.

Table 6. Summary of Granular Borrow Sources

Borrow Area	Available Type of Granular Fill	Estimated Volume Available (m^3)
1A	Types 2/3	31,500
1B	Types 2/3	14,400
1C	Type 1	2,300
1D	Type 3/5/6	10,800
2	Types 3/4/5/6	11,300
3	Types 3/4	3,600
4	Types 1/3	2,500
5	Deemed unsuitable for construction use due to non-granular nature and high moisture content	
6	Types 3/4	20,000
7	Types 2/3/6	5,600
8	Types 2/3/6	4,000

2.7 Removal of Hazardous Material

"Hazardous" waste materials are defined as waste materials that are designated as 'hazardous' under Nunavut or Federal legislation; or as 'dangerous goods' under the Transportation of Dangerous Goods Act (TDGA). The Canadian Environmental Protection Act (CEPA) regulates material containing PCBs at concentrations greater than 50 ppm. Specific hazardous materials may include: batteries, asbestos, fuel tank bottom sludges, solvents, PCB-containing fluids, fuels and lubricating oils, alcohols and glycols, and heavy metal contaminated liquids. Disposal requirements of these hazardous waste materials are presented in Table 7.

Table 7. Hazardous Waste Material Disposal Requirements

Hazardous Waste Material	Disposal Requirement
Batteries Heavy metal contaminated organic liquids Liquids containing organic compounds with chlorine concentrations >1000 ppm Liquids containing organic compounds with PCB concentrations >2 ppm and <50 ppm	Off-site licensed treatment/disposal facility
Fuel tank bottom sludges Fuels, lubricating oils, alcohols and glycols	Off-site licensed treatment/disposal facility **OR** On-site incineration in accordance with the contract specifications
Liquids and solids containing organic compounds with PCB concentration >50 ppm	Off-site licensed treatment and disposal facility

2.8 Transportation of Hazardous Materials Off-Site

Hazardous materials are placed in environmentally suitable containers (typically lined and braced sea-cans) at an approved containment facility on-site. A storage area is established and registered with Environment Canada. The hazardous materials are removed by sea-lift in accordance with the TDGA Regulations.

2.9 Grading and Addition of Granular Materials

There are numerous areas identified that require grading and possible addition of granular materials. These areas generally consist of piles of buried or partially buried non-hazardous debris that will be covered with additional granular material and shaped to blend in with the natural terrain and promote positive drainage.

3. Description of the Existing Environment

3.1 Physical Environment

3.1.1 Geology and Terrain

The surficial geology of Durban Island mainly consists of bedrock outcrops and colluvial blocks and rubble derived from local bedrock with sand and gravel, and glacial erratics and till mixed in by freeze-thaw action. The main work sites (upper and lower) of FOX-E are located in areas of bedrock "blockfields" with fine sand and gravel and occasional glacial deposits of till and erratics. The main access road connecting the work areas travels through areas of exposed bedrock.

The bedrock at Durban Island is comprised of Precambrian metamorphosed sedimentary rocks (metagreywacke, metasiltstone, metapelite), migmatite of sedimentary origin, and minor igneous intrusive rocks (granitoid) of the Hoare Bay Group. The Beach Landing Area and Old Construction Camp are situated on this formation.

The plateaus at higher elevations of central Durban Island contain the erosional remnants of basaltic volcanic rocks of the Cape Dyer Formation, which overlie the Precambrian rocks. The upper main station site is located on bedrock of this formation.

In the northeast corner of Durban Island, about 2 km northeast of the main station site, there are semiconsolidated beds of sedimentary rocks (sandstone, shale, and conglomerate) of the Cape Searle and Quqaluit Formations overlying the Precambrian rocks

3.1.2 Hydrology

Based on air photo interpretation and observations during the 2010 site investigation, regional overland drainage originates from the Upper Site and disperses radically and over the cliff edges within localized drainage channels. In the area of the access road that connects the Upper and Lower sites, the relief is more gradual and drainage seems to follow a series of draws. The access road switchbacks and crosses a seasonal drainage channel twice and it is expected that in periods of intense rainfall and spring snow melt high velocity stream flow will occur within this channel. At the Lower Site surface runoff in some areas occurs as sheet flow and consequently has eroded much of the fine material from the road surface.

3.2 Biological Environment

3.2.1 Vegetation

FOX-E is located within the Davis Highlands Tundra ecoregion. Vegetation in this ecoregion is characterized by a discontinuous cover of mosses, lichens, and cold-hardy vascular plants such as sedge *(Carex* sp.) and cottongrass (*Eriophorum* sp.). As noted in the 1994 ESG report, on the plateau where the main station buildings are located, the vegetation is very sparse and comprised of mostly lichens and mosses with some isolated tufts of willow (*Salix* sp.) and rush (*Lazula* sp.) plants. In the flatter, low lying areas (beach, construction camp, Dump A); the vegetation is fairly lush with willows, sedges, grasses, rushes, and flowering herbs. The following is a detailed list of the vegetation types found at Durban Island as noted in the 1994 ESG report.

Lichens
Map Lichen
Worm Lichen
Reindeer Lichen
Rock Tripe
Jewel Lichen

Horsetail Family
Variegated Horsetail

Grass Family
Polargrass
Arctic Bluegrass

Sedge Family
Cottongrass

Rush Family
Wood Rush

Willow Family
Arctic Willow
Least Willow

Buckwheat Family
Mountain Sorrel
Bistort

Pink Family
Alpine Mouse-ear Chickweed
Bering Mouse-ear Chickweed
Moss-campion

Mustard Family
Draba

Crowfoot Family
Dwarf Buttercup
Buttercup

Poppy Family
Arctic Poppy

Saxifrage Family
Nodding Saxifrage
Prickly Saxifrage

Rose Family
Mountain Avens
Cinquefoil

Primrose Family
Broad-leaved Willow-herb

Crowberry Family
Crowberry

Blueberry Family
Arctic White Heather
Blueberry

Figwort Family
Hairy Lousewort

Aster Family
Fleabane

3.2.2 Wildlife

Terrestrial animals known to inhabit this region include polar bears, Arctic hares, seals and lemmings (ESG, 1994). During the 2010 Phase III ESA, several polar bears were observed around the site. Other mammals that are common in the area are: whales, arctic fox, caribou and ermine. In the nearby marine environment, ringed seals were identified and bowhead whales and narwhal were sighted off-shore. Char and sculpin were present in the waters surrounding the site.

A variety of birds - including, ptarmigan, snowy owl, raven, snow bunting, osprey, shorebirds, seabirds, and waterfowl (ESG, 1994) are known to reside in the area. Evidence of large numbers of Canada geese were noted during the ESG 2009 geochemistry study. During the 2010 assessment, several ptarmigans were noted on-site.

SARA-listed species that may be present in the vicinity include:

- Endangered Species: Eskimo curlew, ivory gull
- Threatened: Peregrine Falcon, Ross's Gull
- Special Concern: Bowhead Whale, Barren-ground Caribou Dolphin and Union Populations

3.2.3 Socioeconomic Environment

FOX-E is a remote, unmanned site located on the east coast of Baffin Island, approximately 95 km southeast of Qikiqtarjuaq. According to local knowledge, there has been no traditional land usage since closure of the station in the early 1960's other than possible transient visits by hunters and trappers. Neither hunting nor fishing are significant land use activities in this area since there are more attractive hunting and fishing areas closer to the nearby communities.

3.2.4 Heritage Resources

An Archaeological Impact Assessment was completed at the FOX-E site in 2010. During the survey, a previously recorded site, MgBs 2, was revisited and one new site, MgBs 4, was identified and recorded. In addition to the heritage sites, a land use site consisting of the remains of 11 Inuit houses were observed. Although the structures have been removed from the beach, material culture left behind indicates that at least eleven Inuit houses were present on the beach approximately 500 m west of the Secondary beach landing area. There were additional house remains to the east that were not recorded as they were outside of the study area.

MgBs 2: This site was originally recorded for the Historical Archaeological Survey Auyuittuq Park and Vicinity as the location of a whaling station as well as the FOX-E DEW Line Site. Although the site was not visited, historic records indicated that there were three whaling companies that were established at this site between 1910 and 1927. During the 2010 AIA, there were no signs of a whaling station within the project footprint. However, due to the amount of disturbance involved in the terra forming of the beach landing area, construction of the POL tank platform, construction camp and access road to the DEW Line site, any remains of the whaling stations could have been easily destroyed and/or buried.

All the remains of the FOX-E site will be removed during the remediation of the site. No further work is recommended as the recording of the site is thought to be sufficient mitigation.

MgBs 4: This is a stone feature site that is made up of two stone circles on a beach ridge overlooking the beach landing area and POL tanks from the FOX-E site. The first stone circle is made up of more than 80 partially buried stones in a 5.5 m diameter circle. There also appears to be a stone centre feature dividing it in half. The second stone circle is made up of more than 27 somewhat dispersed stones, with a 5 m diameter. The site is thought to predate the FOX-E site due to the lack of cultural material found. A single hand wrought iron spike was recorded amongst the stones in the first circle. The origin of the features is unknown as it may represent European use if this area was used as a whaling station, or it may represent Inuit occupation that predated the FOX-E site. This site is thought to be of moderate to high significance and the site should be avoided.

4. Identification of Impacts and Proposed Mitigation Measures

An important part of the assessment process involves identifying mitigation measures that would result in a reduction or elimination of potential environmental effects associated with the remediation of FOX-E. In the case of this project, all potential effects were addressed, not just those deemed to be significantly adverse. The proposed mitigative actions described herein shall form part of the overall project design and planning documentation.

Details of the remediation verification and post-remediation long-term monitoring are provided in the 2011 Remedial Action Plan completed by AECOM and are not included in this report.

4.1 Mitigation Plan Objectives

The mitigation plan provides a description of the general environmental protection measures required to minimize or avoid potential adverse effects, a description of protection measures required for specific valued environmental components at the FOX-E site, and details related to environmental inspection responsibilities and procedures.

The protection measures described herein should be implemented by the contractor to minimize or avoid adverse environmental impacts. These procedures are considered appropriate for known and anticipated situations and conditions. However, should certain procedures or protection measures prove impractical, imprudent or insufficient in field situations, appropriate modifications or substitutions will be proposed by field personnel and then reviewed and approved by the Proponents' Representative on-site.

4.2 Environmental Inspection

As part of its general overall commitment to a strategy of environmental protection and quality assurance, INAC employs dedicated environmental inspection staff to monitor its own compliance with the mitigation plan and all applicable laws, regulations, permits, guidelines and standards. INAC will be represented at the site by the Proponents' Representative, who will report to the PWGSC Project Manager. Communications will include, but not be limited to:

- Attendance at regular meetings as scheduled with the inspector;
- Immediately reporting concerns over any aspect of the mitigation plan; and
- Immediately reporting any spills or other event that may have an effect on human or environmental health and/or safety.

4.3 General Operational Procedures for Protection of Valued Ecosystem Components

The procedures and requirements provided in the following sections are intended to be protective of the Valued Ecosystem Components (VECs) identified at the FOX-E site.

4.3.1 Site Operations

The contractor will likely establish a construction camp on the site, which shall be located in an area with minimal vegetative ground cover. The selected location shall be in an area that is as close as practical to the main area(s) of clean up and where possible, on an existing gravel pad or former borrow area. Surface drainage shall not be impeded and a distance of at least 30 m from the nearest body of water shall be maintained. Permafrost shall be protected by construction of gravel pads, and/or elevation of heated buildings on wooden structures. Areas containing archaeological resources need to be avoided in accordance with Section 4.4.8.

Vehicle and mobile equipment travel shall be restricted at the site to established roads, stream crossings and work pads unless specifically exempted by the Proponents' Representative. Recreational use of vehicles, including all terrain vehicles (ATVs), shall not be allowed off the existing road network. Overland movement of equipment and vehicles shall be minimized where damage to the vegetation or underlying soils may occur. Rubber tired vehicles and wide-turning radii shall be used to minimize disturbance to tundra. Following heavy rains, vehicle and heavy equipment use outside of road and work pad areas shall not be permitted until the soil has drained sufficiently to prevent excessive rutting.

Mobile equipment and vehicle operators are to yield the right-of-way to wildlife where safe to do so, and shall not be operated in a manner that harasses any species of wildlife. Vehicle and equipment servicing shall be performed in designated areas only, where special care can be taken to contain, handle, and dispose of maintenance fluids, parts and waste. Fuelling and lubrication of equipment shall be conducted in a manner that avoids spillage of fuels, oils, greases and coolants. When refueling equipment, leak-free containers and reinforced rip and puncture proof hoses and nozzles shall be used. Drip trays shall also be provided and all storage containers will be properly sealed after use.

4.3.2 Storage and Handling of Fuel and Other Hazardous Substances

All fuel storage containers shall be compliant with the *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* (CEPA SOR/2008-197). Fuel shall be stored at a minimum, in self-dyking, double-walled containers or be in containers positioned over an impervious liner and surrounded by an impervious dyke of sufficient height to contain not less than 110% of the capacity of the tank. Sites that slope towards waterways or other environmentally sensitive areas, exhibiting ponding or flooding, or have high groundwater tables, excessive seepage, or ice-rich (thaw sensitive) soils shall be avoided, as must archaeological resources. Smoking is prohibited within 7.5 m of the fuel storage facility. Appropriate signage shall be posted around the fuelling facility. Fuel storage facilities shall be inspected once per day for the duration of the project and documentation of the inspection maintained. Fire-fighting equipment shall be made available for immediate access at each fuel storage facility. All barrels containing fuel and other similar materials need to be stored in an elevated position either on their side with the bungs facing the 9 and 3 o'clock positions, or on pallets, in an upright position. All barrels shall be individually identified with all information necessary for health and safety, and environmental purposes. Material Safety Data Sheets for all chemicals and fuels stored in the construction camp need to be available to all personnel.

Regular inspections shall be conducted of all machinery hydraulic, fuel and cooling systems and any leaks will be repaired immediately. Emergency spill equipment shall be pre-assembled and stored at all permanent fuel storage sites and work areas, including at least two fuel pumps, empty 200 litre barrel and absorbent material sufficient to clean up a 1000 litre spill. All barrels, redundant fuel storage facilities and associated materials and equipment need to be removed from the site at the conclusion of the clean up.

4.3.3 Surface Water Management

A water use license is required from the Nunavut Water Board for the development of potential water sources. All conditions of the license must be complied with. Water withdrawals must not endanger fish or drawdown the water level so as to adversely affect fish habitat. Water withdrawal rates shall not exceed 10% of total water body volume. All water hoses need to be equipped with a mesh size of 2.5 mm or less to prevent the intake of fish as per the *Freshwater Intake End-of-Pipe Fish Screen Guidelines*.

4.3.4 Wastewater Management and Monitoring

Remediation activities generate wastewater from dewatering activities from contaminated soil treatment areas. Water management on-site is the Contractors' responsibility. However, given the nature of the Arctic terrain, site logistics, and support, climate and weather makes the mitigation of discharge water a challenging task. Contact water associated with contaminated soil excavations contain a number of constituents of concern.

The parameters selected for the monitoring plan are based on and are a reflection of the types of contaminants found at the sites during the environmental assessment. The criteria for the wastewater are considered conservative and appropriately protective of the arctic environment.

Wastewater may be temporarily stored while awaiting test results, provided that it is not stored over the winter months. The volume of wastewater storage during any one construction season shall not exceed the available treatment capacity during that construction season. See Table 8 below for a summary of the typical wastewater discharge criteria, as provided by the Nunavut Water Board for other abandoned military sites.

Table 8. Construction Wastewater Discharge Criteria

Parameter	Criteria (µg/L)
pH	6-9 pH units
Oil & Grease	5000
Arsenic (total)	100
Cadmium (dissolved)	10
Chromium (dissolved)	100
Cobalt (dissolved)	50
Copper (dissolved)	200
Lead (dissolved)	50
Mercury (total)	0.6
Nickel (dissolved)	200
PCB (total)*	1000
Zinc (total)	500

**In respect of application to a road surface.*

The collected wastewater needs to be tested each time prior to discharge. Once it is confirmed that the wastewater meets the discharge criteria, it can be released onto the ground in an area that is at least 30 m from natural drainage courses and 100 m from fish-bearing waters.

The locations of the discharge areas will vary, depending on the work areas. For example, the barrel cleaning operations are typically located within the hazardous materials processing area, which is determined by the contractor. Wastewater that collects at contaminated soil excavations is typically sampled and treated in place. In areas where the volume of wastewater is significant and affects the progression of work, the wastewater may be recirculated.

4.3.5 Sewage Effluent Monitoring

The sewage management system at FOX-E will likely be a simple facultative system where treatment is achieved by the natural degradation of organic substances or biogeochemical activity. Aerobic or anaerobic micro-organisms digest the organic solids and utilize the released energy and nutrients in the effluent to grow and increase in numbers, which in turn accelerates the process. In this type of system, aerobic respiration is the most complete and efficient degrader of organic solids and therefore the most important element in a stable and healthy biological treatment process. This method of treatment within the Arctic environment, combined with relatively short effluent retention times requires good management to achieve the desired level of treatment prior to discharge. See Table 10 below for a summary of the effluent discharge criteria, as provided by the Nunavut Water Board for other abandoned military sites.

Table 9. Sewage Effluent Criteria

Parameter	Criteria
pH	6-9 pH units
Oil & Grease	No visible sheen
Biological Oxygen Demand	120 mg/L
Total Suspended Solids	180 mg/L
Faecal Coliforms	10,000 CFU/dL

In order to maximize the performance of the system, the specifications (which are to be stamped by a qualified engineer) will require sewage lagoons to have sufficient volume to accommodate 100% of the camp water consumption for the duration of the construction season. Each of the two cells will hold 50% of the seasonal flow, to a maximum depth of 1.0 m. The required effluent volume per lagoon can be calculated as follows:

Effluent volume per lagoon = (200 litres/person/day) x (number of people) x (construction duration days) x 50%

Effluent monitoring must be completed prior to discharge.

4.3.6 Domestic Waste Management

Kitchen wastes shall be stored in metal, animal-proof containers to prevent scavenging of waste by wildlife and to reduce scattering of debris prior to daily incineration. All residual kitchen wastes will be packaged with other non-hazardous wastes shall be disposed of with the non-hazardous waste at an off-site facility.

4.3.7 Road Construction and Maintenance

Existing roads and trails provide access to most sources of granular materials. Emphasis on the preservation of the permafrost regime, vegetation patterns, existing surface drainage patterns, water quality and stream flows shall be maintained. Establishment of new roads off-site is subject to the terms of the land use permit and the approval of the Proponents' Representative. New roads shall be located at least 30 m from any water bodies or water courses. Ice-rich soils, especially peatlands, shall also be avoided during road construction. The road bed shall be prepared with a sufficient thickness of fill to prevent terrain damage. Culverts, if required, shall be installed to maintain natural cross-drainage and prevent ponding. Any culverts installed need to be removed from the roads and drainage restored at the end of the clean-up operations. Access roads shall be monitored for signs of erosion and remedial action taken where necessary. Dust suppression, if required, can be maintained with water only.

4.3.8 Stream Crossing and Diversion

The contractor must adhere to all government regulations, licensing requirements/procedures and inspections regarding the protection of water quality and stream integrity. Existing stream crossings shall be utilized as required. Authorizations for any additional works employed are the responsibility of the contractor.

In the event a stream crossing is required, siltation of waterways and disruption of streambeds shall be prevented using the following procedures:

- Minimize activities adjacent to watercourses;
- Install cofferdams, silt barriers or other suitable barriers;
- Do not operate equipment in waterways;
- Do not use streambeds for borrow material; and
- Do not dispose of excavated fill, waste materials and debris in waterways.

4.3.9 Borrow Pit Development and Operation

Environmental protection measures must be implemented for the purpose of minimizing the impact of development and extraction activities on surface drainage patterns, water quality, soil erosion, and in some cases, wildlife or fish. The number of borrow areas opened shall be minimized by using existing borrow areas, roads and building pads where feasible. Use of alternative sources is subject to the approval of the Proponents' Representative and acquisition of a quarry permit. All terms and conditions of the quarry permit are to be complied with, including the recontouring/reclamation of the borrow area and site clean-up prior to site abandonment.

Borrow areas must be located at least 30 m from the nearest water body providing potential fish habitat, and other sensitive resources. A 30 m buffer zone should be marked out prior to commencement of gravel quarrying operations. Organic overburden, if present, shall be stripped and stockpiled separately for use in restoring the borrow area. Following excavation, the area needs to be recontoured to restore natural drainage and the overburden worked into the recontoured borrow area to prevent erosion. Drainage and run-off control needs to be provided using diversion ditches and sediment filters, as required, to prevent sediment laden run-off from reaching water bodies.

During aggregate extraction, vehicle and equipment operations shall be controlled in areas adjacent to the borrow pit to minimize the extent of disturbance. Aggregate shall be stockpiled on ice-poor, well drained ground such that surface drainage is not impeded. The stockpile shall be located in an area that is a minimum of 30 m from archaeological resources, water bodies, and other sensitive resources. If archaeological features or artifacts are encountered during borrow pit operations, the Proponents' Representative is to be notified, the area of the find avoided, and activities in other areas of the pit restricted until further instructions are received.

4.3.10 Hazardous Waste Material Processing Area

A hazardous waste material processing area needs to be developed for the processing of excavated soils. The hazardous waste material processing area shall be located a minimum of 30 m from any archaeological site or water body, on ice poor, well drained soil, and as close to the location of work as practical. Movement of vehicles and equipment between the hazardous material processing area and work site shall be minimized to prevent the spread of potentially hazardous material along the roadways.

4.3.11 Contaminated Soils

Soils exceeding the criteria established for INAC abandoned military sites, including FOX-E, are to be removed. Disturbance to adjacent areas during excavation of contaminated soil shall be minimized. Spillage of material during transportation between the excavation site and the stockpile/treatment location is to be avoided and any spillage shall be cleaned up to the satisfaction of the Proponents' Representative. Following excavation of contaminated soils, equipment shall be decontaminated. All workers need to wear appropriate protective clothing/equipment when handling contaminated soil. A program of sampling and confirmatory testing of specific contaminated areas will be carried out as part of the clean-up program.

4.3.12 WDA Closure

The existing dumps will be covered with gravel to provide a minimum cover thickness as previously discussed in this report. The surface debris located in these areas will be removed and then they will be regraded and restored to natural drainage patterns and topography. There are no high risk WDAs scheduled for excavation at FOX-E.

Drainage controls such as diversion ditches and sediment filters will be provided, as required, to prevent runoff from reaching water bodies during closure and remediation of WDAs.

4.3.13 Disposal of Site Debris

Site debris shall be collected, sorted into hazardous and non-hazardous materials and disposed of accordingly. Both non-hazardous and hazardous materials will be packaged and disposed of at an offsite location. Workers need to wear appropriate protective clothing when handling potentially hazardous waste material. Off-road activity shall be minimized during collection of site debris.

4.3.14 Demolition of Structures

All residual debris is to be removed from the site down to grade. Structures shall be demolished to the top of the concrete foundation level. Gravel pads and other foundations shall be regraded to restore natural drainage patterns and to match adjacent topography.

4.3.15 Aircraft Movements

It is anticipated that chartered helicopters will be used to transport personnel, perishable supplies and some construction materials and equipment to and from the site. Charter pilots will be advised to maintain an altitude at which it does not disturb those on the ground or water when passing over the site. Low level flights to observe or photograph wildlife will not be permitted. Charter pilots will be informed of all applicable mitigation plan requirements when scheduling arrangements are made or at other appropriate periods prior to the arrival of the aircraft on-site.

4.3.16 Handling of Dangerous Goods and Hazardous Waste Materials

Packaging: The Transportation Dangerous Goods Act (TDGA) and Regulations govern the packaging and shipment of dangerous goods within Canada. If shipping out of Canada, Canadian regulations and the regulations of the destination country both apply. Requirements of the International Marine Dangerous Goods Code (IMDGC) must be addressed in international waters. Any material classified by the TDGA must be accompanied by the appropriate shipping documents. The documents must include: the shipper, the receiver and all carriers involved in the transport of the shipment. Non-hazardous materials are also to be accompanied by a document indicating ownership and responsibility of the receiver. The contractor shall refer to the TDGA and regulations for more details regarding shipping document requirements. All dangerous goods will be packaged in accordance with the TDGA.

Waste manifests will be initiated for each shipment, specifying a unique reference number and INAC's waste generator number to accompany the shipment to the final destination. Any waste of unknown TDGA hazard will be tested to determine whether any transport hazard exists according to the regulations. Any substance that is considered hazardous will be packaged under the TDGA in accordance with the regulations and the national standard *Performance Packaging for Transportation of Dangerous Goods*. The TDGA regulations specify the packaging requirements for dangerous or hazardous goods according to risk.

Labeling: Each item will be labeled and placarded according to its hazard class and division. A label or placard design is unique to each classification. Large containers will be placarded as defined by the class and division with the TDGA product identification number clearly defined. The product identification number is indicated by the substance name in the regulations.

4.3.17 Explosives

The use of explosives is potentially dangerous to human and animal health. If required, the following procedures should apply:

- Obtain all necessary permits and licenses;
- Handle, transport, store and use explosives and all other related material in accordance with all applicable laws, regulations and orders of regulating authorities;
- Electric detonation methods are prohibited;
- Restrict use of explosives to authorized and certified/licensed personnel who have been trained in their use;
- Minimize defacement of landscape features and other surrounding objects controlling the scatter of blasted material beyond the cleared working area;
- Minimize shock or instantaneous peak noise levels;
- Prevent blasting scatter from reaching fuel or hazardous substance storage locations. A minimum distance of 300 m in rocky terrain and 1000 m in the presence of metal is required; and
- Do not conduct blasting in the vicinity of wildlife populations.

4.3.18 Work Site Clean-Up and Abandonment

The contractor must comply with all terms and conditions of the water use license and the land use permit. All temporary buildings, fuel barrels, vehicles, equipment, waste materials and surplus materials will be removed from the site following completion of the work. All large earthworks slopes shall be stabilized. Gravel access roads required for operation and maintenance may remain. All disturbed areas shall be graded to match natural drainage patterns.

4.4 Specific Protection Measures for Valued Ecosystem Components

This section describes the required protection measures for the valued environmental components identified at the FOX-E site.

4.4.1 Human Health and Safety

Potential hazards to human health and safety are present at the FOX-E site in the form of hazardous materials and contaminated soil, unpredictable weather conditions and wildlife encounters. Hazardous material and contaminated soil have the potential to enter water bodies and the food chain, and thereby affect vegetation, fish, wildlife and the health of people who travel, hunt and fish in these areas. Site debris may present a physical hazard to people traveling through these locations.

All necessary precautions shall be taken when handling and transporting hazardous material and contaminated soil to avoid site personnel contact with materials. Site workers need to wear protective clothing when handling hazardous materials. All site personnel working on or in the vicinity of the clean-up operations must be trained in, made aware of, and adhere to the requirements of the Workplace Hazardous Materials Information System (WHMIS) program.

Outdoor recreation activities of the site personnel have the potential to adversely affect nearby fish, wildlife and heritage resources. Subject to camp rules and the requirements of territorial fishing licenses and regulations, staff may be permitted to leave the site for recreational purposes. However, recreational use of vehicles, including ATVs, shall not be permitted off of the existing road network. Normal precautions for Arctic travel include: provisions for rapidly changing weather conditions, tactics for possible polar bear and other wildlife encounters, filing a trip plan, first aid kit, a survival kit and insect repellent.

4.4.2 Local Economy and Contact with Local Residents

Employment and local business opportunities in the North and specifically in Qikiqtarjuaq, Clyde River, and Pangnirtung will be maximized as much as possible. Regular briefing meetings shall be scheduled with all camp personnel to discuss and explain camp rules.

4.4.3 Aesthetic Value

It is anticipated that the clean-up activities will have an overall positive effect on the aesthetic value of the FOX-E site in that all disturbed areas (landfills, debris piles, and borrow pits) will be restored as closely as possible to their original appearance. Construction personnel are to avoid and/or modify activities that would otherwise contribute to any degradation of the local environment.

4.4.4 Surface Water and Potential Fish Habitat

The following shall apply to work adjacent to waterways:

- Prevent siltation of water bodies potentially supporting fish by the use of berms or silt fences as required, and by minimizing activities adjacent to watercourses;
- Do not operate equipment in waterways;
- Do not use streambeds for borrow material;
- Do not dispose of excavated fill, waste material or debris in waterways;
- Where possible, conduct in-stream work during low-flow periods or when frozen; in late winter before spring freshet or after mid-August; and
- When removing culverts, slope banks to conform to the grade of the adjacent stream bank, as applicable. If required, stabilize the bank using erosion resistant material.

Recreational fishing shall not be permitted except in compliance with the applicable federal and territorial regulations and guidelines.

4.4.5 Permafrost Soils

Ice-rich soils are common in areas that have vegetation cover and are thus susceptible to permafrost degradation. The top layer provides a protective thermal barrier that prevents permafrost degradation. These soils are susceptible to erosion due to their fine texture. Erosion removes the thermal protection and causes permafrost degradation. Vehicle and equipment traffic, and soil excavation can disturb the surface layer and degrade the permafrost. Disturbance to permafrost soils needs to be minimized by restricting vehicle and heavy equipment traffic to existing roads and designated work areas unless approved by the Proponents' Representative. Activity in areas adjacent to work areas shall also be minimized. Vehicles or heavy equipment shall not be operated off-road following heavy rain or melting snow until the soil has dried sufficiently to prevent excess rutting. Appropriate drainage and erosion control structures shall be installed along access roads, where required. The following measures shall be implemented during the site clean-up operations to minimize disruption of permafrost:

- Facilities such as work camps and storage areas shall be located such that they do not impede surface drainage or result in ponding;
- Gravel pads shall be constructed and used to protect ice-rich soil from thermal or physical damage;
- Disturbance during excavations shall be minimized;
- Excavated areas shall be backfilled promptly with granular fill, upon receipt of confirmatory samples;
- Development of new borrow areas shall be minimized;
- Materials shall not be stored directly on unprotected ground surfaces;
- Disturbed areas shall be regraded to restore natural drainage patterns; and
- Any rutting that occurs and impedes local drainage or exposes permafrost in ice-rich soils shall be repaired to the satisfaction of the Proponents' Representative.

4.4.6 Terrestrial Wildlife

There is always concern over human/wildlife contact at Arctic sites. This could include harassment by project personnel causing disruption of activities such as calving, breeding, nesting and rearing, all of which may take place on the site proper.

The following procedures shall be implemented to prevent human/wildlife conflicts:

- Employ a dedicated wildlife monitor(s) at all times;
- All on-site personnel shall be required to be familiar with the on-site bear safety training for all workers;
- Wildlife may not be fed, injured or harassed by site personnel;
- Do not disturb birds nesting on-site;
- Vehicle and aircraft movements shall conscientiously avoid all known populations of wildlife or areas known to be frequented by known populations of wildlife;
- Do not attempt to chase, catch, divert, follow or otherwise harass wildlife by aircraft, vehicle or on foot;
- Control refuse and make it inaccessible to bears and other scavengers;
- Equipment and vehicles shall yield to wildlife, where possible;
- Except in the vicinity of the heli-pad, advise charter pilots not to fly at elevations that disturb those working on the ground or water;
- In the event that wildlife is spotted from the air, aircraft shall not make descents for observations or photography;
- Domestic or wild pets are not allowed in camps with the exception of controlled watchdogs; and
- Project personnel shall not be permitted to possess personal firearms. The only firearms allowed on site shall be for protection from bears and shooting of animals exhibiting aberrant behavior. The firearms shall be controlled by the contractors' site superintendent.

4.4.7 Avifauna

Disruption of avifauna during the nesting period can result in reproductive failure. For this reason, populations of nesting birds shall be avoided during this period. Impacts on these species shall be minimized by removing any nests before they become active, discouraging nesting at work areas and scheduling disruptive activities outside of the nesting period. Based on the observations during the 2010 site investigation at the FOX-E site, it is not anticipated that work scheduling will be required.

The arrival of avifauna at specific locations in the Arctic is influenced by weather conditions and a number of other factors. Inclement weather or a delayed spring melt may delay arrival by several weeks. In general, however, the chronology of arrival, nesting and departure is relatively consistent. Typically within two weeks of arrival, nesting commences and continues for one to two months until the young leave the nest. Following this, the birds feed in preparation for the fall migration and depart by mid to late September.

4.4.8 Heritage Resources

Archaeological sites and recent camps and cemeteries exhibiting evidence of the presence of the former occupants have been found on or adjacent to all of the DEW Line sites. The traditional and scientific value of heritage resources is greatly diminished if they are disturbed or moved. Archaeological sites in Nunavut are protected by law, and disturbance of these sites and collection of specimens is prohibited except under the terms of an archaeological research permit.

In the event that heritage resources are discovered during clean-up activities, the following procedures apply:

- Report the discovery immediately to the Proponents' Representative;
- Cease work in that area and notify the appropriate authorities with the Department of Culture, Language, Elders and Youth (CLEY);

- Report all archaeological finds, including:
  - The identity of the person making the discovery;
  - A description of the site, including topography, landmarks, etc.;
  - The nature of the activity resulting in the discovery; and
  - A description of the archaeological site, including size, features, or visible details, supplemented by sketches or photographs:
    - Actions currently undertaken to protect the archaeological features.
    - Any extenuating circumstances.
- Do not resume activities in the vicinity of the find until confirmation and direction from the Department of CLEY is received.

These mitigation measures were identified because they will result in a reduction or elimination of likely environmental effects, including potential adverse effects, associated with the clean-up.

5. Cumulative Effects

A summary of the project tasks, potential impacts, proposed mitigation measures, cumulative impacts and significance are presented in Table 10.

Table 10. Summary of Project Tasks, Impacts, Mitigation Measures, Residual Impacts and Significance

VEC	Activity	Description of Impact	Proposed Mitigation Measure	Residual Impact	Overall Significance
Air Quality	Hydrocarbon Contaminated Soil Removal/Landfarming	Air quality may be impacted by the removal of hydrocarbon-contaminated soils and landfarming.	None. Impact is minimal and short-term.	None. Once the impacted soil has been removed, the potential for a residual impact is removed.	N
	Site Grading/Borrow Source Development	The extraction of granular materials and grading activities has the potential to create dust and impact air quality.	Implement dust control measures. Only water will be used for dust control.	None.	M
	Vehicle, Incinerator and Camp Infrastructure (furnaces, generators) Emissions	Operation of the camp and associated equipment will result in emissions that could negatively impact air quality.	Use appropriate furnace filters, do not leave vehicles and equipment running unnecessarily. Impacts occur over the short-term.	None.	M
Soil Quality	WDA Closure	The closure of the existing dumps will reduce the risk of impacting soil quality.	Regrading will promote positive surface runoff. Sedimentation and erosion control measures will reduce the potential for waterway siltation.	Mitigation measures will significantly reduce risk.	M
	Contaminated Soil and Hazardous Materials Removal	The removal of the contaminated soil and hazardous materials from contact with the environment will improve soil quality.	n/a	Improved soil quality and reduced potential for future adverse effects.	P
	Transport of Hazardous Material, Fuel and Contaminated Soil	The potential exists for accidental release of hazardous materials, contaminated soil and/or fuels during transport, which could impact soil quality.	Proper handling, storage, and transportation procedures for hazardous materials to be implemented as per TDGA regulations. All workers to be trained in proper handling procedures for all hazardous materials on-site. Workers to follow the spill contingency plans. All materials and equipment to implement contingency plans to be available on-site.	None.	M
	Camp Operation	The operation of the construction camp will include treatment and disposal of domestic waste, and could negatively impact soil quality.	Hazardous materials will not be disposed of in the camp waste system. All sewage to be disposed of in accordance with Land Use Permit and Water Use License.	None.	M
Water Quality	WDA Closure	The closure of the existing dumps has the potential to disrupt drainage at the site and cause siltation of waterways.	Regrading will promote positive surface runoff. Sedimentation and erosion control measures will reduce the potential for waterway siltation.	Mitigation measures will significantly reduce risk.	M
	Contaminated Soil and Hazardous Materials Removal	Removal of the contaminated soil and hazardous materials from the environment will reduce the risk of contamination to the surface and active layer water.	Prevent sediments from entering waterbodies by use of berms and/or silt fences. Implement other environmental protection measures as necessary.	Reduced potential for future negative effects.	P

VEC	Activity	Description of Impact	Proposed Mitigation Measure	Residual Impact	Overall Significance
	Transport of Hazardous Material, Fuel and Contaminated Soil	The potential exists for accidental release of hazardous materials, contaminated soil, and/or fuels. An accidental release could impact water quality.	Proper handling, storage, and transportation procedures for hazardous materials to be implemented as per TDGA regulations. All workers to be trained in proper handling procedures for all hazardous materials on-site. Workers to follow the spill contingency plans. All materials and equipment to implement contingency plans to be available on-site. Implement mitigation measures to prevent deleterious substances from entering the aquatic environment.	None.	M
	Site Grading/Borrow Source Development	Erosion and sedimentation of waterbodies during grading and gravel extraction activities has the potential to negatively impact water quality. Drainage will be improved as a result of grading disturbed areas. The extraction of granular material will alter the terrain of the borrow area and has the potential to disturb drainage.	Prevent siltation by use of berms and/or silt fences. Do not operate equipment within the wetted perimeter. Disturbed areas adjacent to water are to be stabilized, if required. Site to be graded upon completion to promote positive drainage and to match the existing terrain as much as practical.	None.	M
	Camp Operation	The operation of the construction camp will include treatment and disposal of waste. The potential exists for waste to impact water quality.	Hazardous materials not to be disposed of in the camp waste system. All sewage to be disposed of in accordance with Land Use Permit and Water Use License.	None.	M
	Debris Disposal	The removal of site debris has the potential to disturb existing terrain.	Regrade and reshape disturbed areas to match existing terrain and drainage paths. Use existing roads for movement around the site wherever possible.	Although every effort will be made to match worked areas to the existing terrain and drainage paths, it is unlikely to be exact, and will likely take significant time for the area to blend into the undisturbed terrain.	M
Terrain Quality	Debris Disposal	The development of new landfills and removal of site debris has the potential to disturb existing terrain.	Regrade and reshape disturbed areas to match existing terrain and drainage paths. Use existing roads for movement around the site wherever possible.	Although every effort will be made to match worked areas to the existing terrain and drainage paths, it is unlikely to be exact, and may take significant time for the area to blend into the undisturbed terrain.	M
	Site Regrading	Terrain and drainage will be improved as a result of grading disturbed areas.	All structures implemented either during the operation of the site or as	Positive impact.	P

VEC	Activity	Description of Impact	Proposed Mitigation Measure	Residual Impact	Overall Significance
		Previously disturbed areas will blend into the natural environment.	part of the remediation will be removed to restore natural surface drainage patterns.		
	Borrow Source Development	The extraction of granular material will alter the terrain of the borrow areas.	Regrade and reshape disturbed areas to match existing terrain and drainage paths. Use existing roads for movement around the site wherever possible.	Although every effort will be made to match worked areas to the existing terrain and drainage paths, it is unlikely to be exact, and will likely take significant time for the area to blend into the undisturbed terrain.	M
	Contaminated Soil Excavation	The excavation of contaminated soil has the potential to degrade the permafrost.	Minimize the time permafrost is exposed. Minimize surface area of exposed permafrost or active zone.	Although the permafrost may be disturbed, it is anticipated once the work is completed, permafrost depth will be restored.	M
	Camp Operation	Movement of contractor's equipment and personnel around the site has the potential to disturb the tundra.	Regrade and reshape disturbed areas to match existing terrain and drainage paths. Use existing roads for movement around the site wherever possible.	Although every effort will be made to limit movement to existing roads, the Arctic tundra is quite sensitive and it may take significant time for the disturbed area to recover.	M
Terrestrial Animals	General Clean Up Activities	The use of heavy equipment during the clean up has the potential to disturb wildlife.	Avoid areas of known wildlife colonies or bird nesting areas. Employ minimum distance requirements for transportation activities around the site.	None. The work is seasonal, short-term and temporary.	M
	Contaminated Soil and Hazardous Materials Removal	The removal of hazardous materials and contaminated soil from the environment reduces the risk of exposure to terrestrial animals.	n/a	Reduced risk of future adverse effects.	P
Terrestrial Habitat	Borrow Source Development	The extraction of granular material will disturb the ground and has the potential to impact terrestrial habitat.	Regrade and reshape the disturbed areas to match existing terrain to facilitate recovery of ecosystem components.	Although every effort will be made to match the disturbed area to the existing terrain, the Arctic tundra is quite sensitive and it may take significant time for the disturbed area to recover.	M
Aquatic Habitat and Animals	Site Regrading/Borrow Source Development	The extraction of granular material and grading adjacent to waterbodies has the potential to impact aquatic habitat, and thereby affect aquatic animals, due to sediment entering the water.	Prevent siltation by use of berms and/or silt fences. Do not operate equipment within the wetted perimeter. Disturbed areas adjacent to water are to be stabilized, if required.	None.	M
	Contaminated Soil and Hazardous Materials Removal	The removal of contaminated soil and other hazardous materials from areas close to waterbodies reduces the risk of exposure to aquatic animals. The excavation of contaminated soils from	Implement mitigation measures to prevent deleterious substances from entering the aquatic environment. Prevent siltation by use of berms and/or silt fences.	Reduced risk of future adverse effects.	P/M

VEC	Activity	Description of Impact	Proposed Mitigation Measure	Residual Impact	Overall Significance
		the beach POL area has the potential to degrade the aquatic environment in the event of an accidental release and impact aquatic animals in close proximity to the aquatic environment.	Do not operate equipment within the wetted perimeter. Disturbed areas adjacent to water are to be stabilized, if required.		
Health and Safety	General Clean Up Activities	The excavation of potentially hazardous materials from the landfills, the collection and disposal of potentially hazardous debris, the removal of hazardous materials from the facilities and the general handling of hazardous materials has the potential to impact the health and safety of workers.	Transportation of any hazardous materials is to be in accordance with the TDGA Regulations. Workers must wear and use appropriate personal protective equipment. Workers are to be trained in the use of personal protective equipment and proper handling procedures for hazardous materials. Proper procedures for working around heavy equipment to be implemented.	None.	M
	Contaminated Soil and Hazardous Materials Removal	The removal of contaminated soil and other hazardous materials from the environment reduces the risk of exposure to people.	n/a	Reduced risk of future adverse effects.	P
Archaeological	General Clean Up Activities	The presence and movement of people around the site has the potential to disturb the archaeological resources identified around the site.	Clearly mark and avoid all archaeological resources. Contact authorities in the event a new resource is discovered or a know resource is disturbed.	None.	M
Land Use	General Clean Up Activities	Clean up activities may disturb traditional land use, i.e., hunting and fishing activities that would occur along the coastal areas during the summer months; although it has been noted the area is no longer used.	Contact the local hunters and trappers organization to coordinate clean up activities and traditional land use, if applicable.	None.	M
Aesthetics	General Clean Up Activities	Generally, the clean up will improve the aesthetics of the site by removing unsightly debris and restoring the site to a more natural state.	n/a	Site is restored to a more natural state and therefore is more aesthetically pleasing.	P
Economy	Contractor Support	The contractor will be encouraged to have a significant Inuit content in the workforce for clean up. This will provide employment benefits and related economic benefits.	n/a	Greater number of trained Inuit workers.	P

P – Positive
N – Negative and non-mitigable
M – Negative and mitigable
U – Unknown

6. References

- AECOM (2010) Phase III Environmental Site Assessment, Durban Island (FOX-E) Intermediate DEW Line Site.
- AECOM (2011) Remedial Action Plan, Durban Island (FOX-E) Intermediate DEW Line Site.
- Golder Associates (2010) Archaeological Impact Assessment (AIA) of the Durban Island (FOX-E) Intermediate DEW Line Site.

Appendix A

Drawings

B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 10/12/14 8:09:37 AM

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ISS/REV: 0B

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7 442 000 N
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SCALE 1:15000

ROAD SECTION 1
ROAD SECTION 2
ROAD SECTION 3
ROAD SECTION 4

CROWN LANDS
INUIT OWNED LANDS

INUIT OWNED LANDS
CROWN LANDS

DUMP A

FIGURE 2.0
STATION AREA

FIGURE 3.0
SOUTHWEST OF STATION AREA

FIGURE 4.0
OLD CONSTRUCTION CAMP

FIGURE 5.0
BEACH LANDING

FIGURE 6.0
DUMP A - PLAN

LEGEND:

- SITE GRID (1000m INTERVAL)
- PARCEL BOUNDARY
- POTENTIAL LANDFILL AREAS
- DEBRIS AREAS
- FIGURE SHEET LIMITS
- ROAD SECTION LIMITS

Public Works and Government Services Canada
FOX-E Durban Island Site Investigation

AECOM

Overall Site Plan
Figure 1.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
PLOT: 10/12/14 9:05:26 AM
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GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 0.5m INTERVAL.

LEGEND:

- SITE GRID (100m INTERVAL)
- DEBRIS AREA
- BURIED DEBRIS AREA
- POTENTIAL CAMP AREA
- 10-0000 SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 SAMPLE LOCATION (NOT ANALYZED)
- 10-0000 TIER I
- 10-0000 TIER II
- 10-0000 TIER I / TYPE A PHC
- 10-0000 TYPE B PHC
- TP-14 TEST PIT LOCATION
- EXISTING POWER POLE
- TIER I ESTIMATED AREA OF CONTAMINATION
- TIER I / TYPE A PHC ESTIMATED AREA OF CONTAMINATION
- TIER II ESTIMATED AREA OF CONTAMINATION
- TYPE B PHC ESTIMATED AREA OF CONTAMINATION

0 12.5 25 m SCALE 1:1250

Public Works and Government Services Canada
FOX-E Durban Island Site Investigation

Station Area
Figure 2.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
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GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

LEGEND:

- SITE GRID (500m INTERVAL)
- DEBRIS AREAS
- POTENTIAL BORROW AREA
- POTENTIAL LANDFILL AREA
- PARCEL BOUNDARY
- 10-0000 SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 SAMPLE LOCATION (NOT ANALYZED)
- TP-9 TEST PIT LOCATION

SCALE 1:5000
0 50 100 m

CULVERTS (2)
ACCESS ROAD
POTENTIAL BORROW AREA 2
POTENTIAL BORROW AREA 1
POTENTIAL BORROW AREA 4
POTENTIAL LANDFILL AREA 1
POTENTIAL LANDFILL AREA 2
POTENTIAL LANDFILL AREA 3
DEBRIS AREA 1
DEBRIS AREA 2
DEBRIS AREA 3
DEBRIS AREA 4
DEBRIS AREA 5
DEBRIS AREA 6
DEBRIS AREA 7
DEBRIS AREA 8
DEBRIS AREA 9
DEBRIS AREA 10
DEBRIS AREA 11
LOBE 8
BARREL CACHE
FORMER BARREL STORAGE AREA
ABOVE GROUND CABLE
WIND SOCK
HELIPAD
INUIT OWNED LANDS
CROWN LANDS
1A
1B
1C
1D
TP-1 TP-2 TP-3 TP-4 TP-5 TP-6 TP-7 TP-8 TP-9 TP-10 TP-11 TP-12 TP-13 TP-14 TP-15 TP-16 TP-17 TP-18
10-0325 10-0326 10-0323 10-0324 10-0356 10-0357
10-0275 10-0276 10-0270/71 10-0269 10-0266 10-0267 10-0272 10-0264 10-0265
N 7 441 000 N 7 441 500 N 7 442 000 N 7 442 500
E 536 000 E 536 500 E 537 000 E 537 500

Public Works and Government Services Canada
FOX-E Durban Island Site Investigation

AECOM

Southwest of Station Area
Figure 3.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
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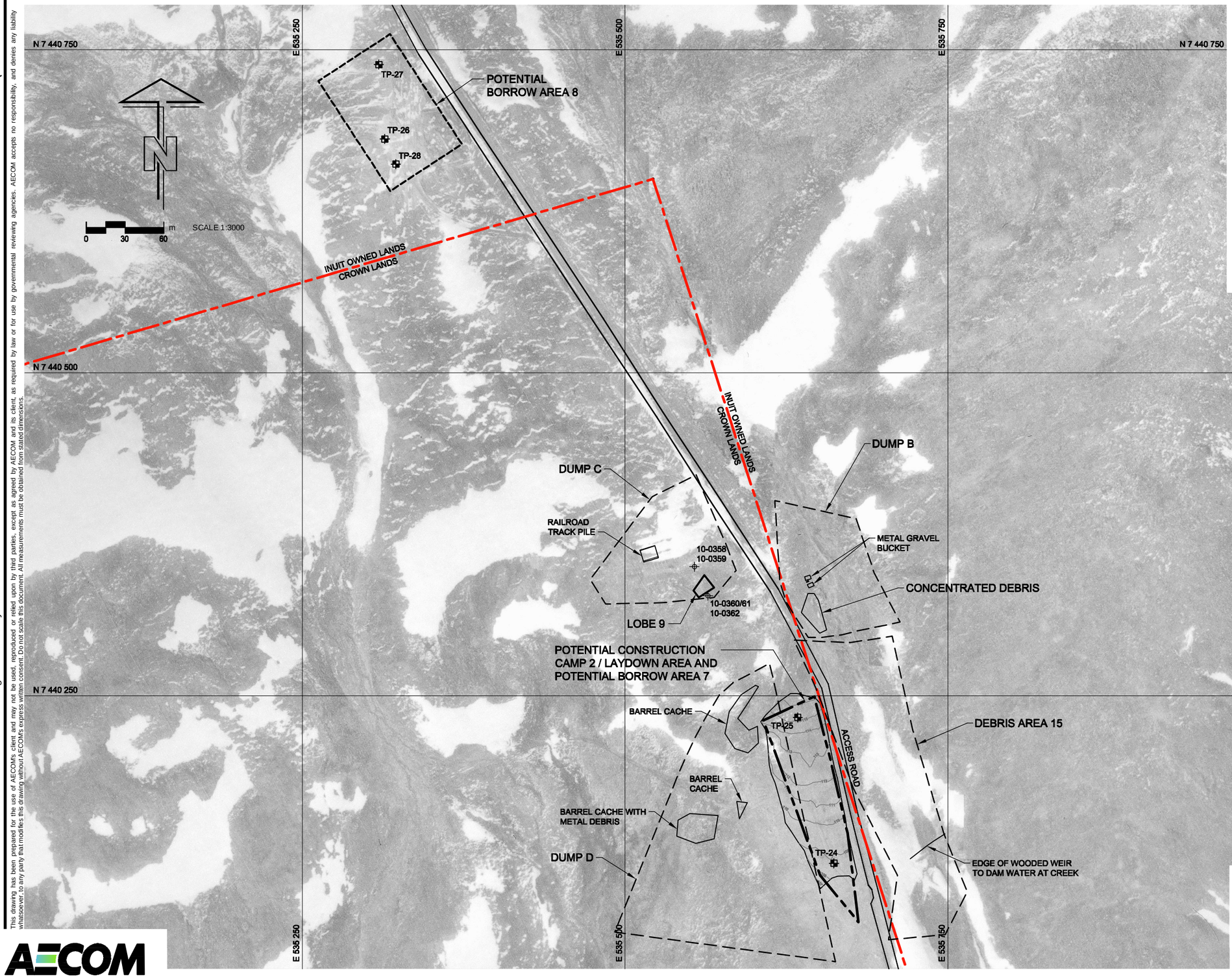

GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

LEGEND:

- SITE GRID (250m INTERVAL)
- DEBRIS AREAS
- BURIED DEBRIS AREA
- POTENTIAL BORROW AREA
- CONCENTRATED DEBRIS AREA
- CONSTRUCTION SITE LAYDOWN AREA
- PARCEL BOUNDARY
- 10-0000 — SAMPLE LOCATION (BELOW CRITERIA)
- TP-26 — TEST PIT LOCATION

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Public Works and Government Services Canada
FOX-E Durban Island Site Investigation

Old Construction Camp
Figure 4.0

B SIZE 11" x 17" (279.4mm x 431.8mm)

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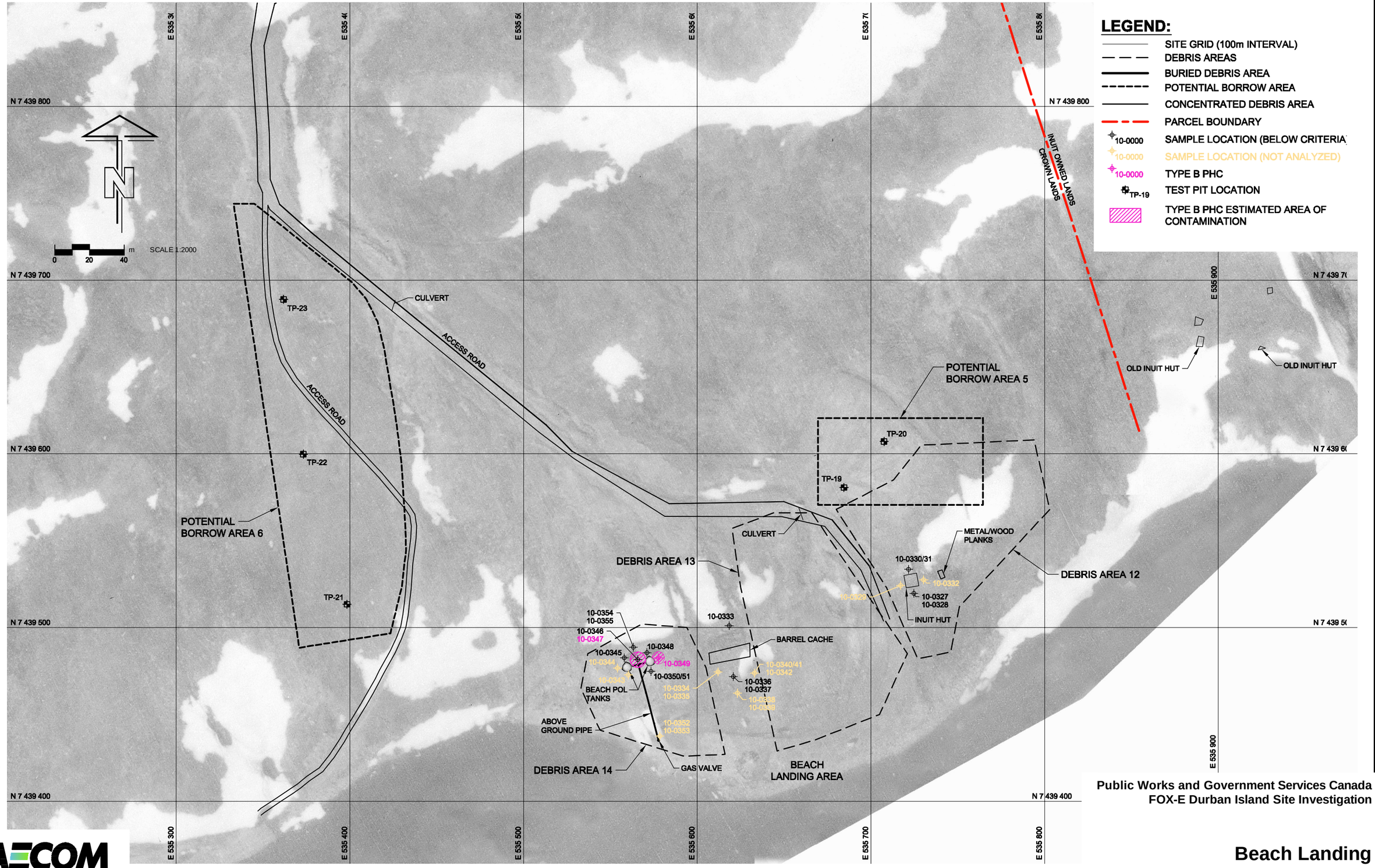

Public Works and Government Services Canada
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Beach Landing
Figure 5.0

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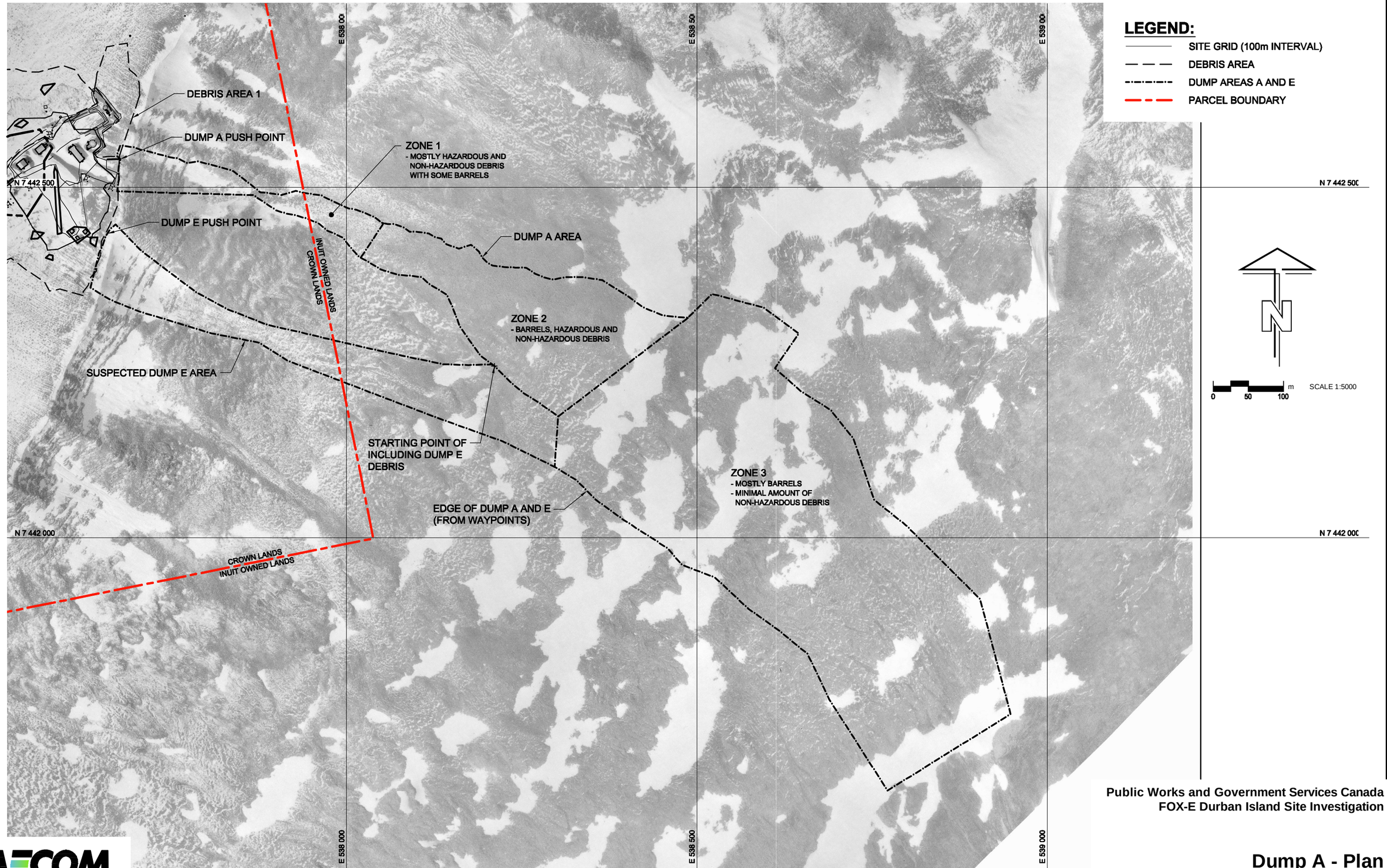

Public Works and Government Services Canada
FOX-E Durban Island Site Investigation

AECOM

Dump A - Plan
Figure 6.0

Public Works and Government Services Canada

Northern Contaminated Sites Program

Environmental Impact Assessment Padloping Island Former US Coast Guard Weather Station - FINAL

Prepared by:

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17007 – 107th Avenue
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780 486 7000 tel
780 486 7070 fax

Project Number:

60158472

Date:

March, 2011

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March 31, 2011

Giselle Cotta, P.Eng.
Senior Environmental Engineer
Public Works and Government Services Canada
Northern Contaminated Sites Program
5th Floor, 10025 Jasper Avenue
Edmonton, AB T5J 1S6

Dear Ms. Cotta:

Project No: **60158472**

Regarding: **Padloping Island Former US Coast Guard Site**
Environmental Impact Assessment

It is our pleasure to provide Public Works and Government Services Canada with the attached Environmental Impact Assessment final report for the Padloping Island site.

Please contact the undersigned at 780-486-7000 if you have any questions.

Sincerely,
AECOM Canada Ltd.

Nick Oke, M.Sc., P.Chem.
nick.oke@aecom.com

NO:slm

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	Nick Oke	March 14, 2011	DRAFT
2	Jennie Turner	March 31, 2011	FINAL

AECOM Signatures

Report Prepared By:

Jennie Turner, EIT
Environmental Engineer

Report Reviewed By:

Eva Schulz, P.Ag.
Senior Environmental Scientist

Executive Summary

The Padloping Island weather station site is located at 67° 02’ N, 62° 44’ W in Merchants Bay on the southwest portion of the island. Padloping Island is off the northeast coast of the Cumberland Peninsula of Baffin Island, approximately 440 km north-northeast of Iqaluit and 75 km southeast of Qikiqtarjuak.

The site is scheduled for remediation according to the Indian and Northern Affairs Canada Abandoned Military Site Remediation Protocol (2009). Activities will include: dump remediation; debris removal; contaminated soil remediation; and containerization and off-site removal of hazardous wastes.

Based on the requirements of the Nunavut Land Claim Agreement (NLCA) through the Nunavut Impact Review Board (NIRB), the project specific information requirements regarding the proposed remediation activities are to be provided and are to undergo an environmental assessment.

The remediation of the site will follow the 2011 Remedial Action Plan (RAP) prepared by AECOM, and the proposed “Walkaway Solution”, which allows for elimination of any new on-site disposal facilities and for the disposal of all site waste and contaminated soil to established southern disposal facilities. The following is the potential proposed schedule for the remediation of the Padloping Island site according to the RAP and the “Walkaway Solution”:

- Source borrow material.
- Construct the landfarm.
- Excavate contaminated soils and package appropriately for either off-site disposal (Tier I, Tier II and Type A) or send to the on-site landfarm for treatment (Type B).
- Excavate waste disposal areas (WDAs) scheduled for removal.
- Collect surface debris.
- Regrade existing WDAs scheduled for regrading.

The following objectives are to be achieved as part of the remediation of Padloping Island:

- To restore the site to meet the environmental objectives established for northern sites;
- To prevent migration of contaminants into the Arctic ecosystem;
- To remove physical hazards for the protection of human health and safety; and
- To implement a cost effective remediation solution.

The remediation of the Padloping Island site will have a net positive effect on the environment through the removal of physical hazards such as the debris, the removal and disposal of Tier I and Tier II impacted soils, site surface and buried debris and hazardous materials, the treatment of hydrocarbon impacted soils, and grading of the site to match the existing terrain. Through the implementation of the proposed mitigation and monitoring plans and project design, potential adverse effects of the proposed project will be minimized and no significant adverse residual effects are expected to occur.

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Appendices

Appendix A. Drawings

1. Introduction

Public Works and Government Services Canada (PWGSC) requested that AECOM prepare an Environmental Impact Assessment (EIA) for the proposed remediation of the Padloping Island Former US Coast Guard Site. The EIA will be submitted to the Federal and Territorial Regulators including Indian and Northern Affairs Canada (INAC) Land Administration, the Nunavut Water Board (NWB), and the Nunavut Impact Review Board (NIRB).

1.1 Padloping Island Location

The Padloping Island weather station site is located at 67° 02' N, 62° 44' W in Merchants Bay on the southwest portion of the island. Padloping Island is off the northeast coast of the Cumberland Peninsula of Baffin Island, approximately 440 km north-northeast of Iqaluit and 75 km southeast of Qikiqtarjuak.

The abandoned weather station is located on a coastal plain approximately 400 m from the bay. The overall site slopes gently towards the south with about a 6% grade overall and a 2% grade in the immediate vicinity of the Main Station Area. It is bordered by a steep cliff beyond two shallow lakes to the west and undulating hills to the east. The site is characterized by abandoned buildings in various states of advanced disrepair, fuel tanks, barrels, contaminated soil, hazardous materials and scattered debris.

The site is only accessible by helicopter or by sea during the summer months. It is understood that an ice landing strip, located just off the shoreline, was used in the past to facilitate landing of fixed wing aircraft during the winter months.

The site is located on a Crown Land parcel of approximately 260 hectares, encompassing government reserve 16M/2-1-1 which is excluded from the surrounding Inuit Owned Land (IOL) parcel BI 13 for which Inuit have surface rights.

1.2 History

In 1943, the United States Military constructed a United States Air Force (USAF) weather station on Padloping Island, codenamed Crystal III. The station was operated by the USAF until the end of the Second World War and subsequently operated by the Canadian Department of Transport until 1956. A long history of Inuit settlement near the Padloping Island site predates the weather station and a written history of an Inuit community dates back to 1884. The remains of a hamlet, abandoned in the early 1960s, are near the remains of the weather station site.

The overall site has three distinct areas: the Main Station Area with associated Metal Dump and drum storage; the Old Hamlet site, located approximately 1 km to the east; and the Original Station Site, which is a further 500 m to the east (Figure 1.0). There is no airstrip at this site, limiting access to helicopter or boat during the summer months.

1.3 General Project Information

1.3.1 Purpose

The purpose of the project is to remediate the site in a manner consistent with the requirements of the INAC Abandoned Military Site Remediation Protocol (AMSRP) (INAC 2009). This protocol provides assessment and remedial guidelines for Waste Disposal Areas (WDAs), disposal of barrel contents and provides clean-up criteria for contaminated soil. There are no criteria for the classification of hazardous waste at federal sites, except for materials regulated under the Canadian Environmental Protection Act (CEPA), including the Inter-provincial Movement of Hazardous Waste Regulations. The classification and remedial recommendations for materials not covered under CEPA has been based on the Transportation of Dangerous Goods (TDG) Regulations and the Nunavut/NWT Guideline for the General Management of Hazardous Waste (1998), under the territorial Environmental Protection Act (R.S.N.W.T 1998 c.E-7). More detailed information related to remedial guidelines or requirements under the sources noted above is provided in the issue-specific sections below.

The ultimate goal is to create a positive environmental impact. The objectives are as follows:

- To restore sites to meet the environmental objectives established in the Abandoned Military Site Remediation Protocol (AMSRP);
- To prevent migration of contaminants into the Arctic ecosystem;
- To remove physical hazards for the protection of human health and safety; and
- To implement a cost effective remediation solution.

To accomplish these objectives, there will be four main areas of activity during the remediation of the Padloping Island site. These activities include:

- Dump remediation;
- Hazardous Waste Removal;
- Non-Hazardous Waste Disposal; and
- Contaminated Soil Remediation.

1.3.2 Project Alternatives

Due to the nature of the site and the location, the range of alternatives to the project is limited. Three alternatives to the remediation of Padloping Island were identified and include:

Do nothing (no clean-up action): The first alternative involved examining the environmental impact of maintaining the status quo at the sites. It was quickly realized that failure to address the environmental problems identified during the site investigations could lead to the following:

- Placing the Arctic environment/food chain at risk.
- Possible future legal liabilities for the federal government.
- Greater clean-up costs in the future.

Walkaway Solution: The second solution would include application of remedial solutions to preclude the requirement for post construction monitoring, including provisions for the following:

- The elimination of any new on-site disposal facilities including a Non-Hazardous Waste Landfill (NHWL) and Secure Soil Disposal Facility.
- The off-site disposal of all site waste and contaminated soil to established southern disposal facilities.

- There is no long monitoring requirement for existing landfills less than 1,000 m^2 in area. For a "Walkaway Solution", all WDA's greater than 1,000 m^2 would have to be excavated with the resulting debris and contaminated soil disposed of at an established southern disposal facility. There are no existing WDA'S with areas exceeding 1,000 m^2 at the Durban Island site.
- The landfarm treatment facility would proceed as planned as there is no monitoring required once the treatment soils are remediated.
- The "Walkaway Solution" could be applied to either an "Individual" or "Combined Contract" scenario for the Padloping and Durban Island Sites.

Combined Contract: The third alternative is to combine the Padloping Island contract with the FOX-E Island contract. The Padloping Island site is only 24 km away from the FOX-E site. A contractor may be able to share resources and realize cost savings if these two sites are tendered together. For this combined scenario, the contractor could procure remediation for the sites concurrently or consecutively with the mobilization of one camp and equipment fleet. Further cost savings could be realized if only one NHWL was built and the waste was consolidated to this location from the two sites.

1.3.3 Schedule

Based on the information provided in the Remedial Action Plan prepared by AECOM, it is anticipated that that construction activities can be completed within one clean-up season, excluding mobilization.

In order to complete the clean-up of the Padloping Island site in one full construction season, the anticipated schedule of activities would be as follows:

- Mobilization in late July or August of 2012 allowing for 4 to 6 weeks of construction following mobilization to source borrow material, perform any required major upgrades and to construct the Landfarm.
- Excavate dumps and contaminated soil and demobilize from site in 2013.

1.3.4 Regulatory Overview

1.3.4.1 Lead Authorizing Agencies

The proponent for this project is Indian and Northern Affairs Canada (INAC). The management of this project is being provided by Public Works and Government Services Canada (PWGSC). These agencies will be responsible for obtaining permits, except in those cases where the clean-up contractor is required to do so by legislation or as part of their contract.

1.3.4.2 List of Approvals, Permits and Licenses Required

The following is a list of permits required for the clean-up of the Padloping Island site:

Land Use Permit (Crown Land): As per the Territorial Land Use Act and Territorial Land Use Regulations, a Class A permit issued by Indian and Northern Affairs Canada (INAC) is required for the activities associated with the remediation of Padloping. Contact: INAC Land Administration, Iqaluit, NU (Tel) 867-975-4283.

Land Use Permit (Inuit Owned Land): As per the Nunavut Land Claims Agreement, a License of Exemption may be required for the activities associated with the remediation of Padloping. Contact: Qikiqtani Inuit Association, Iqaluit, NU (Tel) 1-800-667-2742.

Quarry Permit (Crown Land): As per the Territorial Land Use Act and Territorial Quarrying Regulations, a Quarry Permit(s) issued by INAC is required for the extraction of granular material required for remediation. Contact: INAC Land Administration, Iqaluit, NU (T) 867-975-4283.

Quarry Permit (Inuit Owned Land): As per the Nunavut Land Claims Agreement a Quarry Permit(s) is required for the extraction of granular material required for remediation. Contact: Qikiqtani Inuit Association, Iqaluit, NU (Tel) 1-800-667-2742.

Water Use License: As per the Nunavut Land Claims Agreement Act, a water use license issued by the Nunavut Water Board is required for construction activities associated with the remediation of Padloping Island. Contact: Nunavut Water Board, Gjoa Haven, NU (T) 867-360-6338.

In addition, the successful contractor may require a number of other permits or licenses. These permits or licenses pertain to the operation and maintenance of the contractors' camp or relate to his/her status as an employer. Examples of these permits include those related to the possession of firearms, day-to-day camp operation and federal/territorial labour codes. A list of these and other requirements is presented in Table 1.

Table 1. Other Authorizations

Authorization	Authority	Activity to Authorization Applies
Archaeological Research Permit	Department of Culture, Language, Elders and Youth, Gov't of Nunavut (Nunavut Land Claims Agreement Act)	Investigation of archaeological sites, mitigation, monitoring
Research Permit	Fisheries and Oceans Canada	Fish and shellfish sampling
Transportation Permits	Transport Canada (Transportation of Dangerous Goods Act)	Shipping
Transportation Permits	Transport Canada (International Air Transport Association Dangerous Goods Regulations)	Air transport
Fishing Licenses	Department of Fisheries and Oceans	Recreational fishing
Firearms Acquisition Certificates/ Firearms License (course required)	RCMP	Use and storage of firearms

1.3.4.3 Conformance to Legislation and Policy

The remediation of the site will comply with all applicable environmental laws, regulations and requirements of Federal, Territorial and other regional authorities, and any permits, approvals, and authorizations that may be required. The contractor is subject to and must comply with all permits and approvals obtained on behalf of and by INAC to conduct this work. Throughout all project phases, project personnel will work in close cooperation with regulatory authorities and compliance will be enforced.

Federal Acts, Regulations and Guidelines

Several Federal Acts, regulations and guidelines affect project activities across all Canadian jurisdictions. The most relevant to the remediation of Padloping Island are outlined below:

The **Canadian Environmental Protection Act** regulates toxic substances from their production or import, to consumption, storage and disposal. This Act also incorporates, amongst others, the Storage Tank Regulations (SOR/2008-197) and the PCB Regulations (SOR 2008-273).

The **Transportation of Dangerous Goods Act and Regulations** promotes public safety in the transportation of dangerous goods. The Act applies to all handling, offering for transport and transporting of dangerous goods by any means of transport whether or not the goods originate from or are destined for any place or places in Canada.

The **Fisheries Act** protects fish and fish habitat from pollution, harmful alteration, disturbance and destruction, and impediments to fish movement.

The **Arctic Waters Pollution Prevention Act and Regulations** govern development and shipping activity in Arctic waters adjacent to the mainland islands of the Canadian Arctic to facilitate the continuing welfare of the residents of the areas, and to protect the ecological balance in water, ice and land areas.

The **Migratory Birds Convention Act** provides for the protection of designated migratory species, their habitats, and the regulated harvest of certain species.

The **Canada Wildlife Act** provides for the involvement of the Government of Canada in cooperative research and management programs involving wildlife species normally the responsibility of provinces or territories. This is particularly relevant to rare and endangered species or species such as the Peary caribou, which seasonally move across various regulatory boundaries.

The **Species at Risk Act** aims to protect wildlife from becoming extinct or lost from the wild, with the objective of helping the numbers recover. The act identifies all wildlife species listed as being at risk nationally and protects populations and their habitats.

The **Canada Shipping Act, 2001** regulates shipping activities under the jurisdiction of Canada. Regulations cover technical standards of operation safety and pollution aspects related to shipping activities in Canadian waters.

The **Navigable Waters Protection Act** pertains to the erection of structures or facilities used to support or impede navigation in waters under the jurisdiction of Canada.

The **Territorial Lands Act** provides the authority for administering and protecting lands under the direct control of the Minister of Indian and Northern Affairs Canada (INAC). The following regulations are pursuant to this Act:

- The **Territorial Lands Regulations** provide regulatory control for maintaining sound environmental practises for any land use activities on Territorial lands. These regulations require that land use permits be issued for such operations as work involving the use of heavy equipment, establishment of camps, use of explosives, and clearing of lines, trails and rights-of-way, including construction of access roads.
- The **Territorial Quarrying Regulations** establish the procedures for extracting Crown-owned limestone, granite, slate, marble, gypsum, loam, marl, gravel, sand, clay or stone from Territorial lands. The regulations specify permits, applications, staking and dimensions of quarries.

The **Nunavut Land Claim Agreement Act** provides for the use, management and conservation of land, water, and resources of Nunavut. It also identifies the need to complete an environmental impact assessment for specific projects.

The **Nunavut Waters and Surface Rights Tribunal Act** provides the Nunavut Water Board with the power to issue water use licenses. The NWB evaluates the potential for detrimental effects occurring because of the use of water or a deposit of waste in water on other users.

Canada Labour Code contains the labour code for all Federal employees or activities on Federal owned or controlled land. Private Provincial or Territorial employees are governed by the Provincial/Territorial Labour Acts, even when working on Federal lands or facilities. The Labour Acts control such things as statutory holidays, maximum work hours and minimum wages.

Atomic Energy Control Act and Regulations describe the packaging requirements and approvals needed for the transportation of radioactive materials.

National Fire Code (NFC) established the standard for fire prevention, fire fighting and life safety in buildings in use, including standards for the conduct of activities causing fire hazards, maintenance of sire safety equipment and egress facilities, standards for fire extinguishers, etc. In addition, the NFC established the standard for prevention, containment and fighting of fires originating outside buildings which may present a hazard to a nearby community, and sets the standards for the storage and handling of dangerous goods, flammable liquids and combustible liquids.

The following guidelines are identified as reference materials, and should be used where appropriate in the final design.

Freshwater Intake End-of-Pipe Fish Screen Guidelines (DFO) provide instructions for the protection of anadromous and resident fish where freshwater is extracted from fish-bearing waters.

National Guidelines for the Landfilling of Hazardous Waste (CCME) is to be used by regulators, designers, owners, and operators of hazardous waste facilities. They cover site selection, design, construction, closure and post-closure care, monitoring and operation. They are intended for new, not existing facilities.

Code of Good Practice for Used Oil Management in Canada (CCME) described environmentally sound options for the handling, storage, collection, transportation, recycling, reuse and disposal of used oils in Canada. It is intended to provide guidance for used oil generators and to regulatory authorities in the formulation of provincial or regional used oil management strategies.

Canadian Environmental Quality Criteria for Contaminated Sites (CCME) provide numerical limits for contaminants in soil and water intended to maintain, improve, or protect environmental quality and human health at contaminated sites. The criteria are intended to provide general technical and scientific guidance to provincial, federal, territorial and non-governmental agencies in the assessment and remediation of contaminated sites across Canada. They serve as benchmarks against which to assess the degree of contamination at a site.

Canadian Drinking Water Guidelines (Health Canada) provide criteria for water that are protective of human health and also meet aesthetic objectives.

The **Canada-Wide Standard for Mercury (CCME)** applies to incineration activities on site.

Nunavut and Northwest Territory Acts, Regulations and Guidelines

In addition to the Federal Acts and Regulations identified in Section 3.3.1, the remediation of the Padloping Island site is governed by the following:

Guidelines for the Discharge of Domestic Wastewater in Nunavut, by the Nunavut Water Board, outlines the requirements for water quality effluent from facilities in Nunavut.

Environmental Guidelines for Industrial Waste Discharges establish standards that should be followed when discharging waste from an industrial operation on Commissioners Land or lands administered by municipal governments in Nunavut.

The **Explosives Use Act** provides controls for surface blasting other than for mining purposes.

The **Nunavut Wildlife Act** provides for the protection of wildlife and wildlife habitats as well as regulated harvest of selected species.

The **Nunavut Environmental Protection Act** provides for the protection of the environment from the discharge of contaminants, clean up of contaminants and unsightly premises. In addition, the powers of inspectors as well as offences and penalties are defined. The Act applies only to situations not authorized by other Canadian Acts in the Nunavut Territory. The following guidelines under the Nunavut Environmental Protection Act may be applicable to the clean-up of the Padloping site:

- Contingency Planning and Spill Reporting.
- Disposal Guidelines for Fluorescent Light Tubes.
- Guideline: Dust Suppression.
- Guidelines for the Management of Waste Asbestos.
- Guideline for the Management of Waste Antifreeze.
- Guideline for the Management of Waste Paint.
- Guideline for the Management of Waste Solvents.
- Guidelines for the General Management of Hazardous Waste in Nunavut.

The **Nunavut Environmental Rights Act** provides the people of Nunavut the right to access information concerning the release or potential release of contaminants into the environment, and also the right to prevent the release or potential release of contaminants into the environment.

The **Spill Contingency Planning and Reporting Regulations** outline requirements for filing a contingency plan and for reporting spills.

The **Nunavut Fire Prevention Act and Regulations** provides for the regulation of the decommissioning of fuel lines and fuel tanks.

The **Pesticides Act and Regulations** specifies the requirements for use storage, handling and disposal of pesticides.

The **Nunavut Territorial Archaeological Sites Regulations**, pursuant to the Nunavut Act, protects archaeological sites in Nunavut from disturbance and prohibits the removal of archaeological specimens, except under permit.

The **Safety Act: Occupational Health Regulations** outline the health and safety standards to be maintained at workplaces to facilitate the health and safety of persons.

Guidelines for the Removal of Materials Containing Friable Asbestos outlines the procedures for the removal of friable asbestos.

1.4 DFO Operational Statement Conformity

Based on the work to be completed, there are no activities where a DFO Operation Statement would be applicable.

1.5 Transportation

Transportation associated with the movement of materials, equipment, and personnel to the site, as well as disposal of some waste materials off-site includes air, ground and barge transport. These activities are described as follows:

Air – the site is only accessible by helicopter or by sea during the summer months. It is understood that an ice landing strip, located just off the shoreline, was used in the past to facilitate landing of fixed wing aircraft during the winter months. However, it is expected that transport of personnel to and from the site, and weekly domestic supplies (i.e., food) will be completed using charter helicopter. It is assumed that aircraft access to the site will not be an issue, and the primary mobilization of the contractor's equipment will be via sea-lift.

Ground – existing roads will be used at Padloping Island while on-site. Most of the gravel roads are in poor condition and will require upgrades. It is anticipated that the existing roadways would remain intact once the clean-up work is completed, with the exception of any culverts or other structures that may have been required during the remediation program, which will be removed.

Sea-Lift – the transport of the contractors' equipment and facilities will likely be by sea-lift in the summer. In addition, any waste materials to be transported off-site will be removed via sea-lift.

1.6 Camp Site

If the Padloping and Durban Island projects were combined into one contract, then it is expected that the work activities could be done concurrently. Since there is more work and more variety of work activities at Durban Island, it is anticipated that the contractor would set up the construction camp at the Durban Island Site and shuttle workers to and from the Padloping Island Site with a helicopter or boat. It should be noted that an emergency camp should be set up at the Padloping Island site if the camp facilities are located at Durban Island.

1.7 Equipment

The contract for this work has not yet been tendered or awarded; therefore, the exact types of equipment are not available. However, based on equipment used at other sites, the typical equipment can include, but is not limited to, the following:

- Rock truck.
- Loader.
- Excavator.
- Grader.
- Dozer.
- Fuel truck.
- Water truck.
- Mack truck.
- Passenger van.
- Pick-up trucks.
- Incinerator.
- Generator.
- Backhoe.
- Compactor.
- Drill.
- Landfiller.
- Snowblower.

1.8 Water

The only source of water for drinking water is the Freshwater Lake northwest of the main station. However, assuming that a camp is to be established at Durban Island for use of staff involved on the Padloping Island remediation, drinking water will be supplied from the Durban Island camp. Water use at Padloping will be limited to construction uses (soil moisture control, dust suppression, etc.). It is estimated that water use will be approximately 18 m^3 per day. No water will be returned to the source.

1.9 Waste Water

The location of sewage, grey water, and waste disposal will need to consider the requirements of the Water Use License and Land Use Permit. Typically, the permits require that all waste disposal locations, including sewage treatment systems and greywater discharge areas, and fuel storage areas be located a minimum of 31 m from the high water mark of any water body or drainage course. In addition, all effluent and wastewater must meet water quality requirements prior to discharge. Sewage lagoons are the typically utilized method for sewage disposal at such sites, and as such, it is expected that a sewage lagoon may be used during operations at the Padloping Island site.

In terms of waste disposal, licenses typically require that solid wastes be incinerated on-site, in an approved incinerator facility, and that non-hazardous, non-combustible waste and the ash generated from incineration will likely be packaged and shipped off-site

1.10 Fuel

It is anticipated that fuel used on-site will be comprised of diesel and gasoline. The exact quantity of fuel, details of the secondary containment, method of fuel transfer and spill control measures are to be provided by the contractor, once the contract has been awarded. However, as a minimum, they must meet the requirements as outlined in Section 4.3.2 Storage and Handling of Fuel and Other Hazardous Substances.

1.11 Chemicals and Hazardous Materials

All chemicals and hazardous materials will be dealt with according to Section 4.3.16 Handling of Dangerous Goods and Hazardous Waste Materials.

1.12 Workforce and Human Resources/Socio-Economic Impacts

It is anticipated that the majority of the workforce will come from the nearby communities of Qikiqtarjuaq, Pangnirtung and Clyde River. As part of the contract, the successful contractor is required to provide training programs for employees. Typical positions available are heavy equipment operators, cooks, bear monitors and labourers.

The construction season will be from approximately June 15 to September 15, except during the mobilization year, when the work will occur from the time of arrival of the sea-lift, likely sometime in mid to late August to the middle of September. The rotation schedule is decided by the contractor, but is required to comply with all applicable Government of Nunavut Labour Regulations.

1.13 Public Involvement

A community meeting for this work was conducted during the last week in February (2011) in Qikiqtarjuaq. During the meeting, an outline of the proposed work was provided and any questions and comments regarding the work were addressed. Information on the contracting process was also provided so that people interested in working on the project are aware of when the positions will become available. There were no concerns raised by the community regarding the remedial options presented for the two sites; however, the local Hunters and Trappers Organization identified a request for a fish and shellfish sampling program at the Freshwater Lake and shoreline at the Padloping Island site.

2. Project Specific Information - Site Clean-up/Remediation

2.1 Existing Waste Debris Areas

There are 13 existing buried debris areas at Padloping Island, and these areas are grouped based on their location on-site:

- Original Station Buried Areas - Lobes A, B and C.
- Old Hamlet Buried Debris Area - Lobe D.
- Pond Buried Debris Area - Lobes E, F and G.
- Station South Mound Buried Debris Area - Lobed H and I.
- Station West Mound Buried Debris Area - Lobes J, K L and M.

A summary of the description of each debris area is provided in the following sections. The details of the geotechnical assessment for each area are provided in Table 2.

2.1.1 Original Station Buried Debris Areas - Lobes A, B and C

Lobes A, B and C are buried debris areas located at the Original Station Area (Figure 6.0). The geophysical survey indicated that Lobe A covers a plan area of about 18 m^2 and is situated adjacent to the original powerhouse building footprint. Lobes B and C comprise an area of 135 m^2 and 64 m^2, respectively and are both located on the beach ridge at the southern portion of the Original Station Area near the ocean. These buried debris lobes will be most easily accessed from the ocean beach ridge which consists of coarse gravel and cobbles.

Very little surface debris was noted on the surface of Lobes A, B, and C. These buried debris lobes were all completely covered with a surficial organic layer with an occasional exposed rock. There are numerous drainage channels running through the organic layer in the vicinity of the Original Station Area with the overall surface drainage to the southwest towards the ocean.

The ocean is the aquatic receptor for this Buried Debris Area and the comprising lobes would be subjected to flooding during storm surges. No animal burrows were identified at the dump, likely because of soil saturation levels. No surface staining was identified at Lobes A, B, and C and samples were not collected at this location. Lobes B and C are classified as Class A (High Risk) because of their location in a geotechnically unstable, high erosion location. Because of their immediate proximity to the marine environment, it is recommended that Lobes A, B, and C be excavated in their entirety. The estimated depth of debris is 0.75 m, for a total excavation volume of 163 m^3.

2.1.2 Old Hamlet Buried Debris Area - Lobe D

Lobe D is a small buried debris area located in the concentrated surface debris zone at the Old Hamlet Site, located approximately 700 m east of the sunken barges at the West Beach Area as shown on Figure 5.0. The geophysical survey indicated that Lobe D covers a plan area of about 13 m^2 and is situated approximately 50 m from the ocean. This buried debris lobe will be most easily accessed from the ocean beach ridge, which consists of coarse gravel and cobbles. There is an access trail just up-gradient of the beach ridge that runs from the West Beach to the Original Station Area; however, this trail is not expected to be suitable for construction traffic access as it traverses wet, soft tundra areas.

The Lobe D and Original Hamlet Area is moderately disturbed with a fair amount of surface debris consisting of wood, metal barrels, domestic waste and the remains of wooden Inuit dwellings. The cover soil consisted primarily of thin layer of surface organics with some exposed sandy gravel surface and the occasional exposed boulder or rock outcrop. The Hamlet site slopes gently at a 3 to 4% grade to the south toward the ocean. No evidence of erosion was noted at this buried debris lobe.

The environmental investigation did not indicate contaminant migration from the minimal buried debris at Lobe D and this buried debris lobe is situated in a disturbed and geotechnically stable area. Lobe D is therefore assessed as a Class C (Low Risk) with an associated remedial action of regrading. Because of the very small size of this lobe, its location in a disturbed area and the extensive surface debris removal that will take place in this area, it is recommended that this lobe be excavated to be able to complete the debris removal at the Old Hamlet Area.

The estimated depth of debris in these lobes is 0.75 m, for a total excavation volume of 10 m^3. The estimated excavation component breakdown has been assumed as the average values: 10% Tier I, 10% Tier II, 20% non-hazardous debris, 60% clean fill.

2.1.3 Pond Buried Debris Area - Lobes E, F and G

The Pond Area includes three buried debris Lobes E, F and G located approximately 700 m north of the Main Station Area as shown in Figure 7.0 in Appendix A. This area includes a small pond with slightly mounded areas on three of four sides and a drainage course / outlet on the fourth (southwest) side. This area was accessed along a very wet, 400 m long access trail off the main site access trail from the Station Area to the Freshwater Lake. The geophysical survey identified Pond Buried Debris Area Lobes E, F, and G to have areas of 23 m^2, 58 m^2, and 107 m^2, respectively.

There was occasional surface debris noted at the Pond Area buried debris lobes, consisting of wood, steel debris and cable. The cover soil consisted of exposed gravel and cobbles immediately adjacent to the pond and continuous organic cover further outside of the pond. The overall drainage of this area is to the southwest towards the Tidal Bay, which is approximately 900 m away. The grade is gentle to flat, with a 2 to 4% slope to the southwest. There was significant flow from the outlet/drainage course on the south side of the pond, adjacent to Lobe G and erosion of the surface organics along drainage course. There was no surface staining noted or evidence of contamination migration from these buried debris lobes.

Lobe G is located adjacent to the outlet / drainage course on the south side of the pond and there is the potential for erosion and exposure of this landfill lobe over time. This application of a granular cover to Lobe G is therefore not considered stable in the long term for this location and the recommended remedial option is full excavation of Lobe G. The natural vegetation cover at Padloping Island insulates and stabilizes the soft wet ground in this general area. Because Lobes E and F are very small and located on the perimeter of the pond where the organic cover has been disturbed and the water levels of the pond could fluctuate, it is also recommended that Lobes E and F be excavated in their entirety in conjunction with Lobe G.

The estimated depth of debris in these lobes is 0.75 m, for a total excavation volume of 141 m^3. The estimated excavation component breakdown has been assumed as the average values: 10% Tier I, 10% Tier II, 20% non-hazardous debris, 59% clean fill, with a hazardous waste allowance of 1%.

2.1.4 Station South Mound Buried Debris Area - Lobes H and I

Lobes H and I are Buried Debris Areas located at the South Mound Buried Debris Area situated on the south side of the Main Station Area, as shown on Figure 2.0 in Appendix A. The geophysical survey indicated that Lobes H and I cover a plan area of 55 m^2 and 21 m^2, respectively. These buried debris lobes are accessible from the main access trail.

The South Mound Lobes H and I are moderately disturbed with occasional surface debris consisting of wood, metal and barrels. The cover soil consisted primarily of thin layer of surface organics with some exposed sandy gravel. The Main Station Area slopes gently at about 2 to 4% grade to the south toward the Ocean. No evidence of erosion was noted at this buried debris lobe.

The environmental investigation did not identify any contaminant migration from the buried debris lobes H and I, which are is situated in a disturbed and geotechnically stable area. Lobes H and I are therefore assessed as Class C (Low Risk) with an associated remedial action of regrading. Because of the very small size of these lobes, their mounded shape and the surrounding organic-rich terrain, it is recommended that these lobes be excavated to complete the debris removal at the Main Station Area. The estimated depth of debris is 0.75 m, for a total excavation volume of 57 m^3. The estimated excavation component breakdown has been assumed as the average values: 10% Tier I, 10% Tier II, 20% non-hazardous debris, 59% clean fill, with a hazardous waste allowance of 1%. Upon completion of excavation, this area should be backfilled to match surrounding terrain and the excavated organics should be replaced as surface cover.

2.1.5 Station West Mound Buried Debris Area - Lobes J, K, L and M

The West Mound Buried Debris Area includes Lobes J, K, L, and M, which are situated on the southwest side of the Main Station Area, as shown on Figure 3.0 in Appendix A. The geophysical survey indicated that Lobe J, K, L, and M cover a plan area of 20 m^2, 15 m^2, 20 m^2, and 18 m^2, respectively. These buried debris lobes are accessible from the main access trail.

The West Mound Lobes J, K, L, and M are moderately disturbed with occasional surface debris, consisting of wood, metal and barrels. The cover soil consisted primarily of thin layer of surface organics with some exposed sandy gravel. The Main Station Area slopes gently at about 2 to 4% grade to the south toward the Ocean. No evidence of erosion was noted at this buried debris area.

No surface staining or evidence of contaminant migration was identified at the West Mound Buried Debris Lobes and samples were not collected at this location. These buried debris lobes are situated in a moderately disturbed and geotechnically stable area. West Mound Lobes J, K, L and M are therefore assessed as Class C (Low Risk) with an associated remedial action of regrading. Because of the very small size of these lobes, their mounded shape and the surrounding organic-rich terrain, it is recommended that these lobes be excavated to complete the debris removal at the Main Station Area. The estimated depth of debris is 0.75 m, for a total excavation volume of 55 m^3. The estimated excavation component breakdown has been assumed as the average values: 10% Tier I, 10% Tier II, 20% non-hazardous debris, 59% clean fill, with a hazardous waste allowance of 1%. Upon completion of excavation, this area should be backfilled to match surrounding terrain and the excavated organics should be replaced as surface cover.

2.2 Remedial Requirements of Existing Buried Debris Areas

The assessment of waste disposal areas (WDA or buried debris areas) at Padoping Island was completed with the goal of classifying the WDAs according to the three categories specified under the INAC Abandoned Military Site Remediation Protocol, which are:

Class A: The WDA is located in an unstable, high erosion location. Remediation will involve relocation of buried debris to an engineered landfill. A WDA located at an elevation of less than 2 metres above mean sea level will be removed.

Class B: The WDA is in a suitable, stable location, but there is evidence of contaminant migration. Remedial solutions include the installation of an engineered containment system, or relocation, whichever is deemed more cost effective.

Class C: The WDA is in a suitable, stable location, and there is no evidence of contaminant migration. In such cases, the debris may be left in place, with the placement of additional granular cover to facilitate erosion protection and proper drainage.

Buried debris areas considered a high potential environmental risk, or those located in close proximity to water bodies are to be excavated at the Padloping Island site. Primary excavation includes excavation of all materials to the lateral and vertical extents of the designated debris area. The depth of the primary excavation typically extends to competent bedrock or where debris is no longer visible. Secondary excavation includes the excavation of the buried debris area beyond the primary debris excavation limits.

Buried debris area excavation includes the following tasks:

- Installation/construction of erosion, drainage and sediment control, as required.
- Development of the buried debris survey grid.
- Excavation of all waste materials from the buried debris area.
- Removal of all surface debris from the buried debris area.
- The development, operation, closure and removal of a Material Processing Area (MPA).

Once excavated, the buried debris wastes are transported to the MPA for sorting into hazardous and non-hazardous components. Soil excavated from the buried debris are shall be sorted into the contaminated soil classifications, based on the results of sampling and analysis. Clean soil/gravel is placed in the excavated area, once all confirmatory samples have been collected and analysed. The area shall then be reshaped to match the existing terrain.

During the excavation, the slope stability shall be inspected and maintained. When excavating in the vicinity of a drainage course or a body of water, silt fences, floating silt curtains and/or containment berms shall be constructed to prevent the release of sediment or deleterious substances into the water.

At the completion of work in the area, sediment and erosion controls shall be removed from the water bodies. At the conclusion of the excavation, all sediment, erosion and drainage control measures shall be removed from the worksite.

Table 2 summarizes the anticipated remedial requirements for the existing buried debris areas at Padloping Island. Where the remediation option is excavation, waste segregation during excavation is required to separate potentially hazardous materials from the non-hazardous waste prior to packaging and shipment off-site. Non-hazardous waste will be packaged, shipped off-site and disposed of in a southern Non-Hazardous Waste Landfill. Hazardous waste must be segregated based on PCB-containing waste (for disposal at a licensed PCB disposal facility), or other hazardous waste, which can be disposed of in a licensed Hazardous Waste Landfill. Tier II impacted soils shall be excavated, packaged and shipped off-site for disposal. Soil shall be separated from debris during excavation, and stockpiled in such a manner to allow sampling and classification according to the contaminant criteria outlined under the INAC Protocol. Soil that does not exceed any contaminant criteria may be used for backfilling excavations, but based on the difficulty with removing small pieces of debris during waste segregation; this soil should be used for the first lifts of backfill in excavations, to then be covered with clean borrow soils.

Table 2. Summary of Recommended Buried Debris Remedial Requirements

Buried Debris Area	Area (m^2) & Depth (m)	Environmental Assessment	Landfill Evaluation	Recommended Remediation	Comments
Lobe A	18 0.75	No samples collected. No surface staining noted.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size and location in a disturbed area where extensive surface debris will be removed, excavation of Lobe A is recommended to complete the debris removal at the Original Station Area.
Lobe B	135 0.75	No samples collected. No surface staining noted.	Class A High Potential Environmental Risk.	Excavate	Due to the proximity to the marine environment and the potential for erosion during storm events, this lobe has been classified as Class A.
Lobe C	64 0.75	No samples collected. No surface staining noted.	Class A High Potential Environmental Risk.	Excavate	Due to the proximity to the marine environment and the potential for erosion during storm events, this lobe has been classified as Class A.
Lobe D	13 0.75	There was no surface staining or evidence of contaminant migration from this lobe.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size and location in a disturbed area where extensive surface debris will be removed, excavation of Lobe D is recommended to complete the debris removal at the Old Hamlet Site.
Lobe E	23 0.75	No samples collected. No surface staining noted.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size and location adjacent to the pond, excavation of Lobe E is recommended.
Lobe F	58 0.75	No samples collected. No surface staining noted.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size and location adjacent to the pond, excavation of Lobe F is recommended.
Lobe G	107 0.75	No samples collected. No surface staining noted.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration, this lobe is being classified as Class C, however, because of the instability of this lobe at the outlet / drainage course on the south side of the pond and the potential for future erosion, complete excavation of Lobe G is recommended.
Lobe H	55 0.75	The down-gradient areas of Lobes H & I were evaluated together as there is only a small break between the two lobes. No surface staining or contaminant migration was identified.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe H is recommended to complete the debris removal at the Main Station Area.
Lobe I	21 0.75	The down-gradient areas of Lobes H & I were evaluated together as there is only a small break between the two lobes. No surface staining or contaminant migration was identified.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe I is recommended to complete the debris removal at the Main Station Area.
Lobe J	20 0.75	No samples collected. No surface staining noted.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe J is recommended to complete the debris removal at the Main Station Area.

Buried Debris Area	Area (m^2) & Depth (m)	Environmental Assessment	Landfill Evaluation	Recommended Remediation	Comments
Lobe K	15 0.75	No samples collected. No surface staining noted.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe K is recommended to complete the debris removal at the Main Station Area.
Lobe L	20 0.75	No samples collected. No surface staining noted.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe L is recommended to complete the debris removal at the Main Station Area.
Lobe M	18 0.75	No samples collected. No surface staining noted.	Class C Low Potential Environmental Risk.	Excavate	Based on the lack of contaminant migration and the stability of the lobe, it is being classified as Class C, however, because of its very small size, its mounded shape and the surrounding organic-rich terrain, excavation of Lobe M is recommended to complete the debris removal at the Main Station Area.

2.3 Contaminated Soil

Contaminated soil areas will be excavated, typically using a backhoe and then backfilled with granular material. The excavated soils will be disposed of according to the contaminant type. The disposal requirements are presented below.

Table 3. Summary of Contaminated Soil Disposal Requirements

Contaminant Designation	Description	Estimated Soil Volume (m^3)	Disposal Requirement
Tier I Contaminated Soil	Soils containing concentrations of any or all contaminants listed as follows: Lead ..... 200 to 499 ppm PCBs ..... 1 to <5 ppm	47 (43 from dump excavations)	Off-site at licensed southern disposal facility
Tier II Contaminated Soil	Soils containing concentrations of any or all contaminants listed as follows: • Arsenic 30 ppm • Cadmium 5 ppm • Chromium 250 ppm • Cobalt 50 ppm • Copper 100 ppm • Lead 500 ppm • Mercury 2 ppm • Nickel 100 ppm • Zinc 500 ppm • PCBs ≥5 ppm;<50 ppm	120 (43 from dump excavations)	Off-site at licensed southern disposal facility
TPH Type A Soils F3 and F4 Fractions	Soils contaminated with hydrocarbons consisting primarily of oil and grease at concentrations equal to or greater than: •TPH, Sum of F3 and F4 fractions….. 20,000 ppm	131	Off-site at licensed southern disposal facility
TPH Type B Soils F1-F3 Fractions	Soils contaminated with hydrocarbons consisting primarily of fuel oil, and/or diesel, and/or gasoline, with concentrations equal to or greater than the following concentrations: Beach POL Area: TPH F1 fraction……1,290 ppm F2 fraction……330 ppm Station Area: -Surface soils to 0.5 m depth…2,500 ppm (TPH, sum of F1 through F3 fractions) -Subsurface soils below 0.5 m depth…5,000 ppm (TPH, sum of F1 through F3 fractions)	116 (6 within 30 m of water body)	Landfarm
CEPA/ Hazardous Soil	Soils contaminated with PCBs ≥ 50 ppm or with leachate concentrations above criteria. Leachable lead……5.0 mg/L	16	Off-site at licensed southern disposal facility

A description of the contaminated soil areas identified at Padloping Island is presented below.

2.3.1 Tier I and Type A Soil

The total estimated volume of Tier I soil is 47 m^3. This volume includes the estimated Tier I component of soil that will be encountered during dump excavations, as noted above. It is recommended that the Tier I soil be packaged with other non-hazardous waste for off-site disposal.

The total estimated volume of Type A soil is 131 m^3, all of which is within the top 0.3 m of the identified areas. It is recommended that the Type A soil be excavated to a depth of 0.3 m and disposed of with other non-hazardous waste being shipped off-site for disposal. The Type A contaminated soil below a depth of 0.3 m can be left in place as long as the top 0.3 m is backfilled with clean granular fill.

2.3.2 Tier II Soil

The 2010 site investigation identified small volumes of Tier II Metal Contaminated Soil at the Kitchen/Mess Hall, Maintenance Garage, Maintenance Shed, Water Tank Building, Metal Dump and Original Powerhouse to a depth of 0.3 m. The 2010 site investigation also identified small volumes of Tier II Copper Contaminated Soil at the Weather Building to a depth of 0.6 m and Tier II Lead Co-contaminated with Type B PHC's at the Shower/Washrooms to a depth of 0.3 m. The total volume of Tier II soil identified for remediation is 120 m^3, of which 43 m^3 is the estimated Tier II soil component from dump excavations, and 77 m^3 is from delineated contamination areas.

The decision criteria to determine if a Secure Soil Disposal Facility (SSDF) is required at a DEW Line Site is outlined in Table 5.3 of the INAC AMSRP. The site is not landlocked and landfill excavation accounts for about a third of the Tier II soil volume that requires disposal. The estimated Tier II soil volume is 120 m^3, which is less than the decision criteria volume of 300 to 500 m^3 and the risk of overrun is considered to be low to moderate. Therefore, the remedial option is to ship Tier II contaminated soil off-site to an appropriate facility for disposal.

2.3.3 Hydrocarbon Impacted Soils

2.3.3.1 Type B Soil

Six areas of Type B impacted soil requiring remedial action were identified as part of the 2010 investigation: the Old Generator Building Maintenance Shed, Boiler/Incinerator Building, West Barrel Cache and Former AST Site. The total volume of PHC Type B soil identified for remediation is 116 m^3.

2.3.4 Hazardous Soil

The 2010 site investigation identified a small volume of leachable lead contaminated soils at the Original Powerhouse to a depth of 0.3 m in depth. The total volume of leachable lead contaminated soils identified for disposal remediation is 17 m^3. All soils that exceed the lead leachate criterion of 5 mg/L are to be containerized and disposed of off-site at an approved hazardous waste disposal facility.

2.4 Debris Areas

There were 28 surface debris areas identified at the Padloping Island site. The surface debris covered extensive areas, in particular in the area to the west of the Main Station and Metal Dump roads. In many areas, extensive hand picking of small debris will be required during site clean-up.

It is understood that the Old Hamlet Area is considered to be significant in terms of its place in 20th century Inuit history. The preliminary recommendations from (Golder 2010) include that none of the house foundations, stone tent rings and wooden flooring are to be removed from this area and that debris to be removed, including fuel barrels, metal and wood debris should be hand picked. The recommendations also include that none of the recorded archaeological resources are to be disturbed by borrowing activities or heavy vehicle traffic. These recommendations will affect the methodology and debris volumes to be removed from Debris Area 13, but will not have a significant effect on overall debris removal at this site.

Non-hazardous waste and hazardous waste will be segregated and packaged for disposal at appropriate, licensed southern disposal facilities. Hazardous waste will be packaged in accordance with TDGA regulations for shipping.

2.4.1 Summary of Surface Debris

Table 4 provides a summary of the debris areas inventoried at the Padloping Island site.

Table 4. Summary of Debris Areas Identified at Padloping Island and the Remedial Requirements

Debris Area	Description of Contents	Location	Estimated Areal Extent (m^2)	Estimated Crushed Volume (m^3)	Comments
Library / Shower and Washroom Building Foundation and Debris	**Foundation:** Approx. 50 - 200 mm square timber piles **Debris:** Corrugated sheet metal, structural steel, metal heaters, galvanized and steel plumbing, wire and electrical components, water tanks (2), misc. metal debris, timber flooring and planking, glass, porcelain, fibreglass insulation, asbestos board/shingles/ floor tile (hazardous)	Main Station	1,000	50	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Generator Building Foundation and Debris	**Foundation:** Raised concrete slab on approx. 20 - 200 mm square timber piles. **Debris:** Generators (2), cylindrical steel tank (1500 US Gal.), misc. concrete and wood, barrels (2), misc. electrical wire and components, power poles (4), lead acid truck batteries (hazardous), lubricating oil (50 L) in diesel electric generators (hazardous)	Main Station	400	30	Access to Main Station Area Buildings is fair with site road requiring significant upgrades.
Kitchen / Mess Hall Foundation and Debris	**Foundation:** Approx. 50 - 200 mm square timber piles (some partially burned). **Debris:** Concrete chimney, metal ducting, small cylindrical tanks (6), corruguated sheet metal, power pole, misc. wood and steel, barrels, misc. electrical wire and components, pipe sections, lead sheets (hazardous), asbestos board/shingles/floor tile (hazardous)	Main Station	600	40	Access to Main Station Area Buildings is fair with site road requiring significant upgrades.
Storage Container and Debris	**Debris:** Remnants of a 20' Barge Container including steel angle iron structure and sheet metal on bottom half, corrugated sheet metal, fibreglass insulation, miscellaneous wood, metal and barrels, cylindrical steel tank (1500 US Gal.), misc. electrical wire and components	Main Station	500	20	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Showers / Washroom Foundation and Debris	**Foundation:** Approx. 32 - 200 mm square timber piles (some partially burned). **Debris:** Steel angle iron, steel cylindrical water tanks (2), tracked flatbed carrier machine, corruguated sheet metal, misc. wood and steel, barrels, misc. electrical wire, cable and components, ducting, power poles (2)	Main Station	800	50	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Supply Depot Building Foundation and Debris	**Debris:** corrugated metal panels, steel angle iron, power poles (3), timber beams, wood planking, barrels (1), metal strapping, wood boxes, wax paper rolls, misc. wood and metal, asbestos board/shingles/floor tiles (hazardous)	Main Station	600	25	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Accommodations Building Foundation and Debris	**Foundation:** Approx. 32 - 200 mm square timber piles (some partially burned) **Debris:** steel angle iron, corrugated metal panels, wooden wall sections, fibreglass insulation, steel cable, bags of grout, yellow heavy steel machinery part, misc. wood and metal	Main Station	1,000	40	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Maintenance Garage Foundation and Debris	**Foundation:** Approx. 52 - 200 mm square and 300 x 200 mm timber piles (some partially burned) **Debris:** steel angle iron frame (intact), Corrugated sheet metal, truck, misc. barrels and metal pails, rebar, power poles (2), steel equipment parts including tracks, misc. wire and electrical components, water tanks (2), misc. metal debris	Main Station	1,000	60	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic.
Boiler / Incinerator Building Foundation and Debris	**Foundation:** Approx. 12 - 200 mm square timber piles **Debris:** Brick Chimney Structure (partially intact) on a concrete foundation, timber planking, steel water tanks (4), ducting, galvanized steel pipes, insulated wall panelling, cable, bags of cement, barrels (6), heater unit, power pole, misc. wood and steel, misc. electrical wire, asbestos board/shingles/floor tiles (hazardous)	Main Station	400	55	Access to Main Station Area Buildings is fair with site roads requiring significant upgrades for construction traffic. Standing Water in and around building footprint.
Metal Dump Debris Area	**Debris:** trucks, cars, tractors, grader, motors, barrels, steel angle iron, barrels, power poles, misc. machinery parts, wood and metal	South of Main Station Area	8,000	250	Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.
West of Main Station and Metal Dump Roads	**Debris:** approximately 200 barrels, power poles, misc. wood and metal	50 m to 300 m West of Road through Station and Metal Dump and Outside Previously Identified Debris Areas	160,000	30	Access to Area >50 m West of Main Station and Metal Dump Site Roads is fair to poor with some wet, boggy areas. ATV Access only.
1	**Debris:** dozer, motors, barrels, structural steel, corrugated metal panels, ducting, auger flights, steel barrels, pile of power poles, wooden barrels, misc. wood and metal	East of Main Station Area	6,000	60	Access to Main Station Area is fair with site roads requiring significant upgrades for construction traffic.
2	**Debris:** steel angle iron, corrugated sheet metal, misc. wood and metal debris	Main Station Area - South of Generator Building	1,100	5	Access to Main Station Area is fair with site roads requiring significant upgrades for construction traffic.
3	**Debris:** , ducting, metal heater, tin cans, galvanized piping, misc. electrical wire, misc. wood and metal debris, asphalt shingles, asbestos board/shingles/floor tiles (hazardous), nine gas cylinders (hazardous), lead acid truck batteries (hazardous)	Weather Building Debris Area	300	5	Access to Main Station Area is fair with site roads requiring significant upgrades for construction traffic.
4	**Debris:** steel water tanks (2), stainless steel water tank, ducting, barrels, equipment tracks (2 sets), plumbing pipe, misc. electrical wire, timber planking, power pole, misc. wood, brick and metal debris, plaster pieces, fibreglass insulation, cardboard sheets, floor mats, asbestos board/shingles/floor tiles (hazardous)	Former Water Tank Building Site South of Main Station Area	1,200	10	Access to Areas south of Main Station Area is good.
5	**Debris:** corrugated sheet metal, barrels, metal heater, galvanized plumbing pipe, steel water tanks, timber planking, power poles, cardboard sheets, glass, plastic, ceramic, concrete blocks (2), misc. wood and metal debris, lead acid batteries (hazardous)	South of Main Station Area	3,200	40	Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.
6	**Debris:** barrels (approx. 240), plumbing pipe, metal heater, steel water tanks, truck, domestic debris including tin cans and bedsprings, timber planking (some partially burnt), plastic, porcelain, glass, misc. electrical wire, wood and metal debris	South of Main Station Area	2,700	70	Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.
7	**Debris:** corrugated sheet metal, barrels, misc. metal debris	South of Main Station Area	20	2	Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.

Debris Area	Description of Contents	Location	Estimated Areal Extent (m^2)	Estimated Crushed Volume (m^3)	Comments
8	**Debris:** dozer, sheet metal, bed springs, cinder blocks, wood planking, wooden barrels, misc. wood and metal, asbestos board/shingles/floor tiles (hazardous)	Metal Dump Area	200	2	Access to Metal Dump Area is fair with site roads requiring significant upgrades for construction Traffic.
9	**Debris:** corrugated metal panel, steel angle iron, bed springs, misc. wood and metal, asbestos floor tiles (hazardous)	Metal Dump Area	50	10	Access to Metal Dump Area is fair with site roads requiring significant upgrades for construction Traffic.
10	**Debris:** crushed barrels, dozer blade, steel angle iron, wooden platform, OSB sheets, plastic garbage bags, ceramic electrical insulators, misc. wood and metal	West Beach Area	5,500	450	Access to West Beach Area is fair with site roads requiring significant upgrades for construction Traffic.
11	**Debris:** one submerged barge, one partially submerged barge, steel chassis with hitch	West Beach Area - Submerged or Partially Submerged Items	4,500	90	Barges and steel chassis with hitch are partially to fully submerged dependant on the tide. Refer to Figure 4.0.
12	**Debris:** small tanks, toilet, garbage can, steel angle iron, bed frames, corrugated sheet metal, misc. wood debris	South of Main Station Area	30	10	Access to areas south of Main Station is fair with site roads requiring significant upgrades for construction traffic.
13	**Debris:** corrugated sheet metal, barrels, steel angle iron, bed frames, snowmobile base, metal house frame, domestic debris including clothing, shoes, dishes, etc., timber planking, plywood, plastic bottles, misc. wood and metal debris	Old Hamlet Site - Overall Debris Area (Concentrated Debris within)	54,000 (3,500)	80 (50 in concentrated debris area)	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on up-gradient tundra.
14	**Debris:** steel angle iron, corrugated sheet metal, ducting, timber piles and planking, barrels, misc. wood debris	Original Station Site	16,000	50	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on up-gradient tundra.
15	**Debris:** crushed barrel piles (6), steel angle iron, corrugated sheet metal, boxes of tile, bags of grout, misc. wood and metal debris	Original Station Site - East	10,000	130	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on up-gradient tundra.
Site Roads Debris Corridor	**Debris:** approx. 120 scattered barrels, approx. 340 consolidated barrels in eight caches, power poles, fallen communication tower, wooden cross structure, steel drum roller (3), wooden storage container, misc. wood and metal debris	Within 50 m from centreline of Site Roads and Outside Previously Identified Debris Areas	190,000	100	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on up-gradient tundra.
Power Cable(s) between Main Station and Original Station Site	**Debris:** power cable	Between Main Station and Original Station Sites	5,500	10	Access to Original Station Site - East and Water Lake is fair to poor with some wet, boggy areas. Good, but rough access along rocky beach ridge and ATV Access only on up-gradient tundra.
Total			**474,600**	**1774**	

2.5 New Facilities

2.5.1 Potential Locations

Four potential landfill and landfarm locations were identified during the 2010 investigation including Landfill/Landfarm LF-1 at Borrow 3, Landfill LF-2 at the Main Station, Landfill LF-3 at the Metal Dump and Landfill / Landfarm LF-4 at the Borrow No. 6.

Table 5. Summary of Proposed New Facility Locations

Area	Location	Estimated Available Surface Area (m²)	Environmental Considerations	Engineering Considerations
Proposed Landfill Area 1	Near the Old Hamlet Site at Borrow 3	n/a	No contamination present.	Recommend not using due to the Inuit history.
Proposed Landfill Area 2	Main Station area accessible by existing access trails	10,000	Some surface debris is present.	The site is a well drained, disturbed area with high concentrations of debris. Subsurface consists of a surficial layer of peat underlain by silty gravelly sand. The test pits were both terminated at a depth of 0.6 m due to seepage/sloughing. Seepage was encountered in both test pits below 0.3 m and frozen ground was not encountered in any of the test pits.
Proposed Alternate Landfill Area 3	Metal dump area	n/a	Some debris present.	Located in a well drained, disturbed area within a metal dump-site.
Proposed Landfill Area 4	Well drained, disturbed area west of the main station area at Borrow 6.	n/a		Construction of access road is required. The subsurface consists of a surficial layer of peat underlain by silty, sand with some gravel. The test pits were terminated at depths of 0.45 m and 0.65 m due to seepage.

2.5.2 Recommended Locations and Construction Details

Due to the logistical difficulty and cost in maintaining landfill facilities at this site, there will be no Non-Hazardous Waste Landfill or Secure Soil Disposal Facility constructed at Padloping Island.

2.5.2.1 Landfarm

The total volume of Type B soil identified for remediation is approximately 110 m^3 and the total volume of Type B soil identified for storage is 6 m^3. The estimated footprint for a landfarm to accommodate the treatment soils is approximately 20 x 20 m. Proposed Landfarm LF-4 (see Figure 8.0) was identified as the preferred landfarm site as it is in close proximity to the majority of the Type B Contaminated Soils areas near the Main Station Areas and would not require extensive debris removal to allow for preparation of the landfarm treatment area footprint. The landfarm should be located along the east site of Landfarm LF-4 site to maintain a suitable buffer from the Tidal Bay.

The construction of the landfarm is a priority as the treatment of soil could potentially delay the contractor's demobilization from site.

2.6 Borrow Areas

Borrow quantities were investigated as part of the geotechnical field investigation completed by AECOM in 2010. Nine borrow areas have been identified at Padloping Island, including:

1. Borrow Area 1 (BA -1).
2. Borrow Area 2 (BA-2) (Ridge).

3. Borrow Area 2 (BA-2)(Boulder Field).
4. Borrow Area 3 (BA-3).
5. Borrow Area 4 (BA-4).
6. Borrow Area 5 (BA-5).
7. Borrow Area 6 (BA-6).
8. Borrow Area 7 (BA-7).
9. Talus Material near BA-1.

Table 6 provides a summary of the granular material types and estimated volumes at each of the borrow areas. Based on the proposed construction requirements, it is anticipated that a sufficient quantity of borrow material is available.

Table 6. Summary of Granular Borrow Sources

Borrow Area	Available Type of Granular Fill	Estimated Volume Available (m^3)
BA-1	Types 2	80,000
BA-2 (Ridge)	Types 2/4	20,000
BA-2 (Boulder Field)	Type 1	40,000
BA-3	Type 4	120,000
BA-4	Type 4	500
BA-5	Type 4	5,600
BA-6	Type 4	50,000
BA-7	Type 2	40,000
Talus Material Near BA-1	Types 2/5/6	Unknown

2.7 Removal of Hazardous Material

"Hazardous" waste materials are defined as waste materials that are designated as 'hazardous' under Nunavut or Federal legislation; or as 'dangerous goods' under the Transportation of Dangerous Goods Act (TDGA). The Canadian Environmental Protection Act (CEPA) regulates material containing PCBs at concentrations greater than 50 ppm. Specific hazardous materials may include: batteries, asbestos, fuel tank bottom sludges, solvents, PCB-containing fluids, fuels and lubricating oils, alcohols and glycols, and heavy metal contaminated liquids. Disposal requirements of these hazardous waste materials are presented in Table 7.

Table 7. Hazardous Waste Material Disposal Requirements

Hazardous Waste Material	Disposal Requirement
Batteries Heavy metal contaminated organic liquids Liquids containing organic compounds with chlorine concentrations >1000 ppm Liquids containing organic compounds with PCB concentrations >2 ppm and <50 ppm	Off-site licensed treatment/disposal facility
Fuel tank bottom sludges Fuels, lubricating oils, alcohols and glycols	Off-site licensed treatment/disposal facility **OR** On-site incineration in accordance with the contract specifications
Liquids and solids containing organic compounds with PCB concentration >50 ppm	Off-site licensed treatment and disposal facility

2.8 Transportation of Hazardous Materials Off-Site

Hazardous materials are placed in environmentally suitable containers (typically lined and braced sea-cans) at an approved containment facility on-site. A storage area is established and registered with Environment Canada. The hazardous materials are removed by sea-lift in accordance with the TDGA Regulations.

2.9 Grading and Addition of Granular Materials

There are numerous areas identified that require grading and possible addition of granular materials. These areas generally consist of piles of buried or partially buried non-hazardous debris that will be covered with additional granular material and shaped to blend in with the natural terrain and promote positive drainage.

3. Description of the Existing Environment

3.1 Physical Environment

3.1.1 Geology and Terrain

Padloping Island is situated within the Arctic Cordillera ecozone and specifically, the Davis Highlands Tundra ecoregion. This ecoregion is comprised of the Baffin Mountains extending along the north-eastern flank of Baffin and Bylot Islands.

The surficial geology at Padloping Island is predominantly exposed bedrock overlain by thin patches of till and erratic boulders and residuum fields of predominantly bedrock blocks with interstitial sand and gravel with some glacial erratic and till mixed in by freeze-thaw action. At the site location, the surficial geology is comprised of ground morainal glacial till. The ice flow in the area generally came from the south and/or southwest, so the composition of the till probably reflects bedrock in that direction.

The bedrock at Padloping Island mainly consists of Precambrian sedimentary migmatite and metamorphosed greywacke, siltstone, and pelite of the Hoare Bay Group. About 10 km north of the south end of the island, there is a roughly east-west striking, 1 km wide shear zone of foliated granite of the Cumberland Batholith. At the northeast end of Padloping Island about 15 km from the site, overlying the Precambrian rocks, there are coarse clastic sedimentary rocks (sandstone, mudstone, and conglomerate) of the Cape Searle and Quqaluit Formations overlain by basaltic volcanic rocks of the Cape Dyer Formation.

3.1.2 Hydrology

The Padloping Island sites including the Main Station, Old Hamlet and Original Station are situated in a broad valley, approximately 4 km wide with a steep cliff to the west and undulating hills to the east. Based on air photo interpretation and observations during the 2010 site investigation, regional overland drainage originates from the Upper Site and disperses radically and over the cliff edges within localized drainage channels. The valley slopes relatively consistently at about 8% towards the bay to the south and surface water would follow this surface topography.

3.2 Biological Environment

3.2.1 Vegetation

The vegetation in this region is typical of Baffin tundra and is characterized by low species diversity and sparse vegetative cover. Typical plants found in this region include a discontinuous cover of mosses, lichens and cold-hardy vascular plants such as sedge and cottongrass.

3.2.2 Wildlife

The indigenous wildlife of the area includes the polar bear, arctic fox, arctic hare, ermine, lemming, ptarmigan, snowy owl, geese, migratory seabirds and marine mammals including whales, walrus and seals. In Davis Strait and the surrounding rivers, lakes, and fjords there are Arctic cod and char, as well as sculpins and Greenland sharks in some of the fjords. The SARA-listed species that may be present in the vicinity include:

- Endangered Species: Eskimo curlew, ivory gull.
- Threatened: Peregrine Falcon, Ross's Gull.
- Special Concern: Bowhead Whale, Barren-ground Caribou Dolphin and Union Populations.

3.3 Socioeconomic Environment

While in Qikiqtarjuaq during the Phase III ESA, attempts were made to contact Elders familiar with the sites; however, no Elders were available to interview. Current land use is limited to hunting and occasional trapping.

3.3.1 Heritage Resources

The Padloping Island weather station site is located in Merchants Bay on the southwest portion of the island. The site is off the northeast coast of the Cumberland Peninsula of Baffin Island; approximately 440 km north-northeast of Iqaluit and 75 km southeast of Qikiqtarjuak Padloping Island was the site of a former Inuit community and is used by surrounding communities for hunting and fishing.

Archaeological features identified on-site include an Inuit settlement and cemetery. The *Archaelological Impact Assessment of the Former USAF Padloping Island Weather Station, Padloping, Nunavut* (Golder, 2010) identified the former weather station, Inuit Settlement and cemetery as heritage resource sites due to the fact that all of these sites were more than 50 years old, as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003). The weather station includes the original site, main station, roads and numerous dump sites. The Inuit Settlement is made up of the remains of at least 22 houses that were determined from stone outlines and construction materials. The Inuit graveyard is located adjacent to the study areas and consists of 20 graves. No other significant sites have been identified in the local area; however, it is likely that additional significant areas are located in the regional study area. The three recorded sites are summarized below:

MgBu 5: This site is an abandoned weather station that was built and operated by the United States Air Force from 1943 until the end of the Second World War when it was taken over by the Canadian Department of Transport, who operated the station until 1956. The station is located on a coastal plain approximately 400 m from the bay, bordered by a steep cliff, two shallow lakes to the west and undulating hills to the east.

All that remains at the main site area includes: structural steel and metal sheeting with several US Army canon heaters, generators, some wooden floors, a stove, the metal frame of the maintenance garage, cement and brick foundation of the boiler/incinerator, cement foundation of the library building, and miscellaneous metal and wood debris, wooden power poles, an army truck, fuel barrels, food cans, construction materials, and abandoned vehicles. The area has several roads going from the main site to both the beach landing area and to the freshwater lake to the west of the site. At the beach landing area, there are two sunken barges, crushed barrels and other miscellaneous metal debris. North of the main site in a gravel ridge is an open grave that once contained an American serviceman. The grave consists of a broken wooden cross and portions of a picket fence. The body has since been repatriated.

The remains of the station will be removed during the remediation program. No further work is recommended as the recording of the site is thought to be sufficient mitigation.

MgBu 6: This is the Padloping Island Inuit Settlement that extends along the beach south and east of the weather station. Historic reports indicate that the settlement was mentioned as early as 1884, with seven remaining families being resettled to Qikiqtarjuaq in 1968 so that their children could attend school. There is also a graveyard that is associated with the settlement to the west of a salt water lake that was recorded as MgBu 7.

Approximately 22 houses are located at MgBu 6, and are scattered along the upper beach terrace for 1,100 m. The house remains are quite diverse consisting of stone outlines, wooded floors and areas that appear to have had structures at one time. The site extends southeast of the main weather station on both sides of the original site of the weather station.

During the recording of MgBu 6, there was no cultural material observed that indicated any occupation prior to the construction of the weather station. This may be because the earlier sites are to the east of MgBu 6 or because the site has been occupied since at least 1884 and earlier features and material culture are now mixed in or covered by the more modern debris.

Site MgBu 6 is considered to be significant in terms of its place in the 20th Century Inuit history. It is recommended that none of the house foundations, stone tent rings and wooden flooring be removed during the remediation of the site and that nay material that is removed, fuel barrels, metal debris, wood debris, etc. be hand picked and that none of the recorded features associated with the site be disturbed by borrowing activities, landfills or heavy vehicle traffic.

MgBu 7: This site is an Inuit graveyard that is associated with the Padloping Island Settlement located to the west on a ridge at the base of a cliff on the other side of a salt water lake. The graveyard consists of 20 grave sites placed side by side oriented east to west. Of the 20 graves, all but 5 have wooden crosses with names, in syllabics, and dates. The graves date from 1948 to 1967 and with the exception of a single grave with a collapsed top, are in good shape.

This site is considered to be significant in terms of its place in the 20th Century Inuit history, and will be avoided during the planned remediation activities.

4. Identification of Impacts and Proposed Mitigation Measures

An important part of the assessment process involves identifying mitigation measures that would result in a reduction or elimination of potential environmental effects associated with the remediation of the Padloping Island Weather Station. In the case of this project, all potential effects were addressed, not just those deemed to be significantly adverse. The proposed mitigative actions described herein shall form part of the overall project design and planning documentation.

Details of the remediation verification and post-remediation long-term monitoring are provided in the 2011 Remedial Action Plan completed by AECOM and are not included in this report.

4.1 Mitigation Plan Objectives

The mitigation plan provides a description of the general environmental protection measures required to minimize or avoid potential adverse effects, a description of protection measures required for specific valued environmental components at the Padloping Island site, and details related to environmental inspection responsibilities and procedures.

The protection measures described herein should be implemented by the contractor to minimize or avoid adverse environmental impacts. These procedures are considered appropriate for known and anticipated situations and conditions. However, should certain procedures or protection measures prove impractical, imprudent or insufficient in field situations, appropriate modifications or substitutions will be proposed by field personnel and then reviewed and approved by the Proponents' Representative on-site.

4.2 Environmental Inspection

As part of its general overall commitment to a strategy of environmental protection and quality assurance, INAC employs dedicated environmental inspection staff to monitor its own compliance with the mitigation plan and all applicable laws, regulations, permits, guidelines and standards. INAC will be represented at the site by the Proponents' Representative, who will report to the PWGSC Project Manager. Communications will include, but not be limited to:

- Attendance at regular meetings as scheduled with the inspector;
- Immediately reporting concerns over any aspect of the mitigation plan; and
- Immediately reporting any spills or other event that may have an effect on human or environmental health and/or safety.

4.3 General Operational Procedures for Protection of Valued Ecosystem Components

The procedures and requirements provided in the following sections are intended to be protective of the Valued Ecosystem Components (VECs) identified at the Padloping Island site.

4.3.1 Site Operations

The contractor will likely establish an emergency camp on the site, which shall be located in an area with minimal vegetative ground cover. The selected location shall be in an area that is as close as practical to the main area(s) of clean up and where possible, on an existing gravel pad or former borrow area. Surface drainage shall not be impeded and a distance of at least 30 m from the nearest body of water shall be maintained. Permafrost shall be protected by construction of gravel pads, and/or elevation of heated buildings on wooden structures. Areas containing archaeological resources need to be avoided in accordance with Section 4.4.8.

Vehicle and mobile equipment travel shall be restricted at the site to established roads, stream crossings and work pads unless specifically exempted by the Proponents' Representative. Recreational use of vehicles, including all terrain vehicles (ATVs), shall not be allowed off the existing road network. Overland movement of equipment and vehicles shall be minimized where damage to the vegetation or underlying soils may occur. Rubber tired vehicles and wide-turning radii shall be used to minimize disturbance to tundra. Following heavy rains, vehicle and heavy equipment use outside of road and work pad areas shall not be permitted until the soil has drained sufficiently to prevent excessive rutting.

Mobile equipment and vehicle operators are to yield the right-of-way to wildlife where safe to do so, and shall not be operated in a manner that harasses any species of wildlife. Vehicle and equipment servicing shall be performed in designated areas only, where special care can be taken to contain, handle, and dispose of maintenance fluids, parts and waste. Fuelling and lubrication of equipment shall be conducted in a manner that avoids spillage of fuels, oils, greases and coolants. When refueling equipment, leak-free containers and reinforced rip and puncture proof hoses and nozzles shall be used. Drip trays shall also be provided and all storage containers will be properly sealed after use.

4.3.2 Storage and Handling of Fuel and Other Hazardous Substances

All fuel storage containers shall be compliant with the *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* (CEPA SOR/2008-197). Fuel shall be stored at a minimum, in self-dyking, double-walled containers or be in containers positioned over an impervious liner and surrounded by an impervious dyke of sufficient height to contain not less than 110% of the capacity of the tank. Sites that slope towards waterways or other environmentally sensitive areas, exhibiting ponding or flooding, or have high groundwater tables, excessive seepage, or ice-rich (thaw sensitive) soils shall be avoided, as must archaeological resources. Smoking is prohibited within 7.5 m of the fuel storage facility. Appropriate signage shall be posted around the fuelling facility. Fuel storage facilities shall be inspected once per day for the duration of the project and documentation of the inspection maintained. Fire-fighting equipment shall be made available for immediate access at each fuel storage facility. All barrels containing fuel and other similar materials need to be stored in an elevated position either on their side with the bungs facing the 9 and 3 o'clock positions, or on pallets, in an upright position. All barrels shall be individually identified with all information necessary for health and safety, and environmental purposes. Material Safety Data Sheets for all chemicals and fuels stored in the construction area need to be available to all personnel.

Regular inspections shall be conducted of all machinery hydraulic, fuel and cooling systems and any leaks will be repaired immediately. Emergency spill equipment shall be pre-assembled and stored at all permanent fuel storage sites and work areas, including at least two fuel pumps, empty 200 litre barrel and absorbent material sufficient to clean up a 1000 litre spill. All barrels, redundant fuel storage facilities and associated materials and equipment need to be removed from the site at the conclusion of the clean-up.

4.3.3 Surface Water Management

A water use license is required from the Nunavut Water Board for the development of potential water sources. All conditions of the license must be complied with. Water withdrawals must not endanger fish or drawdown the water level so as to adversely affect fish habitat. Water withdrawal rates shall not exceed 10% of total water body volume. All water hoses need to be equipped with a mesh size of 2.5 mm or less to prevent the intake of fish as per the *Freshwater Intake End-of-Pipe Fish Screen Guidelines*.

4.3.4 Wastewater Management and Monitoring

Remediation activities generate wastewater from dewatering activities from contaminated soil treatment areas. Water management on-site is the Contractors' responsibility. However, given the nature of the Arctic terrain, site logistics, and support, climate and weather makes the mitigation of discharge water a challenging task. Contact water associated with contaminated soil excavations contain a number of constituents of concern.

The parameters selected for the monitoring plan are based on and are a reflection of the types of contaminants found at the sites during the environmental assessment. The criteria for the wastewater are considered conservative and appropriately protective of the arctic environment.

Wastewater may be temporarily stored while awaiting test results, provided that it is not stored over the winter months. The volume of wastewater storage during any one construction season shall not exceed the available treatment capacity during that construction season. See Table 8 below for a summary of the typical wastewater discharge criteria, as provided by the Nunavut Water Board for other abandoned military sites.

Table 8. Construction Wastewater Discharge Criteria

Parameter	Criteria (µg/L)
pH	6-9 pH units
Oil & Grease	5000
Arsenic (total)	100
Cadmium (dissolved)	10
Chromium (dissolved)	100
Cobalt (dissolved)	50
Copper (dissolved)	200
Lead (dissolved)	50
Mercury (total)	0.6
Nickel (dissolved)	200
PCB (total)*	1000
Zinc (total)	500

**In respect of application to a road surface.*

The collected wastewater needs to be tested each time prior to discharge. Once it is confirmed that the wastewater meets the discharge criteria, it can be released onto the ground in an area that is at least 30 m from natural drainage courses and 100 m from fish-bearing waters.

The locations of the discharge areas will vary, depending on the work areas. For example, the barrel cleaning operations are typically located within the hazardous materials processing area, which is determined by the contractor. Wastewater that collects at contaminated soil excavations is typically sampled and treated in place. In areas where the volume of wastewater is significant and affects the progression of work, the wastewater may be recirculated.

4.3.5 Sewage Effluent Monitoring

The sewage management system at Padloping Island will likely be a simple facultative system where treatment is achieved by the natural degradation of organic substances or biogeochemical activity. Aerobic or anaerobic micro-organisms digest the organic solids and utilize the released energy and nutrients in the effluent to grow and increase in numbers, which in turn accelerates the process. In this type of system, aerobic respiration is the most complete and efficient degrader of organic solids and therefore the most important element in a stable and healthy biological treatment process. This method of treatment within the Arctic environment, combined with relatively short effluent retention times requires good management to achieve the desired level of treatment prior to discharge. See Table 9 below for a summary of the effluent discharge criteria, as provided by the Nunavut Water Board for other abandoned military sites.

Table 9. Sewage Effluent Criteria

Parameter	Criteria
pH	6-9 pH units
Oil & Grease	No visible sheen
Biological Oxygen Demand	120 mg/L
Total Suspended Solids	180 mg/L
Faecal Coliforms	10,000 CFU/dL

In order to maximize the performance of the system, the specifications (which are to be stamped by a qualified engineer) will require sewage lagoons to have sufficient volume to accommodate 100% of the water consumption for the duration of the construction season. Each of the two cells will hold 50% of the seasonal flow, to a maximum depth of 1.0 m. The required effluent volume per lagoon can be calculated as follows:

Effluent volume per lagoon = (200 litres/person/day) x (number of people) x (construction duration days) x 50%

Effluent monitoring must be completed prior to discharge.

4.3.6 Domestic Waste Management

Kitchen wastes shall be stored in metal, animal-proof containers to prevent scavenging of waste by wildlife and to reduce scattering of debris prior to daily incineration. All residual kitchen wastes shall be packaged with other non-hazardous wastes and disposed of in a southern disposal facility unless otherwise specified.

4.3.7 Road Construction and Maintenance

Existing roads and trails provide access to most sources of granular materials. Emphasis on the preservation of the permafrost regime, vegetation patterns, existing surface drainage patterns, water quality and stream flows shall be maintained. Establishment of new roads off-site is subject to the terms of the land use permit and the approval of the Proponents' Representative. New roads shall be located at least 30 m from any water bodies or water courses. Ice-rich soils, especially peatlands, shall also be avoided during road construction. The road bed shall be prepared with a sufficient thickness of fill to prevent terrain damage. Culverts, if required, shall be installed to maintain natural cross-drainage and prevent ponding. Any culverts installed need to be removed from the roads and drainage restored at the end of the clean-up operations. Access roads shall be monitored for signs of erosion and remedial action taken where necessary. Dust suppression, if required, can be maintained with water only.

4.3.8 Stream Crossing and Diversion

The contractor must adhere to all government regulations, licensing requirements/procedures and inspections regarding the protection of water quality and stream integrity. Existing stream crossings shall be utilized as required. Authorizations for any additional works employed are the responsibility of the contractor.

In the event a stream crossing is required, siltation of waterways and disruption of streambeds shall be prevented using the following procedures:

- Minimize activities adjacent to watercourses.
- Install cofferdams, silt barriers or other suitable barriers.
- Do not operate equipment in waterways.
- Do not use streambeds for borrow material.
- Do not dispose of excavated fill, waste materials and debris in waterways.

4.3.9 Borrow Pit Development and Operation

Environmental protection measures must be implemented for the purpose of minimizing the impact of development and extraction activities on surface drainage patterns, water quality, soil erosion, and in some cases, wildlife or fish. The number of borrow areas opened shall be minimized by using existing borrow areas, roads and building pads where feasible. Use of alternative sources is subject to the approval of the Proponents' Representative and acquisition of a quarry permit. All terms and conditions of the quarry permit are to be complied with, including the recontouring/reclamation of the borrow area and site clean-up prior to site abandonment.

Borrow areas must be located at least 30 m from the nearest water body providing potential fish habitat, and other sensitive resources. A 30 m buffer zone should be marked out prior to commencement of gravel quarrying operations. Organic overburden, if present, shall be stripped and stockpiled separately for use in restoring the borrow area. Following excavation, the area needs to be recontoured to restore natural drainage and the overburden worked into the recontoured borrow area to prevent erosion. Drainage and run-off control needs to be provided using diversion ditches and sediment filters, as required, to prevent sediment laden run-off from reaching water bodies.

During aggregate extraction, vehicle and equipment operations shall be controlled in areas adjacent to the borrow pit to minimize the extent of disturbance. Aggregate shall be stockpiled on ice-poor, well drained ground such that surface drainage is not impeded. The stockpile shall be located in an area that is a minimum of 30 m from archaeological resources, water bodies, and other sensitive resources. If archaeological features or artifacts are encountered during borrow pit operations, the Proponents' Representative is to be notified, the area of the find avoided, and activities in other areas of the pit restricted until further instructions are received.

4.3.10 Hazardous Waste Material Processing Area

A hazardous waste material processing area needs to be developed for the processing of excavated soils. The hazardous waste material processing area shall be located a minimum of 30 m from any archaeological site or water body, on ice poor, well drained soil, and as close to the location of work as practical. Movement of vehicles and equipment between the hazardous material processing area and work site shall be minimized to prevent the spread of potentially hazardous material along the roadways.

4.3.11 Contaminated Soils

Soils exceeding the criteria established for INAC abandoned military sites, including Padloping Island, are to be removed. Disturbance to adjacent areas during excavation of contaminated soil shall be minimized. Spillage of material during transportation between the excavation site and the stockpile/treatment location is to be avoided and any spillage shall be cleaned up to the satisfaction of the Proponents' Representative. Following excavation of contaminated soils, equipment shall be decontaminated. All workers need to wear appropriate protective clothing/equipment when handling contaminated soil. A program of sampling and confirmatory testing of specific contaminated areas will be carried out as part of the clean-up program.

4.3.12 WDA Closure

Existing WDAs will be excavated and remediated as described in Section 2.2. Drainage controls such as diversion ditches and sediment filters may need to be provided, as required, to prevent runoff from reaching water bodies during closure and remediation of WDAs.

4.3.13 Disposal of Site Debris

Site debris shall be collected, sorted into hazardous and non-hazardous materials and disposed of accordingly. Workers need to wear appropriate protective clothing when handling potentially hazardous waste material. Off-road activity shall be minimized during collection of site debris.

4.3.14 Aircraft Movements

It is anticipated that chartered helicopters will be used to transport personnel, perishable supplies and some construction materials and equipment to and from the site. Charter pilots will be advised to maintain an altitude of at least 610 m and preferably 1000 m above ground or water when passing over the site in an airplane or for a helicopter a height that will not disturb those working on the ground or water. Low level flights to observe or photograph wildlife will not be permitted. Charter pilots will be informed of all applicable mitigation plan requirements when scheduling arrangements are made or at other appropriate periods prior to the arrival of the aircraft on-site.

4.3.15 Handling of Dangerous Goods and Hazardous Waste Materials

Packaging: The Transportation Dangerous Goods Act (TDGA) and Regulations govern the packaging and shipment of dangerous goods within Canada. If shipping out of Canada, Canadian regulations and the regulations of the destination country both apply. Requirements of the International Marine Dangerous Goods Code (IMDGC) must be addressed in international waters. Any material classified by the TDGA must be accompanied by the appropriate shipping documents. The documents must include: the shipper, the receiver and all carriers involved in the transport of the shipment. Non-hazardous materials are also to be accompanied by a document indicating ownership and responsibility of the receiver. The contractor shall refer to the TDGA and regulations for more details regarding shipping document requirements. All dangerous goods will be packaged in accordance with the TDGA.

Waste manifests will be initiated for each shipment, specifying a unique reference number and INAC's waste generator number to accompany the shipment to the final destination. Any waste of unknown TDGA hazard will be tested to determine whether any transport hazard exists according to the regulations. Any substance that is considered hazardous will be packaged under the TDGA in accordance with the regulations and the national standard *Performance Packaging for Transportation of Dangerous Goods*. The TDGA regulations specify the packaging requirements for dangerous or hazardous goods according to risk.

Labeling: Each item will be labeled and placarded according to its hazard class and division. A label or placard design is unique to each classification. Large containers will be placarded as defined by the class and division with the TDGA product identification number clearly defined. The product identification number is indicated by the substance name in the regulations.

4.3.16 Explosives

The use of explosives is potentially dangerous to human and animal health. If required, the following procedures should apply:

- Obtain all necessary permits and licenses.
- Handle, transport, store and use explosives and all other related material in accordance with all applicable laws, regulations and orders of regulating authorities.
- Electric detonation methods are prohibited.
- Restrict use of explosives to authorized and certified/licensed personnel who have been trained in their use.
- Minimize defacement of landscape features and other surrounding objects controlling the scatter of blasted material beyond the cleared working area.
- Minimize shock or instantaneous peak noise levels.
- Prevent blasting scatter from reaching fuel or hazardous substance storage locations. A minimum distance of 300 m in rocky terrain and 1000 m in the presence of metal is required.
- Do not conduct blasting in the vicinity of wildlife populations.

4.3.17 Work Site Clean-Up and Abandonment

The contractor must comply with all terms and conditions of the water use license and the land use permit. All temporary buildings, fuel barrels, vehicles, equipment, waste materials and surplus materials will be removed from the site following completion of the work. All large earthworks slopes shall be stabilized. Gravel access roads required for operation and maintenance may remain. All disturbed areas shall be graded to match natural drainage patterns.

4.4 Specific Protection Measures for Valued Ecosystem Components

This section describes the required protection measures for the valued environmental components identified at the Padloping Island site.

4.4.1 Human Health and Safety

Potential hazards to human health and safety are present at the Padloping Island site in the form of hazardous materials and contaminated soil, unpredictable weather conditions and wildlife encounters. Hazardous material and contaminated soil have the potential to enter water bodies and the food chain, and thereby affect vegetation, fish, wildlife and the health of people who travel, hunt and fish in these areas. Site debris may present a physical hazard to people traveling through these locations.

All necessary precautions shall be taken when handling and transporting hazardous material and contaminated soil to avoid contact between site personnel and materials. Site workers need to wear protective clothing when handling hazardous materials. All site personnel working on or in the vicinity of the clean-up operations must be trained in, made aware of and adhere to the requirements of the Workplace Hazardous Materials Information System (WHMIS) program.

Outdoor recreation activities of the site personnel have the potential to adversely affect nearby fish, wildlife, and heritage resources. Subject to site rules and the requirements of territorial fishing licenses and regulations, staff may be permitted to leave the site for recreational purposes. However, recreational use of vehicles, including ATVs, shall not be permitted off of the existing road network. Normal precautions for Arctic travel include: provisions for rapidly changing weather conditions, tactics for possible polar bear and other wildlife encounters, filing a trip plan, first aid kit, a survival kit and insect repellent.

4.4.2 Local Economy and Contact with Local Residents

Employment and local business opportunities in the north and specifically in Qikiqtarjuaq, Clyde River and Pangnirtung will be maximized as much as possible. Regular briefing meetings shall be scheduled with all site personnel to discuss and explain rules.

4.4.3 Aesthetic Value

It is anticipated that the clean-up activities will have an overall positive effect on the aesthetic value of the Padloping Island site in that all disturbed areas (landfills, debris piles, and borrow pits) will be restored as closely as possible to their original appearance. Construction personnel are to avoid and/or modify activities that would otherwise contribute to any degradation of the local environment.

4.4.4 Surface Water and Potential Fish Habitat

The following shall apply to work adjacent to waterways:

- Prevent siltation of water bodies potentially supporting fish by the use of berms or silt fences as required, and by minimizing activities adjacent to watercourses.
- Do not operate equipment in waterways.
- Do not use streambeds for borrow material.
- Do not dispose of excavated fill, waste material or debris in waterways.
- Where possible, conduct in-stream work during low-flow periods or when frozen; in late winter before spring freshet or after mid-August.
- When removing culverts, slope banks to conform to the grade of the adjacent stream bank, as applicable. If required, stabilize the bank using erosion resistant material.

Recreational fishing shall not be permitted except in compliance with the applicable federal and territorial regulations and guidelines.

4.4.5 Permafrost Soils

Ice-rich soils are common in areas that have vegetation cover and are thus susceptible to permafrost degradation. The top layer provides a protective thermal barrier that prevents permafrost degradation. These soils are susceptible to erosion due to their fine texture. Erosion removes the thermal protection and causes permafrost degradation. Vehicle and equipment traffic, and soil excavation can disturb the surface layer and degrade the permafrost. Disturbance to permafrost soils needs to be minimized by restricting vehicle and heavy equipment traffic to existing roads and designated work areas unless approved by the Proponents' Representative. Activity in areas adjacent to work areas shall also be minimized. Vehicles or heavy equipment shall not be operated off-road following heavy rain or melting snow until the soil has dried sufficiently to prevent excess rutting. Appropriate drainage and erosion control structures shall be installed along access roads, where required. The following measures shall be implemented during the site clean-up operations to minimize disruption of permafrost:

- Facilities such as work camps and storage areas shall be located such that they do not impede surface drainage or result in ponding.
- Gravel pads shall be constructed and used to protect ice-rich soil from thermal or physical damage.
- Disturbance during excavations shall be minimized.

- Excavated areas shall be backfilled promptly with granular fill, upon receipt of confirmatory samples.
- Development of new borrow areas shall be minimized.
- Materials shall not be stored directly on unprotected ground surfaces.
- Disturbed areas shall be regraded to restore natural drainage patterns.
- Any rutting that occurs and impedes local drainage or exposes permafrost in ice-rich soils shall be repaired to the satisfaction of the Proponents' Representative.

4.4.6 Terrestrial Wildlife

There is always concern over human/wildlife contact at Arctic sites. This could include harassment by project personnel causing disruption of activities such as calving, breeding, nesting and rearing, all of which may take place on the site proper.

The following procedures shall be implemented to prevent human/wildlife conflicts:

- Employ a dedicated wildlife monitor(s) at all times.
- All on-site personnel shall be required to be familiar with the on-site bear safety training for all workers.
- Wildlife may not be fed, injured or harassed by site personnel.
- Do not disturb birds nesting on-site.
- Vehicle and aircraft movements shall conscientiously avoid all known populations of wildlife or areas known to be frequented by known populations of wildlife.
- Do not attempt to chase, catch, divert, follow or otherwise harass wildlife by aircraft, vehicle or on foot.
- Control refuse and make it inaccessible to bears and other scavengers.
- Equipment and vehicles shall yield to wildlife, where possible.
- Except in the vicinity of the airstrip, advise charter aircraft pilots not to fly at elevations lower than 610 and preferably 1000 m above ground or water or for a helicopter at an elevation as not to disturb workers on the ground or water.
- In the event that wildlife is spotted from the air, aircraft shall not make descents for observations or photography.
- Domestic or wild pets are not allowed on-site with the exception of controlled watchdogs.
- Project personnel shall not be permitted to possess personal firearms. The only firearms allowed on site shall be for protection from bears and shooting of animals exhibiting aberrant behavior. The firearms shall be controlled by the contractors' site superintendent.

4.4.7 Avifauna

Disruption of avifauna during the nesting period can result in reproductive failure. For this reason, populations of nesting birds shall be avoided during this period. Impacts on these species shall be minimized by removing any nests before they become active, discouraging nesting at work areas and scheduling disruptive activities outside of the nesting period. Based on the observations during the 2010 site investigation and the lack of buildings (where most avifauna at northern sites make nests) scheduled for demolition at the Padloping Island site, it is not anticipated that work scheduling will be required.

The arrival of avifauna at specific locations in the Arctic is influenced by weather conditions and a number of other factors. Inclement weather or a delayed spring melt may delay arrival by several weeks. In general, however, the chronology of arrival, nesting and departure is relatively consistent. Typically within two weeks of arrival, nesting commences and continues for one to two months until the young leave the nest. Following this, the birds feed in preparation for the fall migration and depart by mid to late September.

4.4.8 Heritage Resources

The traditional and scientific value of heritage resources is greatly diminished if they are disturbed or moved. Archaeological sites in Nunavut are protected by law, and disturbance of these sites and collection of specimens is prohibited except under the terms of an archaeological research permit.

In the event that heritage resources are discovered during clean-up activities, the following procedures apply:

- Report the discovery immediately to the Proponents' Representative.
- Cease work in that area and notify the appropriate authorities with the Department of Culture, Language, Elders and Youth (CLEY).
- Report all archaeological finds, including:
  - The identity of the person making the discovery.
  - A description of the site, including topography, landmarks, etc.
  - The nature of the activity resulting in the discovery.
  - A description of the archaeological site, including size, features, or visible details, supplemented by sketches or photographs.
    - Actions currently undertaken to protect the archaeological features.
    - Any extenuating circumstances.
- Do not resume activities in the vicinity of the find until confirmation and direction from the Department of CLEY is received.

These mitigation measures were identified because they will result in a reduction or elimination of likely environmental effects, including potential adverse effects, associated with the clean-up.

5. Cumulative Effects

A summary of the project tasks, potential impacts, proposed mitigation measures, cumulative impacts and significance are presented in Table 10.

Table 10. Summary of Project Tasks, Impacts, Mitigation Measures, Residual Impacts and Significance

VEC	Activity	Description of Impact	Proposed Mitigation Measure	Residual Impact	Overall Significance
Air Quality	Hydrocarbon Contaminated Soil Removal/Landfarming	Air quality may be impacted by the removal of hydrocarbon-contaminated soils and landfarming.	None. Impact is minimal and short-term.	None. Once the impacted soil has been removed, the potential for a residual impact is removed.	N
	Site Grading/Borrow Source Development	The extraction of granular materials and grading activities has the potential to create dust and impact air quality.	Implement dust control measures. Only water will be used for dust control.	None.	M
	Vehicle, Incinerator and Camp Infrastructure (furnaces, generators) Emissions	Operation of the camp and associated equipment will result in emissions that could negatively impact air quality.	Use appropriate furnace filters, do not leave vehicles and equipment running unnecessarily. Impacts occur over the short-term.	None.	M
Soil Quality	Waste Disposal Area (WDA) Closure	The closure of the existing WDAs will eliminate the risk of impacting soil quality.	Removal of a WDA eliminates the risk.	The excavation of WDAs eliminates the risk of potential future impacts.	P
	Contaminated Soil and Hazardous Materials Removal	The removal of the contaminated soil and hazardous materials from contact with the environment will improve soil quality.	n/a	Improved soil quality and reduced potential for future adverse effects.	P
	Transport of Hazardous Material, Fuel and Contaminated Soil	The potential exists for accidental release of hazardous materials, contaminated soil and/or fuels during transport, which could impact soil quality.	Proper handling, storage, and transportation procedures for hazardous materials to be implemented as per TDGA regulations. All workers to be trained in proper handling procedures for all hazardous materials on-site. Workers to follow the spill contingency plans. All materials and equipment to implement contingency plans to be available on-site.	None.	M
Water Quality	WDA Closure	The excavation of WDAs has the potential to disrupt drainage at the site and cause siltation of waterways.	Removal of a WDA removes the risk of future water quality degradation resulting from contact with the waste materials. Regrading following excavation will promote positive surface runoff. Sedimentation and erosion control measures during excavation will reduce the potential for waterway siltation.	Mitigation measures will significantly reduce risk.	M
	Contaminated Soil and Hazardous Materials Removal	Removal of the contaminated soil and hazardous materials from the environment will reduce the risk of contamination to the surface and active layer water.	Prevent sediments from entering waterbodies by use of berms and/or silt fences. Implement other environmental protection measures as necessary.	Reduced potential for future negative effects.	P
	Transport of Hazardous Material, Fuel and Contaminated Soil	The potential exists for accidental release of hazardous materials, contaminated soil, and/or fuels. An accidental release could impact water quality.	Proper handling, storage, and transportation procedures for hazardous materials to be implemented as per TDGA regulations.	None.	M

VEC	Activity	Description of Impact	Proposed Mitigation Measure	Residual Impact	Overall Significance
			All workers to be trained in proper handling procedures for all hazardous materials on-site. Workers to follow the spill contingency plans. All materials and equipment to implement contingency plans to be available on-site. Implement mitigation measures to prevent deleterious substances from entering the aquatic environment.		
	Site Grading/Borrow Source Development	Erosion and sedimentation of waterbodies during grading and gravel extraction activities has the potential to negatively impact water quality. Drainage will be improved as a result of grading disturbed areas. The extraction of granular material will alter the terrain of the borrow area and has the potential to disturb drainage.	Prevent siltation by use of berms and/or silt fences. Do not operate equipment within the wetted perimeter. Disturbed areas adjacent to water are to be stabilized, if required. Site to be graded upon completion to promote positive drainage and to match the existing terrain as much as practical.	None.	M
Terrain Quality	Debris Disposal	The removal of site debris has the potential to disturb existing terrain.	Regrade and reshape disturbed areas to match existing terrain and drainage paths. Use existing roads for movement around the site wherever possible.	Although every effort will be made to match worked areas to the existing terrain and drainage paths, it is unlikely to be exact, and will likely take significant time for the area to blend into the undisturbed terrain.	M
	Site Regrading	Terrain and drainage will be improved as a result of grading disturbed areas. Previously disturbed areas will blend into the natural environment.	All structures implemented either during the operation of the site or as part of the remediation will be removed to restore natural surface drainage patterns.	Positive impact.	P
	Borrow Source Development	The extraction of granular material will alter the terrain of the borrow areas.	Regrade and reshape disturbed areas to match existing terrain and drainage paths. Use existing roads for movement around the site wherever possible.	Although every effort will be made to match worked areas to the existing terrain and drainage paths, it is unlikely to be exact, and will likely take significant time for the area to blend into the undisturbed terrain.	M
	Contaminated Soil Excavation	The excavation of contaminated soil has the potential to degrade the permafrost.	Minimize the time permafrost is exposed. Minimize surface area of exposed permafrost or active zone.	Although the permafrost may be disturbed, it is anticipated once the work is completed, permafrost depth will be restored.	M
Terrestrial Animals	General Clean-Up Activities	The use of heavy equipment during the clean up has the potential to disturb wildlife.	Avoid areas of known wildlife colonies or bird nesting areas. Employ minimum distance requirements for transportation activities around the site.	None. The work is seasonal, short-term and temporary.	M

VEC	Activity	Description of Impact	Proposed Mitigation Measure	Residual Impact	Overall Significance
	Contaminated Soil and Hazardous Materials Removal	The removal of hazardous materials and contaminated soil from the environment reduces the risk of exposure to terrestrial animals.	n/a	Reduced risk of future adverse effects.	P
Terrestrial Habitat	Borrow Source Development	The extraction of granular material will disturb the ground and has the potential to impact terrestrial habitat.	Regrade and reshape the disturbed areas to match existing terrain to facilitate recovery of ecosystem components.	Although every effort will be made to match the disturbed area to the existing terrain, the Arctic tundra is quite sensitive and it may take significant time for the disturbed area to recover.	M
Aquatic Habitat and Animals	WDA Closure/Excavation	The excavation of high risk WDAs in close proximity to water bodies removes the potential for impact.	During excavation, implement mitigation measures to prevent deleterious substances from entering the aquatic environment. Prevent siltation by use of berms and/or silt fences. Do not operate equipment within the wetted perimeter. Disturbed areas adjacent to water are to be stabilized, if required.	Reduced risk of future adverse effects.	P
	Site Regrading/Borrow Source Development	The extraction of granular material and grading adjacent to waterbodies has the potential to impact aquatic habitat, and thereby affect aquatic animals, due to sediment entering the water.	Prevent siltation by use of berms and/or silt fences. Do not operate equipment within the wetted perimeter. Disturbed areas adjacent to water are to be stabilized, if required.	None.	M
	Contaminated Soil and Hazardous Materials Removal	The removal of contaminated soil and other hazardous materials from areas close to waterbodies reduces the risk of exposure to aquatic animals. The excavation of contaminated soils from the beach area has the potential to degrade the aquatic environment in the event of an accidental release and impact aquatic animals in close proximity to the aquatic environment.	Implement mitigation measures to prevent deleterious substances from entering the aquatic environment. Prevent siltation by use of berms and/or silt fences. Do not operate equipment within the wetted perimeter. Disturbed areas adjacent to water are to be stabilized, if required.	Reduced risk of future adverse effects.	P/M
Health and Safety	General Clean Up Activities	The excavation of potentially hazardous materials from the landfills, the collection and disposal of potentially hazardous debris, the removal of hazardous materials from the facilities and the general handling of hazardous materials has the potential to impact the health and safety of workers.	Transportation of any hazardous materials is to be in accordance with the TDGA Regulations. Workers must wear and use appropriate personal protective equipment. Workers are to be trained in the use of personal protective equipment and proper handling procedures for hazardous materials. Proper procedures for working around heavy equipment to be implemented.	None.	M

VEC	Activity	Description of Impact	Proposed Mitigation Measure	Residual Impact	Overall Significance
	Contaminated Soil and Hazardous Materials Removal	The removal of contaminated soil and other hazardous materials from the environment reduces the risk of exposure to people.	n/a	Reduced risk of future adverse effects.	P
Archaeological	General Clean Up Activities	The presence and movement of people around the site has the potential to disturb the archaeological resources identified around the site.	Clearly mark and avoid all archaeological resources. Contact authorities in the event a new resource is discovered or a know resource is disturbed.	None.	M
Land Use	General Clean Up Activities	Clean up activities may disturb traditional land use, i.e., hunting and fishing activities that would occur along the coastal areas during the summer months; although it has been noted the area is no longer used.	Contact the local hunters and trappers organization to coordinate clean up activities and traditional land use, if applicable.	None.	M
Aesthetics	General Clean Up Activities	Generally, the clean up will improve the aesthetics of the site by removing unsightly debris and restoring the site to a more natural state.	n/a	Site is restored to a more natural state and therefore is more aesthetically pleasing.	P
Economy	Contractor Support	The contractor will be required to have a minimum Inuit content in the workforce for clean up. This will provide employment benefits and related economic benefits.	n/a	Greater number of trained Inuit workers.	P

P – Positive
N – Negative and non-mitigable
M – Negative and mitigable
U – Unknown

6. References

- AECOM (2010) Phase III Environmental Site Assessment, Padloping Island Former US Coast Guard Weather Station
- AECOM (2011) Remedial Action Plan, Padloping Island Former US Coast Guard Weather Station
- Golder Associates (2010) Archaeological Impact Assessment (AIA) of the Padloping Island Former US Coast Guard Weather Station

Appendix A

Drawings

B SIZE 11" x 17" (279.4mm x 431.8mm)
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N 7 437 000
N 7 436 500
N 7 436 000
N 7 435 500
N 7 435 000
E 510 000
E 510 500
E 511 000
E 511 500
E 512 000
E 512 500
E 513 000
E 513 500

SCALE 1:10000
0 100 200 m

FRESHWATER LAKE
TIDAL BAY
DELIGHT ANCHORAGE

TP-01
TP-02
TP-03
TP-04
TP-05
TP-06
TP-07
TP-08
TP-09
TP-10
TP-11
TP-12
TP-13
TP-14
TP-15
TP-16
TP-17

BORROW AREA BA-1
BORROW AREA BA-2
BORROW AREA BA-3
BORROW AREA BA-4
BORROW AREA BA-5
BORROW AREA BA-6
BORROW AREA BA-7

LANDFILL LF-1
LANDFILL LF-2
LANDFILL LF-3
LANDFILL LF-4

POSSIBLE EXTENSION TO BORROW AREA BA-2
INUIT OWNED LANDS
CROWN LANDS
POWER CABLE

FIGURE 2.0
MAIN STATION AREA

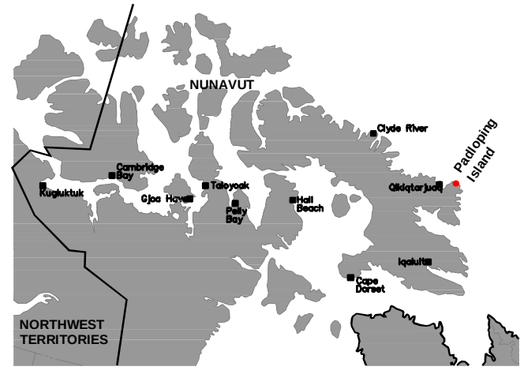
FIGURE 3.0
SOUTH OF MAIN STATION AREA

FIGURE 4.0
WEST BEACH AREA

FIGURE 5.0
OLD HAMLET SITE

FIGURE 6.0
ORIGINAL STATION SITE AND EAST BEACH AREA

FIGURE 7.0
POND AREA



LOCATION OF PADLOPING ISLAND WITHIN NUNAVUT TERRITORY
N.T.S.

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Overall Site Plan

Figure 1.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
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E 511 500 | E 511 600 | E 511 700 | E 511 800

N 7 436 100 | N 7 436 000

0 10 20 m SCALE 1:1000

BOILER/INCINERATOR BUILDING
LIBRARY
MAINTENANCE SHED
MAINTENANCE GARAGE
OLD GENERATOR BUILDING
TRACTOR
TRUCK
ACCESS ROAD
FALLEN COMMUNICATIONS TOWER
TOP OF COMMUNICATION TOWER
WEATHER BUILDING
CONCRETE
KITCHEN/MESS HALL
ACCOMMODATIONS BUILDING
SHOWER / WASHROOMS
SUPPLY DEPOT BUILDING
SHOWER / WASHROOM
LOBE H
LOBE I
STATION AREA SOUTH MOUND

TP-18
TP-19

PI47 PI48 PI49 PI50

ESG-7507 ESG-7508 ESG-7509 ESG-7519 ESG-7558 ESG-7559 ESG-7560 ESG-7562/63 ESG-7564 ESG-7566 ESG-7567 ESG-7568 ESG-7569

10-0000 series sample locations

GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

LEGEND:

- SITE GRID (100m INTERVAL)
- BURIED DEBRIS AREA
- ESG-7000 — ESG SAMPLE LOCATION - TIER I
- ESG-7000 — ESG SAMPLE LOCATION - TIER II
- 10-0000 — SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 — SAMPLE LOCATION (NOT ANALYZED)
- 10-0000 — TIER I
- 10-0000 — TIER I / TYPE B PHC
- 10-0000 — TIER II
- 10-0000 — TIER II / TYPE B PHC
- 10-0000 — TYPE A PHC
- 10-0000 — TYPE B PHC
- PI48 — EARTH TECH SAMPLE LOCATION
- EXISTING POWER POLE
- TIER II ESTIMATED AREA OF CONTAMINATION
- TIER II / TYPE B PHC ESTIMATED AREA OF CONTAMINATION
- TYPE A PHC ESTIMATED AREA OF CONTAMINATION
- TYPE B PHC ESTIMATED AREA OF CONTAMINATION

AECOM

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Main Station Area Environmental Plan
Figure 2.1

B SIZE 11" x 17" (279.4mm x 431.8mm)
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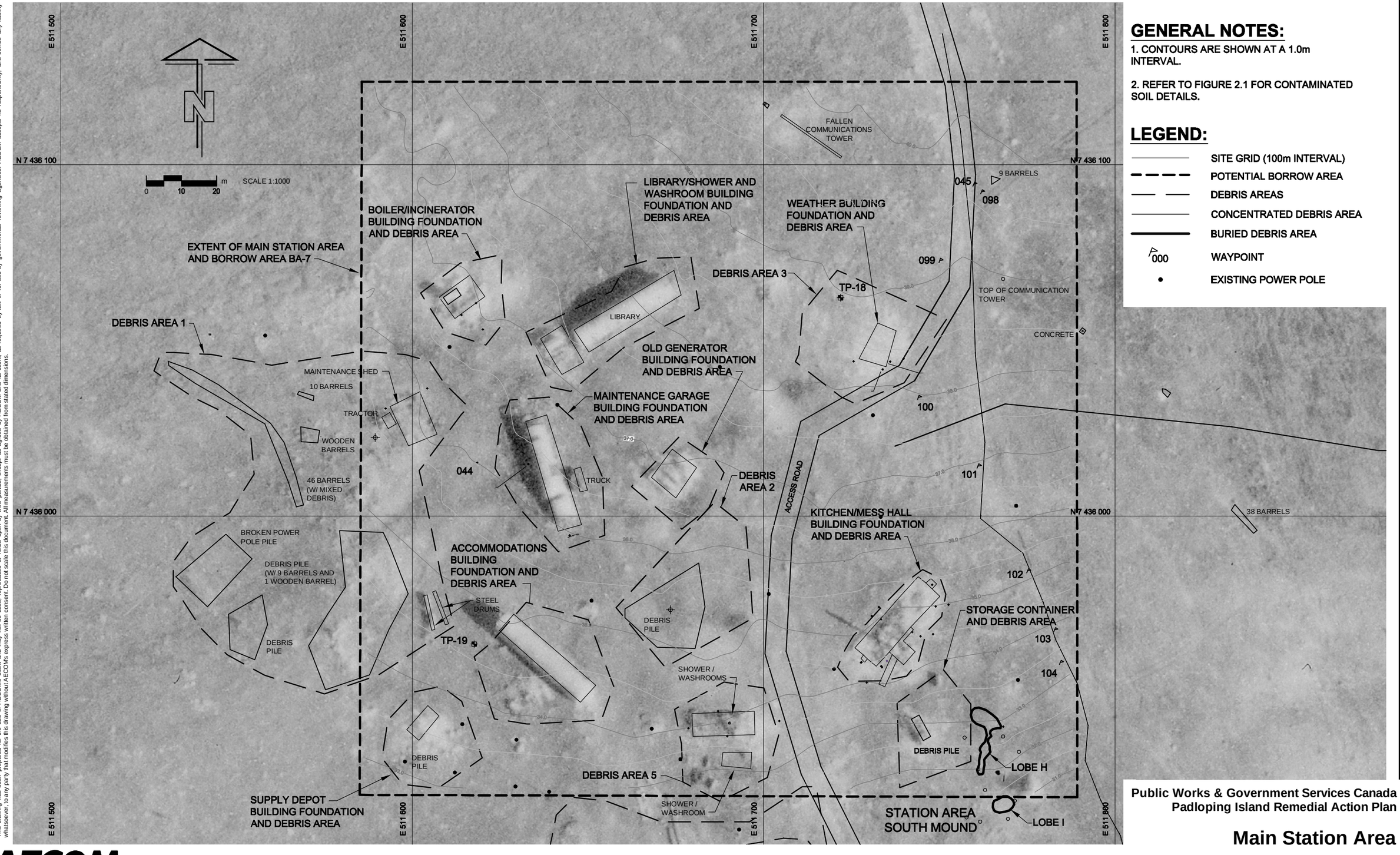

GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

2. REFER TO FIGURE 2.1 FOR CONTAMINATED SOIL DETAILS.

LEGEND:

- SITE GRID (100m INTERVAL)
- POTENTIAL BORROW AREA
- DEBRIS AREAS
- CONCENTRATED DEBRIS AREA
- BURIED DEBRIS AREA
- 000 WAYPOINT
- EXISTING POWER POLE

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Main Station Area

AECOM

Figure 2.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
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N 7 435 900
N 7 435 800
N 7 435 700
E 511 600
E 511 700
E 511 800
E 511 900

SCALE 1:1000
0 10 20 m

OLD GENERATOR BUILDING FOUNDATION AND DEBRIS AREA
DEBRIS PILE
10-0089
10-0090/91
LOBE J
10-0088
10-0099
10-0097
10-0096
105
38 BARRELS
10-0087
LOBE K
10-0092
10-0093
LOBE L
LOBE M
10-0098
10-0094
10-0095
BUILDING DEBRIS WITH 7 BARRELS
UNKNOWN BUILDING
UNKNOWN BUILDING
10-0100/01
ESC-7598
10-0103
10-0104
0105
10-0102
17 BARRELS
WATER TANK BUILDING
DEBRIS AREA 4
17 BARRELS
DEBRIS AREA 5
WOODEN STORAGE CONTAINER
10-0152
10-0153
10-0149
10-0150/51
10-0145
10-0146
48 BARRELS
DEBRIS PILE
87 BARRELS
CRUSHED BARRELS
ACCESS ROAD
TRUCK
220 BARRELS
8 BARRELS
DEBRIS PILE
5 BARRELS
WOODEN X-STRUCTURE
DEBRIS AREA 6
UNKNOWN BUILDING
UNKNOWN METAL OBJECT
ACCESS ROAD
DEBRIS PILE WITH 2 BARRELS
METAL DUMP DEBRIS AREA AND BORROW AREA BA-5
TP-14
TRUCK
TRUCK
TRUCKS
GRADER
AMPHIBIOUS VEHICLE
TRUCK
AMPHIBIOUS VEHICLE
10-0109
10-0107
10-0106
10-0108
10-0110/11
DEBRIS AREA 8
DEBRIS PILE WITH 13 BARRELS
13 BARRELS

LEGEND:

- SITE GRID (100m INTERVAL)
- POTENTIAL BORROW AREA
- DEBRIS AREA
- CONCENTRATED DEBRIS AREA
- BURIED DEBRIS AREA
- EXISTING POWER POLE
- 000 WAYPOINT
- 10-0000 SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 SAMPLE LOCATION (NOT ANALYZED)
- 10-0000 TIER II
- 10-0000 TYPE A PHC
- 10-0000 TYPE B PHC
- TIER II ESTIMATED AREA OF CONTAMINATION
- TYPE A PHC ESTIMATED AREA OF CONTAMINATION
- TYPE B PHC ESTIMATED AREA OF CONTAMINATION
- BUILDING FROM 1967 AERIAL PHOTO THAT NO LONGER REMAINS

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

South of Main Station Area

AECOM

Figure 3.0

B SIZE 11" x 17" (279.4mm x 431.8mm)

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E 511 600 | E 511 700 | E 511 800 | E 511 900

N 7 435 600 | N 7 435 500

METAL DUMP

10-0114
10-0117
10-0112
10-0116
10-0115

TRACTOR
CAR
TRACTOR
CAR

METAL DUMP DEBRIS AREA AND BORROW AREA BA-5

28 BARRELS

ACCESS TRAIL

13 BARRELS

UNKNOWN BUILDING

DEBRIS PILE

DEBRIS PILE

WEST BARREL CACHE

10-0126
CRUSHED BARRELS
10-0130/31
10-0132
10-0133

CRUSHED BARRELS
10-0134

10-0127
10-0128
10-0129
CRUSHED BARRELS

10-0135
CRUSHED BARRELS
10-0140/41
10-0142
10-0136

10-0143
STEEL OBJECT

PARTIALLY SUBMERGED BARGE

DEBRIS PILE
ACCESS ROAD
WOODEN PLATFORM
DEBRIS PILE
DEBRIS PILE

DEBRIS AREA 10

DEBRIS PILE
GRADER BLADE
METAL OBJECT

DEBRIS PILE

HIGH TIDE LEVEL (VEGETATION OBSERVED DURING 2010 SITE INVESTIGATION)

ESTIMATED NORMAL HIGH TIDE

LOW TIDE LEVEL (OBSERVED DURING 2010 SITE INVESTIGATION)

SUBMERGED BARGE

DEBRIS AREA 11

DELIGHT ANCHORAGE

N

0 10 20 m

SCALE 1:1000

LEGEND:

- SITE GRID (100m INTERVAL)
- POTENTIAL BORROW AREA
- DEBRIS AREA
- CONCENTRATED DEBRIS AREA
- 000 WAYPOINT
- 10-0000 SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 SAMPLE LOCATION (NOT ANALYZED)
- 10-0000 TIER II
- 10-0000 TYPE B PHC
- TIER II ESTIMATED AREA OF CONTAMINATION
- TYPE B PHC ESTIMATED AREA OF CONTAMINATION
- BUILDING FROM 1967 AIR PHOTO THAT NO LONGER REMAIN

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Padloping Island Remedial Action Plan

West Beach Area

AECOM

Figure 4.0

B SIZE 11" x 17" (279.4mm x 431.8mm)

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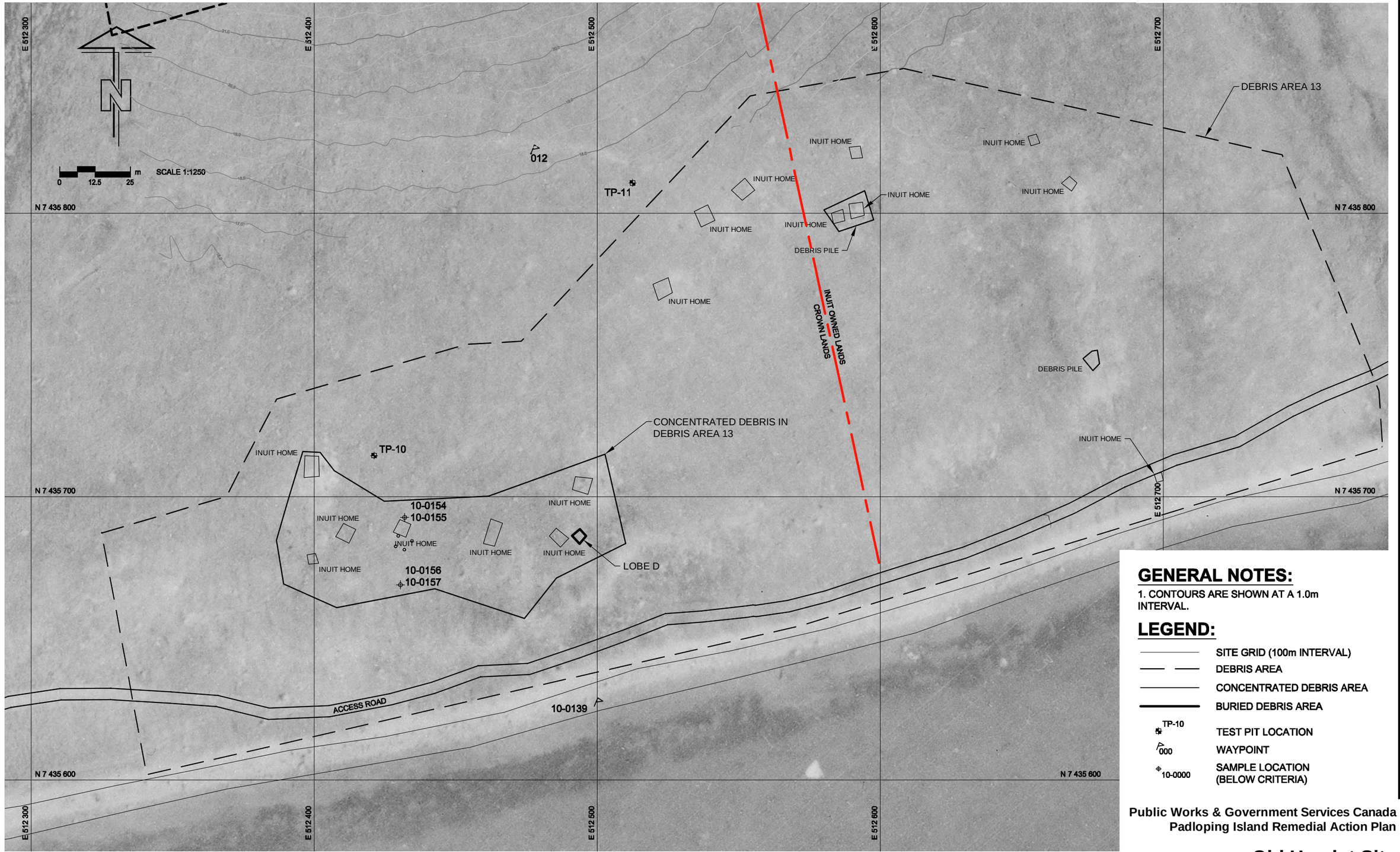

GENERAL NOTES:

1. CONTOURS ARE SHOWN AT A 1.0m INTERVAL.

LEGEND:

- SITE GRID (100m INTERVAL)
- DEBRIS AREA
- CONCENTRATED DEBRIS AREA
- BURIED DEBRIS AREA
- TP-10 — TEST PIT LOCATION
- 000 — WAYPOINT
- 10-0000 — SAMPLE LOCATION (BELOW CRITERIA)

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Old Hamlet Site

AECOM

Figure 5.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
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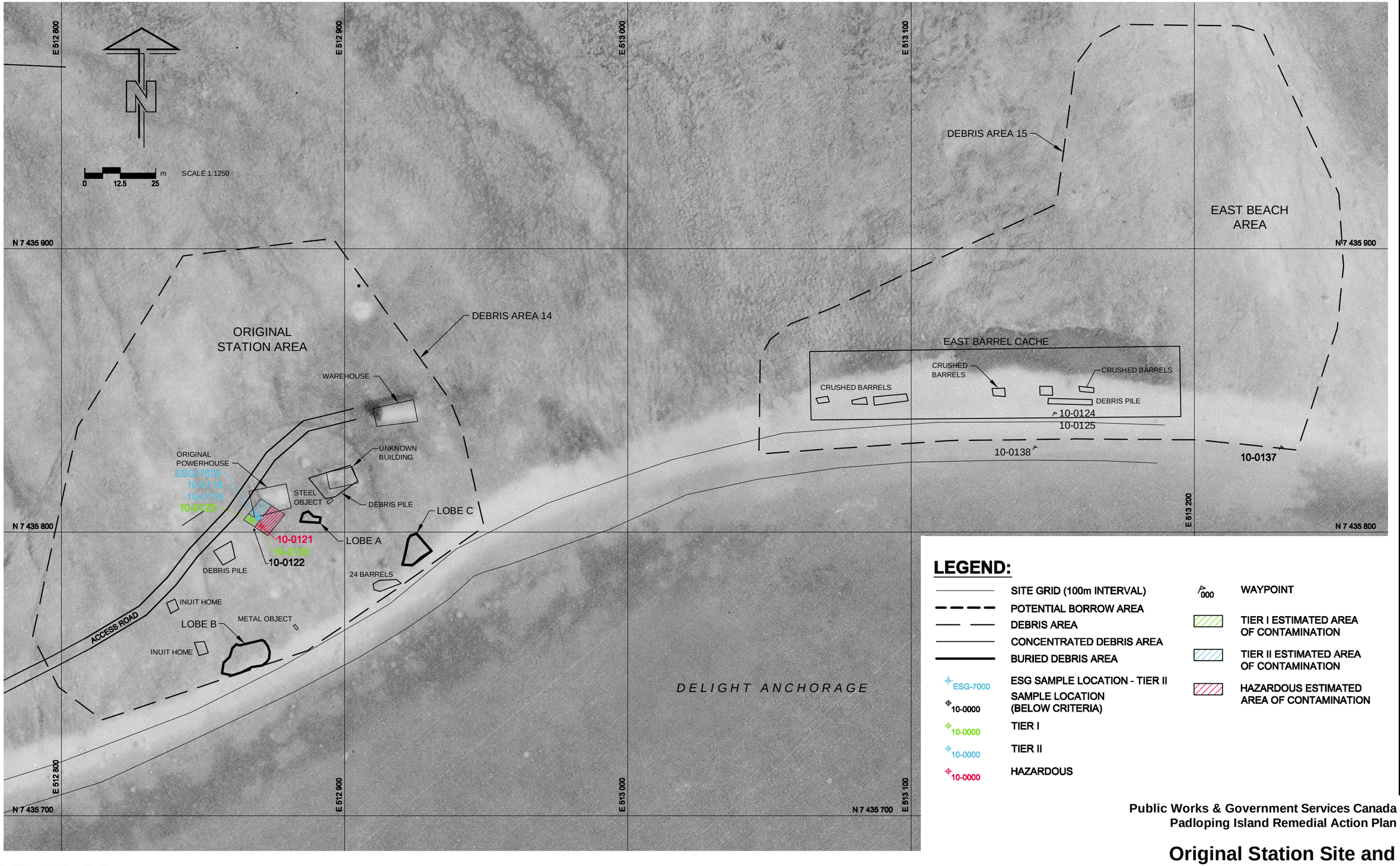

LEGEND:

- SITE GRID (100m INTERVAL)
- POTENTIAL BORROW AREA
- DEBRIS AREA
- CONCENTRATED DEBRIS AREA
- BURIED DEBRIS AREA
- ESG-7000 — ESG SAMPLE LOCATION - TIER II
- 10-0000 — SAMPLE LOCATION (BELOW CRITERIA)
- 10-0000 — TIER I
- 10-0000 — TIER II
- 10-0000 — HAZARDOUS
- 000 — WAYPOINT
- TIER I ESTIMATED AREA OF CONTAMINATION
- TIER II ESTIMATED AREA OF CONTAMINATION
- HAZARDOUS ESTIMATED AREA OF CONTAMINATION

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Original Station Site and East Beach Area
Figure 6.0

AECOM

B SIZE 11" x 17" (279.4mm x 431.8mm)

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E 511 300
E 511 400
E 511 500
E 511 600
E 511 700

N 7 436 800
N 7 436 700
N 7 436 600

0 12.5 25 m SCALE 1:1250

POND DEBRIS AREA
LOBE E
LOBE F
POND AREA
LOBE G
ACCESS TRAIL

LEGEND:

- SITE GRID (100m INTERVAL)
- DEBRIS AREA
- BURIED DEBRIS AREA

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Pond Area

AECOM

Figure 7.0

B SIZE 11" x 17" (279.4mm x 431.8mm)
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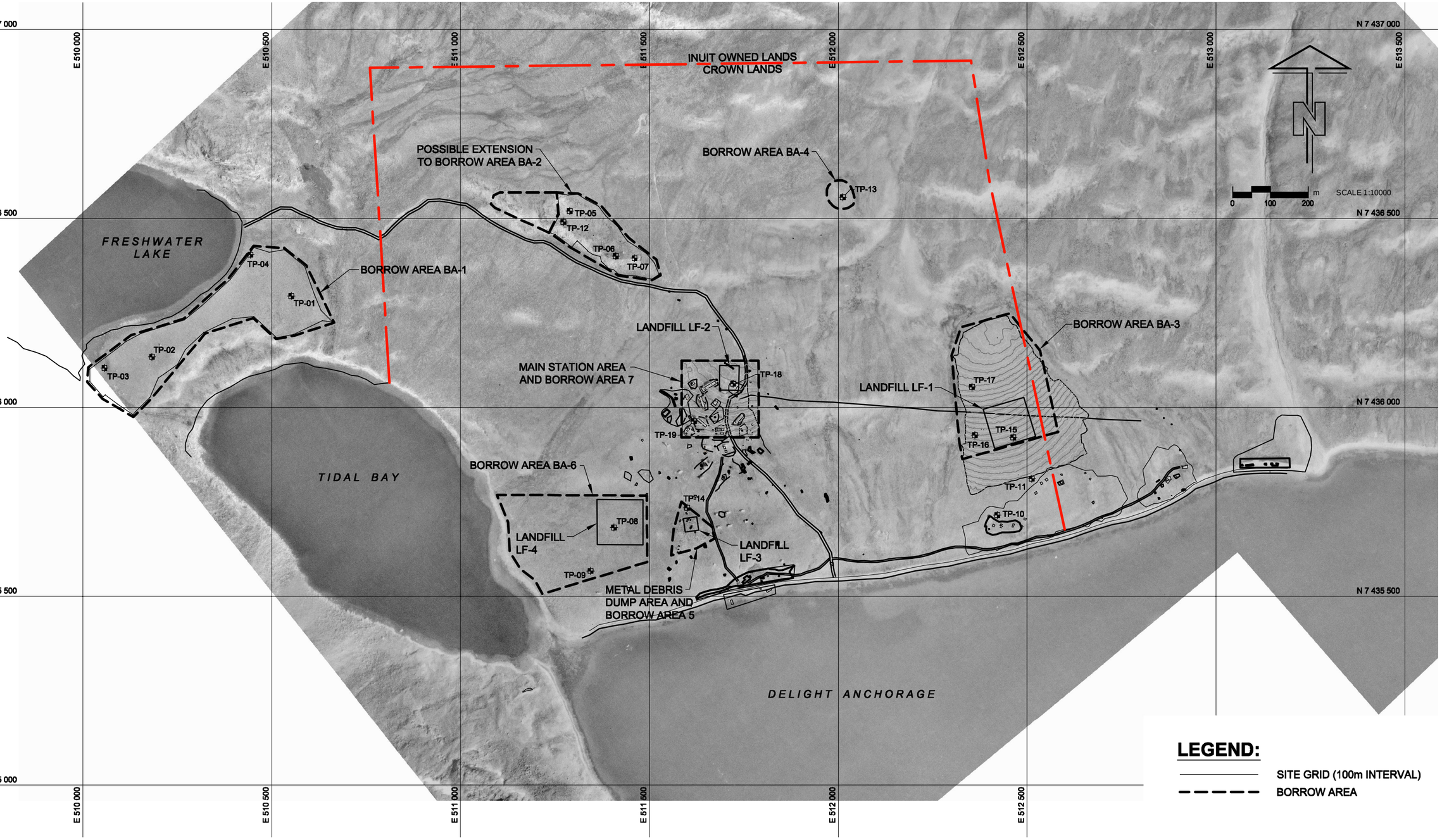


LEGEND:

- SITE GRID (100m INTERVAL)
- BORROW AREA

Public Works & Government Services Canada
Padloping Island Remedial Action Plan

Geotechnical Plan

Figure 8.0

Water Licence Application

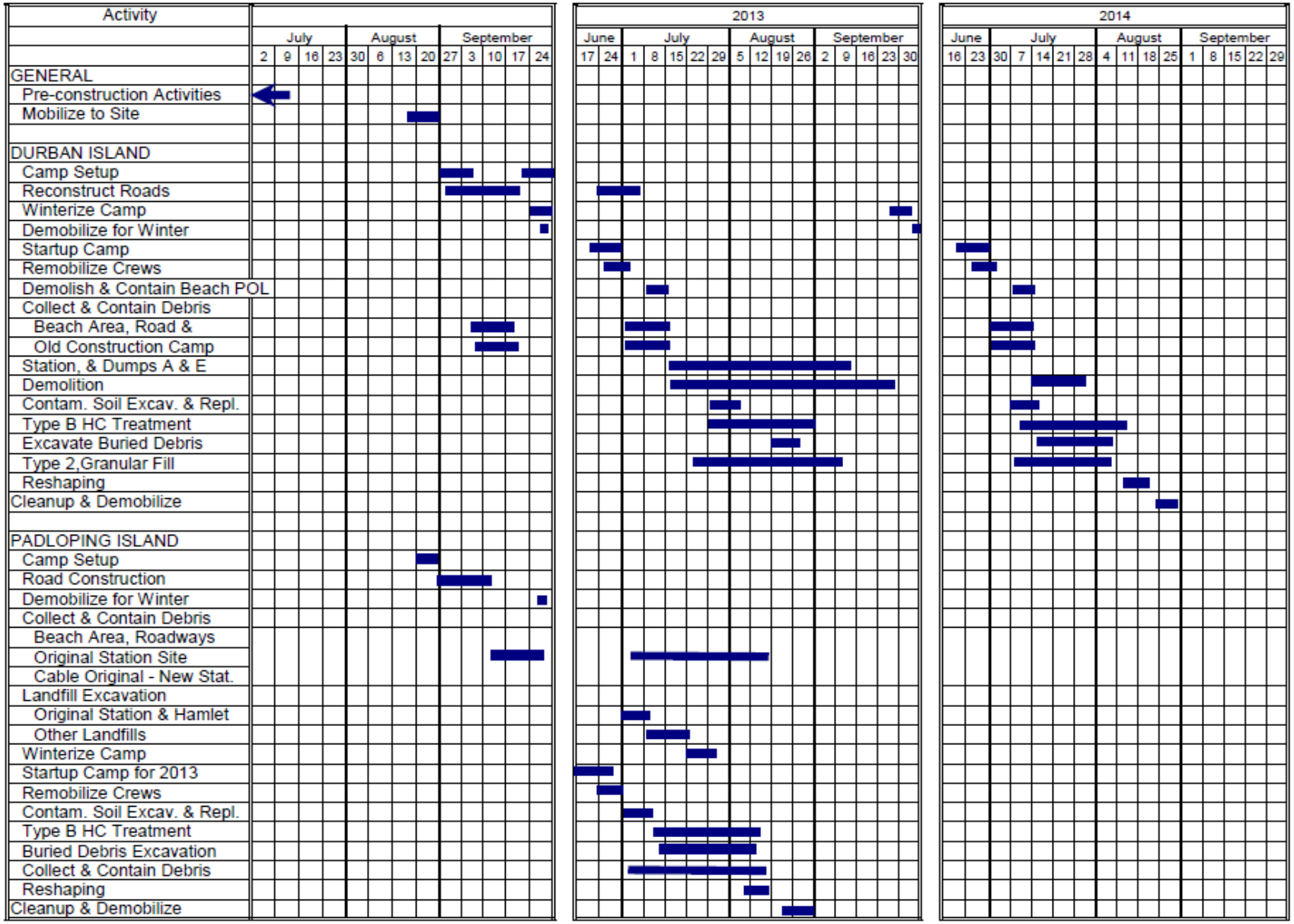
Durban and Padloping Islands

Remediation Project

Appendix 7

Project Schedule

Durban Island and Padloping Island Site Remediation
PRELIMINARY SCHEDULE



Note: Schedule is preliminary and will be modified based on contractor's proposal.

Water Licence Application

Durban and Padloping Islands

Remediation Project

Appendix 8

Archaeological Assessment Reports

Durban Island FOX-E

Padloping Island

FINAL REPORT

ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF THE FOX-E INTERMEDIATE DEW LINE SITE, DURBAN ISLAND, NUNAVUT

Submitted to:

The Department of Culture, Language, Elders and Youth (CLEY), Nunavut
Nunavut Permit No. 2010-017A

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EXECUTIVE SUMMARY

During August of 2010, Golder Associates Ltd. conducted an Archaeological Impact Assessment (AIA) of the FOX-E Intermediate DEW Line Site in on Durban Island, Nunavut on behalf of AECOM working for Public Works and Government Services Canada (PWGSC) and Indian and Northern Affairs Canada (INAC). This AIA was carried out in conjunction with the Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation and Remedial Action Plan. All required fieldwork was completed under an Archaeological Permit (2010-017A) issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut to Brent Murphy of Golder.

The Intermediate DEW Line Site is located on Durban Island, approximately 95 km southeast of Qikiqtarjuaq, Nunavut. Low-level aerial reconnaissance of the site area was conducted in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential. Lack of vegetation and sedimentation enabled surface examination of the facility areas to adequately assess for the presence of cultural materials. As requested, areas which will not be impacted during remediation were not examined. During the study the previously recorded FOX-E DEW Line site, MgBs 2, was revisited and one new site, MgBs 4, was identified and documented as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003).

PWGSC has fulfilled the requirements to identify the potential for impact to heritage resources during the proposed remediation/reclamation of the FOX-E DEW Line site on Durban Island. The AIA included the participation of Losie Audiakiak and Johnny Kooneeliusie from the local community of Qikiqtarjuaq, who acted as bear monitors and participated in the identification and recordation of the heritage resource sites.

The AIA included revisiting the previously recorded DEW Line site, MgBs 2, and the identification of one new heritage resource site, MgBs 4. The FOX-E Dew Line Site, MgBs 2, is considered to be of limited significance given the amount of information that is currently known about the site. MgBs 4 is a stone feature site that is considered to be

of moderate significance and it is recommended that this site be avoided during remediation activities.

It is recommended that PWGSC and INAC have met their obligations to assess the potential for impact to heritage resources during the proposed Remedial Action Plan. It is also recommended that the newly identified site MgBs 4 be avoided during reclamation activities.

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Appendix I Photograph Log

1. INTRODUCTION

During August of 2010, Golder Associates Ltd. (Golder) conducted an Archaeological Impact Assessment (AIA) of the FOX-E Intermediate DEW Line Site, Durban Island in conjunction with the Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation, Remedial Action Plan on behalf of AECOM and Public Works and Government Services Canada (PWGSC). All required fieldwork was completed under an Archaeological Permit (2010-017A) issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut to Brent Murphy of Golder.

Low-level aerial reconnaissance of the site area was initially flown in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential. The AIA was intended to identify any artifacts or heritage resource areas that might be impacted by a remediation program and, as such, only those areas of previous and potential disturbance were assessed. The intent of this program was not to conduct a full AIA of the entire Durban Island. However, during traverses of the former DEW Line station some lands outside of proposed impacts were surveyed (Figure 1).

The amount of previous disturbance associated with the DEW Line site and lack of vegetation facilitated assessment of the facility areas and increased visual assessment for the presence and/or absence of cultural materials. As requested, areas that will not be impacted during remediation were not fully examined. One previously recorded site, the FOX-E DEW Line site (MgBs 2) was revisited and one previously unrecorded heritage resource site (MgBs 4) were identified by the author during the program, which were documented as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003).

INSET MAP NOT TO SCALE

Cape Searle

16/16M

Qaqaluit
Island

BI-15/16M

ALL ISLANDS WITHIN THE BOUNDED ARE
PART OF THE LAND SETTLEMENT PARCEL.

TOUTES LES ÎLES SITUÉES À L'INTÉRIEUR
ZONE DÉLIMITÉE FONT PARTIE DE LA PAR
AYANT FAIT L'OBJET D'UNE ENTENTE.

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2. LOCATION, POTENTIAL IMPACTS, AND OBJECTIVES

2.1 Location

The FOX-E Intermediate DEW Line site is located on Durban Island 95 km southwest of Qikiqtarjuaq, Nunavut. Durban Island is located off the northeast coast of Baffin Island on the Hudson Strait. The site area is made up of a beach area at sea level with the former DEW Line site being located on a flat plateau 650 m above sea level (Plates 1 and 2). The FOX-E site was constructed between 1957 and 1959 and included a module train, warehouse, garage, bulk fuel storage tanks, Inuit house, Quonset huts, water storage, helicopter landing pads and antenna. In addition to the main site two beach landing areas, bulk fuel storage tanks, construction camp, borrow source and an access road were constructed. The site was deactivated in 1963 and has remained this way since.

Plate 1 Aerial photo of the Beach area of the FOX-E DEW Line site, the POL tanks are in the centre of the photo.

Plate 2 View east of FOX-E DEW Line Site showing the module train, warehouse, garage, bulk fuel storage tanks and antenna.

2.2 Potential Impacts

The potential impacts to heritage resources around the FOX-E site on Durban Island are dependent upon the proximity of those resources to the remediation activities that will be conducted to remove the remnants of the former DEW Line site. Heritage resource sites are non-renewable resources that may be located at or near ground level or may be deeply buried. Prehistoric or precontact archaeological sites are those sites which contain features, artifacts or ecofacts reflecting the use of a given land base by people prior to European influences and technologies. Features are non-portable articles that indicate a human modification of the local environment such as hearths, pits, tent rings, stone cairns and Inuksuk. Artifacts are portable items that have been modified by people at some time in the past. These include such items as projectile points, stone flaking debris, and cut and modified bone. Ecofacts are naturally occurring items such as preserved plant remains or pollen that can aid in the interpretation of archaeological sites. Historic

archaeological sites include the features, artifacts and ecofacts relating to the past few hundred years of human occupation. These sites are typically identified by the presence of buildings or structural remains, but may include any site that has evidence of historic use of the landscape.

Alteration of the landscape can result in the damage or complete destruction of all or portions of historic resource sites. These alterations often involve the displacement of artifacts resulting in the loss of valuable contextual information or may involve the destruction of the artifacts and features themselves resulting in complete information loss. These losses are permanent and irreversible. Primary, secondary and tertiary impacts are possible with any new development. Remediation can be considered a new development in this context if it impacts previously undisturbed areas during operation.

Primary impacts include those disturbances resulting immediately from a project. The primary impact zone is the area within the remediation footprint including access roads, temporary work zones, borrow pits and dumps. Individual sites are likely to be affected to varying degrees if they are located within the development area. Artifact context is fundamental to interpretation of archaeological sites. By disturbing the context in which artifacts and features are recovered, interpretations of heritage resources sites and, ultimately, past lifeways are affected negatively.

Secondary impacts can occur when the support services or additional access required by development adversely affects heritage resources outside the primary target areas. The remediation project should have no secondary effect on heritage resources.

Tertiary impacts are the results of project induced changes in demography and land use patterns. Increased rates of intentional and unintentional impacts can be expected as a result of increased visitation to an area if the project were large enough to affect regional population bases. Tertiary impacts are anticipated to be very low for this project, especially because changes to the site through remediation will probably only negatively affect the visitation rates.

The study detailed in this report is intended to identify areas of possible impact and to determine whether the current proposed project will disturb those heritage resources located in proximity to the development.

2.3 Project Objectives

The objective of the 2010 study at the FOX-E Intermediate DEW Line site located on Durban Island is to ensure that heritage resources are not inadvertently impacted by the proposed clean-up and remediation project. The purpose of this AIA is to:

- conduct a pre-impact assessment of the proposed remediation areas;
- identify any archaeological sites within those areas (if present);
- make recommendations to CLEY, AECOM and PWGSC to mitigate or avoid those sites;
- make recommendations on surveillance and monitoring;
- provide a cost estimate on implementing the recommendations during the construction phase; and
- prepare a draft Final Report to be reviewed by AECOM and PWGSC, followed by a Final Report for distribution as required and submission to CLEY.

3. PHYSICAL AND CULTURAL SETTING

3.1 Environmental Context

An understanding of past environmental conditions and the environmental factors that shape human approaches to subsistence and settlement patterns enable archaeologists to not only locate sites, but also to provide more accurate interpretations of individual sites. The physical aspects of the environs (topography, drainage, climate and soils) as well as resource availability (flora, fauna, lithic materials and water) are prime criteria for the identification of site location and function. Assessments of the universal cultural activities of site location, travel within and through the area, and resource exploitation are key components of any archaeological site analysis.

The anthropological theory of environmental determinism suggests that, to a great extent, environmental factors condition human behavioural and cultural adaptations, or patterns of behaviour. The environment has likely influenced many of the activities that contribute to the character of the regional prehistoric record. All available environmental variables must be considered as indicators of prehistoric use of the landscape.

The regional environment influences where specific activities and occupation are located in a pattern of seasonal movements according to the availability of resources: a seasonal round. The variables of archaeological site distribution can be identified and combined into useful criteria for suggesting the potential of an environment to hold heritage resources that includes a wide variety of landforms frequently associated with coastlines and lake shores, river banks, eskers and kames, and bedrock knolls in Arctic environs. Distribution patterns partially reflect environmental opportunities presented to human groups as well as cultural preferences demonstrated by site location. Topography influences much human activity including travel, communication, resource catchments, dwelling locations and eventually constrains human activity areas to defined localities. Based on existing heritage resources, the environment is a key factor in human settlement patterns.

3.2 Regional Environment

Prior to contact with Europeans, the environment in which the people of North America lived strongly influenced their culture and economy. The people who inhabited the North took advantage of the seasons and all the resources that were available.

Baffin Island is part of the Canadian Shield, an old erosion surface of Precambrian rocks. Specifically, the northeast coast is mountainous and framed by numerous fjords, inlets, cliffs, eroded sandstone valleys and intricate alpine glaciers flowing to the sea (Collignon 2005). Hundreds of small islands surround the coast. The vegetation is diverse by sparse and dwarfed with sedges, saxifrage, dryas, Arctic willows, cottongrass, broad-leafed willows, herbs and Arctic poppies being the most common plants of the 350 species recorded on the island. Caribou, wolf, Arctic fox, lemming, Arctic hare, and polar bears are the most common land mammals on the island while sea mammals include walrus and several species of seals and whales are found in coastal waters.

The FOX-E site area is characterized by a beach landing areas that is at sea level with the actual DEW Line Site being located on a high volcanic plateau up to 650 m above sea level surrounded by steep cliffs. The beach landing is connected to the station by a road that was cut into a steep valley with several switch backs. During the study wildlife that was observed near the station area included a polar bear with two cubs, numerous seals and whales. Although the volcanic plateau area is sparsely vegetated wet areas near the beach landing are heavily vegetated with sedges, willows and many flowering plants, grasses and rushes.

3.3 Heritage Resources

Archaeology is the study of human history through the material remains of culture, now known as heritage resources. The ultimate goal in archaeology is to describe the cultures and events responsible for the creation and deposition of the remains at a given archaeological site. As such, archaeologists use material remains to determine the nature

and age of cultural occupations at a site. Artifacts, ecofacts and features deposited into the natural environment, along with their inter-relationships, are the integral parts that make up an archaeological site. The *Nunavut Archaeological and Palaeontological Sites Regulations* (2003) define heritage resources as: "but not limited to, archaeological and historical sites, burial grounds, palaeontological sites, historical buildings and cairns."

Predating the arrival of Europeans, precontact archaeological sites are comprised of artifacts, features and residues of native origin typically characterized by modified bone and stone, and stone structures. Historic sites are those structures, features, and objects of European influence that date back to contact with the Europeans but can also represent more recent activity of more than 50 years. Depending on the context, sites less than 50 years old may be considered to represent traditional land use and are identified to document continued use and occupation of an area to the present time. A key component of the historic period record are the sites, artifacts and affiliated resources relating to post-contact Aboriginal people's use of the landscape. These include both archaeological sites and objects such as standing and collapsed cabins, campsites, graves, and traditional sites and resources, such as special places, hunting and plant collecting areas, traplines and their associated remains, oral traditions and various documents. These latter resources are usually identified through consultation procedures such as Traditional Use Studies (TUS) or community consultations.

Additionally, heritage resources include, as well as the sites where events took place in the past, all of the objects that they contain and any of the contextual information that may be associated with them and will aid in their interpretation, including natural specimens and documents or verbal accounts.

Heritage resources are non-renewable and are susceptible to alteration, damage, and destruction by construction and development activities. The value of heritage resources cannot be measured in terms of individual artifacts or biological specimens, rather the value of these resources lies in the integrated information which is derived from the relationship of the individual artifacts and fossil specimens, associated features, spatial

relationships (distribution), and contextual situations. Interpretation of heritage resource materials, and the ability to interpret the significance of particular sites in a landscape, is based on an understanding of the nature of the relationship between individual archaeological and palaeontological materials as well as the sediments and strata within which they are contained. As such, removal or mixing of cultural or fossil bearing sediments results in the permanent loss of information basic to the understanding of these resources. As a result, heritage resources are increasingly susceptible to destruction and depletion through disturbance.

Similarly, tundra areas north of the tree line are characterized by extremely slow rates of soil development and sediment accumulation. Accordingly, at repeatedly occupied sites, there is little chance of distinguishing occupations relating to different periods within the 5,000-year record of human occupation in the region without recovering a diagnostic indicator. Some areas of high sediment deposition rates are present within the study area, but these are not the typical scenario.

The lack of temporally diagnostic artifacts, the absence of materials suitable for radiocarbon dating, and the natural mixing of shallow archaeological deposits serve to limit the definition of the recognized prehistory for the region. In contrast, extant documents, records, and oral testimony provide a firmer basis for understanding the historic period of the region.

3.3.1 Cultural Chronology

Many of the archaeological materials in the project area represent human activity after the ice sheet receded from Baffin Island about 5,000 years ago. Soon afterward the island was colonized by Paleo-Eskimos with Southwestern Baffin Island, Melville Peninsula, Southhampton Island and the north of Quebec being considered to be part of the core area of Pre-Dorset and Dorset Culture Development.

3.3.1.1 Arctic Small Tool Tradition (4200 B.P. to 2800 B.P.)

There is presently little evidence to link Palaeo-Arctic tradition occupations to the Arctic Small Tool tradition (ASTt) occupations that succeed them. The ASTt represents a widespread cultural manifestation that covers all of the Canadian Arctic as well as parts of Alaska and Greenland. The ASTt is typically thought to date between approximately 4,200 and 2,800 B.P. (McGhee 1990). It includes the Denbigh Flint complex in northern Alaska, the Independence I culture of the Canadian High Arctic, the Inuvik Phase and the Pre-Dorset culture in Arctic Canada, and the Sarqaq culture in Greenland. It is thought that the ASTt relates to a separate migration of peoples from Siberia and does not appear to be related to the preceding Palaeo-Arctic tradition. As the name implies, the toolkit of the ASTt is comprised of lithic artifacts that are finely made and smaller than tools of similar function and age from elsewhere in North America. These include microblades and microcores, burins, gravers, small side and end scrapers, side and end blades, and bipointed (arrow) and triangular (harpoon) projectile points (Wright 1995). In Alaska it appears to have developed into the cultures of the Norton tradition while in Canada it developed into the Dorset culture.

3.3.1.2 Dorset Culture (2,500 B.P. to 1,000 B.P.)

The Dorset culture occupied the Canadian Arctic from 2,500 B.P. until at least 1,000 B.P. (McGhee 1990). Best known for miniature carvings, Dorset appears to have been a more successful adaptation to the conditions of the north than the preceding ASTt cultures from which it developed. This is demonstrated by the huge area occupied by Dorset groups and by evidence that they had perfected winter hunting on the sea ice. Cooler conditions in the northern hemisphere around 3,000 years ago resulted in expansion of the sea ice and a shift away from terrestrial hunting of caribou and hunting of sea mammals from boats in open water to a procurement of sea mammals from coastal edges and sea ice. This is evidenced in the archaeological record with a shift away from bow hunting to harpoon and spear hunting (McGhee 1990). Artifacts recovered from sites representing this period are more diverse and “reflect a richer and more secure way of life

than that of earlier Palaeo-Eskimos." including the establishment of permanent winter villages (McGhee 1990).

However, when the people of the Thule culture arrived in the Canadian Arctic approximately 1,000 years ago, the Dorset culture had largely or entirely disappeared for reasons that are not well understood (McGhee 2001; Wright 1999).

3.3.1.3 Thule (1,000 B.P. to 400 B.P.)

The Thule tradition dates from approximately 1,000 to 400 B.P. and is derived from the Norton tradition in northern Alaska. More specifically, Thule grows out of the Old Bering Sea and Punuk traditions, which have numerous similarities to Thule cultural assemblages. These assemblages suggest subsistence based on maritime resources such as seals and whales that were hunted from kayaks or umiaks as identified by harpoon floats. Thule represented a new kind of adaptation to the Arctic environment, based on the hunting of large sea mammals in open water through the use of drag floats attached to the harpoon line. Large skin boats and the use of dogs to pull large sleds were other Thule innovations. Winters were spent in sometimes large communities of semi-subterranean houses, subsisting on a stored surplus obtained most typically by hunting bowhead whales. The introduction of Thule into the Canadian Arctic is noted by a distinct change in a number of cultural markers from the Dorset culture. The earliest Thule occupations currently recognized are on islands in the Bering Strait and exhibit an almost complete reliance on maritime resources; however, later sites demonstrate that both maritime and terrestrial resources were utilized (McGhee 1990). Climatic changes following the thirteenth century likely caused the Thule to modify their way of life into that of the various historic Inuit groups.

3.3.2 Historic Inhabitants

Historic use of the project area is identified with the 'Baffin Eskimo'. This group inhabited the southern two-thirds of Baffin Island and some of the nearby islands off its

shores (Kemp 1984:464). The remaining northern region of the Island is inhabited by the Iglulik (Kemp 1984:464). The island region that is inhabited by the Baffin Eskimo is characterized by freshwater systems located in the central interior and mountainous areas in the northeast and southwest (Kemp 1984:464). The region was first inhabited by the Pre-Dorset approximately 4,200 years ago, supported by archaeological sites identified at Lake Harbour, Frobisher Bay, and Pond Inlet (Desrosiers 2005:193). Prior to this inhabitation, a large ice sheet had covered the island until its melting 5,000 years ago (Desrosiers 2005:193). Dorset groups are identified in the archaeological record following this, between 2,500 and 600 years ago. The regions of southwestern Baffin Island, Melville Peninsula, Southampton Island, and northern Quebec are considered the central regions of Pre-Dorset and Dorset cultural development (Desrosiers 2005:193). Thule groups entered the area during the final 200 years of the Dorset occupation of the area. These two archaeologically distinct cultures coexisted in the region, but the character of this relationship is unclear. Much of the information known of the historic Thule, or Baffin Eskimo, is based on the ethnographic recordings of Franz Boas from the late 1800's. At this time, Boas recognized seven distinct regional populations within the Baffin Eskimo area (Kemp 1984:464). These populations were "linked together by [bilateral] kinship and the mutual use of hunting and territory, to form larger territorial and social groupings...bands" (Kemp 1984:464). Importantly, by the time of Boas' ethnography the Baffin Eskimo possessed many European goods, which influenced and altered the traditional life-ways of the local groups.

European contact with the Baffin Eskimo populations began in the 16th Century with the Frobisher Expedition (Kemp 1984:467), whose task it was to find the North West Passage (Desrosiers 2005:193). However, previously Baffin Bay had been explored by the Norse (Heinrichs 2005:191). During the 10th Century these Norseman built settlements on Greenland and perhaps Newfoundland but little evidence remains of where and how far they had actually travelled as these same settlements collapsed during the 13th Century. Baffin Bay was next explored and recorded by John Davis in 1587. European interaction gradually increased with the rise of European whale hunting; whaling stations began operating throughout the eastern arctic in the 1880's (Kemp

1984:466). Such whaling activities around Davis Strait originated in the 1700's, but it was not until the 1850's that all the inhabitants of the Cumberland Sound and Davis Strait regions were in contact with whalers (Kemp 1984:466). The whaling industry was eventually eclipsed by fur trapping in 1910 (Kemp 1984:474). Also at this time Anglican missionaries entered the region (Kemp 1984:474).

The Baffin Eskimo have historically utilized a vast array of subsistence resources, including marine, terrestrial, avian, and freshwater game; however, the wolf was sought but not utilized for subsistence (Kemp 1984:467). A vast array of tools was used for hunting, such as plugs to stop the bleeding of seals that made it easier for their transport. Bird nets were also constructed and used to ensnarl various avian species (Kemp 1984:468). Hunting weapons included breathing-hole harpoons that had compound elements, and single-curve bows (Kemp 1984:69). Metal, along with driftwood, antler, bone, and stone, were used in the construction of these implements. In addition, Baffin Eskimo technology allowed for water transportation via kayaks and umiaks, or women's boats (Kemp 1984:469); the form of the kayaks was not consistent throughout the Baffin Eskimo area. Dog sleds were used as well. These sleds were the dominant method of transportation until the 1960's when snowmobiles were introduced (Kemp 1984:469). With these forms of transportation, the Baffin Eskimo interacted with neighbouring groups such as those from northern Quebec (Kemp 1984:465). However, this interaction did not occur regularly.

Different subsistence resources were procured based on the season. For instance, seals (particularly ringed seal) were hunted along the floe-edge during the spring months, and caribou herds were hunted during the fall in the interior and coastal regions (sometimes with the aid of drives) (Kemp 1984:467-468). As this instance suggests, Baffin Eskimo mobility was seasonal and influenced by the location of what game they were pursuing. As a rule, Baffin Eskimo groups resided primarily in the coastal regions. It was the caribou that pulled groups into the interior, whereby three particular lakes were favoured as hunting locals: Nettling, Amadjuak, and Sylvia Grinnel Lakes (Kemp 1984:468). During these interior hunts, if excess caribou meat was produced, then it would be cached

at these interior locations and retrieved at times of food stress during the winter months (Kemp 1984:468). In addition to there being differences in subsistence procurement based on seasonality, there were also differences in dwellings. Winter dwellings were commonly snow houses, although occasionally early and abandoned Thule houses were reused through the addition of roofs (Kemp 1984:470). In contrast to the winter, skin tents were utilized during the warmer months. These tents varied in form and size depending on how far they were to be transported and their use (Kemp 1984:470). A further seasonal distinction is found in Baffin Eskimo clothing; only caribou skin was used for winter clothing, and seal skin was used in addition to caribou for summer clothes (Kemp 1984:470).

3.3.3 Heritage Studies

Prior to the current study of the FOX-E Intermediate DEW Line site on Durban Island, only one heritage resources site was recorded in the Nunavut or Canadian Museum of Civilization database for this location. The site, MgBs 2 was recorded as the location of both a whaling station and the FOX-E DEW Line site. MgBs 2 is reported in more detail below. There have also been four sites recorded in the surrounding area that were not revisited during the present study.

MgBs 1 is located directly south of MgBs 2 on Cumberland Point, southwestern Baffin Island. MgBs 1 is described as a historic British campsite consisting of 4 qarmats, numerous tent rings, caches, and a marker. A boulder at this site had the following inscribed upon its surface: “67"1' N / 62"20" W / TR J.G. PHD / July 17, 1837”. The carving may have been used for future sailors to check their navigation instruments. The “TR J.G. PHD” is thought to relate to the crew of the Joseph Green (J.G.) out of Peterhead (PHD), Scotland, captained by J. Volum. An alternate explanation is that the inscription was made by the crew of the "Traveller" (TR), also a member of the Peterhead whaling fleet in that year.

Four islands, situated in close proximity to Durban Island hold four further previously archaeological sites. These islands are called: Qaqaluit Island, Paugnang Island, Block Island, and Padloping Island. The MhBt 1 was also known as the Cape Searle site, located on the north shore of Qaqaluit Island. The site was recorded by D. Clark in 1964 as a stone cairn with undetermined temporal and cultural associations. The second site, MgBt 2, was a prehistoric site located on a rocky ledge along the south shore of Paugnang Island. George Sabo in 1975 recorded this (and MgBt 1) site while conducting the Thule Archaeology Conservation Project. There were a total of three structures identified, two of which were looted. The other structure was eroding but did not evidence looting. These three structures were associated with the late Thule. The third site, MgBt 1, was located on the south shore of Block Island. The site was identified as 4 closely placed villages. The first was an Inuit village comprised of numerous wood platformed qarmats. The second, a Thule village, was also comprised of qarmats (n=2) but were made of stone and one had a stone cairn built within. The third village, associated with the Thule, had 3 stone houses. One of these structures had a recent cache placed within it and two burial cairns placed behind the structure's back walls. Nearby to this structure were 2 kayak rests, a number of tent rings, and additional caches. Approximately 105 M. to the north of these three villages was the forth and final grouping of structures. These structures (n=3) were associated with the Thule. Finally, MhBt 2 is a previously recorded site located on Padloping Island and was identified by D. Clark in 1964 as a cairn of undetermined age.

4. METHODOLOGY

4.1 Field Inventory and Assessment

All field work was conducted under a valid Class II Archaeological Permit issued by CLEY. The field program focused on assessment of all areas of high and moderate archaeological potential within the disturbed DEW Line site, and the proposed borrow source and landfill locations. The purpose of the field investigation was to identify archaeological materials, document location and content and provide data to be used in the development of recommendations for future remediation programs. Inventory and assessment techniques followed established practices and consisted of the following:

- visual examination of the identified areas to determine the presence of such surficial features such as standing or collapsed buildings, dumps, cache pits, cabin foundations, etc. and exposed precontact cultural materials such as stone tool making debris and tools;
- visual examination of the identified areas to determine the presence of items of historical military interest;
- excavation of shovel tests (ca. 40 x 40 cm) to varying depths to determine the potential for subsurface precontact cultural remains if deposition is present;
- visual examination of bedrock exposures (if any) or gravels for precontact quarrying activity;
- excavation of either additional shovel tests or 1 x 1 m units for the purpose of identifying the distribution, density, and nature of cultural remains associated with sites identified through inventory procedures;
- documentation of the location (GPS coordinates), nature, size, and complexity of each identified site; and
- documentation of individual site features to record content, context, potential identity, and to provide information required to develop a mitigation program.

These results, along with updates and recommendations will be included in written submissions to CLEY as required by the Permit to conduct the AIA, and discussed with the Chief Archaeologist of Nunavut.

4.2 Heritage Feature / Structure Evaluation

Evaluations of heritage features and standing structures were to be completed for features/structures that are observed during the investigations. These evaluations would consider perceived heritage resource value and community cultural value as well as the predicted impact from the proposed program. In general, disturbed sites with limited cultural remains would be assigned lower archaeological resource values than undisturbed sites, large sites with large amounts of cultural material, complex sites, and multicomponent sites. Undisturbed multicomponent sites would generally be assigned the highest heritage resource value.

Community input will play a role in the evaluation of site value, and the inclusion of members of the local community on the field crew aided in the in-field discussions regarding site significance.

4.3 Detailed Archaeological Site Investigations / Mitigation

If required, mitigation of significant heritage resources sites may include a number of different options. Prior to evaluation of these mitigative options, the perceived value of the identified archaeological sites will be discussed with the AECOM Project team to determine the feasibility of avoiding important sites. Only if site avoidance is not possible, will other mitigative measures such as collection and documentation, and controlled mapping/excavation be considered. In areas of no sediment deposition surface collection and mapping of artifacts and features may satisfy regulatory requirements for mitigation. Recommendations for excavation may include a controlled excavation mitigative plan and will specify the number of square metres and suggest locations for excavation units/blocks.

Overall mitigative options may be summarized by:

- collection and documentation undertaken at the time of the field assessment at all sites with low archaeological resource value;
- avoidance if feasible at all sites assigned high archaeological resource value;
- mitigative excavations which will be recommended at those sites assigned high archaeological resource value that could not be avoided by borrow source relocation; and
- a management plan for required mitigation relative to the proposed construction schedule will be discussed with the site project team.

4.4 Reporting

Analysis of collected artifacts includes cleaning, cataloguing, identification, inventory, and description of each individual piece for inclusion in the final report. GPS site information is provided for mapping relative to the former site structures at the site and to CLEY, but not included in the final versions of this report. Archaeological site maps, photographs, and artifact scans are prepared as digital files.

5. RESULTS

Upon completion of the field component and the artifact curation, a draft report was prepared. This final permit report on the archaeological studies will be forwarded to AECOM for review, and then submitted to CLEY for review. This report includes a project description, the environmental setting, the historical and archaeological context for the project area, field methodology, and the results of the field reconnaissance. The report includes descriptive data on the sites, artifacts, and features identified, as well as detailed information on the nature, content, and significance of the artifacts and features identified. Cultural material that was recovered was inventoried, described, and discussed within the report text to aid in evaluation of scientific and interpretive value. All identified sites have been documented on appropriate site inventory forms.

If required, a summary of the findings will be prepared for inclusion in a screening document.

The following workplan was followed:

- avoidance has been recommended where feasible at all sites assigned high archaeological resource value (this to include all constructed features: burials, tent rings, caches, hunting blinds, hearths);
- collection and documentation has been undertaken as a mitigative option of sites with low archaeological resource value and as a method of protecting the heritage resource from future undocumented impacts due to increased personnel activity in the vicinity; and
- acceptable methods of mitigation were discussed with CLEY and the Territorial Archaeologist, and may lead to a recommendation for detailed mapping, collection and/or test excavations at those sites assigned high archaeological resource value that cannot be avoided by reclamation project.

A management plan for required mitigation, monitoring or surveillance relative to the proposed remediation will be developed as part of the contracted services deliverable to PWGSC. This includes site mitigation, additional survey of any project re-locates required due to site avoidance, and verification of those heritage sites located outside the proposed development activity area that should remain outside re-located areas.

A search of the Canadian Museum of Civilization database identified only one previously recorded site on Durban Island. That site, MgBs 2, is a 19th century whaling station and the FOX-E DEW Line Site. Therefore the current study included the revisit of MgBs 2.

5.1 Community Consultation

Consultation regarding the FOX-E Intermediate DEW Line site Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation, Remedial Action Plan is ongoing.

5.2 Field Results

The AIA assessment included all of the areas of moderate to high archaeological potential that has been disturbed by the FOX-E DEW Line site as well as areas identified as having potential for future borrow sources or dumps. The disturbed areas that were surveyed included the Station Area (Plate 2), access road, beach landing area (Plate 1), barrel dumps, landfills (Plate 3 and 4) and all the existing roads and anywhere there was evidence of a bull dozer push or any other disturbance. Previously undisturbed areas that were examined included the periphery of all the impacted areas as well as several areas that were identified as potential borrow areas and landfills for remediation activities (Plates 5).

During the survey the previously recorded site MgBs 2 was revisited and one new site, MgBs 4 was identified and recorded. The sites include the FOX-E Intermediate DEW line station and reported whaling station and a stone tent ring site, MgBs 4, which are described in more detail below. In addition to the heritage sites, a land use site consisting

of the remains of 11 Inuit houses were observed. Although the structures have been removed from the beach, material culture left behind indicates that at least eleven Inuit houses were present on the beach approximately 500 m west of the Secondary beach landing area (Plate 6 and 7). Material culture observed includes domestic artifacts such as children's toys (Plate 8), flat glass, piece of clothing, ceramic and plastic plate fragments, bed frame, container glass, seal and bird bone as well as electrical wire, metal stove (Plate 9), metal strapping, remains of a mop, electrical switches and other unidentified artifacts related to the DEW Line site (Plate 10). There were additional house remains to the east that were not recorded as they were outside of the study area.

Plate 3 View southeast of Dump A, material was pushed off the side of the cliff.

Plate 4 View northeast of B with fuel barrels and construction equipment.

Plate 5 View east of road going down to the beach area and possible borrow source on top of the hill.

Plate 6 View south of house remains made up of dimensional lumber and plywood.

Plate 7 View north of house remains with bed frame, food cans and dimensional lumber.

Plate 8 Photo of home made toy cat or bulldozer that was among the house remains.

Plate 9 Photo of iron stove that was among the house remains.

Plate 10 Vehicle instrument panel that was found among house remains.

5.3 Revisited Heritage Resource Site

5.3.1 MgBs 2

MgBs 2 was originally recorded by Philips (1980) for the Historical Archaeological Survey Auyuittuq National Park and Vicinity as the location of a whaling station as well as the FOX-E DEW Line Site. Although the site was not visited, historic records indicated that there were three whaling companies that established at this site: the Robert Kinnes Co. (1910-14), The Arctic Gold Exploration Syndicate (1914-16) and the Sabellum Trading Company (1924-27) (CMC 2010). During the current study there were no signs of a whaling station within the project footprint. However, due to the amount of disturbance involved in the terra forming of the beach landing area, construction of the POL tank platform, construction camp and access road to the DEW Line site any remains of a whaling stations could have been easily destroyed and/or buried (Plate 1 and Plate 11).

The FOX-E DEW Line is made up of the beach landing area and station area on top of a high plateau that are connected by a road that was ploughed into the steep banks of a valley (Plate 12; Figure 2). The beach area consists of two beach landing areas, POL tanks, the remains of the construction camp (Plate 13), three dumps, a barrel cache (Plate 14), the wooden floor of a building and numerous smaller dump location, roads and gravel borrow areas.

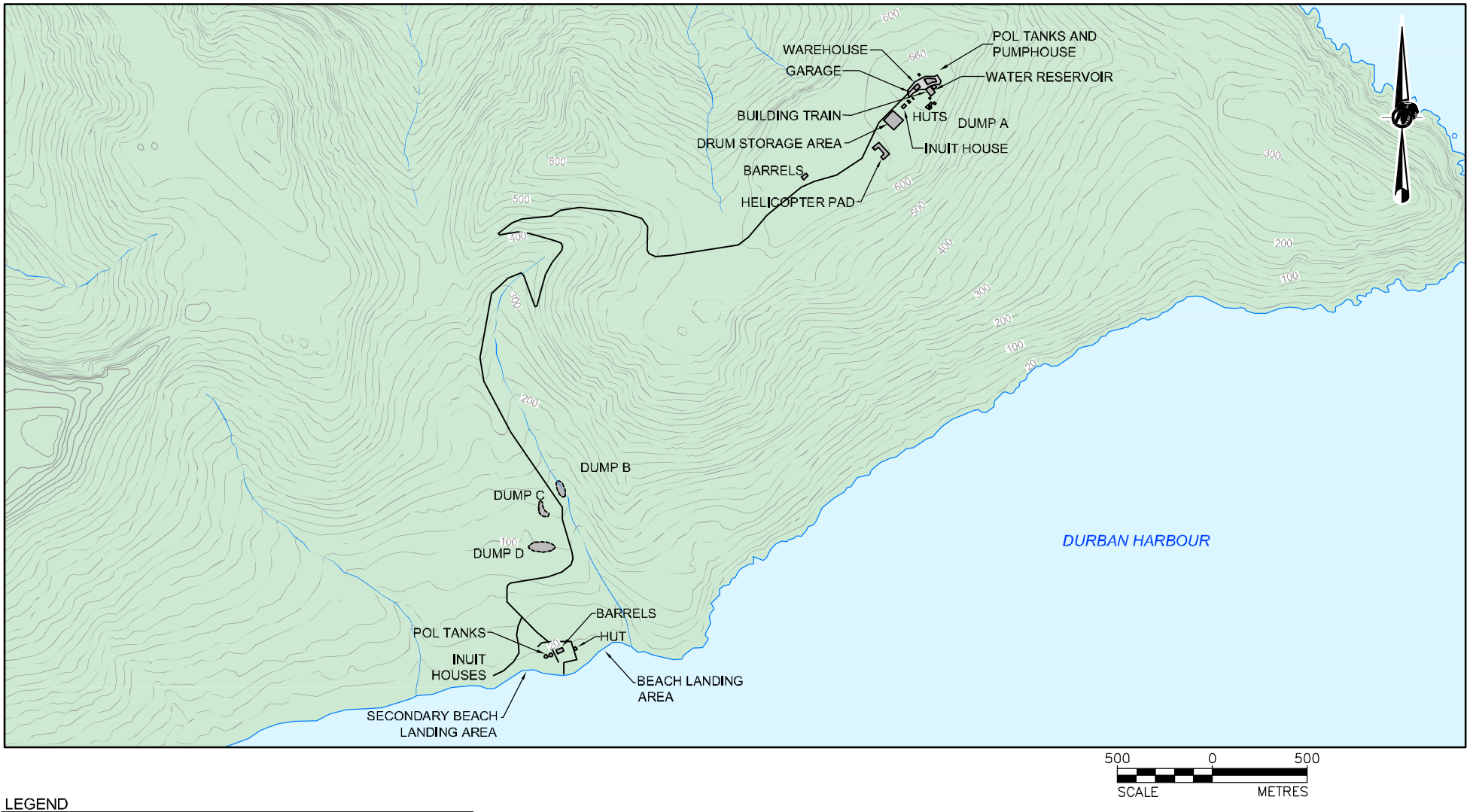
The station consists of a garage, warehouse, Module train, antennae (Plate 15), bulk water storage, POL tanks, remains of what is believed to be the Inuit house (Plate 16), the remains of three Quonset huts (Plate 17), helicopter landing pad a main dump, barrel dump and several smaller dump areas. With the exception of the Inuit house, which has burned down and the Quonset huts all of the buildings are standing and in relatively good shape.

Plate 11 View south of Beach Landing Area showing POL tanks, barrel dumps and disturbance area.

Plate 12 View south of road from the FOX-E site to the Beach Landing area.

Plate 13 View south construction camp area, the foundation of the camp can be seen in the right side of the photo.

L:\2010\1333\10-1333-0023\8470\Report A\Fig 2 10133300238470A002 Site Plan.dwg Nov 23, 2010 - 11:37am



500 0 500
SCALE METRES

LEGEND

- CONTOUR (METRES)
- ROAD
- WATERCOURSE
- WATERBODY

REFERENCE

ALBERTA NTDB DIGITAL DATA OBTAINED FROM GEOMATICS CANADA, AUGUST 2001. MAPSHEET 16M01 DATUM: NAD83 PROJECTION: UTM ZONE 20

PROJECT

FOX-E DEW LINE SITE DURBAN ISLAND

TITLE

SITE LOCATION MAP

Golder Associates
Calgary, Alberta

PROJECT 10.1333.0023.8470			FILE No. 10133300238470A003	
DESIGN	BM	15/10/10	SCALE AS SHOWN	REV. 0
CADD	KJM	19/10/10		
CHECK	BM	19/10/10		
REVIEW	DB	19/10/10		

FIGURE: 2

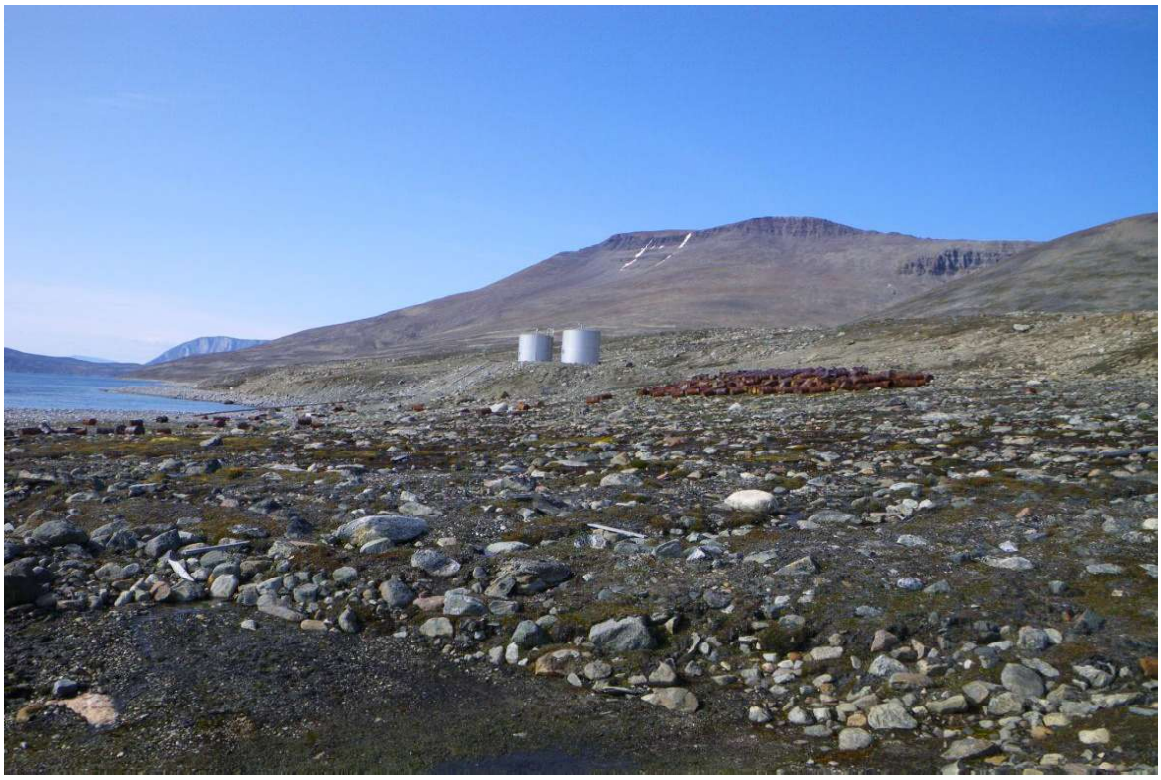


Plate 14 View west of barrel cache with POL tanks in the background.

Plate 15 View northeast of the base of the antennae, module train and POL tanks in the background.

Plate 16 View north east of Inuit House remains with garage and warehouse in the background.

Plate 17 View northeast of the remains of two of the three Quonset huts.

MgBs 2 was originally recorded as the location of both a 20th Century whaling station as well as the FOX-E Intermediate DEW Line. During the current study there were no signs of a whaling station within the project footprint. It is thought that either the station location is wrong or that the remains of the whaling station may have been disturbed by the construction of the FOX-E DEW Line Site. Johnny Kooneeliusie suggested that the location of the whaling station was across Hudson Strait from Durban Island on Baffin Island and that his grandfather had worked as a whaler at that location.

All the remains of the FOX-E Intermediate DEW Line Site will be removed during the planned remediation by PWGSC. No further work is recommended as the recording of the site is thought to be sufficient mitigation.

5.4 Newly Identified Heritage Resource Site

5.4.1 MgBs 4

MgBs 4 is a stone feature site that is made up of two stone circles on beach ridge overlooking the beach landing area and POL tanks associated with the FOX-E DEW Line site. Feature 1 is made up of more than 80 stones in a 5.5 m diameter that are partially buried (Plate 18). There also appears to be a stone centre feature dividing the stone feature in half. Feature 2 is made up of more than 27 stones in a 5 m diameter and is somewhat dispersed (Plate 19). The site is thought to predate the FOX-E DEW Line site due to the lack of cultural material found. A single hand wrought iron spike was recorded amongst the stones in Feature 1 (Plate 20). The origin of the features is unknown as it may represent European use if this area as a whaling station in the early 20th Century or may represent Inuit occupation that predated the FOX-E DEW Line site. MgBs 4 is thought to be of moderate to high significance and it is recommended that any impacts to the site be avoided. At this time there area no plans to disturb MgBs 2 during the remediation of the FOX-E DEW Line site.

Plate 18 View southwest Feature 1, MgBs 4 with POL tanks in the background.

Plate 19 View southwest Feature 2, MgBs 4 with POL tanks in the background.

Plate 20 Detail of hand wrought iron spike associated with Feature 2, MgBs 4.

6. SUMMARY AND RECOMMENDATIONS

The AIA of the FOX-E Intermediate DEW Line site conducted under Nunavut Permit 2010-017A produced the results discussed in Section 5 and outlined in Table 1. The disturbed nature of the site and lack of vegetation and sedimentation enabled a high visibility surface examination of the facility areas to adequately assess for the presence of cultural materials. As requested, areas which will not be impacted during remediation were not fully examined. During the study one previously recorded site, MgBs 2, was revisited and one new site, MgBs 4 was identified and recorded as per the *Guidelines for Applicants and Holders of Nunavut Territory Archaeology and Palaeontology Permits* (CLEY 2003).

Table 1 Heritage Site Recommendations

Site	Type	Significance	Recommendations
MgBs 2	DEW Line Site	Limited	No further work is recommended
MgBs 4	Stone Feature	Moderate	Avoidance is recommended

PWGSC has fulfilled the requirements to indentify the potential for impact to heritage resources during the proposed remediation/reclamation of the FOX-E DEW Line site on Durban Island. The AIA of the FOX-E Site included the participation of Losie Audiakiak and Johnny Kooneeliusie from the local community of Qikiqtarjuaq, who acted as bear monitors and participated in the identification and recording of the heritage resource sites.

The AIA included revisiting the previously recorded DEW Line site, MgBs 2, and the identification of one new heritage resource site, MgBs 4. The FOX-E Dew Line Site, MgBs 2, is considered to be of limited significance given the amount of information that is currently known about the site. MgBs 4 is a stone feature site that is considered to be of moderate significance and it is recommended that this site be avoided during remediation activities.

7. CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

GOLDER ASSOCIATES LTD.

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Report reviewed by:

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8. REFERENCES

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APPENDIX I

PHOTOGRAPH LOG

FOX-E AIA Photo Log

Number	Borden Number (if applicable)	Comment
10-017Aphoto1		View south of bottom of site - west of the POL tanks - from the air
10-017Aphoto2		View south of bottom of site with the POL tanks - from the air
10-017Aphoto3		View south of bottom of site with the POL tanks - from the air
10-017Aphoto4		View east from eastern edge of landform
10-017Aphoto5		View northeast of the North dump
10-017Aphoto6		Detail of the north dump
10-017Aphoto7		View northeast from north dump
10-017Aphoto8		View east from eastern edge of landform
10-017Aphoto9		View down from the top of the north dump
10-017Aphoto10		Detail of the north dump
10-017Aphoto11		View west from the northern edge of landform
10-017Aphoto12		View west from the northern edge of landform
10-017Aphoto13		View west of garage and warehouse
10-017Aphoto14		View north of POL tanks
10-017Aphoto15		View west of module train
10-017Aphoto16		View north of module train and POL tanks
10-017Aphoto17		View east of the base of the tower
10-017Aphoto18		View northeast of the fallen tower
10-017Aphoto19		View northeast of fallen tower and module train
10-017Aphoto20		View northwest of tower
10-017Aphoto21		View northwest of tower, garage and warehouse
10-017Aphoto22		View northwest of tower
10-017Aphoto23		Photo of billboard on the top of the tower
10-017Aphoto24		View northeast of Quonset hut
10-017Aphoto25		View east of Quonset
10-017Aphoto26		View north of Quonset
10-017Aphoto27		View west of Quonset with module train in the background
10-017Aphoto28		View north of Quonset
10-017Aphoto29		View east of Quonset
10-017Aphoto30		View north of module train, water storage and POL tanks
10-017Aphoto31		Detail of the base of the tower
10-017Aphoto32		View west from metal dump
10-017Aphoto33		View west from metal dump
10-017Aphoto34		view southwest of debris along edge of landform
10-017Aphoto35		Barrel and can dump on the west side of landform
10-017Aphoto36		View north along edge of landform
10-017Aphoto37		Sleigh with brunt metal cans of something
10-017Aphoto38		Detail of cans
10-017Aphoto39		View west from western edge of landform
10-017Aphoto40		View north of large cairn on the southwest edge of landform
10-017Aphoto41		View north of large cairn on the southwest edge of landform

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-017Aphoto42		View north of FOX-E from cairn
10-017Aphoto43		View west of cairn
10-017Aphoto44		Barrel dump south of site along road
10-017Aphoto45		View northeast from site
10-017Aphoto46		View northeast from site
10-017Aphoto47		View northwest from site
10-017Aphoto48		View north of station
10-017Aphoto49		View south down the valley to the bottom site
10-017Aphoto50		View southeast of the road where it starts to descend
10-017Aphoto51		View north of landform that the station is on from potential borrow source
10-017Aphoto52		View west from potential borrow source
10-017Aphoto53		Inuit house at the station that has burned down
10-017Aphoto54		Inuit house at the station that has burned down
10-017Aphoto55		Inuit house at the station that has burned down
10-017Aphoto56		Inuit house at the station that has burned down
10-017Aphoto57		View north of tower
10-017Aphoto58		Photo of potential dump
10-017Aphoto59		View northeast of barrel storage area
10-017Aphoto60		View north of station from barrel storage area
10-017Aphoto61		Photo of dump south of helicopter landing pad
10-017Aphoto62		Snowshoe north of helicopter landing pad
10-017Aphoto63		Snowshoe north of helicopter landing pad
10-017Aphoto64		Inside the module train
10-017Aphoto65		Inside the module train
10-017Aphoto66		Inside the module train
10-017Aphoto67		Inside the module train
10-017Aphoto68		View southeast of the module train
10-017Aphoto69		Photo of the water storage tank for the base
10-017Aphoto70		View west across valley along road to the bottom of site
10-017Aphoto71		View southwest across valley along road
10-017Aphoto72		View southwest across valley along road
10-017Aphoto73		View southwest across valley along road
10-017Aphoto74		View south down valley from road
10-017Aphoto75		View south of drainage and MgBs-2 from the air
10-017Aphoto76	MgBs-2	View north of Feature 1, MgBs-2
10-017Aphoto77	MgBs-2	View north of Feature 1, MgBs-2
10-017Aphoto78	MgBs-2	View southeast of Feature 1, MgBs-2
10-017Aphoto79	MgBs-2	Detail of mop head
10-017Aphoto80	MgBs-2	Misc electrical panel
10-017Aphoto81	MgBs-2	View south of Feature 2, MgBs-2

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-017Aphoto82	MgBs-2	View southwest of Feature 2, MgBs-2
10-017Aphoto83	MgBs-2	Children's sled
10-017Aphoto84	MgBs-2	Children's sled with scale
10-017Aphoto85	MgBs-2	Photo of sled
10-017Aphoto86	MgBs-2	View south of Feature 3, MgBs-2
10-017Aphoto87	MgBs-2	View north of Feature 3, MgBs-2
10-017Aphoto88	MgBs-2	View northeast of Feature 4, MgBs-2
10-017Aphoto89	MgBs-2	View northeast of Feature 4, MgBs-2
10-017Aphoto90	MgBs-2	View northeast of Feature 5, MgBs-2
10-017Aphoto91	MgBs-2	Detail of cut bone
10-017Aphoto92	MgBs-2	Detail of army heater
10-017Aphoto93	MgBs-2	Shipping crate from California
10-017Aphoto94	MgBs-2	Toy tractor
10-017Aphoto95	MgBs-2	Toy tractor
10-017Aphoto96	MgBs-2	Toy tractor
10-017Aphoto97	MgBs-2	Toy tractor
10-017Aphoto98	MgBs-2	View north of Feature 1, MgBs-2
10-017Aphoto99	MgBs-2	View east of Feature 1, MgBs-2
10-017Aphoto100	MgBs-2	View south of Feature 1, MgBs-2
10-017Aphoto101	MgBs-2	View south of Feature 2, MgBs-2
10-017Aphoto102	MgBs-2	View south of Feature 6, MgBs-2
10-017Aphoto103	MgBs-2	View west of Feature 6, MgBs-2
10-017Aphoto104	MgBs-2	View south of Feature 7, MgBs-2
10-017Aphoto105	MgBs-2	View northwest of Feature 7, MgBs-2
10-017Aphoto106	MgBs-2	View southeast of Feature 7, MgBs-2
10-017Aphoto107	MgBs-2	View north of Feature 8, MgBs-2
10-017Aphoto108	MgBs-2	View east of Feature 8, MgBs-2
10-017Aphoto109	MgBs-2	View south of Feature 8, MgBs-2
10-017Aphoto110	MgBs-2	Detail of wood debris
10-017Aphoto111	MgBs-2	View south of Feature 9, MgBs-2
10-017Aphoto112	MgBs-2	View north of Feature 9, MgBs-2
10-017Aphoto113	MgBs-2	View east of Feature 10, MgBs-2
10-017Aphoto114	MgBs-2	View east of Feature 10, MgBs-2
10-017Aphoto115	MgBs-2	View north of Feature 11, MgBs-2
10-017Aphoto116	MgBs-2	View southwest of Feature 11, MgBs-2
10-017Aphoto117	MgBs-2	View south of Feature 11, MgBs-2
10-017Aphoto118		Detail of radio
10-017Aphoto119		View north of the plowed road with switchbacks in the background
10-017Aphoto120		View north of the plowed road with switchbacks in the background
10-017Aphoto121		View north of the plowed road with switchbacks in the background
10-017Aphoto122		View east of POL tanks

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-017Aphoto123		View east of POL tanks
10-017Aphoto124		View southeast of pipe from POL tanks
10-017Aphoto125		View west of POL tanks and barrels on the beach
10-017Aphoto126		View west of POL tanks and barrels on the beach
10-017Aphoto127		View north of hut on the beach
10-017Aphoto128		View west of hut on the beach
10-017Aphoto129		Survey monument marked by a cairn
10-017Aphoto130	MgBs-4	View northeast of stone ring, Feature 1, MgBs-4
10-017Aphoto131	MgBs-4	View east of Feature 1, MgBs-4
10-017Aphoto132	MgBs-4	View southwest of Feature 1, MgBs-4
10-017Aphoto133	MgBs-4	Detail of cloth that has blown in
10-017Aphoto134	MgBs-4	View southwest of Feature 2, MgBs-4
10-017Aphoto135	MgBs-4	View north of Feature 2, MgBs-4
10-017Aphoto136	MgBs-4	View east of Feature 2,MgBs-4
10-017Aphoto137	MgBs-4	View southeast of Feature 2, MgBs-4
10-017Aphoto138	MgBs-4	Detail of iron spike among ring rocks in Feature 2, MgBs-4
10-017Aphoto139	MgBs-4	Detail of iron spike among ring rocks in Feature 2, MgBs-4
10-017Aphoto140	MgBs-4	View east off Feature 2, MgBs-4 showing centre feature
10-017Aphoto141		View south of modern cairn - survey?
10-017Aphoto142		View southwest of modern cairn
10-017Aphoto143		View southeast of cat train sleigh
10-017Aphoto144		View north of road showing huge plowed area
10-017Aphoto145		View south of lower site area showing, disturbed areas, washed out barrel culvert and POL tanks
10-017Aphoto146		View south of lower site area showing, disturbed areas, washed out barrel culvert and POL tanks
10-017Aphoto147		View south of lower site area showing, disturbed areas, washed out barrel culvert and POL tanks
10-017Aphoto148		Photo of washed out culverts along road
10-017Aphoto149		View east of barrel dump
10-017Aphoto150		View southeast of another barrel dump
10-017Aphoto151		View south of road at a turn showing the amount of disturbance
10-017Aphoto152		View east of water reservoir
10-017Aphoto153		View northwest of water reservoir
10-017Aphoto154		Detail of water reservoir
10-017Aphoto155		View west of barrel dump
10-017Aphoto156		View north of barrel dump
10-017Aphoto157		View northeast of heavy equipment and barrels
10-017Aphoto158		View northeast of heavy equipment and barrels
10-017Aphoto159		View south of construction camp location
10-017Aphoto160		View northeast of construction camp
10-017Aphoto161		View southeast of camp and surrounding are showing debris

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-017Aphoto162		View southeast of camp and surrounding are showing debris
10-017Aphoto163		View south of borrow area with bear monitor
10-017Aphoto164		View north of road from borrow area
10-017Aphoto165		View south of road and borrow area with bear monitor
10-017Aphoto166		View south of road and borrow area with bear monitor
10-017Aphoto167		View south of road and borrow area with bear monitor
10-017Aphoto168		View north of road with switch backs in the background
10-017Aphoto169		View north of road with switch backs in the background
10-017Aphoto170		View south of road
10-017Aphoto171		View south of road
10-017Aphoto172		View south of road

FINAL REPORT

ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF THE FORMER USAF PADLOPING ISLAND WEATHER STATION, PADLOPING, NUNAVUT

Submitted to:

The Department of Culture, Language, Elders and Youth (CLEY), Nunavut
Nunavut Permit No. 2010-016A

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November 2010 **10-1333-0025**

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EXECUTIVE SUMMARY

During August of 2010, Golder Associates Ltd. conducted an Archaeological Impact Assessment (AIA) of the former United States Air Force (USAF) Padloping Island Weather Station on Padloping Island, Nunavut on behalf of AECOM working for Public Works and Government Services Canada (PWGSC) and Indian and Northern Affairs Canada (INAC). This AIA was carried out in conjunction with the Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation and Remedial Action Plan. All required fieldwork was completed under an Archaeological Permit (2010-016A) issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut to Brent Murphy of Golder.

The former USAF Padloping Island Weather Station is located on Padloping Island, approximately 80 km southeast of Qikiqtarjuaq, Nunavut. Low-level aerial reconnaissance of the site area was conducted in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential. The site area is characterized by natural springs and is poorly drained. During the study three heritage resource sites were newly recorded including the weather station, Inuit settlement and cemetery were identified and documented as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003).

PWGSC has fulfilled the requirements to identify the potential for impact to heritage resources during the proposed remediation/reclamation of the former USAF Padloping Island Weather Station on Padloping Island. The AIA included the participation of Losie Audiakiak and Johnny Kooneeliusie from the local community of Qikiqtarjuaq, who acted as bear monitors and participated in the identification and recording of heritage resource sites.

During the investigation a former weather station, an Inuit settlement and cemetery were recorded as heritage resource sites and assigned Borden site numbers: MgBu 5, MgBu 6 and MgBu 7. It is recommended that PWGSC and INAC have met their obligations to assess the potential for impact to heritage resources during the proposed Remedial Action Plan. It is also recommended that the newly identified site MgBu 7 be avoided during reclamation activities, none of the structures from MgBu 6 be removed during

remediation, and that any material that is removed from MgBu 5 such as fuel barrels, metal debris, and wood debris, be hand picked. Further, that none of the recorded features associated with MgBu 5 be disturbed by borrow sources, landfills or heavy vehicle traffic.

It is also recommended that any information on the sites be recorded during public consultation and used to assess the potential for impact during the development of the Remedial Action Plan of the USAF Padloping Weather Station.

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Appendix I Photograph Log

1. INTRODUCTION

During August of 2010, Golder Associates Ltd. (Golder) conducted an Archaeological Impact Assessment (AIA) of the former United States Air Force Padloping Island Weather Station, Padloping Island in conjunction with the Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation, Remedial Action Plan on behalf of AECOM and Public Works and Government Services Canada (PWGSC). All required fieldwork was completed under an Archaeological Permit (2010-016A) issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut to Brent Murphy of Golder.

Low-level aerial reconnaissance of the site area was initially flown in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential. The AIA was intended to identify any artifacts or heritage resource areas that might be impacted by a remediation program and, as such, only those areas of previous and potential disturbance were assessed. The intent of this program was not to conduct a full AIA of the entire Padloping Island. However, during traverses of the former weather station some lands outside of proposed impacts were surveyed (Figure 1).

As requested, areas that will not be impacted during remediation were not fully examined. As a result of the survey three new heritage resources sites, MgBu 5, MgBu 6, and MgBu 7 were recorded by the author during the program, which were documented as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003).

INSET MAP NOT TO SC

Cape Searle

BI-16/16M

Qaqaluit Island

HANTS BAY

7450000 N

THE BOUNDED AREA ARE
TLEMENT PARCEL.

ÉES À L'INTÉRIEUR DE LA
PARTIE DE LA PARCELLE
NE ENTENTE.

BI-15/16M

PADLOPING ISLAND

500

814

7440000 N

BI-13/16L, M

Paugnang Island

200

Padloping Island (site)

Delight Anchorage

BI-12/16L, M

200

2. LOCATION, POTENTIAL IMPACTS, AND OBJECTIVES

2.1 Location

The former USAF Padloping Island Weather Station, codenamed Crystal III is located on Padloping Island 80 km southwest of Qikiqtarjuaq, Nunavut. Padloping Island is off the northeast coast of Baffin Island on the Hudson Strait. The abandoned weather station was built and operated by the United States Air Force from 1943 until the end of the Second World War when it was taken over by the Canadian Department of Transport who operated the station until 1956. The abandoned weather station is located on a coastal plain approximately 400 m from the bay bordered by a steep cliff, two shallow lakes to the west and undulating hills to the east. (Plates 1 and 2) The site includes the remains of several buildings and large amount of debris including fuel barrels and abandoned vehicles.

Plate 1 Aerial photo of the Project area, view southwest showing building remains.

Plate 2 Aerial photo of the beach landing area with main site in the background. Barrel dumps can be seen on shore and a sunken barge is seen off the beach.

2.2 Potential Impacts

The potential impacts to heritage resources around the former weather station on Padloping Island are dependent upon the proximity of those resources to the remediation activities that will be conducted to remove the remnants of the former weather station. Heritage resource sites are non-renewable resources that may be located at or near ground level or may be deeply buried. Prehistoric or precontact archaeological sites are those sites which contain features, artifacts or ecofacts reflecting the use of a given land base by people prior to European influences and technologies. Features are non-portable articles that indicate a human modification of the local environment such as hearths, pits, tent rings, stone cairns and Inuksuk. Artifacts are portable items that have been modified

by people at some time in the past. These include such items as projectile points, stone flaking debris, and cut and modified bone. Ecofacts are naturally occurring items such as preserved plant remains or pollen that can aid in the interpretation of archaeological sites. Historic archaeological sites include the features, artifacts and ecofacts relating to the past few hundred years of human occupation. These sites are typically identified by the presence of buildings or structural remains, but may include any site that has evidence of historic use of the landscape.

Alteration of the landscape can result in the damage or complete destruction of all or portions of historic resource sites. These alterations often involve the displacement of artifacts resulting in the loss of valuable contextual information or may involve the destruction of the artifacts and features themselves resulting in complete information loss. These losses are permanent and irreversible. Primary, secondary and tertiary impacts are possible with any new development. Remediation can be considered a new development in this context if it impacts previously undisturbed areas during operation.

Primary impacts include those disturbances resulting immediately from a project. The primary impact zone is the area within the remediation footprint including access roads, temporary work zones, borrow pits and dumps. Individual sites are likely to be affected to varying degrees if they are located within the development area. Artifact context is fundamental to interpretation of archaeological sites. By disturbing the context in which artifacts and features are recovered, interpretations of heritage resources sites and, ultimately, past lifeways are affected negatively.

Secondary impacts can occur when the support services or additional access required by development adversely affects heritage resources outside the primary target areas. The remediation project should have no secondary effect on heritage resources.

Tertiary impacts are the results of project induced changes in demography and land use patterns. Increased rates of intentional and unintentional impacts can be expected as a result of increased visitation to an area if the project were large enough to affect regional

population bases. Tertiary impacts are anticipated to be very low for this project, especially because changes to the site through remediation will probably only negatively affect the visitation rates.

The study detailed in this report is intended to identify areas of possible impact and to determine whether the current proposed project will disturb those heritage resources located in proximity to the development.

2.3 Project Objectives

The objective of the 2010 study at the former USAF Padloping Island Weather Station located on Padloping Island is to ensure that heritage resources are not inadvertently impacted by the proposed clean-up and remediation project. The purpose of this AIA is to:

- conduct a pre-impact assessment of the proposed remediation areas;
- identify any archaeological sites within those areas (if present);
- make recommendations to CLEY, AECOM and PWGSC to mitigate or avoid those sites;
- make recommendations on surveillance and monitoring;
- provide a cost estimate on implementing the recommendations during the construction phase; and
- prepare a draft Final Report to be reviewed by AECOM and PWGSC, followed by a Final Report for distribution as required and submission to CLEY.

3. PHYSICAL AND CULTURAL SETTING

3.1 Environmental Context

An understanding of past environmental conditions and the environmental factors that shape human approaches to subsistence and settlement patterns enable archaeologists to not only locate sites, but also to provide more accurate interpretations of individual sites. The physical aspects of the environs (topography, drainage, climate and soils) as well as resource availability (flora, fauna, lithic materials and water) are prime criteria for the identification of site location and function. Assessments of the universal cultural activities of site location, travel within and through the area, and resource exploitation are key components of any archaeological site analysis.

The anthropological theory of environmental determinism suggests that, to a great extent, environmental factors condition human behavioural and cultural adaptations, or patterns of behaviour. The environment has likely influenced many of the activities that contribute to the character of the regional prehistoric record. All available environmental variables must be considered as indicators of prehistoric use of the landscape.

The regional environment influences where specific activities and occupation are located in a pattern of seasonal movements according to the availability of resources: a seasonal round. The variables of archaeological site distribution can be identified and combined into useful criteria for suggesting the potential of an environment to hold heritage resources that includes a wide variety of landforms frequently associated with coastlines and lake shores, river banks, eskers and kames, and bedrock knolls in Arctic environs. Distribution patterns partially reflect environmental opportunities presented to human groups as well as cultural preferences demonstrated by site location. Topography influences much human activity including travel, communication, resource catchments, dwelling locations and eventually constrains human activity areas to defined localities. Based on existing heritage resources, the environment is a key factor in human settlement patterns.

3.2 Regional Environment

Prior to contact with Europeans, the environment in which the people of North America lived strongly influenced their culture and economy. The people who inhabited the North took advantage of the seasons and all the resources that were available.

Baffin Island is part of the Canadian Shield, an old erosion surface of Precambrian rocks. Specifically, the northeast coast is mountainous and framed by numerous fjords, inlets, cliffs, eroded sandstone valleys and intricate alpine glaciers flowing to the sea (Collignon 2005). Hundreds of small islands surround the coast. The vegetation is diverse by sparse and dwarfed with sedges, saxifrage, dryas, Arctic willows, cottongrass, broad-leafed willows, herbs and Arctic poppies being the most common plants of the 350 species recorded on the island. Caribou, wolf, Arctic fox, lemming, Arctic hare, and polar bears are the most common land mammals on the island while sea mammals include walrus and several species of seals and whales are found in coastal waters.

The abandoned weather station is located on a coastal plain approximately 400 m from the bay bordered by a steep cliff two shallow lakes to the west and undulating hills to the east. The main site is connected to the beach landing area and fresh water lake by roads. During the study wildlife that was observed near the station area included a polar bear, numerous seals and whales. The site area is wet, boggy and heavily vegetated with sedges, willows and many flowering plants, grasses and rushes (Plate 3).

Plate 3 View south along road with the main station to the right of the photo showing typical vegetation.

3.3 Heritage Resources

Archaeology is the study of human history through the material remains of culture, now known as heritage resources. The ultimate goal in archaeology is to describe the cultures and events responsible for the creation and deposition of the remains at a given archaeological site. As such, archaeologists use material remains to determine the nature and age of cultural occupations at a site. Artifacts, ecofacts and features deposited into the natural environment, along with their inter-relationships, are the integral parts that make up an archaeological site. The *Nunavut Archaeological and Palaeontological Sites Regulations* (2003) define heritage resources as: "but not limited to, archaeological and historical sites, burial grounds, palaeontological sites, historical buildings and cairns."

Predating the arrival of Europeans, precontact archaeological sites are comprised of artifacts, features and residues of native origin typically characterized by modified bone and stone, and stone structures. Historic sites are those structures, features, and objects of European influence that date back to contact with the Europeans but can also represent more recent activity of more than 50 years. Depending on the context, sites less than 50 years old may be considered to represent traditional land use and are identified to document continued use and occupation of an area to the present time. A key component of the historic period record are the sites, artifacts and affiliated resources relating to post-contact Aboriginal people's use of the landscape. These include both archaeological sites and objects such as standing and collapsed cabins, campsites, graves, and traditional sites and resources, such as special places, hunting and plant collecting areas, traplines and their associated remains, oral traditions and various documents. These latter resources are usually identified through consultation procedures such as Traditional Use Studies (TUS) or community consultations.

Additionally, heritage resources include, as well as the sites where events took place in the past, all of the objects that they contain and any of the contextual information that may be associated with them and will aid in their interpretation, including natural specimens and documents or verbal accounts.

Heritage resources are non-renewable and are susceptible to alteration, damage, and destruction by construction and development activities. The value of heritage resources cannot be measured in terms of individual artifacts or biological specimens, rather the value of these resources lies in the integrated information which is derived from the relationship of the individual artifacts and fossil specimens, associated features, spatial relationships (distribution), and contextual situations. Interpretation of heritage resource materials, and the ability to interpret the significance of particular sites in a landscape, is based on an understanding of the nature of the relationship between individual archaeological and palaeontological materials as well as the sediments and strata within which they are contained. As such, removal or mixing of cultural or fossil bearing

sediments results in the permanent loss of information basic to the understanding of these resources. As a result, heritage resources are increasingly susceptible to destruction and depletion through disturbance.

Similarly, tundra areas north of the tree line are characterized by extremely slow rates of soil development and sediment accumulation. Accordingly, at repeatedly occupied sites, there is little chance of distinguishing occupations relating to different periods within the 5,000-year record of human occupation in the region without recovering a diagnostic indicator. Some areas of high sediment deposition rates are present within the study area, but these are not the typical scenario.

The lack of temporally diagnostic artifacts, the absence of materials suitable for radiocarbon dating, and the natural mixing of shallow archaeological deposits serve to limit the definition of the recognized prehistory for the region. In contrast, extant documents, records, and oral testimony provide a firmer basis for understanding the historic period of the region.

3.3.1 Cultural Chronology

Many of the archaeological materials in the project area represent human activity after the ice sheet receded from Baffin Island about 5,000 years ago. Soon afterward the island was colonized by Paleo-Eskimos with Southwestern Baffin Island, Melville Peninsula, Southhampton Island and the north of Quebec being considered to be part of the core area of Pre-Dorset and Dorset Culture Development.

3.3.1.1 Arctic Small Tool Tadition (4200 B.P. to 2800 B.P.)

There is presently little evidence to link Palaeo-Arctic tradition occupations to the Arctic Small Tool tradition (ASTt) occupations that succeed them. The ASTt represents a widespread cultural manifestation that covers all of the Canadian Arctic as well as parts of Alaska and Greenland. The ASTt is typically thought to date between approximately

4,200 and 2,800 B.P. (McGhee 1990). It includes the Denbigh Flint complex in northern Alaska, the Independence I culture of the Canadian High Arctic, the Inuvik Phase and the Pre-Dorset culture in Arctic Canada, and the Sarqaq culture in Greenland. It is thought that the ASTt relates to a separate migration of peoples from Siberia and does not appear to be related to the preceding Palaeo-Arctic tradition. As the name implies, the toolkit of the ASTt is comprised of lithic artifacts that are finely made and smaller than tools of similar function and age from elsewhere in North America. These include microblades and microcores, burins, gravers, small side and end scrapers, side and end blades, and bipointed (arrow) and triangular (harpoon) projectile points (Wright 1995). In Alaska it appears to have developed into the cultures of the Norton tradition while in Canada it developed into the Dorset culture.

3.3.1.2 Dorset Culture (2,500 B.P. to 1,000 B.P.)

The Dorset culture occupied the Canadian Arctic from 2,500 B.P. until at least 1,000 B.P. (McGhee 1990). Best known for miniature carvings, Dorset appears to have been a more successful adaptation to the conditions of the north than the preceding ASTt cultures from which it developed. This is demonstrated by the huge area occupied by Dorset groups and by evidence that they had perfected winter hunting on the sea ice. Cooler conditions in the northern hemisphere around 3,000 years ago resulted in expansion of the sea ice and a shift away from terrestrial hunting of caribou and hunting of sea mammals from boats in open water to a procurement of sea mammals from coastal edges and sea ice. This is evidenced in the archaeological record with a shift away from bow hunting to harpoon and spear hunting (McGhee 1990). Artifacts recovered from sites representing this period are more diverse and "reflect a richer and more secure way of life than that of earlier Palaeo-Eskimos." including the establishment of permanent winter villages (McGhee 1990).

However, when the people of the Thule culture arrived in the Canadian Arctic approximately 1,000 years ago, the Dorset culture had largely or entirely disappeared for reasons that are not well understood (McGhee 2001; Wright 1999).

3.3.1.3 Thule (1,000 B.P. to 400 B.P.)

The Thule tradition dates from approximately 1,000 to 400 B.P. and is derived from the Norton tradition in northern Alaska. More specifically, Thule grows out of the Old Bering Sea and Punuk traditions, which have numerous similarities to Thule cultural assemblages. These assemblages suggest subsistence based on maritime resources such as seals and whales that were hunted from kayaks or umiaks as identified by harpoon floats. Thule represented a new kind of adaptation to the Arctic environment, based on the hunting of large sea mammals in open water through the use of drag floats attached to the harpoon line. Large skin boats and the use of dogs to pull large sleds were other Thule innovations. Winters were spent in sometimes large communities of semi-subterranean houses, subsisting on a stored surplus obtained most typically by hunting bowhead whales. The introduction of Thule into the Canadian Arctic is noted by a distinct change in a number of cultural markers from the Dorset culture. The earliest Thule occupations currently recognized are on islands in the Bering Strait and exhibit an almost complete reliance on maritime resources; however, later sites demonstrate that both maritime and terrestrial resources were utilized (McGhee 1990). Climatic changes following the thirteenth century likely caused the Thule to modify their way of life into that of the various historic Inuit groups.

3.3.2 Historic Inhabitants

Historic use of the project area is identified with the 'Baffin Eskimo'. This group inhabited the southern two-thirds of Baffin Island and some of the nearby islands off its shores (Kemp 1984:464). The remaining northern region of the Island is inhabited by the Iglulik (Kemp 1984:464). The island region that is inhabited by the Baffin Eskimo is characterized by freshwater systems located in the central interior and mountainous areas in the northeast and southwest (Kemp 1984:464). The region was first inhabited by the Pre-Dorset approximately 4,200 years ago, supported by archaeological sites identified at Lake Harbour, Frobisher Bay, and Pond Inlet (Desrosiers 2005:193). Prior to this inhabitation, a large ice sheet had covered the island until its melting 5,000 years ago

(Desrosiers 2005:193). Dorset groups are identified in the archaeological record following this, between 2,500 and 600 years ago. The regions of southwestern Baffin Island, Melville Peninsula, Southampton Island, and northern Quebec are considered the central regions of Pre-Dorset and Dorset cultural development (Desrosiers 2005:193). Thule groups entered the area during the final 200 years of the Dorset occupation of the area. These two archaeologically distinct cultures coexisted in the region, but the character of this relationship is unclear. Much of the information known of the historic Thule, or Baffin Eskimo, is based on the ethnographic recordings of Franz Boas from the late 1800's. At this time, Boas recognized seven distinct regional populations within the Baffin Eskimo area (Kemp 1984:464). These populations were "linked together by [bilateral] kinship and the mutual use of hunting and territory, to form larger territorial and social groupings...bands" (Kemp 1984:464). Importantly, by the time of Boas' ethnography the Baffin Eskimo possessed many European goods, which influenced and altered the traditional life-ways of the local groups.

European contact with the Baffin Eskimo populations began in the 16th Century with the Frobisher Expedition (Kemp 1984:467), whose task it was to find the North West Passage (Desrosiers 2005:193). However, previously Baffin Bay had been explored by the Norse (Heinrichs 2005:191). During the 10th Century these Norseman built settlements on Greenland and perhaps Newfoundland but little evidence remains of where and how far they had actually travelled as these same settlements collapsed during the 13th Century. Baffin Bay was next explored and recorded by John Davis in 1587. European interaction gradually increased with the rise of European whale hunting; whaling stations began operating throughout the eastern arctic in the 1880's (Kemp 1984:466). Such whaling activities around Davis Strait originated in the 1700's, but it was not until the 1850's that all the inhabitants of the Cumberland Sound and Davis Strait regions were in contact with whalers (Kemp 1984:466). The whaling industry was eventually eclipsed by fur trapping in 1910 (Kemp 1984:474). Also at this time Anglican missionaries entered the region (Kemp 1984:474).

The Baffin Eskimo have historically utilized a vast array of subsistence resources, including marine, terrestrial, avian, and freshwater game; however, the wolf was sought but not utilized for subsistence (Kemp 1984:467). A vast array of tools was used for hunting, such as plugs to stop the bleeding of seals that made it easier for their transport. Bird nets were also constructed and used to ensnarl various avian species (Kemp 1984:468). Hunting weapons included breathing-hole harpoons that had compound elements, and single-curve bows (Kemp 1984:69). Metal, along with driftwood, antler, bone, and stone, were used in the construction of these implements. In addition, Baffin Eskimo technology allowed for water transportation via kayaks and umiaks, or women's boats (Kemp 1984:469); the form of the kayaks was not consistent throughout the Baffin Eskimo area. Dog sleds were used as well. These sleds were the dominant method of transportation until the 1960's when snowmobiles were introduced (Kemp 1984:469). With these forms of transportation, the Baffin Eskimo interacted with neighbouring groups such as those from northern Quebec (Kemp 1984:465). However, this interaction did not occur regularly.

Different subsistence resources were procured based on the season. For instance, seals (particularly ringed seal) were hunted along the floe-edge during the spring months, and caribou herds were hunted during the fall in the interior and coastal regions (sometimes with the aid of drives) (Kemp 1984:467-468). As this instance suggests, Baffin Eskimo mobility was seasonal and influenced by the location of what game they were pursuing. As a rule, Baffin Eskimo groups resided primarily in the coastal regions. It was the caribou that pulled groups into the interior, whereby three particular lakes were favoured as hunting locals: Nettling, Amadjuak, and Sylvia Grinnel Lakes (Kemp 1984:468). During these interior hunts, if excess caribou meat was produced, then it would be cached at these interior locations and retrieved at times of food stress during the winter months (Kemp 1984:468). In addition to there being differences in subsistence procurement based on seasonality, there were also differences in dwellings. Winter dwellings were commonly snow houses, although occasionally early and abandoned Thule houses were reused through the addition of roofs (Kemp 1984:470). In contrast to the winter, skin tents were utilized during the warmer months. These tents varied in form and size

depending on how far they were to be transported and their use (Kemp 1984:470). A further seasonal distinction is found in Baffin Eskimo clothing; only caribou skin was used for winter clothing, and seal skin was used in addition to caribou for summer clothes (Kemp 1984:470).

3.3.3 Heritage Studies

A search of the Canadian Museum of Civilization database identified five previously recorded sites on Padloping Island with an additional three sites recorded on the neighbouring Qaqaluit, Paugnang and Block Islands. However, none of the previously recorded sites are located within the study area and therefore were not revisited.

Prior to the current study of the USAF Padloping Island Weather Station on Padloping Island, a total of five archaeological sites were recorded on the island. These sites included: MgBu 1, MgBu 3, MgBu 4, MgBt 3, and MhBt 2. The first of these sites, MgBu 1, was classed as a prehistoric lithic scatter, though bone and ivory artifacts were also recovered. Identified in 1963 by Father Guy Mary-Rousseliere (1913-1994), the site possibly relates to the Pre-Dorset or Thule. The second site previously recorded on Padloping Island was MhBt 2. This site was identified by D. Clark in 1964 as a cairn of undetermined age. The other three sites previously recorded on Padloping island (MgBu 3, MgBu 4, and MgBt 3) are all listed as Sabo sites, named after George Sabo who identified them in 1975; individually these are Sabo sites JJ, KK, and II. Located by local informants, MgBu 4 was a prehistoric Thule campsite with multiple structures, two of which were found eroding from a terrace edge. In total, six Thule semi-subterranean sod and stone dwellings, and two sod and stone qarmats were recorded. Four of these Thule dwellings were bilobate. Besides the multiple features, one harpoon ice pick was also recovered. MgBt 3 had both prehistoric and indigenous historic associations (Thule and Inuit). This site consisted of two areas, the first area held the remains of a qarmat, a tent ring, and a cache; the qarmat was badly disturbed. Qarmats are rectangular structures that were built on the surface or in a shallow pit with interiors that were arranged in a way that was identical to semi-subterranean houses, in terms of sleeping

plarforms, and were often be made of snow or ice walls with caribou or muskox hide roofs. The cache and tent ring were actually a single feature as the ring had been transformed into a cache. The second area was to the east and consisted of multiple rectangular tent rings, associated with recent debris. These rings were situated on higher ground than the first area. The third Sabo site was MgBu 3, which was an undisturbed indigenous historic site. It was classed as a campsite with a qarmat, tent ring, and cache. The caches from MgBt 3 and MgBu 3 were not elaborated upon.

Three islands, situated in close proximity to Padloping Island hold three additional previously identified archaeological sites. These islands have one previously recorded site each and are called: Qaqaluit Island, Paugnang Island, and Block Island. The MhBt 1 was also known as the Cape Searle site, located on the north shore of Qaqaluit Island. The site was recorded by D. Clark in 1964 as a stone cairn with undetermined temporal and cultural associations. The second site, MgBt 2, was a prehistoric site located on a rocky ledge along the south shore of Paugnang Island. George Sabo in 1975 recorded this (and MgBt 1) site while conducting the Thule Archaeology Conservation Project. There were a total of three structures identified, two of which were looted. The other structure was eroding but did not indicate looting. These three structures were associated with the late Thule. The third and final site, MgBt 1, was located on the south shore of Block Island. The site was identified as 4 closely placed villages. The first was an Inuit village comprised of numerous wood platformed qarmats. The second, a Thule village, was also comprised of qarmats (n=2) but were made of stone and one had a stone cairn built within. The third village, associated with the Thule, had 3 stone houses. One of these structures had a recent cache placed within it and two burial cairns placed behind the structure's back walls. Nearby to this structure were 2 kayak rests, a number of tent rings, and additional caches. Approximately 105 metres to the north of these three villages was the forth and final grouping of structures. These structures (n=3) were associated with the Thule.

4. METHODOLOGY

4.1 Field Inventory and Assessment

All field work was conducted under a valid Class II Archaeological Permit issued by CLEY. The field program focused on assessment of all areas of high and moderate archaeological potential within the abandoned weather station, and the proposed borrow source and landfill locations. The purpose of the field investigation was to identify archaeological materials, document location and content and provide data to be used in the development of recommendations for future remediation programs. Inventory and assessment techniques followed established practices and consisted of the following:

- visual examination of the identified areas to determine the presence of such surficial features such as standing or collapsed buildings, dumps, cache pits, cabin foundations, etc. and exposed precontact cultural materials such as stone tool making debris and tools;
- visual examination of the identified areas to determine the presence of items of historical military interest;
- excavation of shovel tests (ca. 40 x 40 cm) to varying depths to determine the potential for subsurface precontact cultural remains if deposition is present;
- visual examination of bedrock exposures (if any) or gravels for precontact quarrying activity;
- excavation of either additional shovel tests or 1 x 1 m units for the purpose of identifying the distribution, density, and nature of cultural remains associated with sites identified through inventory procedures;
- documentation of the location (GPS coordinates), nature, size, and complexity of each identified site; and
- documentation of individual site features to record content, context, potential identity, and to provide information required to develop a mitigation program.

These results, along with updates and recommendations will be included in written submissions to CLEY as required by the Permit to conduct the AIA, and discussed with the Chief Archaeologist of Nunavut.

4.2 Heritage Feature / Structure Evaluation

Evaluations of heritage features and standing structures were to be completed for features/structures that are observed during the investigations. These evaluations would consider perceived heritage resource value and community cultural value as well as the predicted impact from the proposed program. In general, disturbed sites with limited cultural remains would be assigned lower archaeological resource values than undisturbed sites, large sites with large amounts of cultural material, complex sites, and multicomponent sites. Undisturbed multicomponent sites would generally be assigned the highest heritage resource value.

Community input will play a role in the evaluation of site value, and the inclusion of members of the local community on the field crew aided in the in-field discussions regarding site significance.

4.3 Detailed Archaeological Site Investigations / Mitigation

If required, mitigation of significant heritage resources sites may include a number of different options. Prior to evaluation of these mitigative options, the perceived value of the identified archaeological sites will be discussed with the AECOM Project team to determine the feasibility of avoiding important sites. If site avoidance is not possible, other mitigative measures such as collection and documentation, and controlled mapping/excavation be considered and discussed with CLEY. In areas of no sediment deposition surface collection and mapping of artifacts and features may satisfy regulatory requirements for mitigation. Recommendations for excavation may include a controlled excavation mitigative plan and will specify the number of square metres and suggest locations for excavation units/blocks.

Overall mitigative options may be summarized by:

- collection and documentation undertaken at the time of the field assessment at all sites with low archaeological resource value;
- avoidance if feasible at all sites assigned high archaeological resource value;
- mitigative excavations which will be recommended at those sites assigned high archaeological resource value that could not be avoided by borrow source relocation; and
- a management plan for required mitigation relative to the proposed construction schedule to be discussed with the site project team and CLEY.

4.4 Reporting

Analysis of collected artifacts includes cleaning, cataloguing, identification, inventory, and description of each individual piece for inclusion in the final report. GPS site information is provided for mapping relative to the former site structures at the site and to CLEY, but not included in the final versions of this report. Archaeological site maps, photographs, and artifact scans are prepared as digital files.

5. RESULTS

Upon completion of the field component and the artifact curation, a draft report was prepared. This final permit report on the archaeological studies will be forwarded to AECOM for review and then submitted to CLEY for review. This report includes a project description, the environmental setting, the historical and archaeological context for the project area, field methodology, and the results of the field reconnaissance. The report includes descriptive data on the sites, artifacts, and features identified, as well as detailed information on the nature, content, and significance of the artifacts and features identified. Cultural material that was recovered was inventoried, described, and discussed within the report text to aid in evaluation of scientific and interpretive value. All identified sites have been documented on appropriate site inventory forms.

If required, a summary of the findings will be prepared for inclusion in a screening document.

The following workplan was followed:

- avoidance has been recommended where feasible at all sites assigned high archaeological resource value (this to include all constructed features: burials, tent rings, caches, hunting blinds, hearths);
- collection and documentation has been undertaken as a mitigative option of sites with low archaeological resource value and as a method of protecting the heritage resource from future undocumented impacts due to increased personnel activity in the vicinity; and
- acceptable methods of mitigation were discussed with CLEY and the Territorial Archaeologist, and may lead to a recommendation for detailed mapping, collection and/or test excavations at those sites assigned high archaeological resource value that cannot be avoided by reclamation project.

A management plan for required mitigation, monitoring or surveillance relative to the proposed remediation will be developed as part of the contracted services deliverable to PWGSC. This includes site mitigation, additional survey of any project re-locates required due to site avoidance, and verification of those heritage sites located outside the proposed development activity area that should remain outside re-located areas.

A search of the Canadian Museum of Civilization database identified five previously recorded sites on Padloping Island with an additional three sites having been recorded on the neighbouring Qaqaluit, Paugnang and Block Islands. However none of the previously recorded sites are located within the study area and were therefore not revisited.

5.1 Community Consultation

Consultation regarding the USAF Padloping Island Weather Station Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, Geotechnical Evaluation, Remedial Action Plan is ongoing.

5.2 Field Results

The AIA assessment included all of the areas of moderate to high archaeological potential that have been disturbed by the weather station as well as areas identified as having potential for future borrow sources or dumps. The disturbed areas that were surveyed included the main site (Plate 4), original site (Plate 5) access roads, beach landing area (Plate 6), barrel dumps, metal dumps (Plate 7) and anywhere there was evidence of a bull dozer push or any other disturbance. Previously undisturbed areas that were examined included the periphery of all the impacted areas as well as several areas that were identified as potential borrow areas, landfills and landfarms for remediation activities (Plate 8).

During the investigation the former weather station, Inuit Settlement and cemetery were recorded as heritage resource sites. This was due to the fact that all of these sites were more than 50 years old, as per the *Nunavut Archaeological and Palaeontological Sites*

Regulations (2003). The weather station includes the original site, main station, roads and numerous barrel and metals dumps. The Inuit Settlement is made up of the remains of at least 22 houses that were determined from stone outlines and constructions materials, and the Inuit graveyard is located adjacent to the study area and consists of 20 graves. All three sites are described in more detail below.

Plate 4 View east of the remains of the maintenance garage.

Plate 5 View southwest of original warehouse.

Plate 6 View west of beach landing area with crushed barrels and sunken barge.

Plate 7 View west of metal dump area.

Plate 8 View south of potential borrow source between salt water and fresh water lakes.

In addition to the heritage sites, modern land use sites consisting of modern tent rings and Inuksuit were observed. There are two rather large Inuksuit at the beach landing area of the site, both have dates engraved or written on them from 1999 and 2003, respectively (Plate 9 and 10). There are also at least 11 modern tent rings along the beach landing area and along the access road from the beach to the station (Plate 11). Recent plastic and aluminum debris around the beach landing area further attests to the continued use of the island. The community of Qikiqtarjuaq initiated a clean up of the Padloping Island site in 1993, crushing approximately 3,000 fuel barrels (INAC 2008) which can be seen in the background of Plate 6.

Plate 9 Photo of modern Inuksuk dated August 7, 1999.

Plate 10 Photo of modern Inuksuk dated 2003.

Plate 11 Modern tent ring with wooden floor, a second tent ring can be seen in the background.

5.3 Newly Recorded Heritage Resource Sites

5.3.1 MgBu 5

MgBu 5 is an abandoned weather station that was built and operated by the United States Air Force from 1943 until the end of the Second World War when it was taken over by the Canadian Department of Transport who operated the station until 1956. The abandoned weather station is located on a coastal plain approximately 400 m from the bay bordered by a steep cliff, two shallow lakes to the west and undulating hills to the east (Figure 1).

The abandoned weather station consists of two localities, the original site and the main site (Figure 2). The original site includes two warehouses (Plate 12) and a powerhouse (Plate 13) as well as metal debris, wooden power poles, electrical wire, fuel barrels and dimensional lumber. All that remains of one of the warehouses is structural steel and metal sheeting with several US Army canon heaters (Plate 12). The remains of the powerhouse consist of two generators that are on their side with some of the wooden floor remaining. There is also a stove between the warehouse and generators with a manufacture date of June 19, 1942.

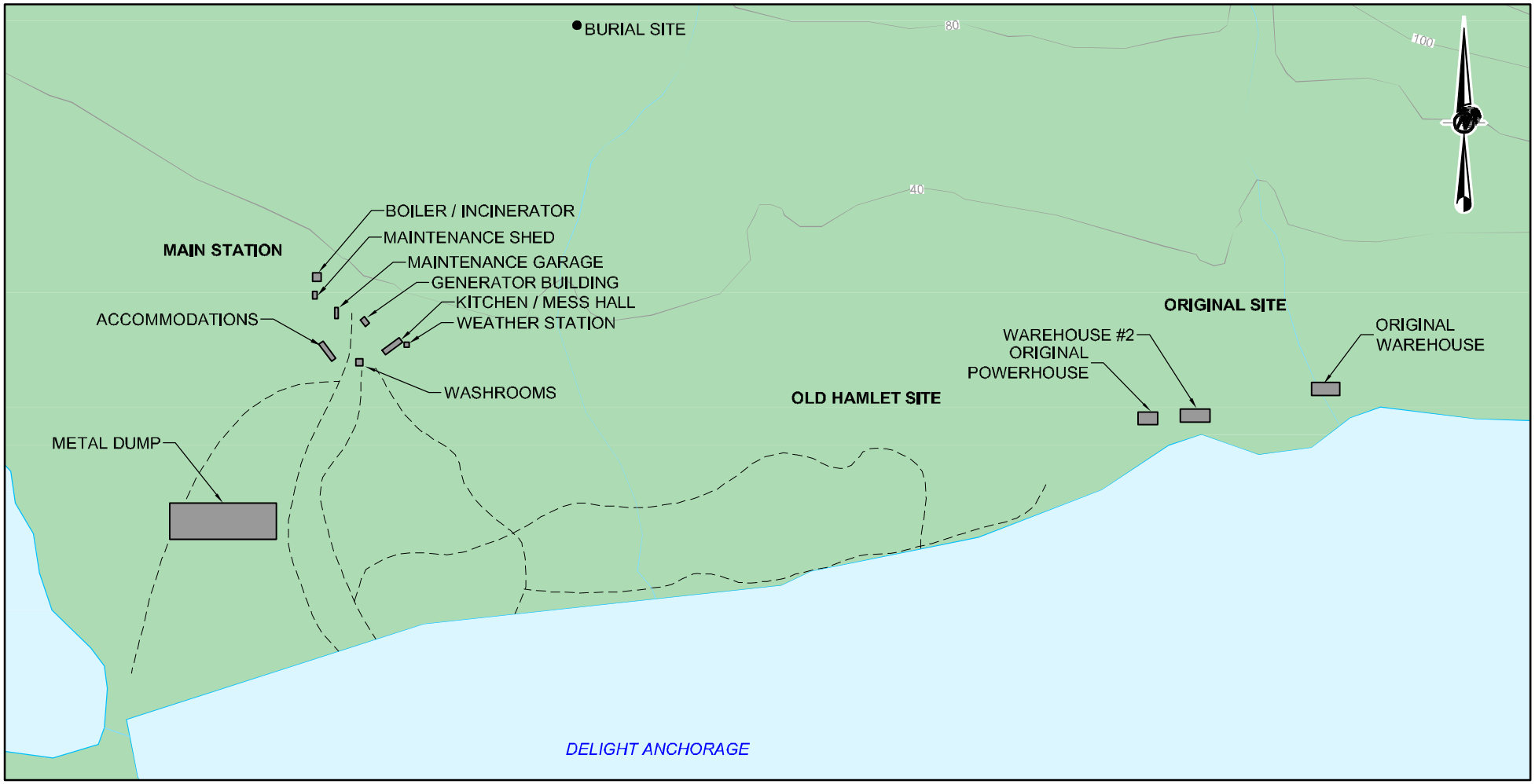
The main site consists of a maintenance shed, supply depot, boiler/incinerator, library, maintenance garage, washrooms, accommodations, kitchen/mess hall, weather station and several barrel and metal dumps. Structural remains consists of the metal frame of the maintenance garage (Plate 4), cement and brick foundation of the boiler/incinerator (Plate 14), cement foundation of the library building and two generators from the Generator Building (Plate 15). There is also a lot of miscellaneous metal and wood debris, wooden power poles and an army truck. The main metal dump is south of the main site. Fuel barrels, construction material, food cans and abandoned vehicles were all observed there (Plate 7 and Plate 16). The area has several roads going from the main site to both the

beach landing area and to the freshwater lake to the west of the site area (Plate 3). At the beach landing area there are two sunken barges, only one of which is visible above the water; crushed oil barrels and miscellaneous metal debris litter the area (Plate 6).

North of the main site on a gravel ridge is an open grave that once contained an American serviceman (Plate 17). The grave consists of a broken wooden cross and portions of a picket fence. The body has since been repatriated. No further information is available on the grave.

All of the remains of the USAF Padloping Weather Station will be removed during the planned remediation of the site by PWGSC. The site was recorded as a heritage site as it is more than 50 years old the as per the *Nunavut Archaeological and Palaeontological Sites Regulations* (2003). No further work is recommended as the recording of the site is thought to be sufficient mitigation.

L:\2010\1333\10-1333-0025\8470\Report A\Fig 2 10133300258470A002 Site Plan.dwg Nov 23, 2010 - 11:52am



200 0 200
SCALE METRES

LEGEND

- CONTOUR (METRES)
- TRAIL
- WATERCOURSE
- WATERBODY

REFERENCE

ALBERTA NTDB DIGITAL DATA OBTAINED FROM GEOMATICS CANADA, AUGUST 2001. MAPSHEET 16M AND 16N DATUM: NAD83 PROJECTION: UTM ZONE 20

PROJECT

PADLOPING ISLAND USAF WEATHER STATION

TITLE

SITE LOCATION
MgBu 5

Golder Associates
Calgary, Alberta

PROJECT	10.1333.0025.8470		FILE No.	10133300258470A002
DESIGN	BM	14/10/10	SCALE	AS SHOWN REV. 0
CADD	KJM	19/10/10		
CHECK	BM	19/10/10		
REVIEW	DB	19/10/10		

FIGURE: 2

Plate 12 View east of warehouse #2 showing structural remains and US Army canon heaters.

Plate 13 Photo of generators at the original site, MgBu 5.

Plate 14 View northwest of the remains of the boiler/incinerator.

Plate 15 Photo of generators at the main site, MgBu 5.

Plate 16 View south of metal dump.

Plate 17 View north of grave.

5.3.2 MgBu 6

Site MgBu 6 is the Padloping Island Inuit Settlement that extends along the beach south and east of the USAF Weather Station. Historic reports indicate that the settlement was mentioned as early at 1884 with seven remaining families being resettled to Broughton Island (now Qikiqtarjuaq) in 1968 so that their children could attend school. The Padloping Island Settlement, along with the settlement at Kivitoo, were the larger centers of Inuit occupation in the region prior to the establishment of the DEW Line site at Broughton Island (Qikiqtani Truth Commission (QTC) 2010). There is also a graveyard that is associated with the settlement to the west of a salt water lake that was recorded as MgBu 7 and reported on below.

Approximately 22 Inuit houses are located at MgBu 6, as they are scattered along the upper beach terrace for 1,100 m. The house remains are quite diverse consisting of stone outlines (Plate 18), wooded floors (Plate 19) as well as areas that appear to have had structures at one time (Plate 20) (Table 1). The site extends southeast of the main station of the USAF Padloping Weather Station on both sides of the Original Site of the weather station.

Table 1 Feature metrics, MgBu 6

Feature	Size (m)	Orientation	Shape	Feature	Size (m)	Orientation	Shape
1	4.5 X 9.5	NW/SE	Rectangular	12	4 X 5	N/S	Rectangular
2	7 X 5.4	NE/SW	Rectangular	13	5 X 5		Square
3	5 X 5		Circular	14	5 X 7	N/S	Rectangular
4	5.5 X 5	NW/SE	Rectangular	15	4		Circular
5	3.5 X 2.5	E/W	Rectangular	16	5 X 3	N/S	Rectangular
6	5 X 7	N/S	Rectangular	17	5		Circular
7	7 X 7	NE/SW	Rectangular	18	5 X 3	N/S	Rectangular
8	8 X 8	N/S	Rectangular	19	5 X 7	N/S	Rectangular
9	6 X 6		Square	20	4 X 4		Circular
10	7 X 6	NW/SE	Rectangular	21	5 X 7	N/S	Rectangular
11	5 X 5		Circular	22	5 X 7	E/W	Rectangular

The debris around the houses consists of both domestic material such as books, clothing, eating utensils, bed frames, pots, lanterns, two rifles, women's figure skates, a snowmobile and a sewing machine and material from the weather station. The debris from the weather station includes bricks (stamped "SEABOARD PENN MADE IN U.S.A."), miscellaneous pieces of metal, stove parts, electronic parts, electrical wire, as well as fuel barrels. Around the house remains there are also several areas where debris has been burned. The amount of debris around the house features are not evenly distributed with the western feature, close to the weather station main site, having much more debris than the features that were recorded on the east side of the site. East of the recorded site there are also several recent stone tent rings and it was thought that the site continues to the east but was not surveyed during the current program as it was not within the study area.

During the recording of MgBu 6, there was no cultural material observed that indicated any occupation prior to the construction of the weather station. This may be because earlier sites are to the east of MgBu 6 or because the site has been occupied since at least 1884 and earlier features and material culture are now mixed in or covered by the more modern debris.

Site MgBu 6 is considered to be significant in terms of its place in the 20th Century Inuit history. It is recommended that none of the house foundations, stone tent rings and wooden flooring be removed during the remediation of the site and that any material that is removed, fuel barrels, metal debris, wood debris be hand picked and that none of the recorded features associated with the site be disturbed by borrow sources, landfills or by heavy vehicle traffic. It is also recommended that during public consultation for the remediation of the USAF Padloping Weather Station any information on the site be recorded.

Plate 18 View south of Feature 19, MgBu 6.

Plate 19 View southeast of Feature 2, MgBu 6, with wooden floor and the remains of walls.

Plate 20 View northeast of Feature 5, MgBu 6, showing the former location of a house.

5.3.3 MgBu 7

Site MgBu 7 is an Inuit graveyard that is associated with the Padloping Island Settlement located to the west of the settlement on a ridge at the base of a cliff on the other side of a salt water lake. The lake is easily accessible in low tide when the mouth of the lake can be traversed as water is draining out of the lake into the ocean. The graveyard consists of twenty grave sites placed side by side oriented east to west (Plate 21 and 22). Of the twenty graves all but five have wooded crosses with names, in syllabics, and dates. The graves date from 1948 to 1967 and with the exception of a single grave with a collapsed top are in good shape. According to the dates and judging by the size of the graves most are those of children.

Site MgBu 7 is considered to be significant in terms of its place in the 20th Century Inuit history. It is recommended that this site be avoided during the planned remediation

activities and that any information on the cemetery that is brought up during public consultation for the remediation of the USAF Padloping Weather Station be recorded.

Plate 21 View east of graveyard with Padloping Settlement and weather station in the background.

Plate 22 View west of the graveyard, MgBu 7.

6. SUMMARY AND RECOMMENDATIONS

The AIA of the USAF Padloping Weather Station conducted under Nunavut Permit 2010-016A produced the results discussed in Section 5 and outlined in Table 2. As requested, areas which will not be impacted during remediation were not fully examined. During the study three sites, the weather station, Padloping Island Inuit Settlement and Inuit Graveyard, were recorded as per the *Guidelines for Applicants and Holders of Nunavut Territory Archaeology and Palaeontology Permits* (Government of Nunavut 2003).

Table 2 Heritage Site Recommendations

Site	Type	Significance	Recommendations
MgBu 5	Weather Station	Limited	No further work is recommended
MgBu 6	Inuit Settlement	High	Avoidance is recommended
MgBu 7	Graveyard	High	Avoidance is recommended

PWGSC has fulfilled the requirements to indentify the potential for impact to heritage resources during the proposed remediation/reclamation of the USAF Padloping Island Weather Station on Padloping Island. The AIA of the Padloping Island weather station included the participation of Losie Audiakiak and Johnny Kooneeliusie from the local community of Qikiqtarjuaq, who acted as bear monitors and participated in the identification and recording of the heritage resource sites.

During the investigation the former weather station, the Inuit Settlement and cemetery were recorded as heritage resource sites and were assigned Borden site numbers Mgbu 5, MgBu 6, and MgBu 7. All of the remains of the USAF Padloping Weather Station will be removed during the planned remediation of the site by PWGSC. The site was recorded as a heritage site as it is more than 50 years old as per the *Nunavut Archaeological and Palaeontological Sites Regulations*. No further work is recommended as the recording of the site is thought to provide sufficient mitigation.

Site MgBu 6 is considered to be significant in terms of its place in 20th Century Inuit history. It is recommended that none of the house foundations, stone tent rings and wooden flooring be removed during the remediation of the site and that any material that is removed (fuel barrels, metal debris, wood debris) be hand picked and that none of the recorded features associated with the site be disturbed by borrow sources, landfills or by heavy vehicle traffic. It is also recommended that any information on the site be recorded during public consultation and used to assess the potential for impact during the development of the Remedial Action Plan of the USAF Padloping Weather Station.

Site MgBu 7 is considered to be significant in terms of its place in the 20th Century Inuit history. It is recommended that this site be avoided during the planned remediation activities and that any information on the cemetery be recorded during public consultation and used to assess the potential for impact during the development of the Remedial Action Plan of the USAF Padloping Weather Station

7. CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

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APPENDIX I

PHOTOGRAPH LOG

Padloping Island AIA Photo Log

Number	Borden Number (if applicable)	Comment
10-016Aphoto1		View north of metal dump from the air
10-016Aphoto2		View north of metal dump from the air
10-016Aphoto3		View northwest of the metal dump from the air
10-016Aphoto4		View west of quad trail with metal dump in the background
10-016Aphoto5		View southwest of metal dump from the air
10-016Aphoto6		View southwest of metal dump from the air
10-016Aphoto7		Rifle
10-016Aphoto8		View south across Hudson Strait from the site
10-016Aphoto9		View south across Hudson Strait from the site
10-016Aphoto10		View southeast across Hudson Strait from the site
10-016Aphoto11		View east across hamlet
10-016Aphoto12	MgBu-5	View northwest of tent ring, Feature 1, MgBu-5
10-016Aphoto13	MgBu-5	View west of tent ring, Feature 1, MgBu-5
10-016Aphoto14	MgBu-5	View south of tent ring , Feature 1, MgBu-5
10-016Aphoto15	MgBu-5	View west of tent ring, Feature 1, MgBu-5
10-016Aphoto16	MgBu-5	View southwest of Feature 1, MgBu-5
10-016Aphoto17	MgBu-5	Detail of wood along the outer ring of site, Feature 1, MgBu-5
10-016Aphoto18	MgBu-5	Photo of metal debris close to Feature 1 at MgBu-5
10-016Aphoto19	MgBu-5	Photo of sewing machine close to Feature 1, MgBu-5
10-016Aphoto20	MgBu-5	View west of garbage that has been burned
10-016Aphoto21	MgBu-5	View west of garbage that has been burned
10-016Aphoto22	MgBu-5	View north from the beach area of burned material
10-016Aphoto23	MgBu-5	View north of another area with burned garbage
10-016Aphoto24	MgBu-5	View west of second area with burned garbage
10-016Aphoto25	MgBu-5	View north of Feature 2, MgBu-5
10-016Aphoto26	MgBu-5	View west of Feature 2, MgBu-5
10-016Aphoto27	MgBu-5	Detail of cultural material at Feature 2, MgBu-5
10-016Aphoto28	MgBu-5	View south of Feature 2, MgBu-5
10-016Aphoto29	MgBu-5	Detail of coal at Feature 2, MgBu-5
10-016Aphoto30	MgBu-5	View southeast of Feature 2, MgBu-5
10-016Aphoto31	MgBu-5	View southeast of Feature 2, MgBu-5
10-016Aphoto32	MgBu-5	View south from Feature 2, MgBu-5
10-016Aphoto33	MgBu-5	Detail of metal stove/furnace at Feature 2, MgBu-5
10-016Aphoto34	MgBu-5	Detail of brick
10-016Aphoto35	MgBu-5	Detail of clothing at Feature 2, MgBu-5
10-016Aphoto36	MgBu-5	Detail of wood debris, including 'ribs' from a Quonset type hut, Feature 2, MgBu-5
10-016Aphoto37	MgBu-5	marker
10-016Aphoto38	MgBu-5	View northwest of Feature 3, MgBu-5

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto39	MgBu-5	View northwest of Feature 3, MgBu-5
10-016Aphoto40	MgBu-5	Detail of Feature 3, MgBu-5
10-016Aphoto41	MgBu-5	Detail of Feature 3, MgBu-5
10-016Aphoto42	MgBu-5	Detail of Feature 3, MgBu-5
10-016Aphoto43	MgBu-5	View southeast of Feature 3, MgBu-5
10-016Aphoto44	MgBu-5	Book at Feature 3, MgBu-5
10-016Aphoto45	MgBu-5	Book at Feature 3, MgBu-5
10-016Aphoto46	MgBu-5	Book at Feature 3, MgBu-5
10-016Aphoto47	MgBu-5	Snow machine west of Feature 3, MgBu-5
10-016Aphoto48	MgBu-5	Ceramic insulator
10-016Aphoto49	MgBu-5	View northwest of Feature 4, MgBu-5
10-016Aphoto50	MgBu-5	View northwest of Feature 4, MgBu-5
10-016Aphoto51	MgBu-5	View west of Feature 4, MgBu-5
10-016Aphoto52	MgBu-5	View southwest of Feature 4, MgBu-5
10-016Aphoto53	MgBu-5	View southeast of Feature 4, MgBu-5
10-016Aphoto54	MgBu-5	Detail of domestic artifacts, Feature 4, MgBu-5
10-016Aphoto55	MgBu-5	Women's figure skate, Feature 4, MgBu-5
10-016Aphoto56	MgBu-5	Electric light fixture, MgBu-5
10-016Aphoto57	MgBu-5	Toy snow machine, MgBu-5
10-016Aphoto58	MgBu-5	Toy snow machine, MgBu-5
10-016Aphoto59	MgBu-5	Toy snow machine, MgBu-5
10-016Aphoto60	MgBu-5	Tape player, MgBu-5
10-016Aphoto61	MgBu-5	View northeast of Feature 5, MgBu-5
10-016Aphoto62	MgBu-5	View southeast of Feature 5, MgBu-5
10-016Aphoto63	MgBu-5	View south of Feature 5, MgBu-5
10-016Aphoto64	MgBu-5	View east across the site from Feature 5, MgBu-5
10-016Aphoto65	MgBu-5	View south of Feature 5, MgBu-5
10-016Aphoto66	MgBu-5	View south of Feature 6, MgBu-5
10-016Aphoto67	MgBu-5	View west of Feature 6, MgBu-5
10-016Aphoto68	MgBu-5	View north of Feature 6, MgBu-5
10-016Aphoto69	MgBu-5	View southeast across MgBu-5 from Feature 6
10-016Aphoto70	MgBu-5	View northwest of Feature 7, MgBu-5
10-016Aphoto71	MgBu-5	View northwest of Feature 7, MgBu-5
10-016Aphoto72	MgBu-5	View southwest of Feature 7, MgBu-5
10-016Aphoto73	MgBu-5	Misc debris around Feature 7, MgBu-5
10-016Aphoto74	MgBu-5	Detail of wood stuck in the ground, Feature 7, MgBu-5
10-016Aphoto75	MgBu-5	Misc debris around Feature 7, MgBu-5
10-016Aphoto76	MgBu-5	View south of MgBu-5 from Feature 7
10-016Aphoto77	MgBu-5	View northeast of Feature 8, MgBu-5

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto78	MgBu-5	View west of Feature 8, MgBu-5
10-016Aphoto79	MgBu-5	View south of Feature 8, MgBu-5
10-016Aphoto80	MgBu-5	View east of Feature 8, MgBu-5
10-016Aphoto81	MgBu-5	View north of Feature 9, MgBu-5
10-016Aphoto82	MgBu-5	View west of Feature 9, MgBu-5
10-016Aphoto83	MgBu-5	View south of Feature 9, MgBu-5
10-016Aphoto84	MgBu-5	Detail of electronics at Feature 9, MgBu-5
10-016Aphoto85	MgBu-5	Detail of cultural material at Feature 9, MgBu-5
10-016Aphoto86	MgBu-5	View southwest of Feature 10, MgBu-5
10-016Aphoto87	MgBu-5	View southeast of Feature 10, MgBu-5
10-016Aphoto88	MgBu-5	View north of Feature 10, MgBu-5
10-016Aphoto89	MgBu-5	Detail of burned area, Feature 10, MgBu-5
10-016Aphoto90	MgBu-5	View west of Feature 10,MgBu-5
10-016Aphoto91	MgBu-5	Warehouse at main station, view east
10-016Aphoto92	MgBu-5	View northeast across main station
10-016Aphoto93	MgBu-5	View south of metal dump
10-016Aphoto94	MgBu-5	View southeast across site from the air
10-016Aphoto95	MgBu-5	View southwest of main station form the air
10-016Aphoto96	MgBu-5	View southwest of main station form the air
10-016Aphoto97	MgBu-5	View northwest of site from the air
10-016Aphoto98	MgBu-5	View south of original warehouse
10-016Aphoto99	MgBu-5	View south of original warehouse
10-016Aphoto100	MgBu-5	View southwest of original warehouse
10-016Aphoto101	MgBu-5	View southwest across original site with warehouse in the background
10-016Aphoto102	MgBu-6	View north of Feature 20, MgBu-6
10-016Aphoto103	MgBu-6	View southwest of Feature 20, MgBu-6
10-016Aphoto104	MgBu-6	Detail of electronic equipment near Feature 20, MgBu-6
10-016Aphoto105	MgBu-6	View northeast of Feature 21, MgBu-6
10-016Aphoto106	MgBu-6	View north of Feature 21, MgBu-6
10-016Aphoto107	MgBu-6	Detail of floor and debris, Feature 21, MgBu-6
10-016Aphoto108	MgBu-6	View south off Feature 21, MgBu-6
10-016Aphoto109	MgBu-6	View northwest of Feature 22, MgBu-6
10-016Aphoto110	MgBu-6	View northwest of Feature 22, MgBu-6
10-016Aphoto111	MgBu-6	View south of Feature 22, MgBu-6
10-016Aphoto112	MgBu-6	View southwest of modern rings east of MgBu-6
10-016Aphoto113	MgBu-6	View south of modern rings east of MgBu-6
10-016Aphoto114	MgBu-6	View southwest of modern rings east of MgBu-6
10-016Aphoto115	MgBu-6	View south of modern rings east of MgBu-6

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto116		View west along beach on the east end of the study area
10-016Aphoto117		View west along beach on the east end of the study area
10-016Aphoto118	MgBu-6	View south of Feature 19,MgBu-6
10-016Aphoto119	MgBu-6	View north of Feature 19, MgBu-6
10-016Aphoto120	MgBu-6	View north of Feature 14, MgBu-6
10-016Aphoto121	MgBu-6	View southeast of Feature 14, MgBu-6
10-016Aphoto122	MgBu-6	View southwest of Feature 14, MgBu-6
10-016Aphoto123	MgBu-6	View east of Feature 14, MgBu-6
10-016Aphoto124	MgBu-6	View south of Feature 15, MgBu-6 with original warehouse in the background
10-016Aphoto125	MgBu-6	View east of Feature 15, MgBu-6
10-016Aphoto126	MgBu-5	View southeast of original warehouse with heaters
10-016Aphoto127	MgBu-5	detail of a heater
10-016Aphoto128	MgBu-5	Stove at original weather station site
10-016Aphoto129	MgBu-5	Detail of stove at original station site
10-016Aphoto130	MgBu-5	Diesel genset at the original site
10-016Aphoto131	MgBu-5	View east across original site
10-016Aphoto132	MgBu-6	View north of Feature 18, MgBu-6
10-016Aphoto133	MgBu-6	View east of Feature 18, MgBu-6
10-016Aphoto134	MgBu-6	View south of Feature 18, MgBu-6
10-016Aphoto135	MgBu-6	Detail of telephone pole beside Feature 18, MgBu-6
10-016Aphoto136	MgBu-6	View north of Feature 17, MgBu-6
10-016Aphoto137	MgBu-6	View northeast of Feature 17, MgBu-6
10-016Aphoto138	MgBu-6	View north of Feature 16, MgBu-6
10-016Aphoto139	MgBu-6	View northeast of Feature 16, MgBu-6
10-016Aphoto140	MgBu-6	View north of Feature 11,MgBu-6
10-016Aphoto141	MgBu-6	View west of Feature 11, MgBu-6
10-016Aphoto142	MgBu-6	Gun beside Feature 11, MgBu-6
10-016Aphoto143	MgBu-6	Polar bear skull near Feature 11, MgBu-6
10-016Aphoto144	MgBu-6	View north of Feature 12, MgBu-6
10-016Aphoto145	MgBu-6	View east of Feature 12, MgBu-6
10-016Aphoto146		View north of modern tent rings
10-016Aphoto147		View west of modern tent ring with wooden floor
10-016Aphoto148		View southwest of modern tent ring with wooden floor
10-016Aphoto149	MgBu-5	View west of barrels and sunken barge at beach
10-016Aphoto150		Modern Inuksuk
10-016Aphoto151		Detail of modern Inuksuk
10-016Aphoto152		Detail of modern Inuksuk
10-016Aphoto153		Detail of modern Inuksuk

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto154	MgBu-5	Photo of crushed army jeep and cat
10-016Aphoto155	MgBu-5	Photo of amphibious vehicle
10-016Aphoto156	MgBu-5	Detail of amphibious vehicle
10-016Aphoto157	MgBu-5	Photo of truck and amphibious vehicle
10-016Aphoto158	MgBu-5	Photo of amphibious vehicle
10-016Aphoto159	MgBu-7	View east of Inuit grave yard
10-016Aphoto160	MgBu-7	Detail of grave marker
10-016Aphoto161	MgBu-7	Detail of grave marker
10-016Aphoto162	MgBu-7	Detail of grave marker
10-016Aphoto163	MgBu-7	Detail of grave marker
10-016Aphoto164	MgBu-7	Detail of grave marker
10-016Aphoto165	MgBu-7	Detail of grave marker
10-016Aphoto166	MgBu-7	Detail of grave marker
10-016Aphoto167	MgBu-7	Detail of grave marker
10-016Aphoto168	MgBu-7	Detail of grave marker
10-016Aphoto169	MgBu-7	Detail of grave marker
10-016Aphoto170	MgBu-7	Detail of grave marker
10-016Aphoto171	MgBu-7	Detail of grave marker
10-016Aphoto172	MgBu-7	Detail of grave marker
10-016Aphoto173	MgBu-7	View east of Inuit grave yard
10-016Aphoto174	MgBu-7	View east of Inuit grave yard
10-016Aphoto175	MgBu-7	Detail of grave with collapsed lid
10-016Aphoto176	MgBu-7	View west of Inuit grave yard
10-016Aphoto177	MgBu-7	View east of site from the Inuit grave yard
10-016Aphoto178	MgBu-7	View west of Inuit grave yard
10-016Aphoto179	MgBu-7	View west of Inuit grave yard
10-016Aphoto180		Modern Inuksuk
10-016Aphoto181		Detail of walrus skull on Inuksuk
10-016Aphoto182		Modern Inuksuk
10-016Aphoto183		View south of site from outcrop to the north of site
10-016Aphoto184		View south of site from outcrop to the north of site
10-016Aphoto185		View south east of site from proposed borrow near freshwater lake
10-016Aphoto186		View southwest of proposed borrow between lakes
10-016Aphoto187		View southwest of proposed borrow between lakes
10-016Aphoto188		View south of outcrop that may be borrow near fresh water lake
10-016Aphoto189		View east across proposed borrow of freshwater lake and outcrop
10-016Aphoto190	MgBu-5	View east of American grave
10-016Aphoto191	MgBu-5	View northwest of American grave
10-016Aphoto192	MgBu-5	Detail of American grave

PIN-E AIA Photo Log (continued)

Number	Borden Number (if applicable)	Comment
10-016Aphoto193		View northwest of proposed gravel borrow
10-016Aphoto194		View south of site from proposed borrow
10-016Aphoto195	MgBu-5	View south of site from road
10-016Aphoto196		View south west of site from road
10-016Aphoto197		View south west of site from road
10-016Aphoto198	MgBu-5	Photo of genset at main site
10-016Aphoto199	MgBu-5	Photo of a truck
10-016Aphoto200	MgBu-5	Photo of the warehouse
10-016Aphoto201	MgBu-5	Photo of building remains

Water Licence Application

Durban and Padloping Islands

Remediation Project

Appendix 9

Supplemental Information

Available Reports

Durban Island

TITLE	AUTHOR	DATE
DEW Line Datafile Covering Report	Andzans Associates	1984
Removal of Contaminants From DEW Sites in Canada's Eastern Arctic	Holtz et. Al.	1986
FOX-E Durban Military Inspection Form	DND	1987
Six Intermediate DEW Line Sites in the Eastern Arctic	RRMC/ESG	1994
Risk Assessment for 7 Abandoned Military Stations in the Eastern Arctic	Qikiqtaaluk Corporation	1998
Contaminated Sites Water Monitoring Program – East Nunavut	Gartner Lee	2003 & 2004
FOX-E Durban Island Health Canada PQRA (Draft)	SENES	2008
FOX-E Durban Island Ecological Risk Assessment	SENES	2008
Cost Estimates for Remediation of Eight Nunavut Sites	AECOM	2009
FOX-E Durban Island Background Geochemistry Study Report	ESG	2010
FOX- E Durban Island Phase III Environmental Assessment	AECOM	2010
FOX E Durban Island Remedial Action Plan (provided)	AECOM	2011
FOX E Durban Island Environmental Impact Assessment (provided)	AECOM	2011
Issued for Tender Specification for the Environmental Site Remediation at FOX E Durban Island and Padloping Island	PWGSC	2011

Padloping Island

TITLE	AUTHOR	DATE
DEW Line Datafile Covering Report	Andzans Associates	1984
Removal of Contaminants From DEW Sites in Canada's Eastern Arctic	Holtz et. Al.	1986
Padloping Military Inspection Form	DND	1987
Remediation Options for Abandoned US Coast Guard Bases at Cape Christian and Padloping Island, NWT	Avati Ltd	1993
An Environmental Assessment of Padloping Island, NWT (Phase I & II)	RMC/ESG	1997
Risk Assessment for 7 Abandoned Military Stations in the Eastern Arctic	Qikiqtaaluk Corporation	1998
Limited Phase III Environmental Site Assessment and limited Remedial Action Plan	PWGSC / Earth Tech	2001-2002
Padloping Island Human Health Screening Level Risk Assessment	SENES	2003
Padloping Island Ecological Risk Assessment	SENES	2003
Contaminated Sites Water Monitoring Program – East Nunavut	Gartner Lee	2003 & 2004
Padloping Island Background Geochemistry Study Report	ESG	2010
Padloping Island Phase III Environmental Site Assessment	AECOM	2010
Padloping Island Remedial Action Plan (provided)	AECOM	2011
Padloping Island Environmental Impact Assessment (provided)	AECOM	2011
Issued for Tender Specification for the Environmental Site Remediation at FOX E Durban Island and Padloping Island	PWGSC	2011