APPENDIX 4:

HOPE LAKE
REMEDIATION PROJECT

REMEDIAL ACTION PLAN

Public Works and Government Services Canada

ISSUED FOR USE

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

SOLICITATION NUMBER: EW699-110498/001/NCS
PWGSC PROJECT NUMBER: R.040717.012
SUPPLY ARRANGEMENT NUMBER: EW699-100053/003/NCS

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EXECUTIVE SUMMARY

Foreword

The objective of the remedial action plan is to reduce environmental liability, maximize benefits to the local community and Inuit, and ensure good value to the people of Canada. This is done by identifying environmental liabilities at the sites; determining volumes of hazardous and non-hazardous wastes and contaminated soils; and identifying and evaluating remediation and disposal options.

The project consists of three sites: Hope Lake, Willow Creek and Husky Creek. Hope Lake, the largest site, is 75 km southwest of Kugluktuk and was a mining exploration site; it was to become an operating mine in 1968. It consists of three separate exploration sites (Coppermine River Ltd. (CRL) Camp, Hearne Camp and New Camp) with metal and buildings debris, an unmaintained airstrip, trail network, several drum caches, eight large petrol, oil and lubricant (POL) tanks, and numerous other fuel tanks. Willow Creek consists collectively of three small sites: main site, south cabins site and a southwest cabins site, and is located approximately 65 km south of Kugluktuk. The sites were historically accessed using float planes. The sites contain drum caches, structures (collapsed and intact), and several debris areas as well as scattered debris. Husky Creek is located about 55 km south of Kugluktuk and consists of a south and north site; site materials are comprised of wood, metal debris, drums, drill core boxed and a Bombardier muskeg vehicle.

Site access to the Hope Lake site is via airplane. A trail system exists throughout Hope Lake linking infrastructure on-site. There is no functional infrastructure at either the Husky Creek or Willow Creek sites.

Reclamation of the sites will include making the site safe; remediating soil that is either above federal or territorial guidelines or site-specific risk-based criteria; removing hazardous materials from the site; properly disposing of non-hazardous materials; and ensuring the site is aesthetically restored. A summary of the materials found at the sites and recommended remedial actions are provided below.

SUMMARY OF RECOMMENDED REMEDIAL OPTIONS

Waste Stream	Recommended Option	Comments
Wood Waste Non-Hazardous (588 m^3)	Control burn on-site	Hazardous material must be separated as well as non-wood waste removed. Wood would be burned in controlled burn. Ashes to be taken off-site
Aqueous Liquid Waste in Drums Non-Hazardous (8,269 L)	Treat on-site	Treatment may prove to be problematic but is the most cost effective option. Liquid not meeting water discharge criteria will be shipped off-site.
Other Solid Non-Hazardous Waste (503 m^3)	Remove off-site	Non-hazardous solid waste will need to be separated, compacted and removed off-site to an approved facility.
Asbestos Waste Hazardous (7 m^3)	Remove off-site	Asbestos waste will be handled by trained personnel and removed off-site to an approved facility.

SUMMARY OF RECOMMENDED REMEDIAL OPTIONS		
Waste Stream	**Recommended Option**	**Comments**
Liquid Organic Wastes in Drums Hazardous (14,642 L)	Incinerate	Organic liquid waste (fuels, oils drilling liquid) in drums and containers will be incinerated on-site, with the exception of those drums that can be identified and returned to owners and those not meeting the incineration criteria. These exceptions will be shipped off-site to an approved facility.
Pressurized Cylinders Hazardous (13 m^3)	Remove off-site	Depressurize and remove off-site to an approved facility, following facility and shipping company approval. Known contents that cannot be safely depressurized will be shipped offsite in an approved container, following landfill and shipping company approval.
Fire Extinguishers Hazardous (1 m^3)	Remove off-site	Remove off-site to an approved facility, following facility and shipping company approval. Volumes are limited.
Leachable Lead Paint on Tanks and a Caterpillar Hazardous (622 m^3)	Remove off-site, intact, with paint still on	This may be logistically challenging; will require coordination with another company to receive the tanks and caterpillar. (Note volume is for intact tanks)
Leachable Lead Paint on Drums Hazardous (1,535 drums)	Compact and remove off-site	Remove off-site to an approved facility.
Other Solid Hazardous Waste (3 m^3)	Compact and remove off-site	Remove off-site to an approved facility. Volumes are limited.
Metal-Impacted Soils (101 m^3)	Remove off-site	Remove off-site to an approved facility, will require waste characterization.
Hydrocarbon- Impacted Soils (106 m^3)	Remove soil > 2,500 mg/kg TPH off-site	Will require regulatory approval of site specific remediation criteria (SSRC); impacted soil adjacent to APEC 6A (30 m buffer) will be excavated. If SSRC is not accepted, soil will be landfarmed to meet remedial objectives.

Along with the materials on-site, there are physical hazards. These include an excavation, dilapidated building and debris such as broken glass, nails and cut metal. A site-specific safety plan will have to be developed to identify and mitigate all physical hazards.

To remediate the site a camp will be required at Hope Lake. Materials would be brought into Hope Lake during the winter prior to remediation; remediation will occur during the summer months and then all materials would be hauled out the following winter. If remedial activities proceed as planned there is no need for long-term monitoring as there would be no impacts remaining on-site. Verification and monitoring of construction works, environmental clean-up, verification of quantities and quality of work will need to be carried out during the remediation phase of this project.

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1.0 INTRODUCTION

1.1 GENERAL

EBA Engineering Consultants Ltd. (EBA) was retained by Public Works and Government Services Canada (PWGSC) to complete a Remedial Action Plan (RAP) at three former mineral exploration sites south of Kugluktuk, Nunavut (NU) (Figure 1). The three sites are: Hope Lake, Willow Creek, and Husky Creek. The RAP is a continuation of work that began in 2008 with a Phase I and II Environmental Site Assessments (ESA) (WESA 2009) and continued in July 2010 with a Phase III ESA (EBA 2010). The Phase III ESA also included geotechnical evaluation of the airstrip, landfill and borrow locations as well as an archaeological investigation. An Environmental Screening Report (ESR) is also being prepared under a separate document.

EBA understands that, through the Contaminated Sites Program, Indian and Northern Affairs Canada (INAC) is responsible to manage a number of contaminated properties that are no longer maintained by the original occupant. PWGSC Northern Contaminated Sites Group is managing the current project on behalf of INAC.

1.2 AUTHORIZATION

EBA obtained the authorization for undertaking the Phase III ESA and RAP at the three exploration sites from the PWGSC supply specialist, Mr. Brad McFadden, on June 2, 2010. Mr. Michael Bernardin, B.Env. D. of PWGSC is the Project Manager for this project.

2.0 OBJECTIVE

The objective of the work is to prepare a RAP for the sites along with a Class C substantive cost estimate that will be used to develop specifications and tender documents for remedial contractors.

The objective of the RAP is to reduce environmental liability, maximize benefits to the local community and Inuit, and ensure good value to the people of Canada.

3.0 SCOPE OF WORK

EBA will complete the following scope of work to develop a comprehensive site remediation plan:

- Identify environmental liabilities at the sites. This was done during the Phase III ESA.
- Determine volumes of hazardous and non-hazardous wastes and contaminated soils. This was completed during the Phase III ESA.

- Identify and evaluate remediation and disposal options. Options are to be evaluated based on the value to the Crown, the resources available to complete the project and the reduction in environmental liability.
- Prepare a substantive cost estimate in the latest version of Elemental Cost Analysis format (issued by the Canadian Institute of Quantity Surveyors).
- Evaluate and integrate the options into a recommended remedial approach for the site. The compilation of the above tasks would constitute the draft RAP.
- Conduct community consultation to present the draft RAP. It is important that the community understands the plans and they are given an opportunity to ask questions and be given answers. It is imperative that the final RAP meets the requirements of the community.
- Inherently included in this scope of work, but not specifically detailed is the incorporation of key factors such as INAC policies, clean up criteria and risk management techniques.

4.0 BACKGROUND

This background section provides a basic understanding of current site conditions, environmental conditions, site history and previous work that has been completed at the Hope Lake sites.

4.1 SITE AND AREA DESCRIPTION

Hope Lake (WK027) is 75 km southwest of Kugluktuk as shown in Figure 1 and was a mining exploration site with intentions to become an operating mine in 1968. It consists of three separate exploration sites (Coppermine River Ltd. (CRL) Camp, Hearne Camp and New Camp) with numerous metal and building debris, an unmaintained airstrip, trail network, several drum caches, eight petrol, oil and lubricant (POL) tanks, three fuel tanks, 21 horizontal tanks and several drum caches. There are both full and empty fuel drums. The site covers 1,500 ha. A southern exploration area, south of the main Hope Lake site is currently under a mineral lease but is not part of this investigation as it is situated on Inuit-owned lands.

Willow Creek consists collectively of three small sites, main site, south cabins site and a southwest cabins site, and is located approximately 65 km south of Kugluktuk. The sites were accessed using float planes. The main site (WK172) is spread out over 16 ha and consists of seven drum caches, four collapsed structures, one intact structure, two burn pits, seven main debris areas as well as scattered debris. The south cabins site (WKB01) consists of two debris areas, one collapsed and one dilapidated structure, and two drum caches over an area of 0.45 ha. The southwest cabins site (WKB02) consists of one debris area, one collapsed structure, one drum cache and one float plane dock.

Husky Creek (WK197) is located about 55 km south of Kugluktuk and consists of a south site and north site with site footprints of 0.08 ha and 0.95 ha, respectively. At the south site

are a floor platform, wood, a propane cylinder, metal debris, drill core boxes, an old water pump and drill, nine drums with one full, two partially full and six empty. At the north site are a bombardier muskeg vehicle, wood and metal debris, and three drums with one full, one partially full and one empty.

More detailed descriptions of the infrastructure and material at each site can be found in the Phase III ESA (EBA 2010).

4.2 OVERVIEW OF BIOPHYSICAL CONDITIONS

The daily average temperature in Kugluktuk is -10.6ºC with an average summer temperature of 5ºC and average winter temperature of -26ºC (Environment Canada 2010a). The average annual precipitation is 249.3 mm. Precipitation in the form of snow can occur at any time throughout the year, but is not common in June through August. Winds prevail from the north and northeast in the summer and west and southwest in the winter.

The site is part of the Bear Geological Province in the northwest part of the Precambrian Canadian Shield. The rocks of the Bear Geological Province contain deposits of uranium, chalcocite, copper, bornite and chalcopyrite. The surficial geology of the area is predominantly glaciofluvial deposits of sand, gravel, and till with bedrock outcrops. The main glacial landforms found in the area are till plains, drumlins, eskers, scarps and erratics (Dredge 2001). The northern two-thirds of this region is underlain by continuous permafrost with medium to high ice content in the form of ice wedges, while the southern one-third adjacent to Coronation Gulf is underlain by permafrost with low to medium ice content. Thaw ponds and thermokarst lakes are common where ground ice has melted near the surface. At Hope Lake, drainage is to the north towards Hope Lake. At Willow Creek, drainage is to the south toward Big Creek. At Husky Creek, drainage is toward the unnamed lake (Natural Resources Canada 2010).

Cryosolic soils are common in northern Canada due to the low mean annual temperatures and present of permafrost. Soils encountered during the field program consisted typically of a few centimetres of LFH horizon followed by B horizon usually of friable or loose silty clay or silty clay loam with abundant cobbles and gravel. Occasionally A or Ah horizons were present. Hope Lake is part of the Coronation Hills Southern Arctic Ecoregion within the Southern Arctic Ecozone. The tundra vegetation, also known as "barren grounds", consists of dwarf birch, willow, northern Labrador tea, avens, cranberries, heather, saxifrage, and sedge tussocks.

Wildlife that is noted to be present in the Hope Lake area includes caribou, moose, musk ox, grizzly bear, snowshoe hare, fox, wolf, coyote, beaver, muskrat, osprey, raven, spruce grouse and waterfowl (Environment Canada 2010b). During the 2010 field program, caribou, grizzly bear, wolf, osprey and waterfowl were observed at the sites. Detailed information on the biophysical conditions at each of the sites is provided in the ESR that will be submitted as part of this project.

4.3 SITE HISTORY

The sites are situated in Coppermine Region which was named by Samuel Hearne in 1771 when he travelled over land from Hudson's Bay to investigate the source of copper discovered by locals. Float equipped aircraft allowed active exploration to commence in 1929. From 1929 to 1966, numerous exploration companies actively prospected and drilled in the area; however, no deposits of significant size were located. In 1966, PCE Explorations Ltd. undertook a large mineral staking program. Several other companies were attracted to the area by the news of a major exploration venture. In 1968, Coppermine River Limited prepared a feasibility study to conduct copper mining and build a town site at Hope Lake; however, these plans were not carried out (Bracken 1968). No reported exploration activities have occurred near any of the sites since the 1970s.

Several mineral claims are present at the sites and surrounding the sites. The active and lapsed mineral claims are summarized below in Table 1 (INAC 2010).

TABLE 1: MINERAL CLAIMS

Area	Claim Number	Claim Name	Owner	Lapse Date
Hope Lake WK027 Northeast	F97941	RC -1	Rory Calhoun	December 24, 2007
Hope Lake WK027 South	Nunavut Land Claims Parcel 1046	Parcel ID 405 CO-54	Kitikmeot Region	-
Willow Creek WK172	K07215	MA-19	Angus Alexander McPherson	June 7, 2010
Willow Creek WKB01	K07214	MA-18	Angus Alexander McPherson	June 7, 2010
Willow Creek WKB02	F67979	A-17	Rory Calhoun	December 21, 2001
Husky Creek WK197 North	F98042	RC-103	Rory Calhoun	Active
Husky Creek WK197 South	F97952	RC-12	Rory Calhoun	December 24, 2007

Historical information indicates that "JIM" claims surround Willow Creek WKB01, "VIC" claims lie south of Willow Creek WKB02 (Huntec 1968), and South Husky Creek WK197 belonged to the "WIL" claim group (Ritchie 1968).

The south portion of Hope Lake WK027, as well as Willow Creek WKB02, are located within the Nunavut Land Claim Parcel Area (INAC 2010).

The three sites are currently unoccupied with no ongoing land use since previous exploration activities ceased in the 1970s. The Kugluktuk Hunters and Trappers Organization (HTO) own and manage a cabin at the Hope Lake site, which is used by local hunters. Newer barrels of fuel were observed at the Hope Lake airstrip indicating the airstrip may have been recently used as a fuel cache site. Other than this, the only other known uses of the site have

been during the 1960s and 1970s as exploration camps. There are no nearby adjacent land uses, but historically, there has been exploration conducted on surrounding land as well.

4.4 PREVIOUS STUDIES

There have been Phase I, II and III ESAs completed at all three sites. These reports are listed below and findings are in the following sections.

- Integrated Phase I and Limited Phase II ESA, WK197 - Husky Creek, WESA, March 2009, File: KB6852 (WESA 2009a).
- Integrated Phase I and Limited Phase II ESA, WK172 - Willow Creek and Nearby Sites, WKB01 – Cabins South of WK172, WKB02 - Cabins Southwest of WK172, WESA, March 2009, File: KB6852 (WESA 2009b).
- Integrated Phase I and II ESA, WK027 – Hope Lake, WESA, March 2009, File: KB6852 (WESA 2009c).
- Phase III ESA, Hazardous and Non-hazardous Materials Audit, Geotechnical Evaluation and Archaeological Investigation, Hope Lake Nunavut. December 2010, File: Y22101167.007 (EBA 2010).

No other known studies were identified during the records review at Hope Lake, Willow Creek, and Husky Creek.

Other reports completed in the region that were reviewed as part of the Phase III ESA (EBA 2010) are included in the reference section of that report.

Details on the materials inventory for all three sites are provided in Appendix A. A photo log is provided in Appendix B. Photos and video log are provided digitally on DVD. Figures 2 to 4 are for Husky Creek; Figures 5 to 9 are for Willow Creek and Figures 10 to 19 are for Hope Lake.

4.4.1 Husky Creek

EBA has separated Husky Creek North and South sites into nine areas of potential environmental concern (APECs) as shown on Figures 2, 3 and 4:

- APEC 1 to 6 and 10: South Site (Figure 3);
- APEC 7 to 9 and 11: North Site (Figures 4 and 4A)

EBA identified 6 m^3 of hydrocarbon contaminated soil at the North Site. There is a small amount of debris at the Husky sites, summarized in Table 2 below. The small amount of debris, the close proximity to the lake, and inaccessibility of the site make the siting of a landfill or landfarm unfavourable at Husky Creek.

TABLE 2: INVENTORY SUMMARY AT HUSKY CREEK WK197			
TOTALS	Non-Hazardous	Solid Material	38 m^3
		Liquid Material (Aqueous)	546 L
		Drums (205 L)	3 drums
	Hazardous	205 L Drums (Leachable Lead Paint)	13 drums
		Pressurized Cylinder	1

4.4.2 Willow Creek

Based on the spatial distributions of the materials and historical site activities, EBA separated Willow Creek into 27 APECs as shown on Figures 5 through 9:

- APEC 1 to 16 and 27: Willow Creek Main Camp - WK172 (Figures 6, 6A through 6C, and 7)
- APEC 17 to 22: Cabin South - WKB01 (Figures 8 and 8A)
- APEC 23 to 26: Cabin Southwest - WKB02 (Figure 9)

There was 16.8 m^3 of hydrocarbon-impacted soil and 0.1 m^3 of metal-impacted soil at Willow Creek. A summary of the materials inventoried at the Willow Creek sites is provided below (Table 3). At Willow Creek WK172 Main Site, an area south of the southern debris area was identified as a potential landfill/landfarm location. At Willow Creek WKB01 South Cabin and Willow Creek WKB01 Southwest Cabin, the local topography, drainage, proximity to the lake, and/or amount of material on-site were not favourable to siting a landfill or landfarm at either of these locations.

TABLE 3: INVENTORY SUMMARY OF ALL WILLOW CREEK SITES (WK172, WKB01, WKB02)			
TOTALS	Non-Hazardous	Solid Material	127 m^3
		Liquid Material (Aqueous)	6,867 L
		Drums (205 L)	132 drums
	Hazardous	Fiberboard and Insulating Materials (Asbestos Containing)	1.6 m^3
		Batteries (Content)	0.3 m^3
		Drums (205 L) (Leachable Lead Paint)	355 drums

4.4.3 Hope Lake

Based on the spatial distributions of the materials and activities, EBA separated Hope Lake into eight APECs as shown on Figures 10 through 19:

- APEC 1: West of CRL Camp (waste dump site, Figure 11)
- APEC 2: POL Tanks (Group of 6, Figure 12)

- APEC 3: CRL Camp (Figures 13, 13A through 13E and 14)
- APEC 4: Hearne Camp (Figures 15, 15A and B)
- APEC 5: New Camp (Figure 16)
- APEC 6A: POL Tanks (Group of 2, Figure 17)
- APEC 6B and 7: Airstrip Area (Figures 18, 18A through 18C and 19)
- APEC 8: Southern Exploration Area (outside of current scope of work)

As APEC 8 is located on Inuit-owned land, it was removed from the scope of this Phase III ESA.

There is 1,739 m^3 of hydrocarbon contaminated soil, 97 m^3 of metal and salt contaminated soil and 4 m^3 of hydrocarbon and metal contaminated soil at Hope Lake. The infrastructure and debris located at Hope Lake is summarized in Table 4 below. Three potential landfill/landfarm locations were identified at Hope Lake. These sites could alternatively be used for borrow sources. Approximate granular borrow quantities are 8,000 to 16,000 m^3 at each of landfill/landfarm location. Three other borrow sources were identified in the area, ranging from 5,000 to 20,000 m^3 for borrow depths of 1 to 2 m.

TABLE 4: INVENTORY SUMMARY OF HOPE LAKE (WK027)

TOTALS	**Non-Hazardous**	Solid Material	803 m^3
		Liquid Material (Aqueous)	854 L
		Tanks	123 m^3
		Small Drums	213 drums
		Drums (205 L)	227 drums
	Hazardous	Light Ballasts, Fire Extinguishers, Fluorescent Lights, Batteries	2 m^3
		Electrical Insulators, Gaskets, Mastic (Asbestos Containing)	5 m^3
		Caterpillar, POL Tanks (Leachable Lead Paint)	622 m^3
		Small Drums (Leachable Lead Paint)	24 drums
		205 L Drums (Leachable Lead Paint)	1,143 drums
		Liquid Waste (Organic Content in drums)	14,300 L
		Drilling Fluid Containers (Contents)	342 L
		Pressurized Cylinder	11 m^3

5.0 SITE ACCESS AND INFRASTRUCTURE

Site access to the Hope Lake site is via airplane. A trail system exists throughout Hope Lake linking infrastructure on-site; however, this is primarily a quad trail. Access to Willow and Husky Creek can be made by float plane; however, functional docks are not present. Quad access to these sites via Hope Lake was attempted during the 2010 field season; however, it was not possible due to terrain and stream crossings constraints. Kugluktuk

residents indicated that winter access connects the three sites as well as a winter trail from Kugluktuk to Hope Lake that is used by local hunters. There is an active Hunters and Trappers Organization (HTO) cabin at Hope Lake.

There is no functional infrastructure at either Husky Creek site. Of the structures at Willow Creek WK172, one cabin remains standing near the shore of Willow Lake and is in relatively good condition while all other structures have collapsed. At Willow Creek WKB01, one leaning structure is present; at WKB02, the float dock remains.

The infrastructure at Hope Lake was not maintained and all structures have collapsed but numerous fuel tanks and barrels remain. The airstrip at Hope Lake is in fair condition, and was used during the 2010 field program for landing of Dornier and Skyvan aircraft. The HTO cabin, located east of the former Hearne Camp, is maintained by the local HTO, and is in good condition.

6.0 REGULATORY CONSIDERATIONS

Based on the terms of reference for this work, the Canadian Council of Ministers of Environment (CCME 1999, 2008) Environmental Quality Guidelines (EQGs) were used to compare and interpret the laboratory analytical results of the soil, water and sediment samples. Where CCME EQGs do not exist or are not applicable to the specific site conditions, environmental guidelines or standards from the territorial or provincial jurisdictions were adapted. Site-specific criteria, based on background conditions, were also developed for certain metal parameters. Details on the appropriate criteria and site-specific remediation criteria (SSRC) for metals is provided in the Phase III ESA (EBA 2010).

Based on the Phase III results, human health and ecological evaluations were conducted during development of the remedial action plan to determine if site-specific or risk-based criteria could be used for the impacted material found on-site. With the exception of pathway elimination, there are no options available to develop risk based criteria for metal and/or salt-impacted soils. The only receptor pathway that could be reasonably excluded at the sites was the human inhalation and this pathway is only valid for petroleum hydrocarbons.

However, as part of the RAP, the development of SSRC to protect the human and ecological health was considered under the specific site conditions and to reduce the environmental footprint of remediation for hydrocarbon-impacted soil. Full explanation and calculations are provided in Appendix C. Based on previous research a criteria of 2,500 mg/kg total petroleum hydrocarbon (TPH) F1-F3 was derived for use at Hope Lake.

All applicable territorial guidelines or criteria will be identified for the final RAP. Territorial guidelines relevant to site remediation will be reviewed and followed. For example, remediation may require monitoring air quality if burning material on-site, or surface water may need to be tested prior to disposal if doing on-site treatment.

7.0 REMEDIAL OPTIONS

This section outlines remedial options for each waste stream. We begin by providing a summary of the waste streams and potential options. We also provide details on how the options were ranked using parameter that were deemed to be important (i.e., community acceptance and cost).

7.1 SUMMARY OF POTENTIAL REMEDIAL OPTIONS

Reclamation of the site will include making the site safe; remediating soil that is either above federal or territorial guidelines or site-specific risk-based criteria; removing hazardous materials from the site; properly disposing non-hazardous materials; and reclaiming and ensuring the site is aesthetically restored. A summary of the materials found at the three sites and identified options are provided in Table 5 below. Each of these materials is addressed in subsequent sections in more detail.

TABLE 5: REMEDIAL OPTIONS IDENTIFIED FOR MATERIALS AT HOPE LAKE, WILLOW CREEK AND HUSKY CREEK

Issue	Description
Wood Waste Non-Hazardous	Approximately 588 m^3 of wood, primarily from existing collapsed buildings on all three sites. Wood waste can be dealt with by controlled burning on-site, on-site disposal in a landfill or off-site disposal to an approved facility.
Aqueous Liquid Waste in Drums Non-Hazardous	Approximately 8,269 L of liquid aqueous wastes in drums on all three sites. This waste can be treated and disposed on-site or removed off-site.
Other Waste Non-Hazardous	Approximately 503 m^3 of metal, tanks, or other inert waste and 575 small and large drums can be placed in on-site landfill or disposed of at an off-site approved facility.
Asbestos Waste Hazardous	Approximately 7 m^3 of asbestos containing insulation, mastic, electrical insulators and gaskets at the Hope Lake and Willow Creek sites will require either on-site disposal in a landfill or off-site disposal to an approved facility.
Liquid Organic Wastes in Drums Hazardous	Approximately 14,300 L of liquid organic wastes in drums and 342 L of drilling lubricants at the Hope Lake site. This waste can be incinerated on-site, disposed in an approved off-site facility and/or returned to the original owners.
Pressurized Cylinders Hazardous	Approximately 13 m^3 of pressurized cylinders at all three sites. This waste can be placed in on-site landfill or disposed of at an off-site approved facility. A specialist may be required for venting unknown contents if landfilled on-site.
Fire Extinguishers Hazardous	Approximately 1 m^3 of fire extinguishers (and potentially content) are at the Hope Lake site. This waste can be landfilled on-site or if there is content, removed off-site.
Leachable Lead Paint on Tanks, Caterpillar Hazardous	Approximately 622 m^3 of tanks (note volume is for intact tanks) and one caterpillar are at the Hope Lake site. For this waste, the paint can be removed (very labour intensive) and tanks and caterpillar dismantled and landfilled on-site, or the tanks and caterpillar can be removed intact to an off-site landfill. Note if the paint is removed the paint has to be removed off-site.

TABLE 5: REMEDIAL OPTIONS IDENTIFIED FOR MATERIALS AT HOPE LAKE, WILLOW CREEK AND HUSKY CREEK	
Issue	**Description**
Leachable Lead Paint on Drums Hazardous	Approximately 1,535 drums with leachable lead paint are at the three sites. This waste will be crushed and removed off-site to an approved facility.
Other Solid Hazardous Waste	Approximately 3 m^3 of miscellaneous solid hazardous waste (batteries, light ballast, etc.) will require disposal in an off-site to an approved facility.
Contaminated Soil	Approximately 101 m^3 of soil contaminated with metal and salts will require off-site landfill disposal. 1,762 m^3 of soil contaminated with only PHCs can be disposed of off-site, remediated on-site, or left in-situ.

7.2 REMEDIAL OPTIONS ANALYSIS

Evaluation of the various remedial options was done using a systematic process that identifies parameters in which to rank the options and the relative importance of those parameters. For this project a decision making matrix based on the Kepner Tregoe process was used. Kepner Tregoe is a rational process for assessment and prioritizing risk and selecting between various options, weighting attributes, such as cost or aesthetics, according to their relative importance to stakeholders. There are four basic steps to Kepner Tregoe:

- **Situation appraisal** - is used to clarify the situation, outline concerns and choose a direction.
- **Problem analysis** - here the problem is defined and its root cause determined.
- **Decision analysis** - alternatives are identified and a risk analysis done for each.
- **Potential problem analysis** - the best of the alternatives is further scrutinized against potential problems and negative consequences and actions are proposed to minimize the risk.

For each remedial option identified, the following weighted attributes are considered important for determining which option may be the most preferred.

- **Cost** - This will include all costs including initial costs of implementing the option and any long-term costs such as monitoring. This attribute is weighted the highest at 25%.
- **Effectiveness in Meeting Remedial Goals** - This attribute includes an evaluation on whether the option will meet a regulatory target, such as a guideline criteria or site-specific risk-based criteria. Where criteria or site-specific criteria are not met an evaluation is made on whether the exposure pathway can be effectively managed or a receptor can be prevented from being impacted by the contaminant or hazard. This attribute has been weighted moderately at 15%.

- **Ease of Implementation** - This includes how easily an option can be implemented, with proven solutions and the solutions that can be done easy on remote sites ranking higher than solutions that are problematic, less proven or are more complex. This attribute has been weighted moderately at 15%.
- **Regulatory Acceptance** - Is the likelihood that an option could be readily accepted by the various regulators including INAC, Environment Canada and Territorial regulators. This attribute has been weighted relatively moderately at 15%.
- **Community Acceptance** - This is how likely stakeholders from the community and First Nations nearby Hope Lake, Willow Creek and Husky Creek will accept the remedial option. This attribute is weighted relatively moderate at 15%.
- **Loss of Natural Capital** - Natural capital can be defined as the value that natural ecosystems contribute in terms of ecosystem goods (i.e., fish, wildlife, trees) or services (water catchment, erosion control, carbon cycling). The loss of the natural ecosystem through disturbance does have an impact to natural capital. The higher ranking corresponds to a lesser chance that there will be a loss of natural capitol. This attribute has been weighted lower at 10%.
- **Timeframe for Remediation** - Is the length of time that an option will take to remediate to applicable criteria. Options involving risk management will rank lower typically due to the timeframe required. This attribute has been weighted lower at 5%.

Each option is ranked with respect to the attribute. For the ranking within the attribute, the higher number indicates a better option. The percent weight is multiplied by the ranking and the resultant numbers for each of the options are summed to produce a final score. The option with the highest score is the most desirable with respect to the weighted attributes. The options are then ranked against each other, with the number one option being the one with the highest weighted score.

This method allows decision makers to qualitatively judge options and to determine sensitivity of the parameter weighting. Number one options may not always be the best solution, as the parameters are just ranked from high to low. For example, for cost, there is no indication that one option may only be 10% or 100% more than another. The three options would still be ranked as 1, 2 and 3. While there are some draw backs to this process, it is done objectively, so personal biases are not introduced and it provides a means to looking at multiple parameters, not just one.

7.3 NON-HAZARDOUS WASTE

7.3.1 General

Non-hazardous waste includes materials such as metal, canvas, ceramic/porcelain, cores, empty drums, household items, plastic, rubber, tanks, textile, fibreglass insulation, roofing material, glass, linoleum, non-PCB ballasts, machinery, equipment and other inert items. The boxed cores at APEC 5 at Hope Lake will be restacked and left on-site, since they have the

potential for future use. The items documented by EBA that are considered to be non-hazardous waste are summarized in Table 6.

TABLE 6: TOTAL NON-HAZARDOUS MATERIALS

Site	Material Description	Volume
Husky Creek	Wood	11 m^3
	Liquid Aqueous Waste in Drums	547 L
	Other Non-Hazardous Waste	27 m^3, 3 drums
Willow Creek	Wood	75 m^3
	Liquid Aqueous Waste in Drums	6,868 L
	Other Non-Hazardous Waste	52 m^3, 132 drums
Hope Lake	Wood	502 m^3
	Liquid Aqueous Waste in Drums	854 L
	Other Non-Hazardous Waste	424 m^3(includes tanks), 440 large and small drums

Notes
For remedial planning purposes (cost and schedule) we increased the volume of the aqueous liquid waste and other non-hazardous waste products by 30% and 35% respectively. This increase is to reflect the uncertainty with volumes and the impact they have on planning and costs.
The wood waste volume was not altered as that material is being disposed of on-site and cost and time for disposal are not greatly affected by volume.

The waste streams for the three sites have been combined for the purposes of this report. Due to the small amounts at Husky and Willow, these wastes be removed and will require shipment via air or cat train from their location to the landfill or staging area at Hope Lake. Each of the waste streams listed in Table 6 are discussed separately below.

7.3.2 Wood Waste

Wood waste is not an environmental concern but may be both an aesthetic and safety concern. Dilapidated and collapsed buildings have little historic value and can be an extreme hazard to occasional visitors. The buildings should be dismantled and the wood adequately disposed of. Approximately 588 m^3 of wood from buildings will need to be adequately disposed of. Most of the wood is unpainted. There is some painted wood at APEC 5 at Hope Lake; this paint does not contain lead.

There are three options for the wood waste: it can be burned and the ashes placed in a landfill on-site or off-site; it can be placed in an on-site landfill, or it can be taken off-site for landfill disposal. A description of each of the options is as follows:

1. **Burning:** The unpainted wood would be gathered to a central location. Only unpainted wood can be burned. The wood would be burned in a controlled fire at a time of year when the chance for getting out of control would be minimal. To save money buildings and wood debris can be burned in place; however, some of the

buildings and wood debris may not be in ideal locations. Conceptually, the steps for conducting a controlled burn of the wood at the site are as follows:

- Conduct separation of hazardous materials from the building and wood debris.
- Conduct separation of other non-hazardous materials that should not be burnt, such as painted wood, metals, fibreglass, etc., from the wood debris.
- Demolish the buildings that are still intact.
- Haul wood to designated burn location.
- Conduct controlled burn at appropriate time of year.
- Test ashes to determine whether they require landfill disposal off-site.

2. **Landfill On-Site:** Conceptually, a non-hazardous waste landfill could be built, or alternatively, if other wastes are to also to be landfilled, a Class 2 or higher landfill can be built. Details of landfill design and use, as well as information on borrow material is provided in Section 9. The steps are as follows:

- Conduct separation of hazardous material from the building and wood debris.
- Demolish the buildings that are still intact.
- Haul wood to on-site landfill, compact and cover.

3. **Remove Off-Site**: The wood would be taken to a staging area and then hauled out via winter trail to Kugluktuk for shipment to another suitable location for landfilling. The steps are as follows:

- Conduct separation of hazardous material from the building and wood debris
- Demolish the buildings that are still intact.
- Haul to staging area.
- In winter, load on cat train and haul on winter trail for further shipment to an off-site licensed, disposal facility.

The options are evaluated below:

TABLE 7: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR WOOD

Option/Attribute	Attribute Weighting	Burning	Landfill On-Site	Remove Off-Site
Cost	25%	3	1	2
Effectiveness in Meeting Remedial Goals	15%	2	1	3
Ease of Implementation	15%	3	2	1
Regulatory Acceptance	15%	2	1	3
Community Acceptance	15%	3	1	2

TABLE 7: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR WOOD				
Option/Attribute	**Attribute Weighting**	**Burning**	**Landfill On-Site**	**Remove Off-Site**
Loss of Natural Capital	10%	2	1	3
Timeframe for Remediation	5%	3	1	2
Total Score		18	8	16
Weighted Score		2.6	1.2	2.2
Number of High Scores		4	0	3
Ranking		1	3	2

The highest ranked and preferred option is burning. Burning is the most cost effective, easiest to implement, will be accepted by the community (common practise) and can be done during other remedial activities on-site. Landfilling on-site was the least preferred as it is not cost effective; does not effectively meet remedial goals (landfill monitoring); and there is a loss of natural capital due to disturbance of the tundra for landfill and borrow. There are several potential concerns with burning on-site:

- Wood must be separated from the other non-hazardous waste.
- Burning must be done at certain times of years when fire risk to the surrounding tundra is low and should be done by someone experienced. If done improperly, a tundra fire could result.
- Regulatory approval for a controlled burn will need to be obtained and the burn will have to be completed in an approved container.
- Ashes from burn will need to be tested and properly disposed.

7.3.3 Aqueous Liquid Wastes in Drums

Liquid aqueous waste in drums is a potential contamination concern if the drum leaks and contents spread to underlying soil. It can also further spread by surface water flow. The drums can also be a hazard if under pressure and can spray if opened. An estimated 8,269 L of aqueous waste is known to be present in drums throughout all three sites; there may be additional volume identified once remediation is started. There are two options for the disposition of aqueous waste in drums: treatment and disposal on-site or removal off-site (INAC 2008). A description of each of the options follows:

1. **Treatment and Disposal On-Site:** An oil and water separator (and possibly an activated carbon water treatment system) would be brought to site and the contents of the drums would be run through the separator and disposed of. The steps are as follows:

- Bring drums to the separator;
- Run contents of drums through the separator to separate aqueous and organic phases;

- Test remaining water according to the water permit and dispose accordingly; and
- The remaining organic liquids would be incinerated on-site.

2. **Remove Off-Site:** The drums would be placed in overpack drums and then hauled in winter via winter trail to Kugluktuk. The steps are as follows:

- Place drum in overpack drum, sample for TDG and waste disposal;
- Haul to staging area; and
- In winter, load on cat train and haul on winter trail to Kugluktuk for further shipment to an off-site licensed disposal facility.

The options are evaluated below:

TABLE 8: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR AQUEOUS WASTES IN DRUMS

Option/Attribute	Attribute Weighting	Treatment On-Site	Remove Off-Site
Cost	25%	2	1
Effectiveness in Meeting Remedial Goals	15%	1	2
Ease of Implementation	15%	1	2
Regulatory Acceptance	15%	1	2
Community Acceptance	15%	1	2
Loss of Natural Capital	10%	1.5	1.5
Timeframe for Remediation	5%	1.5	1.5
Total Score		9	12
Weighted Score		1.3	1.7
Number of High Scores		1	4
Ranking		2	1

Our preferred option is to treat on-site, even though the highest ranked option is to remove off-site. While there may be some challenges with on-site treatment (e.g., effectiveness or timeframe) the cost advantage to on-site treatment outweighs the other parameters. The following are potential issues with the treatment of the aqueous liquid on-site:

- Additional logistical planning involved in getting a separator on-site.
- The separated water must meet current criteria/guidelines for on-site disposal.
- The separated hazardous organic liquid waste will be incinerated on-site, its ashes tested for leachates, and disposed of accordingly.

In the event that on-site treatment is not cost effective, the aqueous liquids would be removed and disposed of off-site at a licensed disposal facility.

7.3.4 Other Solid Non-Hazardous Waste

Other solid non-hazardous waste includes metal, canvas, ceramic/porcelain, cores, empty drums, household items, plastic, rubber, tanks, textile, fibreglass insulation, roofing material, glass, linoleum, non-PCB ballasts, machinery, equipment and other inert items in various locations. It is an aesthetic concern and a minor safety hazard. None of the machinery has historical value or could be put to use, and the majority of this material has little value.

Approximately 503 m^3 of other non-hazardous material and 575 small and large empty drums have been identified at all three sites within buildings and at debris areas. There are two options for the other non-hazardous waste: it can be placed in a landfill on-site or off-site. A description of each of the options follows:

1. **Landfill On-Site:** Conceptually, a landfill could be built as previously described. The steps are as follows:

- Conduct the separation of non-hazardous materials from wood buildings and removal from debris areas and burn pit sites.
- Haul to staging area.
- Clean drums and tanks and remove residual fluids/fuels from machinery.
- Cut up the tanks, crush the metal debris, drums and machinery.
- Haul materials to an on-site landfill, compact and cover.

2. **Remove Off-Site:** The other non-hazardous waste would be hauled to a staging area and then hauled in winter via winter trail to Kugluktuk for shipment to another suitable location for landfilling. The steps are as follows:

- Conduct the separation of non-hazardous materials from wood buildings and removal from debris areas and burn pit sites.
- Haul to staging area.
- Clean drums and remove residual fluids/fuels from machinery.
- Cut up the tanks, crush the metal debris, drums and machinery.
- In winter, load on cat train and haul on winter trail to Kugluktuk for further shipment to a licensed disposal facility.

The options are evaluated and provided on the following page:

TABLE 9: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR OTHER NON-HAZARDOUS WASTE			
Option/Attribute	**Attribute Weighting**	**Landfill On-Site**	**Remove Off-Site**
Cost	25%	1	2
Effectiveness in Meeting Remedial Goals	15%	1	2
Ease of Implementation	15%	2	1
Regulatory Acceptance	15%	1	2
Community Acceptance	15%	1	2
Loss of Natural Capital	10%	1	2
Timeframe for Remediation	5%	1	2
Total Score		8	13
Weighted Score		1.2	1.8
Number of High Scores		1	6
Ranking		2	1

The highest ranked and the preferred option is to remove off-site. It scored highest for cost, effectiveness, community and regulatory acceptance, natural capital and timeframe. The following are potential issues with removing the other non-hazardous waste off-site:

- Separating the other non-hazardous waste from the wood waste may be time consuming and challenging.
- There will be additional logistical planning associated with transporting the waste off-site.

7.4 HAZARDOUS WASTE

7.4.1 General

Wastes are considered hazardous due to their toxicity, flammability, explosiveness, corrosivity or properties and fall under the definition of hazardous materials under most federal, provincial or territorial legislation under transportation of dangerous goods regulations. The following is a list of known hazardous waste at the sites.

TABLE 10: TOTAL HAZARDOUS MATERIALS

Site	Material Description	Volume
Husky Creek	Pressurized Cylinders	1 m^3
	Leachable Lead Paint on Drums	13 drums
Willow Creek	Asbestos Wastes	2 m^3
	Batteries	1 m^3
	Leachable Lead Paint on Drums	355 drums
Hope Lake	Asbestos Wastes	5 m^3
	Organic Liquid Wastes in Drums	14,300 L
	Drilling Fluids	342 L
	Pressurized Cylinders	11 m^3
	Fire Extinguishers	0.4 m^3
	Leachable Lead Paint on Tanks and Caterpillar	622 m^3
	Leachable Lead Paint on Large and Small Drums	1,167 drums
	Other Solid Hazardous Waste	2 m^3

Notes
For remedial planning purposes (cost and schedule) we increased the volume of the organic liquid waste products by 30% to reflect the uncertainty with volumes and the impact they have on planning and costs. The costs for the leachable lead paint and drums were increased by 15% (weight basis) after discussions with Mindecom on converting volume/number of drums to a weight basis. The other hazardous waste (e.g., cylinders, asbestos, batteries) was not increased as volumes estimated in the field are sufficient to accommodate an increase in actual number.

The waste streams for the three sites will combined since materials will be moved from Husky Creek and Willow Creek to Hope Lake. Wastes at Husky and Willow Creeks will require shipment via air or cat train from their location to a staging area at Hope Lake and then be disposed of. Each waste stream is discussed below.

7.4.2 Asbestos Wastes

Asbestos is an inhalation hazard and is more of a safety hazard than a hazardous waste, but due to special handling, precautions and disposal, it is similar in nature to hazardous waste and needs to be dealt with adequately. Approximately 7 m^3 of asbestos will need to be removed and appropriately disposed of, according to the applicable guideline (Government of Nunavut 2011a). There are two options for disposal of asbestos containing materials: disposal in an on-site landfill or disposal in an off-site landfill, possibly Hay River, or further south. A description of each of the options follows:

1. **Landfill On-Site:** For asbestos, the material is double bagged or containerized in a sound, sealable and not damaged or leaking container, in accordance with the applicable guideline. It is then placed in a known location within the landfill and the location is recorded. The steps are as follows:

- Conduct removal of asbestos materials from the building or substrate. Asbestos is handled and removed by trained personnel and properly bagged.
- Haul asbestos to an on-site landfill, record location and cover.

2. **Remove Off-Site:** The asbestos would be hauled to a staging area and then hauled in winter via winter trail or by air to Kugluktuk for shipment to another suitable location for landfilling. The steps are as follows:

- Conduct removal of asbestos materials from building or substrate. Asbestos is handled and removed by trained personnel and is double bagged or containerized in a sound, sealable and not damaged or leaking container, in accordance with the applicable guideline.
- Haul to staging area
- In winter, load on cat train and haul on winter trail or by air to Kugluktuk for further shipment to a licensed disposal landfill for this type of hazardous waste.

The options are evaluated below:

TABLE 11: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR ASBESTOS

Option/Attribute	Attribute Weighting	Landfill On-Site	Remove Off-Site
Cost	25%	1	2
Effectiveness in Meeting Remedial Goals	15%	1	2
Ease of Implementation	15%	2	1
Regulatory Acceptance	15%	1	2
Community Acceptance	15%	1	2
Loss of Natural Capital	10%	1	2
Timeframe for Remediation	5%	1	2
Total Score		8	13
Weighted Score		1.2	1.8
Number of High Scores		1	6
Ranking		2	1

The highest ranked and preferred option for asbestos is to remove off-site. The only attribute that it did not score highest on was for ease of implementation. As the volume is low, this would be the most practical solution. The following are potential concerns with removal of asbestos waste off-site:

- Asbestos can only be handled by personnel with asbestos abatement training (required regardless of the remedial option)

- There will be additional logistical planning associated with transporting the asbestos waste off-site and determining landfill acceptance of the asbestos waste at a licensed disposal facility.

7.4.3 Organic Liquid Wastes in Drums

Liquid diesel, Jet A, Jet B, heating oil and other organic wastes within drums is a potential contamination concern if the drum leaks and contents spread to underlying soil. It can also further spread by surface water flow. The drums can also be a hazard if under pressure and can spray if opened. Approximately 14,300 L of organic waste are present at the Hope Lake site, but additional volume could still be found during remediation. There were no organic liquid wastes found at either Husky Creek or Willow Creek. There is also 342 L of oil/drilling fluids at Hope Lake. There are three options for the disposition of organic liquid waste: incineration on-site, removal off-site, (possibly for recycling or deep well injection), or return to the original owners (not possible for all the organic liquid waste). A description of each of the options follows:

1. **Incineration On-Site:** An incinerator designed to meet Nunavut draft air quality guidelines (Government of Nunavut 2010a), would be brought to the site and the contents of the drums would be run through the incinerator. The steps are as follows:

- Bring drum to incinerator.
- Run contents of drums through incinerator.
- Perform air monitoring during the incineration to meet specific air emission standards
- Test ash for leachable metals and dispose accordingly.

2. **Remove Off-Site:** The drums would be placed in overpack drums and then hauled in winter via winter trail to Kugluktuk for shipment to another suitable location for disposal. The steps are as follows:

- Place drum in overpack drum, sample for TDG and waste disposal.
- Haul to staging area.
- In winter, load on cat train and haul on winter trail to Kugluktuk, then to a licensed disposal facility for hazardous waste.

3. **Remove Off-Site by/to Original Owners:** The drums would be shipped off-site via winter train to the original owners of the drums. The steps are as follows:

- Contact the owner listed on the drum label.
- The owner will arrange shipment off-site.
- Or place drum in overpack drum, sample for TDG and waste disposal.
- In winter, load on cat train and haul on winter train to the original owner.

The options are evaluated below:

TABLE 12: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR LIQUID ORGANIC WASTES IN DRUMS

Option/Attribute	Attribute Weighting	Incineration	Remove Off-Site	Remove by Owners
Cost	25%	3	1	2
Effectiveness in Meeting Remedial Goals	15%	1	2	3
Ease of Implementation	15%	3	1	2
Regulatory Acceptance	15%	1	2	3
Community Acceptance	15%	1	2	3
Loss of Natural Capital	10%	1	2.5	2.5
Timeframe for Remediation	5%	3	1.5	1.5
Total Score		13	12	17
Weighted Score		1.9	1.6	2.5
Number of High Scores		3	0	3
Ranking		2	3	1

The highest ranked option is to remove the organic waste off-site by the owners; however, the preferred option is incineration due to the logistical challenges with contacting drum owners. While having the owners remove the drums that contain organic waste, this will be logistically challenging, while at the same time, not providing assurance that all the waste will be removed during remedial activities. As well, information on many of the drums is no longer legible; indicating that this option is not available for all of the waste in this category.

The following are potential issues with incineration of the organic liquid waste on-site:

- Additional logistical planning associated with obtaining the proper incinerator and transporting it to and from site.
- The equipment used is required to meet sufficient air pollution controls, specific air emission standards and will be specifically designed to safely incinerate the organic waste, according to the applicable guideline.
- Any organic liquid waste that does not meet the incineration guidelines will be shipped off-site for disposal at a licensed disposal facility for hazardous waste.

7.4.4 Pressurized Cylinders

Pressurized cylinders are a hazard due to a danger of a catastrophic leak which can then propel the cylinders at a high speed. Depending on the type of gas, the gas itself may be a fire, explosive or other hazard. Approximately 38 cylinders (estimated 13 m^3 of pressurized gas) are known to be present; others may be found during remediation. The majority of these

cylinders are propane gas. There are two options for disposition of pressurized cylinders: depressurization and then disposal in an on-site landfill or disposal in an off-site landfill. A description of each of the options follows:

1. **Landfill On-Site**: The cylinder would be depressurized, evacuated, and placed in the landfill. The cylinder would then be covered. The steps are as follows:

- If the content is known, depressurize, evacuate, landfill and cover.
- If content is not known, or should not be depressurized (e.g. chlorofluorocarbons [CFCs]), a specialist will depressurize, evacuate and landfill.
- If the content is known and contents cannot be depressurized on-site, the cylinder will be placed in an approved container and shipped off-site with the content to a licensed landfill.

2. **Remove Off-Site:** The cylinder would be depressurized as above and then hauled off-site for disposal. The steps are as follows:

- If the content is known, depressurize, and evacuate. If the content is known, and the shipping company approves the conditions of the cylinder, the cylinder can be shipped with the content.
- If the content is known and contents cannot be depressurized on-site, the cylinder will be placed in an approved container and shipped off-site with the content.
- If content is not known, a specialist will depressurize, and evacuate.
- Haul to staging area.
- In winter, load on cat train and haul on winter trail to Kugluktuk for further shipment to an off-site to a licensed disposal facility. The cylinders may or may not be hazardous, depending on if they were depressurized.

The options are evaluated below.

TABLE 13: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR PRESSURIZED CYLINDERS

Option/Attribute	Attribute Weighting	Landfill On-Site	Remove Off-Site
Cost	25%	1	2
Effectiveness in Meeting Remedial Goals	15%	1	2
Ease of Implementation	15%	2	1
Regulatory Acceptance	15%	1	2
Community Acceptance	15%	1	2
Loss of Natural Capital	10%	1	2
Timeframe for Remediation	5%	1	2
Total Score		8	13
Weighted Score		1.2	1.8

TABLE 13: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR PRESSURIZED CYLINDERS			
Option/Attribute	**Attribute Weighting**	**Landfill On-Site**	**Remove Off-Site**
Number of High Scores		1	6
Ranking		2	1

The highest ranked and preferred option is to remove off-site. This option scores highest in all the attributes, except ease of implementation. The following is a potential issue with the disposal of the cylinder off-site:

- Some known contents in cylinders may not be safely depressurized on-site, therefore, there will be additional logistical planning associated with transporting the waste off-site in these circumstances.

7.4.5 Fire Extinguishers

Fire extinguishers are a hazard due to the hazardous chemicals that are within the extinguisher. This is dependent on the type of fire extinguisher. Approximately 0.4 m^3 (three cylinders were found, all empty) of fire extinguishers are known to be present at the Hope Lake site; others (with content) may buried under debris. There are two options for disposition of the fire extinguishers: either disposal in an on-site landfill or disposal in an off-site landfill. A description of each of the options follows:

1. **Landfill On-Site**: The landfill would be built as previously described. The fire extinguishers would be evacuated and placed in the landfill and covered. Content would be disposed off-site at a licensed disposal facility.
2. **Remove Off-Site:** The fire extinguisher would be hauled off-site for disposal. The steps are as follows:

- If there is content remaining in the extinguisher, and the shipping company approves the conditions of the extinguisher, it can be shipped with the content.
- Haul to staging area.
- In winter, load on cat train and haul on winter trail to Kugluktuk for further shipment to an off-site licensed disposal facility for hazardous waste. If the extinguishers are empty, they are not considered hazardous waste.

The options are evaluated below:

TABLE 14: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR FIRE EXTINGUISHERS			
Option/Attribute	**Attribute Weighting**	**Landfill On-Site**	**Remove Off-Site**
Cost	25%	1	2
Effectiveness in Meeting Remedial Goals	15%	1	2

TABLE 14: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR FIRE EXTINGUISHERS			
Option/Attribute	**Attribute Weighting**	**Landfill On-Site**	**Remove Off-Site**
Ease of Implementation	15%	2	1
Regulatory Acceptance	15%	1	2
Community Acceptance	15%	1	2
No Loss of Natural Capitol	10%	1	2
Timeframe for Remediation	5%	1	2
Total Score		8	13
Weighted Score		1.2	1.8
Number of High Scores		1	6
Ranking		2	1

The highest ranked and preferred option is to dispose off-site. Similar to the other hazardous material, removal off-site was the highest ranked option with the exception of ease of implementation. The following are potential issues with the disposal of the extinguishers off-site:

- If full or partially full extinguishers are found, they need to be evacuated or disposed of as hazardous waste; costs will increase for evacuating or disposing as hazardous waste.
- For the extinguishers with content; they would need to be approved by the shipping company and the landfill.

7.4.6 Leachable Lead Paint on Tanks and Caterpillar

Leachable lead paint on tanks and a caterpillar can be a dermal and respiratory hazard and lead can leach into soil. Approximately 622 m^3 of tanks and a caterpillar with leachable lead paint are at the Hope Lake site. There are three options for disposition of the tanks and the caterpillar with leachable lead paint: 1) remove the paint on-site then dismantle the tank and caterpillar and landfill on-site; 2) remove paint on-site, dismantle, and take off-site for disposal; or 3) remove the intact tanks and caterpillar off-site. Note that the paint that is removed from the tanks and caterpillar would have to be disposed as hazardous waste. A description of the options follows:

1. **Remove Paint and Landfill On-Site:** The lead paint would be removed from the tanks and caterpillar, they would be then be dismantled and placed in the landfill. The steps are as follows:

- Clean the inside of the tanks and drain any remaining fuel/fluids from the caterpillar (note liquid from cleaning would need to be treated/tested for disposal).
- Construct an enclosure over and around the tanks and caterpillar that will sufficiently collect the paint chips and prevent them from contaminating adjacent areas.

- Remove paint by sandblasting or scrapping and collect the sand/paint for disposal off-site in a licensed disposal facility for hazardous waste.
- Dismantle and cut apart.
- Sample the surrounding soil to determine that the paint did not contaminate the soil.
- Landfill and cover.

2. **Remove Paint and Dispose of Off-Site:** The tanks and caterpillar would have the paint removed, dismantled and then hauled off-site for disposal. The steps are as follows:

- As above, but tanks and caterpillar are dismantled in such a way that they can be transported off-site.
- In winter, load on cat train and haul on winter trail for further shipment to an off-site licensed disposal facility for hazardous waste.

3. **Leave Paint On and Dispose of Off-Site:** The tanks and the caterpillar would be taken to a staging area and then hauled off-site for disposal. The steps are as follows:

- Clean the inside of the tanks and drain any remaining fuel/fluids from caterpillar.
- Haul the hazardous tanks and caterpillar to the staging area.
- In winter, load on cat train and haul on winter trail to Kugluktuk for further shipment to an off-site licensed disposal facility for hazardous waste.

The options are evaluated below:

TABLE 15: KEPNER TREGOE ANALYSIS OF DISPOSAL OPTIONS FOR LEACHABLE LEAD PAINT ON TANKS AND CATERPILLAR

Option/Attribute	Attribute Weighting	Landfill On-Site	Remove Paint, Landfill Off-Site	Leave Paint, Landfill Off-Site
Cost	25%	1	3	2
Effectiveness in Meeting Remedial Goals	15%	3	1.5	1.5
Ease of Implementation	15%	3	2	1
Regulatory Acceptance	15%	1	2	3
Community Acceptance	15%	1	2	3
No Loss of Natural Capitol	10%	1	2	3
Timeframe for Remediation	5%	1	2	3
Total Score		11	14.5	16.5
Weighted Score		0.2	1.6	2.2
Number of High Scores		2	1	4
Ranking		3	2	1

The highest ranked and preferred option is to leave the paint on the tanks and caterpillar and dispose off-site. Paint removal on-site may be difficult to safely implement as sand blasting would need to be completed in an enclosed environment. Scrapping the paint off would be extremely time consuming and likely not possible within the proposed schedule. The following are potential issues with the disposal of the tanks and the caterpillar off-site:

- The material has to be transported to a location where the paint can be removed and the materials disposed of in an appropriate manner.
- There will be additional logistical planning associated with transporting the large volume of tanks off-site.

7.4.7 Leachable Lead Paint on Drums

Leachable lead paint on drums can be a dermal and respiratory hazard and lead can leach into soil. Approximately 1,535 drums (1,511 - 205 L drums and 24 - 20 L to 80 L drums) with leachable lead paint are at the Hope Lake, Willow Creek and Husky Creek sites. There is only one option for disposal of the drums with leachable lead paint: crush the drums on-site and remove the drums off-site for disposal in a licensed disposal facility for hazardous waste. A description of the option follows:

1. **Remove Off-site:** The hazardous waste would be taken to a staging area, crushed and then hauled off-site for disposal. The steps are as follows:

- Haul hazardous material to staging area.
- Clean the inside of the drums and crush.

- In winter, load on cat train and haul on winter trail or load on a plane to Kugluktuk for further shipment to an off-site to licensed disposal facility for hazardous waste.

The following are potential issues with the disposal of the drums off-site:

- The paint that may fall off during the crushing has to be collected and removed off-site to a licensed disposal facility for hazardous waste.
- Lead based paint needs to be handled by personnel with lead abatement training.

7.4.8 Other Solid Hazardous Waste

Various solid hazardous waste represent different kinds of hazards. Batteries have acids and lead, and the acid can be a dermal hazard and lead can leach into soil. The mercury vapour in fluorescent lights can be a source of mercury leaching into the environment. The PCBs in ballasts can be a dermal hazard and a source of PCBs leaching into the soil. Bags of calcium chloride can also act as a source of chloride which leaches into the soil. There are various containers of drilling fluids and lubricants which we have classified as hazardous as detailed chemical analysis has not been completed.

Approximately 8 m^3 of solid hazardous waste exists in batteries, fluorescent lights, ballasts, and calcium chloride bags. There is only one option for disposal of other solid hazardous waste, such as batteries, fluorescent lights, ballasts, and calcium chloride bags: Disposal off-site in a licensed disposal facility for hazardous waste, according to the applicable guideline (Government of Nunavut. 2010b, Government of Nunavut. 2011b and Environmental Protection Services. 2003). A description of the option follows:

1. **Remove Off-Site:** The hazardous waste would be taken to a staging area and then hauled off-site for disposal. The steps are as follows:

- Haul hazardous material to staging area.
- In winter, load on cat train and haul on winter trail or load on a plane to Kugluktuk for further shipment to an off-site licensed disposal facility for hazardous waste.

The following are potential issues with removal of other solid hazardous waste off-site:

- As the amount of solid hazardous waste is small, it can also be taken out by aircraft, if required.

7.5 METAL AND SALT-IMPACTED SOILS

There are metals-impacted soils (primarily arsenic, copper, chromium, nickel, lead, vanadium and zinc) in the area of the debris, structures, burn pits in various locations throughout Hope Lake. The Phase III ESA identified two areas that made up the majority of the impacted soil, APECs 3P and 7D (Figure 13D and 18B). Details are provided in Table 16 on the following page. In addition, there are several small isolated areas that represent small volumes. Each of these areas represents perhaps only a couple of cubic

meters or less of impacted soil. A total of 6 m^3 of metals-impacted soil was associated with burn pits, tank, drill platform and old drill (APECs 3Q, 7F and 7I).

TABLE 16: ESTIMATE OF AREA AND VOLUME OF INORGANIC IMPACTS IN SOIL AT HOPE LAKE AREA

Location	Area (m^2)	Assumed Depth (m)	Volume (m^3)
Soil Debris, Structures, Burn Pits and Tank Area (APEC 3P)	150	0.3	45
Salt storage Area (APEC 7D)	25	2.0	50
Soil Drill Platform and Old Drill Area (APECs 3Q, 7F and 7I)	20	0.3	6
		Total	**101 m^3**

Soil has been impacted by metals related to various activities and equipment in on-site. The salt storage area indicates that there is a possibility for the vertical migration of salt. Both the metals and salt may migrate in soils, increasing the risk to sensitive receptors. There are approximately 101 m^3 of metal and salt contaminated soil. There are three remedial options for metal and salt contaminated soils at the site: cover in place, disposal in a lined landfill on-site or disposal off-site. A description of each of the options follows:

1. **Cover In-situ:** Based on research on depth of organisms in arctic soils, a 0.3 m granular cover would be sufficient to cover the metal contaminated soil. The estimated volume of granular cover material required would be approximately 60 m^3. The steps are as follows:

- The compacted surface of the area being covered should be scarified to promote natural drainage patterns and for a proper bond between the existing and placed over material.
- The granular cover material is to be placed onto the scarified surface using low ground pressure equipment to minimize the compaction of the cover.
- Revegetation of the granular cover materials is to be conducted through application of grass seed and fertilizer. Details of a suitable seed mixture would be developed during the design stage.

2. **Landfill On-Site:** Conceptually, an inert landfill could be constructed on-site. The steps are as follows:

- Salvage the surface soil to be re-used during reclamation. Store soil away from potential contaminants and in a manner that minimizes erosion.
- The consolidation of metal contaminated soil would require excavation of the upper 0.3 m of existing soil and the upper 2.0 m of the existing soil for the salt contaminated soil. The total excavation would generate a volume of 101 m^3 (in situ) of impacted soil.
- Landfill and cover impacted soil.

3. **Remove Off-Site**: The metal contaminated soils could be consolidated for transport from the site to a licensed disposal facility. The contaminated soils would need to be placed into bulk transport containers following excavation so that they are able to be handled when it is time for shipping. The steps are as follows:

- Excavate impacted material from specified areas and package for transport.
- Haul impacted material to staging area.
- Materials would be loaded onto a cat train. The type and number of loads required for hauling contaminated soils from the site would be dependent on the method of bulk storage and transport that was selected by the contractor.

The options are evaluated in Table 17 below:

TABLE 17: KEPNER TREGOE ANALYSIS OF METAL AND SALT-IMPACTED SOIL OPTIONS

Option/Attribute	Attribute Weighting	Cover	Landfill On-Site	Remove Off-Site
Cost	25%	3	2	1
Effectiveness in Meeting Remedial Goals	15%	1	2	3
Ease of Implementation	15%	3	1	2
Regulatory Acceptance	15%	1	2	3
Community Acceptance	15%	1	2	3
Loss of Natural Capital	10%	2	1	3
Timeframe for Remediation	5%	1	2	3
Total Score		12	12	18
Weighted Score		1.9	1.8	2.4
Number of High Scores		2	0	5
Ranking		2	3	1

The highest ranked and the preferred option is to remove off-site; however, this is also the most costly but scored highest in effectiveness, regulatory and community acceptance, impacts to surrounding environmental and timeframe. The following are potential issues with removal of soil off-site:

- All of the soil should be acceptable to dispose in a licensed disposal facility subject to landfill characterization.

7.6 HYDROCARBON-IMPACTED SOILS

Based on the Phase III ESA, there is an estimated volume of 1,762 m^3 of petroleum hydrocarbon contaminated (PHC) soil at the Husky Creek, Willow Creek and Hope Lake site (assuming a depth to impact is 2 m). These volumes of soil were based on Canada Wide Standard (CWS) generic guidelines (CCME 2008). After collecting additional site data, it was determined that site specific remediation criteria (SSRC) used on other northern sites could be applied at Hope Lake (INAC 2008a, 2008b). The development of site specific remediation criteria is provided in Appendix C.

Based on criteria of 2500 mg/kg TPH, the volumes of impacted soils were recalculated based on the data that both EBA and WESA collected as part of their environmental site assessments. Contaminated soil at Husky Creek is approximately 2 m^3 (F1 through F3); Willow Creek soil meets the SSRC and at Hope Lake has approximately 104 m^3 (F1 through F3 and some F4). The majority of the soil at Hope Lake is found in three areas: adjacent to the six POL tanks at APEC 2A, the 21 horizontal tanks at APEC 4D and the two POL tanks at APEC 6. There are isolated areas in Hope Lake where minor contamination quantities were found. The distribution and estimated volume of PHC contaminated soils are shown in Table 18 and on Figures 4A, 8A, 11, 12, 13A, 13C, 15B, 17 and 18B.

TABLE 18: SUMMARY OF HYDROCARBONS CONTAMINATED SOIL

Location (APEC)	Description	Contaminant of Concern	Volume of Contaminated Soil
Husky Creek (7)	Drums	**PHC:** F1 through F3	2 m^3
Hope Lake (1A, 2A, 2B, 3A, 3B, 3C, 3J, 3K, 3L, 4D, 6A, 7E, 7G)	Debris Areas, POL Tanks, Drums and Drum Caches	**PHC:** F1 through F4	104 m^3
			106 m^3

Notes:
Volume of 106 m^3 is based on soil that is over the SSRC of 2500 mg/kg TPH. In the event that the SSRC is not accepted, the volume of material above CWS (CCME 2008) is estimated at approximately 1762 m^3.

The PHC contamination is fully delineated at most locations. There are four remedial options for PHC contaminated soils (greater than SSRC): remove from site, landfarm on-site, chemical oxidation, or leave in-situ with no cover and monitor. These options are described in further detail below.

1. **Remove Off-Site:** The PHC contaminated soils (>2500 mg/kg) would be consolidated for transport from the site to a licensed disposal facility. In addition to removing soils >2,500 mg/kg TPH, at APEC 6 at Hope Lake, soil adjacent to the wetland, and 30 m towards the tanks would be excavated to CWS generic criteria (CCME 2008) since the SSRC is not applicable within 30 of a waterbody. The contaminated soils would be

placed into bulk transport containers following excavation so that they are able to be handled when it is time for shipping. The steps are as follows

- Excavate impacted material from specified areas and package for transport.
- Haul impacted material to staging area.
- Materials would be loaded onto a cat train and moved to Kugluktuk in the winter. The soil would then be transported to a licensed disposal facility.
- Recontouring and revegetation would be completed as required in areas of excavation.

This option requires no specialized equipment; however, there is an additional disturbance to the tundra.

2. **Landfarming On-Site:** This involves construction of a land treatment area (LTA) (further details provided in Section 9). Nutrients would be added and the soil tilled on a regular basis to introduce oxygen and promote biodegradation. The remedial objectives can be achieved within three seasons. Landfarming would require that the contractor construct one or more treatment facilities to store and treat the PHC contaminated soils. Given the limited warm season at the site the contractor may also wish to apply oxidants, or other applicable agents to shorten the time required for remediation. The steps are as follows:

- Construction of LTA impermeable base and perimeter berms.
- Excavation and hauling of PHC contaminated soils to the LTA.
- Treatment and tillage of contaminated soils; to be most effective, soils should be less than 0.5 m thick.
- Collection and submission of analytical samples from the LTA to quantify the level of contamination and determine need for additional treatment. If the level of contamination is above criteria then the soil will need additional treatment.
- Once the soils are successfully remediated, LTA reclamation activities may include grading to promote natural drainage of water, seeding and if required, fertilization. If an artificial liner has been installed, this will be removed prior to reclamation.

This remediation has been proven to be effective in northern climates; however, the time line for remediation closure is weather dependent. No specialized equipment is required; however, large machinery will be required for landfarm construction. Also, excavations will need to be filled in and/or contoured to be safe for HTO users. This requires additional disturbance to the natural tundra.

3. **Chemical Oxidation:** A specialized product such as sodium permanganate, potassium permanganate or hydrogen peroxide would be added to the impacted soil and mixed. The chemical product would react with the hydrocarbons producing carbon dioxide (CO2) and water (H2O) as well as smaller hydrocarbon chains, which would be more

amenable to biodegradation and volatilization. Sometimes chemical oxidants are mixed with a slow-release oxygen product (available commercially, such as Regenesis ORC®), which promotes biodegradation by maintaining an aerobic environment. The steps are as follows:

- Set up treatment area; this may consist of a soil or geosynthetic liner.
- Excavate soil and treat on-site; treatment rates would be determined by manufacturer of the chemical oxidant.
- Allu soil and chemical oxidant and sample after a suitable length of time to determine hydrocarbon levels.

Chemical oxidation is a proven technology for the remediation of hydrocarbons. The technology will work in cold climate but reactions are somewhat related to temperature, provided soil is not frozen. Note that no effective treatment can be obtained with frozen soils. Remediation can be nearly immediate with hydrogen peroxide or will take approximately one month with sodium or potassium permanganate and any residual hydrocarbons will be more readily amenable to biodegradation. Remediation can be quick, but these chemicals are highly reactive and dangerous to handle and transport. There may be other chemical adverse effects such as changes to soil salinity which can be detrimental to plant growth or soil organisms. Impact of residual chemicals on permafrost is unknown. Reagents can be costly, and may require specialized equipment to implement. Based on all of these factors, this option was not included in the scoring.

4. **Leave In-situ with No Cover:** This treatment involves leaving the hydrocarbon-impacted soil in place in APECs 2A, 4D and 6A. All ecological receptors and or ecological pathways have been eliminated with the exception of soil-eco contact in all the areas, and the freshwater aquatic pathway in APEC 6 as the hydrocarbon impacts are currently at the toe of a slope adjacent to a wetland. As discussed in Appendix C, the soil organisms within these areas have already been impacted and have died or adapted to the hydrocarbon levels in the surface soil. Impact to organisms below 0.3 m is considered minimal as most of the ecological activity exists within the top 10 cm of soil. Based on the level of contaminates, the distance to sensitive receptors and the type of hydrocarbons, additional ecological impacts are negligible. At APEC 6A impacted soil would be removed so that there is 30 m between the wetland and any impacted soil. Steps to follow:

- Seek regulatory approval for this option
- Remove impacted soil at APEC 6A to establish 30 m between the wetland and the impacted zone.
- For those impacted soils that remain, develop a long-term monitoring plan that includes the installation of groundwater monitoring wells and soil sampling.

TABLE 19: KEPNER TREGOE ANALYSIS OF HYDROCARBON-IMPACTED SOIL OPTIONS				
Option/Attribute	**Attribute Weighting**	**Remove Off-Site**	**Landfarm On-Site**	**Leave In-Situ, No Cover**
Cost	25%	2	1	3
Effectiveness in Meeting Remedial Goals	15%	3	2	1
Ease of Implementation	15%	2	1	3
Regulatory	15%	3	2	1
Community Acceptance	15%	3	2	1
Loss of National Capital	10%	2	1	3
Timeframe for Remediation	5%	3	2	1
Total Score		18	11	13
Weighted Score		2.5	1.5	2
Number of High Scores		4	0	3
Ranking		1	3	2

Removal off-site is the highest ranked option and the preferred option. It was the highest ranked for effectiveness, regulatory and community acceptance, and timeframe. The following are potential issues with removing the hydrocarbon soil off-site:

- Requires regulatory approval of the SSRC to limit the amount of soil to be excavated and removed off-site.
- Volumes of soils are estimated at just over 100 m^3 for soils greater than 2500 mg/kg TPH. If this volume increases, the economics of removing soil off-site can become similar to landfarming.

In the event that the SSRC is not approved, then the next preferred option would be landfarming. This was the third ranked option, but the leave in-situ/no cover option scored lowest in both regulatory and community acceptance and would have ongoing monitoring with the uncertainty of site closure. These factors make this option unattractive to INAC. Landfarming is a proven means of remediating PHC impacted soils and would require monitoring while the landfarm was active.

7.7 PHYSICAL HAZARDS

Physical hazards are considered to be man-made structures; openings and other features that could constitute a risk to humans. There are four physical hazards that exist: buildings that are on-site that are dilapidated and present a risk of collapse; **a**n excavated pit (approximately 3 m deep) west of APEC 2A that has vertical walls; steep slopes (most notably at APEC 1A) that contain debris that will have to be removed; and debris that contains nails, broken glass and other sharp objects.

Burning or removing the buildings will remove this hazard. There is a building structure that is located within the pit at APEC 2A that will have to be removed. The soil and

surficial material that was excavated is adjacent to the pit and can be replaced to eliminate this hazard. A specific safety plan will have to be completed for removal of debris that is located on steep slopes and for sorting of material in the debris areas. This will include, but not be limited to type and placement of equipment and proper safety gear for people working in these areas.

8.0 RECOMMENDED REMEDIAL OPTIONS

8.1 SUMMARY

EBA proposes that all solid materials, with the exception of wood, be removed off-site to an appropriate landfill as opposed to a landfill being built on-site, as the cost of landfill construction, long-term monitoring (or in some instances capping of materials) will be more costly than removal. Aqueous and organic liquids will be remediated on-site.

Logistical planning associated with shipping and off-site landfill disposal of materials will be the primary issue with this option. In the development of this RAP, a number of companies were contacted for cost estimates. The alternative to shipping all of the non-hazardous material off-site is to build a landfill on-site. Hazardous material would still be removed from site.

Metal and salt contaminated soil would be removed from site. As per the SSRC, hydrocarbon-impacted soil above 2,500 mg/kg TPH will be removed from the site. This option would require regulatory approval. In the event that this is not approved, then landfarming would be the alternative option.

A summary of proposed recommended options for this site is shown in Table 20.

TABLE 20: SUMMARY OF RECOMMENDED REMEDIAL OPTIONS

Waste Stream	Recommended Option	Comments
Wood Waste Non-Hazardous	Control burn on-site	Hazardous material must be separated as well as non-wood waste removed. Wood would be burned in controlled burn. Ashes to be taken off-site
Aqueous Liquid Waste in Drums Non-Hazardous	Treat on-site	Treatment may prove to be problematic but is the most cost effective option. Liquid not meeting water discharge criteria will be shipped off-site.
Other Solid Non-Hazardous Waste	Remove off-site	Non-hazardous solid waste will need to be separated, compacted and removed off-site to a landfill.
Asbestos Waste Hazardous	Remove off-site	Asbestos waste will be handled by trained personnel and removed off-site to a landfill.
Liquid Organic Wastes in Drums Hazardous	Incinerate on-site	Organic liquid waste in drums will be incinerated on-site, with the exception of those drums that can be identified and returned to owners and those not meeting the incineration

TABLE 20: SUMMARY OF RECOMMENDED REMEDIAL OPTIONS		
Waste Stream	**Recommended Option**	**Comments**
		criteria. These exceptions will be shipped off-site.
Pressurized Cylinders Hazardous	Remove off-site	Depressurize and remove off-site to a landfill, following landfill and shipping company approval. Known contents that cannot be safely depressurized will be shipped offsite in an approved container, following landfill and shipping company approval.
Fire Extinguishers Hazardous	Remove off-site	Remove off-site to a landfill, following landfill and shipping company approval. Volumes are limited.
Leachable Lead Paint on Tanks and a Caterpillar Hazardous	Remove off-site, intact, with paint still on	This may be logistically challenging; will require coordination with another company to receive the tanks and caterpillar
Leachable Lead Paint on Drums Hazardous	Compact and remove off-site	Remove off-site to a Class 1 landfill.
Other Solid Hazardous Waste	Compact and remove off-site	Remove off-site to a Class 1 landfill. Volumes are limited.
Metal-Impacted Soils	Remove off-site	Remove off-site to an approved landfill, will require waste characterization.
Hydrocarbon-Impacted Soils	Remove soil > 2,500 mg/kg TPH off-site	Will require regulatory approval of SSRC; impacted soil adjacent to APEC (30 m) will be excavated. If SSRC is not accepted, soil will be landfarmed to meet remedial objectives.
Physical Hazards	Remove all buildings and develop site-specific safety plans	Each hazard will need to be identified and properly mitigated prior to work commencing. Proper personal protective equipment to be worn at all times.

Recommendations for each of these waste streams are discussed further in the subsequent sections.

8.2 NON-HAZARDOUS WASTE

For wood non-hazardous wastes at the site EBA recommends the following steps be taken:

- Remove all hazardous materials from the buildings on-site. Asbestos abatement and handling should be conducted by trained professionals.
- Remove all non-wood waste and remove off-site.
- Demolish buildings, photograph and document. Remove wood to an area, ideally where there is a large amount of bedrock and little vegetation. Some areas of the camp may be ideal.

- Conduct a controlled burn within an approved container, under careful supervision, and at a time of year when moisture conditions are higher and there is a low likelihood of causing a tundra fire. Fire suppression equipment should be at hand when the controlled burn takes place and air monitoring should be conducted. Conduct the burn according to the applicable guideline (Government of Nunavut. 2010a).

For aqueous liquid wastes in drums at the site EBA recommends the following steps be taken:

- Treat on-site and then on-site disposal. Organic constituent would be incinerated.

For other solid non-hazardous wastes at the site, EBA recommends the following:

- Separate all hazardous and non-hazardous materials from buildings.
- Following removal and compaction of the hazardous waste, remove all non-hazardous debris off-site.
- From selected areas, where metal impacts were found in soil beneath dump sites, excavate soil beneath dump sites for off-site disposal and collect confirmatory samples for testing. Details on areas with metal impacts are located in the Phase III ESA.

8.3 HAZARDOUS WASTE

For asbestos waste at the site, EBA recommends the following:

- Remove asbestos waste at the sites using trained abatement workers.
- Friable asbestos must be wetted and double bagged in approved asbestos disposal bags and sealed with duct tape. The exterior of the bags must be cleaned with a damp cloth or HEPA vacuum prior to removing from work area.
- Remove to an off-site licensed disposal facility for hazardous waste.
- Conduct inspection of workspace where asbestos was formerly contained to ensure removal, prior to any demolition being carried out.

For organic liquid wastes in drums at the site, EBA recommends the following:

- Incineration on-site for all wastes that cannot be removed off-site by owners.
- Complete air quality monitoring while this process is occurring, according to the applicable guideline (Government of Nunavut, 2010a).

For pressurized cylinders at the site, EBA recommends the following:

- A specialist will vent the unknown contents on-site.
- Remove to an off-site licensed disposal facility for hazardous waste.
- Known contents that cannot be safely vented on-site will be removed in an approved container to an off-site licensed disposal facility for hazardous waste.

- For fire extinguishers at the site, EBA recommends the following:
- Arrange pre-approval by the shipping company for extinguishers with content.
- Remove to an off-site license disposal facility for hazardous waste.

For leachable lead paint on tanks and a caterpillar at the site, EBA recommends the following:

- Clean the inside of the tanks and drain any remaining fuel/fluids from the caterpillar. Ensure this liquid is disposed of properly.
- Remove the tanks intact to an off-site facility to remove the paint and/or landfill.

For leachable lead paint on drums at the site, EBA recommends the following:

- Clean the inside and crush the drums.
- Remove to an off-site licensed disposal facility for hazardous waste.

For other solid hazardous waste at the site, EBA recommends the following:

- Collect solid hazardous waste and remove to an off-site licensed disposal facility for hazardous waste.

8.4 METAL AND SALT-IMPACTED SOILS

For remediation of metal-impacted soils at the site, EBA recommends the following:

- Excavate all metal and soil-impacted soils and conduct confirmatory sampling of base and adjacent soil boundaries to ensure soils all impacted soil has been removed.
- Metal and salt impacted soil is removed off-site to a licensed disposal facility.

8.5 HYDROCARBON-IMPACTED SOILS

For remediation of hydrocarbon-impacted soils at the site, EBA recommends the following:

- Remove soil that is >2,500 mg/kg and dispose of off-site at a licensed disposal facility
- At APEC 6 excavate a 30 m buffer, starting at the wetland and moving towards the tanks, and remove all material that exceeds CWS (CCME 2008) generic criteria. Soils that are greater than 30 m from the wetland need to meet the SSRC of 2,500 mg/kg TPH.

9.0 GEOTECHNICAL CONSIDERATIONS

9.1 HOPE LAKE TRAIL NETWORK

The on-site road network is now a trail system with varying degrees of trafficability depending on integrity of the granular surface course, the stability of the subgrade, the capacity of the culverts, the extent of the vegetative cover, and local grades. Table 21

provides a summary of the Hope Lake trail network as it connects various remediation sites. (APECs 1, 2, 3, 3V and 4). The trail system is shown in Figures 22 and 23.

At the time of the ESA fieldwork in July 2010, these trails were trafficable by small ATVs. However, these could require upgrading to accommodate construction equipment and there is the potential to restrict access during wet weather when the subgrade could become very soft.

There are also several culvert crossings along the trail network that may require upgrading to accommodate surface water flows and construction traffic. These may need permitting to meet regulatory requirements (i.e., DFO fish habitat).

TABLE 21: SUMMARY OF THE HOPE LAKE TRAIL NETWORK (OBSERVATIONS JULY 30, 2010)

From	To	Approximate Distance (m)	Water Crossings	Conditions
APEC 1	APEC 3	500	2 - Status unknown	Mostly dry and granular subgrade
APEC 2	APEC 3	350	1 - Status unknown	Mostly dry and granular subgrade
APEC 4	Landfill Site LF-2 (APEC 3V)	700	1 - Modest flow	Mostly dry and granular subgrade
APEC 3	Landfill Site LF-2 (APEC 3V)	600	1 - Modest flow	Mostly dry and granular subgrade with some softer, poorly drained area
Airstrip	Landfill Site LF-2 (APEC 3V)	3000	5 – Four with culverts and flowing water	Mostly dry with granular subgrade; some vegetation growing in poorly drained areas

9.1.1 Airstrip

The Hope Lake Airstrip was able to support Arctic Sunwest's Skyvan operations during the 2010 field program. The pilots did an on-ground inspection of the airstrip along with the geotechnical observer.

The 1969 air photo shows that the airstrip was originally about 1,450 m (4,760 feet) long. However, the northwest boundary of the airstrip has decreased by about 200 m due to erosion where the airstrip crosses a drainage course. Two sets of yellow drum markers were found on the airstrip: the first row about 300 m southeast of the apron area (located at APEC 7) and the second row about 550 m southeast of the apron area. The Skyvan used these markers for landing as the surface is fairly level and clear of vegetation.

Southeast of the second set of yellow drums the airstrip surface became more vegetated and rougher. The airstrip boundary on the southeast side is intact and there were signs that it had been used in the previous 18 months as a cache for aircraft fuel. The surface course

and subgrade down to 0.75 m consist of well drained, dense sands and gravels. Except where noted earlier, there are no significant signs of surface erosion.

The airstrip is fairly good shape considering its age and lack of maintenance over the previous 40 years. It will need extensive levelling with new fill to lengthen it sufficiently to support heavy lift aircraft. There is an old borrow area and potential for develop additional borrow areas adjacent to the airstrip.

9.2 BORROW SOURCES

A number of borrow prospects for granular material were identified in the terrain analysis and most were investigated during the field program (see Figures 22 and 23). Based on the site conditions and soil conditions encountered at LF-2, LF-3 and LF-4, any of these sites not used for landfill/landfarm location could be considered a borrow prospect. They are well drained sands and gravels with some silt, cobbles and boulders and a topsoil/vegetative mat that is less than 150 mm thick. The depth of these deposits is not known; permafrost was not encountered at the maximum depth of 0.75 m in any of the test pits dug. These sites are within 100 m of each other and are readily accessible by an existing trail. Approximate granular borrow quantities are 8,000 to 16,000 m^3 at each of LF-2, LF-3 and LF-4 for a borrow depths of 1 to 2 m.

South of LF-2 and LF-3 on the other side of a small creek is a previously exploited borrow area. However, it appears to be a small area adjacent to a block field that would be difficult to develop as a borrow (Photo 103 of ESA).

Three other borrow prospects were identified during the field program: Borrow Prospect A, Borrow Prospect B, and the Airstrip Borrow Prospect. Borrow Prospect A is located east of LF-4 south of the access road (Photo 104 of ESA). There are signs that this glaciofluvial area has been used in past as a borrow source. TP-10-18 log and sieve results indicates that subsurface consists of sand and gravel with silt to 0.75 m (Photos 105 and 106 of ESA). Borrow Prospect B is located southeast of Borrow Prospect A (Photo 107 of ESA). The test pit log and sieve results for TP-10-19 show that the sands and gravel with silt extend into this area (Photo 108 of ESA). Both of these borrow prospects can be accessed off the same road that goes to the airstrip. The approximate granular borrow quantities are 5,000 to 10,000 and 10,000 to 20,000 m^3 for borrow depths of 1 to 2 m at Borrow Prospect A and B, respectively.

The Airstrip Borrow Prospect is located north of the airstrip and across a drainage area from the airstrip. Sand and gravel with trace of silt were found at TP21 as confirmed in the sieve results. The potential borrow quantity could exceed 10,000 m^3 but a road would have to be built into this area.

Test pit TP-10-22 was excavated in a disturbed area next to the airstrip. Test pit TP-10-23 was excavated in an undisturbed area about 50 m east of TP-10-22. Both areas have sand and gravel soils with some silt and cobbles and boulders as indicated in the logs and sieve results (Photos 109 and 110 of ESA). Although granular has been removed from this area,

there appears to be more granular material that can be sourced from this area (another 5,000 to 10,000 m^3). A summary table of the borrow sources is provided below.

BORROW SUMMARY AT HOPE LAKE			
Borrow #	**Material Description**	**Estimated Quantity**	**Notes**
LF-2	Sand and gravel with trace silt	8,000 to 16,000 m^3	Also a potential landfill/ landfarm
LF-3	Sand and gravel with trace silt	6,500 to 13,000 m^3	Also a potential landfill/ landfarm
LF-4	Sand and gravel with trace silt	8,000 to 16,000 m^3	Also a potential landfill/ landfarm
Borrow A	Sand and gravel with trace silt	5,000 to 10,000 m^3	Previously used as borrow
Borrow B	Sand and gravel with trace silt	10,000 to 20,000 m^3	Near a trail
Borrow C	Sand and gravel with trace silt	5,000 to 10,000 m^3	Previously used as borrow
Airstrip	Sand and gravel with trace silt	5,000 to 10,000 m^3	Requires building a road
Notes: Estimated quantity based on assumes depth of 1 to 2 m			

All borrow sites contain little fines with large volumes of granular materials ranging from fine-grained sands to boulders. All material will need to be screened in order to meet the gradation limits for Types 1 and 2 granular fill as we estimate there could be 10 to 30% oversize (material coarser than 200 mm).

9.3 NON-HAZARDOUS LANDFILL

As part of the planning process, it was necessary to identify and cost out options including on-site disposal of non-hazardous material. For this site, in review of the volumes of material and the costs associated with building a landfill on-site and long-term monitoring, it was determined that off-site disposal would be the recommended option. The sections below are provided for information purposes only.

9.3.1 General

Non-hazardous landfills could be constructed for the disposal of non-hazardous waste collected from the sites during clean-up and building demolition waste. Non-hazardous landfills are above ground facilities constructed of a granular fill perimeter berm with a minimum 1.0 m thick granular fill cover. Granular fill is mixed between subsequent layers of waste to fill voids and minimize settlement. The proposed non-hazardous waste landfill design is shown in Figure 20.

The solid waste to be contained within the Hope Lake landfill primarily consists of inert waste including wood, metal wastes from demolition and equipment disposal, depressurized cylinders, and empty crushed drums of varying sizes. All drums will have residue removed and crushed to minimize volume in the landfill.

9.3.2 Location

Hope Lake would be the location for the non-hazardous landfill as both Husky and Willow Creek contain minimal quantities of waste compared to the Hope Lake site.

Four sites were assessed as a possible location for the landfill at the Hope Lake site as shown in Figure 22. LF-1 was eliminated as it was determined to be too close to Hope Lake and was located in an area with large cobbles and boulders. LF-4 was concluded to be the best option for a landfarm and was thus not considered as landfill location. After reviewing both LF-2 and LF-3, it was determined that LF-2 would be the best option for the landfill. Although both locations are adjacent to one another it appeared that there was a greater quantity of fine material located in the vicinity of LF-3 which could be used as a potential borrow source. LF-2 also has a relatively level topography with a difference in elevation of approximately a meter over the 75 m x 75 m area, and is also close to many of the debris areas and connected by an existing trail.

This site is adjacent to LF-3 which contains approximately 8,000 to 16,000 m^3 of granular material.

9.3.3 Granular Fill Types

Two types (Types 1 and 2) of granular fill are required for the construction of a non-hazardous landfill. Type 1 Granular Fill is generally a graded gravel and cobble material with trace sand. It will be used for erosion protection of the berm. Type 2 Granular Fill is well-graded sand and gravel with trace silt. Type 2 Granular Fill will be used for the construction of the landfill berms, cover, and the intermediate layer of fill between the layers of waste. The gradation limits for Types 1 and 2 Granular Fill are listed in Tables 22 and 23.

TABLE 22: RECOMMENDED TYPE 1 GRANULAR FILL PARTICLE SIZE DISTRIBUTION LIMITS

Particle Size (mm)	Percent Passing
250	100
150	60 to 100
50	40 to 70
5	5 to 30
0.425	0 to 15
0.08	0 to 8

TABLE 23: RECOMMENDED TYPE 2 GRANULAR FILL PARTICLE SIZE DISTRIBUTION LIMITS

Particle Size (mm)	Percent Passing
200	100
50	60 to 100

TABLE 23: RECOMMENDED TYPE 2 GRANULAR FILL PARTICLE SIZE DISTRIBUTION LIMITS	
Particle Size (mm)	**Percent Passing**
5	30 to 55
0.425	10 to 30
0.08	5 to 20

9.3.4 Construction

The conceptual steps to construct a non-hazardous landfill for the site are as follows:

- Survey landfill footprint and elevations.
- Excavate suitable landfill construction material and haul to site.
- Construct landfill perimeter berms to design elevations, while leaving an access corridor as shown in Figure 20.
- Install up-gradient and down-gradient monitoring wells and conduct baseline soil and water sampling.
- Place waste in 0.5 m lifts separated by 0.15 m intermediate cover and compact; place lifts to design height.
- Close access area.
- Cover with a minimum 1 m of granular fill.
- Place Type 1 granular fill on outside landfill perimeter.

9.3.5 Landfill Options

Two options were reviewed for the Hope Lake non-hazardous landfill based on anticipated non-hazardous waste quantities. The first consisting of 684 m^3 of waste and the second consisting of 1,444 m^3 of waste, which included an additional 760 m^3 of waste from dilapidated and collapsed buildings. Six 75 m^3 POL tanks were also included in both landfill options. The tanks once disassembled and cut into pieces were assumed to contain 10% of their initial volume, which totalled an additional 45 m^3.

Upon review of landfill design and potential for decomposition of the wood and subsequent subsidence of the landfill cap, landfilling the wood was not considered an option; therefore a landfill for 684 m^3 was designed to contain 684 m^3 of non-hazardous solid waste including six POL tanks comprising 45 m^3.

Design and Granular Fill Quantities

Three possible options were reviewed with varying layers of waste. After assessing the granular fill quantities required for construction, a design with two layers of waste was selected as it minimized the amount of granular fill required for construction. The waste is

to be placed in 0.5 m lifts with a 0.15 m intermediate lift of fill between the two layers of waste for a total thickness of 1.15 m. The following points summarize the landfill dimensions and the granular fill quantities for Option A.

DESIGN SPECIFICATIONS – OPTION A	
Footprint (inside toe of berms)	26 x 26 m
Footprint (outside toe of berms)	44 x 44 m
Height of berms	1.15 m
Type 1 Fill Quantity	500 m^3 (in place)
Type 2 Fill Quantity	2,500, m^3 (in place)
Total Fill Quantity	3,000 m^3

9.4 LANDFARM FOR HYDROCARBON CONTAMINATED SOIL

Utilizing the site specific remediation criteria for hydrocarbons as specified in Appendix C is the preferred treatment option; any soil above 2,500 mg/kg will be removed form site. In the event that a landfarm is required, information is provided below.

9.4.1 General

Landfarms are above ground facilities that remediate contaminated soil through biological processes. Contaminated soil is spread in thin beds (less than 0.5 m), and is then periodically tilled, together with other factors, to stimulate aerobic microbial activity. Landfarming is an effective and simple method for remediating low concentrations of PHC contaminated soil and is a practical option for remote locations.

The waste to be contained at a landfarm at Hope Lake would include petroleum hydrocarbon (PHC) contaminated soil fractions F1 to F3 as defined in the Canada-Wide Standard (CWS) for Petroleum Hydrocarbons in Soil (CCME 2008). Design would follow applicable guidelines (EBA 2008, SAIC 2006).

9.4.2 Location

The landfarm would be located at Hope Lake as both Husky and Willow Creek contain small quantities of contaminated soil compared to the Hope Lake site. LF-4 was selected as the most viable option as it is relatively flat with a natural slope less than 5% and there is also a trail connecting it to other areas of the site. There's also more room to alter the landfarm dimensions during the final design stage compared to the other locations. We propose incorporating a geomembrane liner within the down-gradient berms to reduce the potential for groundwater flow within the underlying sands and gravels. The liner would be placed 1 m below existing ground and would keyed into the underlying permafrost as shown in Figure 21.

9.4.3 Design and Granular Fill Quantities

Type 2 Granular Fill will be used for the construction of a landfarm at Hope Lake. Type 2 Granular Fill is well-graded sand and gravel with trace silt. The recommended gradation limits for Type 2 Granular Fill are listed in Table 23.

The landfarm dimensions are based on approximately 2,270 m^3 of PHC contaminated soil including a 30% bulking factor. Granular fill quantities are based on a 0.3 m pad below the waste and a minimum 1.5 m berm height which may have to be increased to accommodate the natural slope across the site.

The following points summarize the landfarm dimensions and the granular fill quantities.

LANDFARM SPECIFICATIONS	
Footprint (inside toe of berms)	125 x 60 m
Footprint (outside toe of berms)	148 x 83 m
Height of berms	1.5 m
Type 2 Fill Quantity	7,000 m^3 (in place)

The required fill material would be sourced from Borrow Prospect A (Figure 22), which contains approximately 5,000 to 10,000 m^3 of granular material.

The quantity of geomembrane liner is approximately 1,700 m^2, and approximately 3,400 m^2 of non-woven geotextile fabric will be required to protect the liner.

10.0 SITE REQUIREMENTS FOR REMEDIATION

A camp and other facilities will need to be constructed as part of this remediation plan and equipment will need to be brought to site.

10.1 CAMP

For the remediation at Hope Lake, a camp will need to be set up sufficient distance away from the site to ensure workers are not affected by hazards and contamination. A suitable location might be west of the airstrip, near APEC 5. The camp will need to house workers and will need to meet the specifications laid out by PWGSC. Facilities that will be required include the following:

- Sleeping quarters
- Office (also contains communications area)
- Kitchen and dining area
- Bathroom and showers

- Laundry facilities
- First aid facilities (may depend on the number of workers)
- Sewage lagoon or water treatment system
- Incinerator
- Mechanics and equipment area that would also have a petroleum and lube containment area, tanks and drums
- Water supply and pumps
- Diesel powered generator and back-up
- Emergency shelter

10.2 EXPECTED CONTRACTING EQUIPMENT NECESSARY FOR SITE

Anticipated equipment needs for this project are:

- Excavator(s)
- Front end loader(s)
- Haul Truck(s)
- Packer
- Dozer
- Half-ton trucks and quads
- Incinerator and oil/water separator
- Drum crusher
- Cat train

11.0 VERIFICATION AND POST REMEDIATION LONG-TERM MONITORING PROGRAM

11.1 VERIFICATION AND MONITORING DURING REMEDIATION ACTIVITIES

Verification and monitoring of construction works, environmental clean-up, verification of quantities and quality of work will need to be carried out during the remediation phase of this project. Skill sets needed will be residential engineering experience, hazardous materials testing and abatement, safety monitoring, soil sampling, and geotechnical and materials testing. The following work tasks will need to be performed:

Hazardous Materials Testing and Abatement

- Testing of liquid in drums or other containers for Transportation of Dangerous Goods (TDG) and disposal purposes.

- Supervision and monitoring of asbestos and lead paint abatement and verification of clean-up.
- Supervision and verification of depressurization of cylinders.
- Testing of solid suspected hazardous materials to determine appropriate disposition.
- Verification of appropriate storage of hazardous waste in temporary storage area until shipment.
- Verification of shipments and quantities of materials off-site.

Disposition of Non-Hazardous Waste

- Ensuring removal of all hazardous materials from dumps sites and buildings prior to removal or demolition of buildings.
- Removal of all non-wood materials that is not hazardous from buildings and verification of hauling to staging area for off-site disposal.
- Verification of clean-up of all debris areas and removal to staging area for off-site disposal.
- Verification of buildings demolition and removal to burn area. Supervision of controlled burn. Sampling and testing of ashes if necessary. Removal of ashes either off-site or to on-site landfill.
- Photo documentation and surveying of above activities where applicable.

Remediation of Impacted Areas

- Sampling beneath and adjacent to metal and salt-impacted soil areas to ensure complete removal.
- Baseline soil sampling of temporary storage area, camp area, sewage lagoon, incinerator areas, fuel and lube oil storage facilities, camp area, and mechanics area.
- Baseline groundwater sampling and documentation of well installation and stratigraphy of boreholes for areas where impacts will remain in-situ.
- Verification of manifests for impacted soil that goes off-site.
- Photo documentation and surveying of above activities where applicable.

Construction of Landfill/Landfarm, Materials Testing and Borrow Development (if required)

- Conduct grain size distribution testing and moisture density relationship tests of borrow material proposed for any site construction.
- Verification of quantities taken from borrow area.
- Compaction monitoring.

11.2 POST REMEDIATION LONG-TERM MONITORING PROGRAM

If the preferred remedial options for all the waste streams are implemented there will be no need for long-term monitoring, as all impacted materials will be removed from site, with the exception of groundwater impacts at APEC 2A at Hope Lake. We suspect that with removal of the impacted soil, and the recontouring required in the area of ground water impacts, that monitoring will only be required for one or two years until the impacts in the groundwater have naturally attenuated.

In the event that a landfarm is required to remediate the hydrocarbon impacted soils, yearly monitoring will be required during land farm operations. It is anticipated that the landfarm would be in operation for four years. Once the soils were remediated to applicable criteria, the soils would be replaced and no further monitoring would be required.

12.0 LIMITATIONS OF LIABILITY

Recommendations presented herein are based on a Supplemental Site Investigation as described in Section 1.0. This report has been prepared for the exclusive use of PWGSC and INAC or other parties designated by PWGSC or INAC for the specific application described in Section 1.0 of this report. It has been prepared in accordance with generally accepted geo-environmental engineering practices. No other warranty is made, either expressed or implied. Professional judgement has been applied in developing the recommendations of this report.

13.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

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P 018
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/dlm

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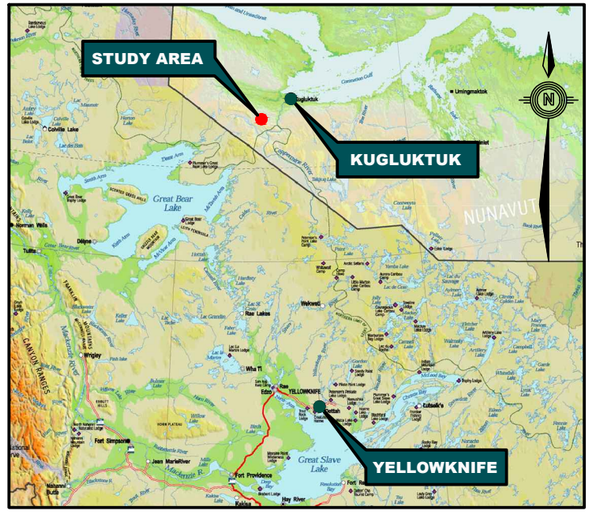
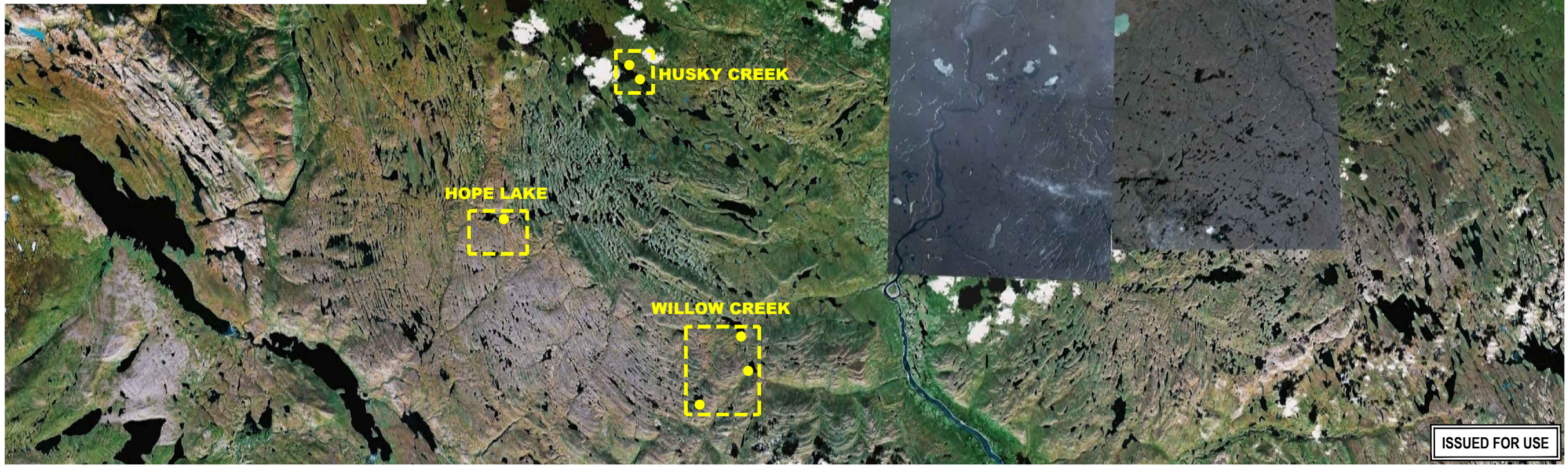
WESA Inc. 2009c. Integrated Phase I and Limited Phase II Environmental Site Assessment, WK197 – Husky Creek. File: KB6852.

FIGURES



KEY PLAN

N.T.S.



0 10 000 m

Scale (m)

CLIENT

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

OVERALL SITE PLAN

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0

OFFICE: EBA-EDM

DATE: March, 2011

Figure 1

E 533 000
E 533 500
E 534 000
E 534 500
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E 535 500
N 7 493 000
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N 7 492 000

UNNAMED LAKE

FIGURE 4 - WK197 (NORTH)

FIGURE 3 - WK197 (SOUTH)

ISSUED FOR USE

REFERENCES:

1) BASE DRAWING: NTS MAP NO. 86N09, ZONE 11 W. UTM NAD 83

2) SURVEY DRAWING: PROVIDED BY SUB-ARCTIC SYRVEYS LTD.
FILE NO. 10-079-HUSKY LAKE; UTM COORDINATES, ZONE 11 W, CENTRAL MERIDIAN 117° WEST (NAD 83, CSRS, PPP), ORTHOMETRIC ELEVATION

0 250 m
Scale (m)

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

OVERALL HUSKY CREEK SITE PLAN

EBA Engineering Consultants Ltd.

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Y22101167.005	DBD	KO	0
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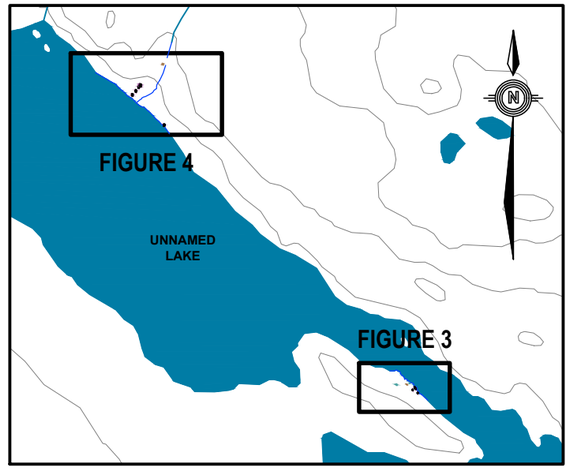
Figure 2

Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y2211\Y22101167005\01_Drawings\02_Husky Creek\Y22101167.005_Fig 2-Fig 4A_Husky.dwg [FIGURE 2] March 24, 2011 - 11:16:34 am (BY: DAS, DEBASHIS)

N 7 491 900
N 7 491 850
N 7 491 800
E 534 450
E 534 500
E 534 550
UNNAMED LAKE
CREST
TOE OF SLOPE
APEC 10
APEC 5
COLLAPSED BUILDING
APEC 1
APEC 3
APEC 4B
APEC 2
APEC 6
APEC 4A
SHORELINE
TOE OF SLOPE
CREST OF SLOPE
2010-4
276.0
277.0
275.0



KEY PLAN

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
1	Non-Hazardous	Wood Debris	0.1
		Metal Debris	2
		Canvas Debris	0.5
	Hazardous (Leachable lead paint[3] and Propane)	Pressurized Cylinder	1 cylinder
2	Non-Hazardous	Wood Debris	3
		Metal Debris	3
3	Non-Hazardous	Wood Debris	0.5
		Metal Debris	0.1
	Hazardous (Leachable lead paint)	Drums (205 L)	6 drums
4a, 4b and 6	Non-Hazardous	Wood Debris	4
		Metal Debris	1
	Hazardous (Leachable lead paint)	Drums (205 L)	3 drums
5	Non-Hazardous	Wood Debris	0.5
-	Non-Hazardous	Metal Debris	0.1
10	Non-Hazardous	Metal Debris	0.2

Notes:
1. All volumes: uncrushed.
2. Drums/cylinder volumes are numbers of drums/cylinders, not m^3.
3. Total lead in paint exceeds criteria, however, leachable lead analysis was not possible. Assume the paint contains leachable lead.

ISSUED FOR USE

LEGEND
- APPROXIMATE DRUM(S) LOCATION
- SURVEY CONTROL POINT (2010-4)
- CAN CACHE
- STRUCTURE

0 25 m
Scale (m)

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

OVERALL HUSKY CREEK
WK197 (SOUTH) SITE PLAN

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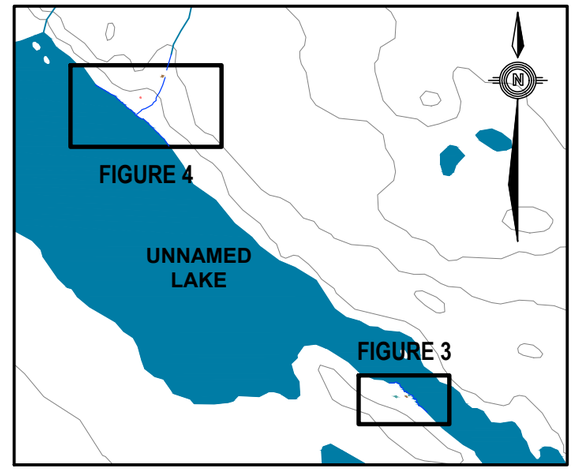
Figure 3

Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y221\Y22101167\005\01_Drawings\02_Husky Creek\Y22101167.005_Fig 2-Fig 4A_Husky.dwg [FIGURE 3] March 30, 2011 - 12:13:21 pm (BY: DAS, DEBASHIS)

E 533 400
E 533 500
E 533 600
E 533 700
N 7 492 900
N 7 492 800
N 7 492 700
COLLAPSED BUILDING
APEC 11
2010-5
CREST
TOE
285.0
279.0
277.0
276.0
275.0
APEC 7
BOMBARDIER SNOW CAT
SEE DETAIL A (FIGURE 4A)
APEC 9B
CREEK
HUSKY LAKE
SHORELINE
APEC 8
APEC 9A



KEY PLAN

NORTH CAMP WK197 HUSKY CREEK INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
7	Non-Hazardous	Wood Debris	0.5
		Metal Debris	2
		Plastic Debris	1
		Machinery	15.8
		Drums (205 L)	2 drums
	Hazardous (Leachable Lead paint)	Drums (205 L)	2 drums
8	Non-Hazardous	Metal Debris	0.8
		Canvas Debris	1.2
		Rubber Debris	0.1
9a and 9b	Non-Hazardous	Wood Debris	0.4
		Drum (205 L)	1 drum
	Hazardous (Leachable lead paint)	Drums (205 L)	2 drums
11	Non-Hazardous	Wood Debris (East of APEC 8 on ridge)	2

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3

ISSUED FOR USE

LEGEND
- APPROXIMATE DRUM(S) LOCATION
- 2010-5 - SURVEY CONTROL POINT
- STRUCTURE

0 50 m
Scale (m)

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

OVERALL HUSKY CREEK WK197 (NORTH) SITE PLAN

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PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0

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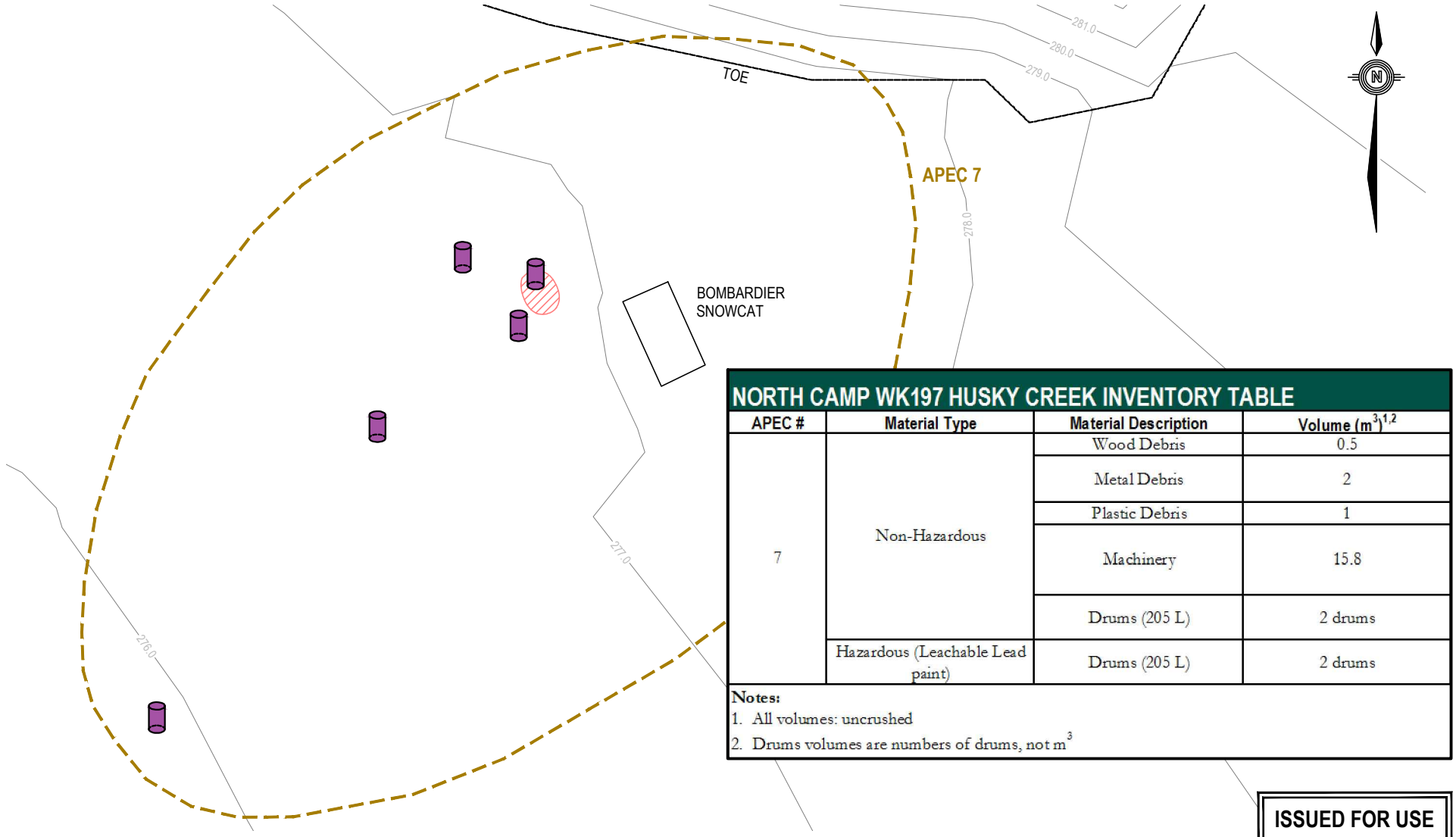
DATE: March, 2011

Figure 4



NORTH CAMP WK197 HUSKY CREEK INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
7	Non-Hazardous	Wood Debris	0.5
		Metal Debris	2
		Plastic Debris	1
		Machinery	15.8
		Drums (205 L)	2 drums
	Hazardous (Leachable Lead paint)	Drums (205 L)	2 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- IMPACTED AREA

0 10 m
Scale (m)

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL A
(FIGURE 4)

EBA Engineering Consultants Ltd.

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Y22101167.005	DBD	KO	0
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Figure 4A

E 534 000
E 536 000
E 538 000
E 540 000
E 542 000
E 544 000
E 546 000
E 548 000

N 7 472 000
N 7 470 000
N 7 468 000
N 7 466 000

FIGURE 7

FIGURE 6 - WK172

FIGURE 8 - WKB01

FIGURE 9 - WKB02

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REFERENCES:

1) BASE DRAWING: NTS MAP NO. 86N09, ZONE 11 W. UTM NAD 83

2) SURVEY DRAWING: PROVIDED BY SUB-ARCTIC SYRVEYS LTD.
FILE NO. 10-079-WILLOW LAKE; UTM COORDINATES, ZONE 11 W, CENTRAL MERIDIAN 117° WEST (NAD 83, CSRS, PPP), ORTHOMETRIC ELEVATION

0 2 000 m
Scale (m)

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

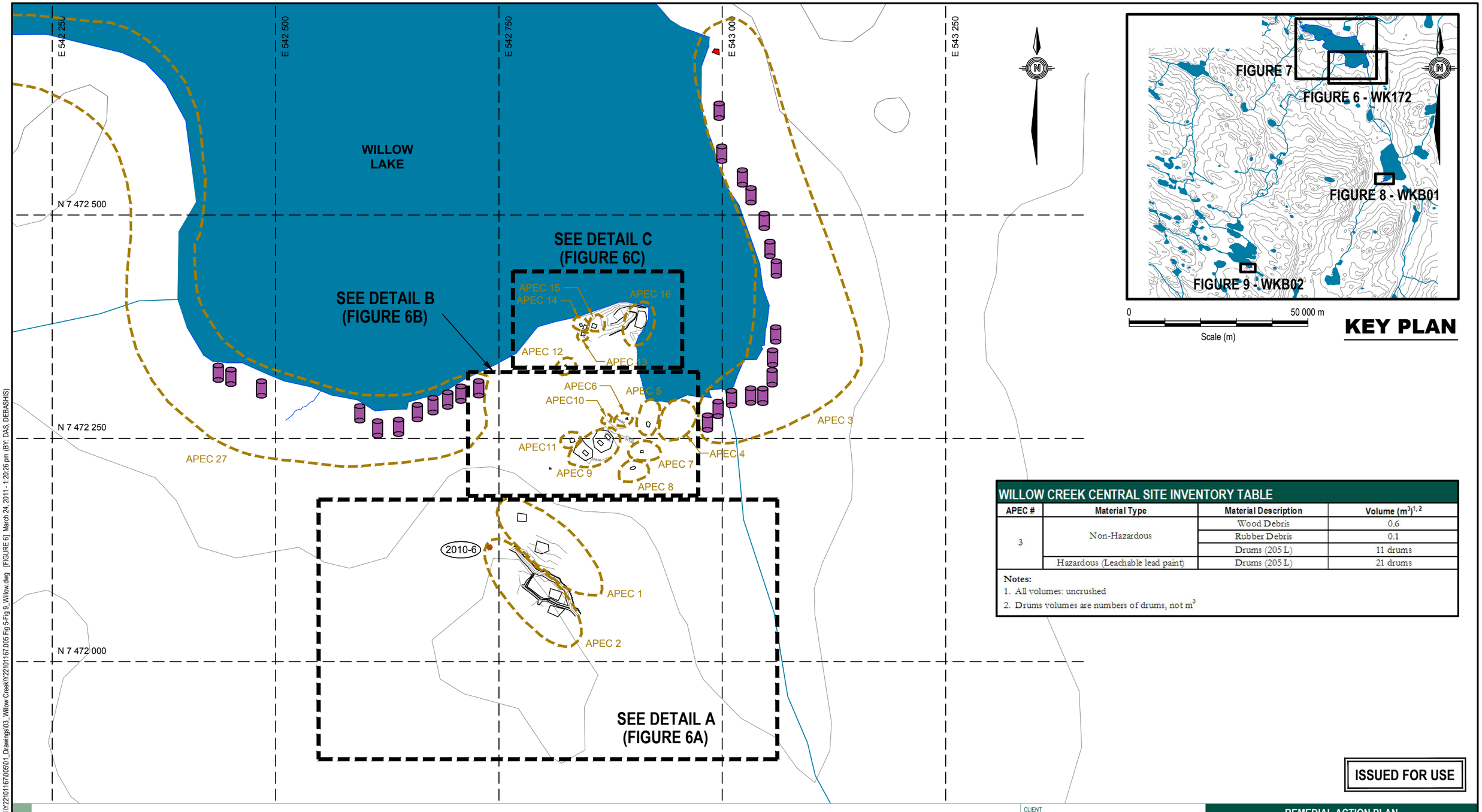
OVERALL WILLOW CREEK SITE PLAN

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 5

Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y221\Y22101167005\1_Drawings\03_Willow Creek\Y22101167.005 Fig 5-Fig 9_Willow.dwg [FIGURE 5] March 24, 2011 - 1:08:02 pm (BY: DAS, DEBASHIS)



KEY PLAN

WILLOW CREEK CENTRAL SITE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1, 2]
3	Non-Hazardous	Wood Debris	0.6
		Rubber Debris	0.1
		Drums (205 L)	11 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	21 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- CONTROL POINT
- DRUM CACHE

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

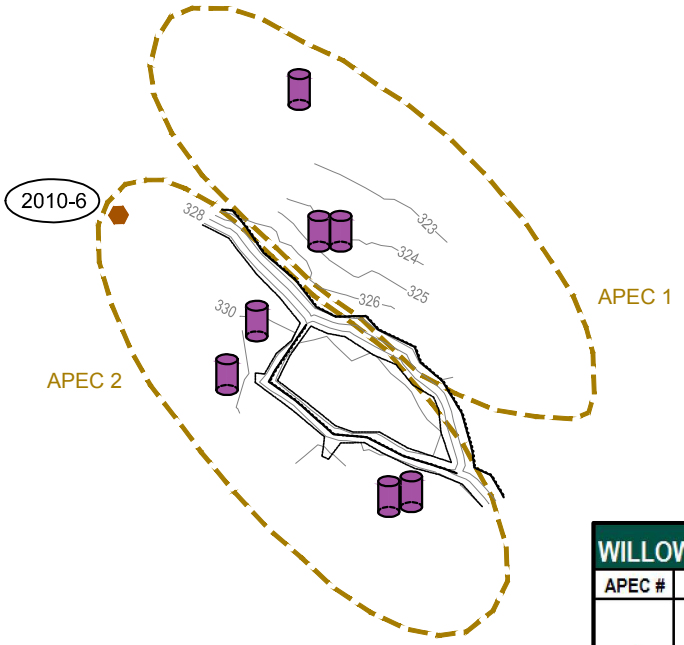
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

OVERALL WILLOW CREEK WK172 SITE PLAN

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 6



WILLOW CREEK CENTRAL SITE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1, 2]
1	Non-Hazardous	Wood Debris	4
		Metal Debris	0.1
		Roofing Material	0.1
	Hazardous (Leachable lead paint)	Drums (205 L)	7 drums
2	Non-Hazardous	Wood Debris	4.5
		Metal Debris	1
		Rubber Debris	0.1
		Fibreglass	2
		Drums (205 L)	4 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	5 drums

Notes:

1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- 2010-6 - CONTROL POINT

0 100 m

Scale (m)

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

EBA Engineering Consultants Ltd.

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL A
(FIGURE 6)

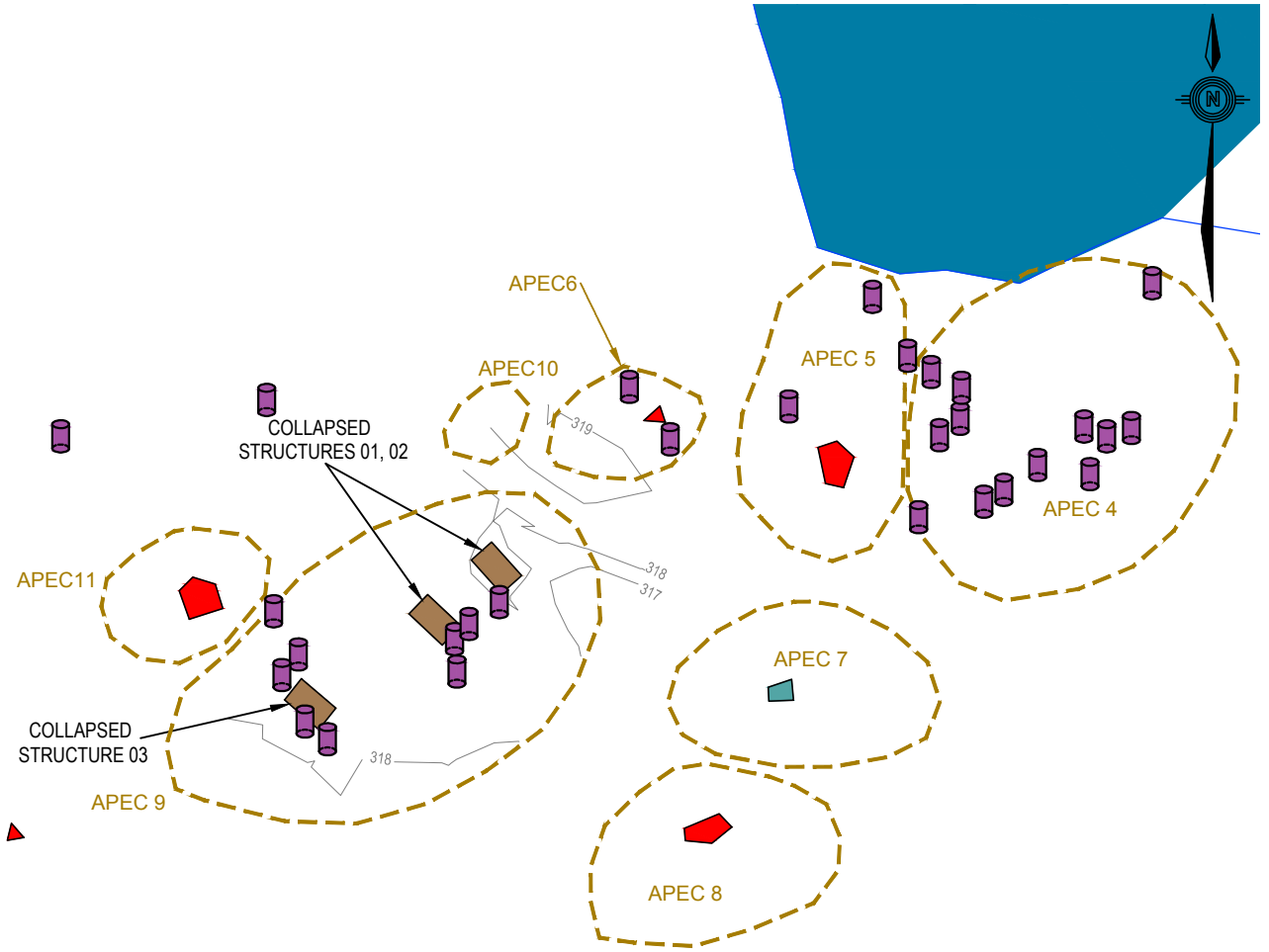
PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 6A

WILLOW CREEK CENTRAL SITE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3) [1,2]
4	Non-Hazardous	Wood Debris	2.4
		Rubber Debris	0.1
	Hazardous (Leachable lead paint)	Drums (205 L)	9 drums
5	Non-Hazardous	Wood Debris	1.8
		Cables	1
		Drums (205 L)	5 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	23 drums
6	Non-Hazardous	Wood Debris	0.1
		Metal Debris	0.7
		Plastic	0.5
		Porcelain	0.1
		Drums (205 L)	5 drums
	Hazardous (Leachable lead paint)	Drums (205 L) drums	3 drums
7	Non-Hazardous	Metal Debris	4
		Drums (205 L)	1 drum
8	Non-Hazardous	Wood Debris	3
		Metal Debris	1
		Plastic	1
		Battery	0.1
		Drums (205 L)	2 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	9 drums
9	Non-Hazardous	Wood Debris	3
		Wood Structure 01: Core Storage, 02, 03	6.7
		Metal Debris	5
		Rubber Debris	1
		Tank	0.1
		Textiles	2
		Plastic	2
		Cores	3
		Drums (10 L)	4 drums
	Hazardous (Battery contents)	Batteries	0.1
	Hazardous (Leachable lead paint)	Drums (205 L)	15 drums
10	Non-Hazardous	Plastic	0.1
	Hazardous (Battery contents)	Batteries	0.1
11	Non-Hazardous	Wood Debris	2
		Metal Debris	1
		Drums (205 L)	1 drum
	Hazardous (Leachable lead paint)	Drums (205 L)	17 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3



ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- CAN CACHE
- DRUM CACHE
- STRUCTURE

0 50 m
Scale (m)

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

EBA Engineering Consultants Ltd.

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL B
(FIGURE 6)

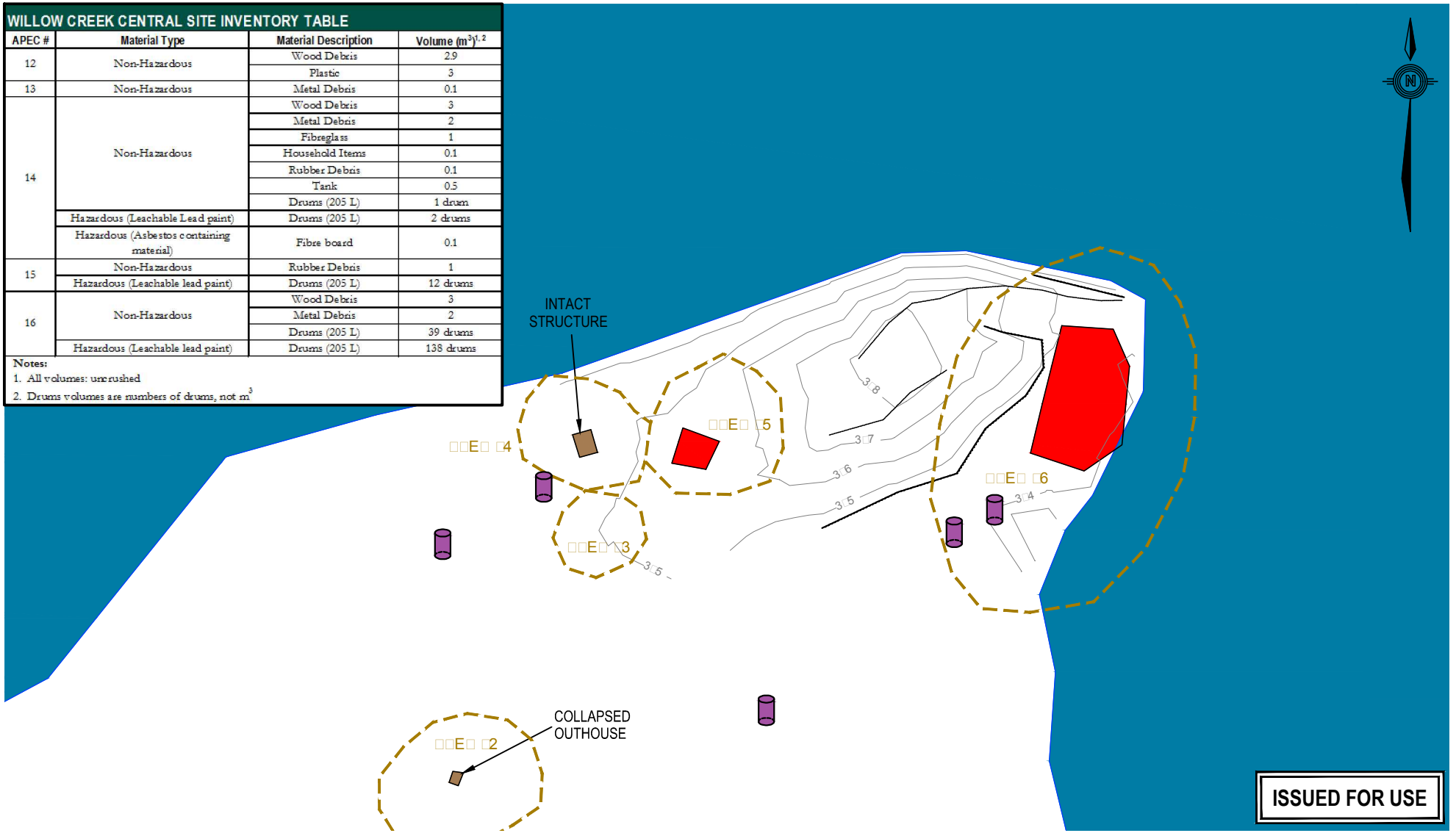
PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 6B

WILLOW CREEK CENTRAL SITE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1, 2]
12	Non-Hazardous	Wood Debris	2.9
		Plastic	3
13	Non-Hazardous	Metal Debris	0.1
14	Non-Hazardous	Wood Debris	3
		Metal Debris	2
		Fibreglass	1
		Household Items	0.1
		Rubber Debris	0.1
		Tank	0.5
		Drums (205 L)	1 drum
	Hazardous (Leachable Lead paint)	Drums (205 L)	2 drums
	Hazardous (Asbestos containing material)	Fibre board	0.1
15	Non-Hazardous	Rubber Debris	1
	Hazardous (Leachable lead paint)	Drums (205 L)	12 drums
16	Non-Hazardous	Wood Debris	3
		Metal Debris	2
		Drums (205 L)	39 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	138 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3



ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- DRUM CACHE
- STRUCTURE

0 25 m

Scale (m)

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

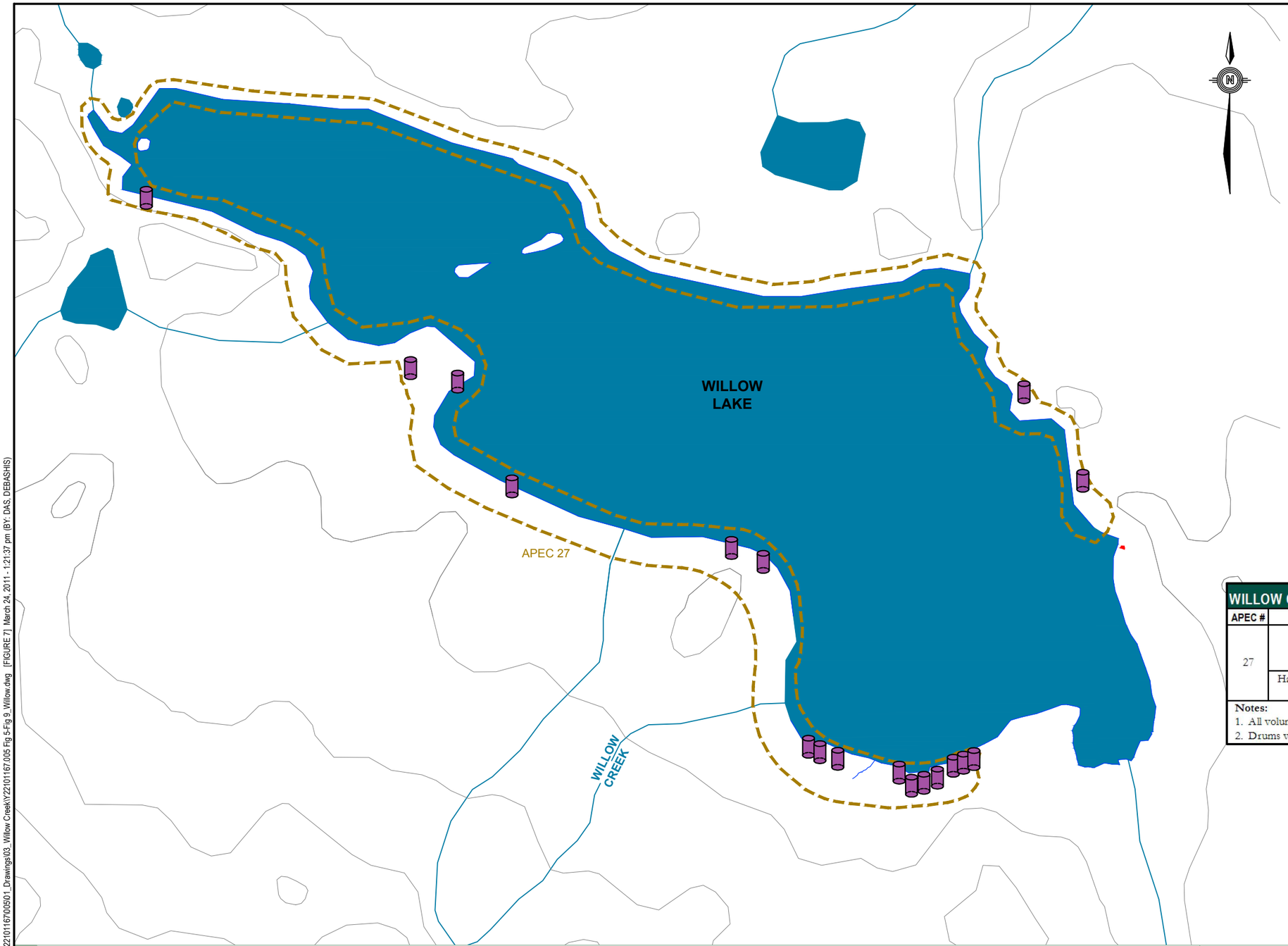
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

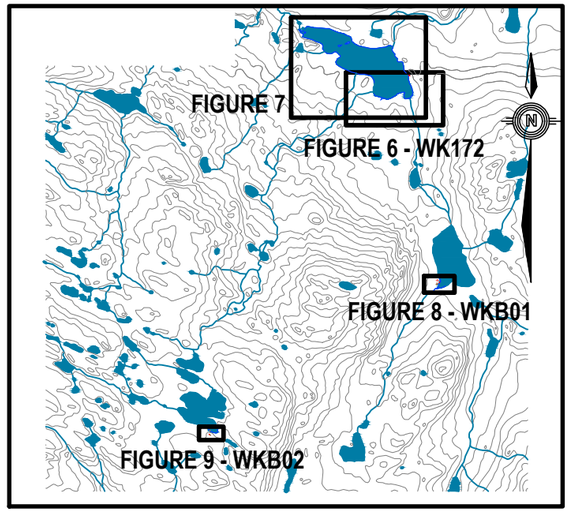
DETAIL C
(FIGURE 6)

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 6C





0 50 000 m
Scale (m)

KEY PLAN

WILLOW CREEK CENTRAL SITE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
27	Non-Hazardous	Wood Debris	4
		Plastic	2
		Drums (205 L)	11 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	26 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m3

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION

0 250 m
Scale (m)

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

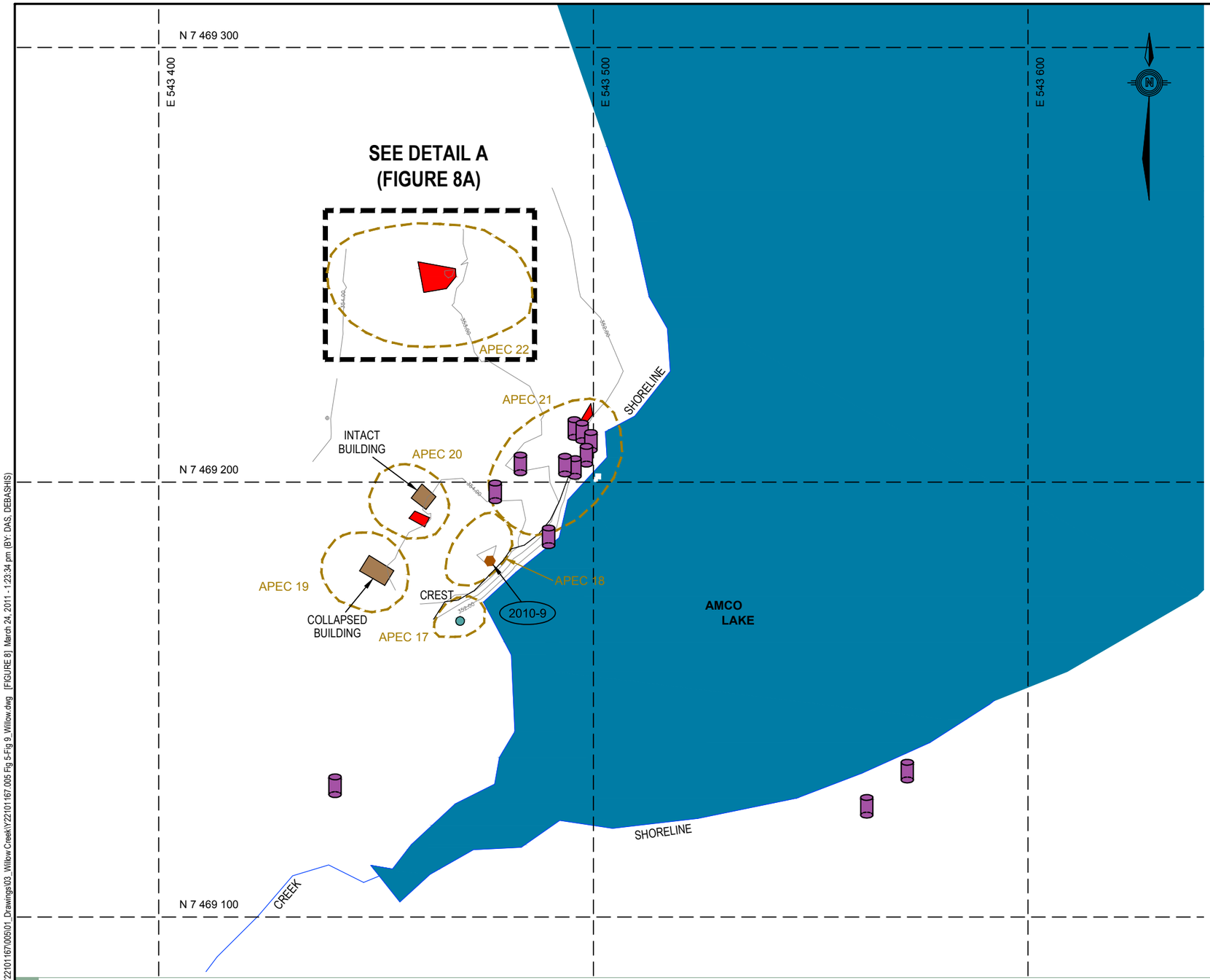
DRUM LOCATIONS AROUND WILLOW LAKE

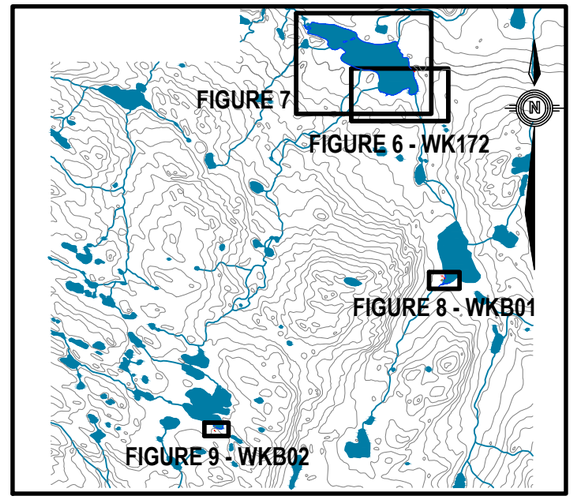
EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 7

Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y22\Y22101167\005\1_Drawings\03_Willow Creek\Y22101167.005 Fig 5-Fig 9_Willow.dwg [FIGURE 7] March 24, 2011 - 1:21:37 pm (BY: DAS, DEBASHIS)





0 50 000 m

Scale (m)

KEY PLAN

WILLOW CREEK SOUTH CABINS SITE WKB01 INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
17	Non-Hazardous	Wood Debris	4.8
		Metal Debris	0.1
N/A	Non-Hazardous	Wood Debris	1
		Metal Debris	0.5
		Drums (205 L)	2.5 drums
18	Non-Hazardous	Wood Debris	1
		Cores	1
19	Non-Hazardous	Wood Debris	4
		Metal Debris	2
	Hazardous (Asbestos containing material)	Insulating Material	1
20	Non-Hazardous	Wood Debris	3
		Metal Debris	1
		Drums (205 L)	5 drums
	Hazardous (Battery components)	Battery	0.1
N/A	Non-Hazardous	Wood Debris	0.5
		Metal Debris	0.3
		Cans	0.1
21	Non-Hazardous	Wood Debris	1
		Metal Debris	0.1
		Drums (205 L)	9 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	16 drums
	Hazardous (Battery components)	Battery	0.1
22	Non-Hazardous	Wood Debris	0.5
		Metal Debris	0.1
		Drums (205L)	27 drums
	Hazardous (Asbestos containing material)	Insulating Material	0.5
	Hazardous (Leachable lead paint)	Drums (205 L)	22 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- 2010-9 - SURVEY CONTROL POINT
- CAN CACHE
- DRUM CACHE
- STRUCTURE

0 50 m

Scale (m)

ISSUED FOR USE

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

EBA Engineering Consultants Ltd.

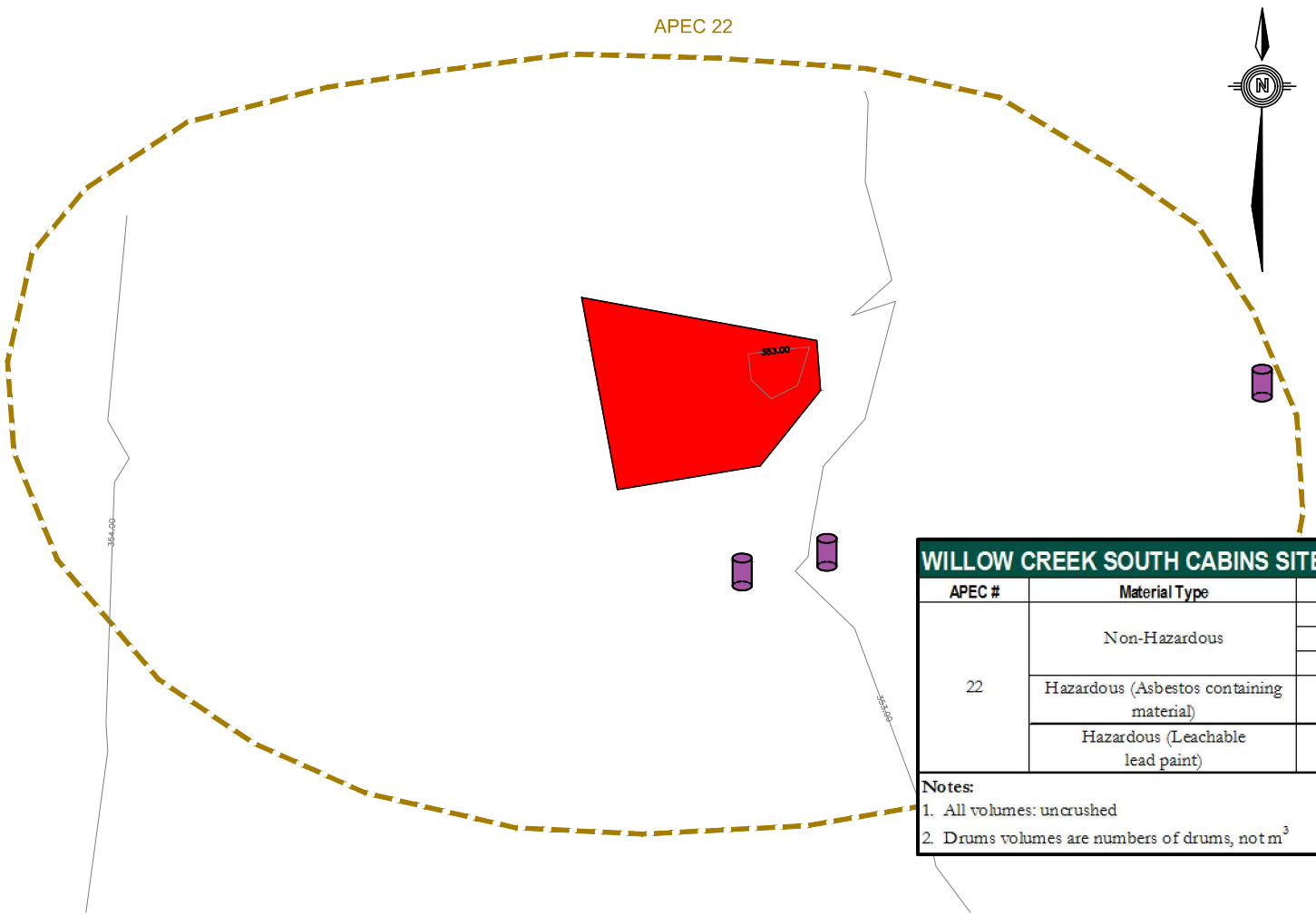
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

OVERALL WILLOW CREEK WKB01 SITE PLAN

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 8

Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y221\Y22101167\005\01_Drawings\03_Willow Creek\Y22101167.005 Fig 5-Fig 9_Willow.dwg [FIGURE 8] March 24, 2011 - 1:23:34 pm (BY: DAS, DEBASHIS)



WILLOW CREEK SOUTH CABINS SITE WKB01 INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
22	Non-Hazardous	Wood Debris	0.5
		Metal Debris	0.1
		Drums (205L)	27 drums
	Hazardous (Asbestos containing material)	Insulating Material	0.5
	Hazardous (Leachable lead paint)	Drums (205 L)	22 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- DRUM CACHE

0 10 m

Scale (m)

CLIENT

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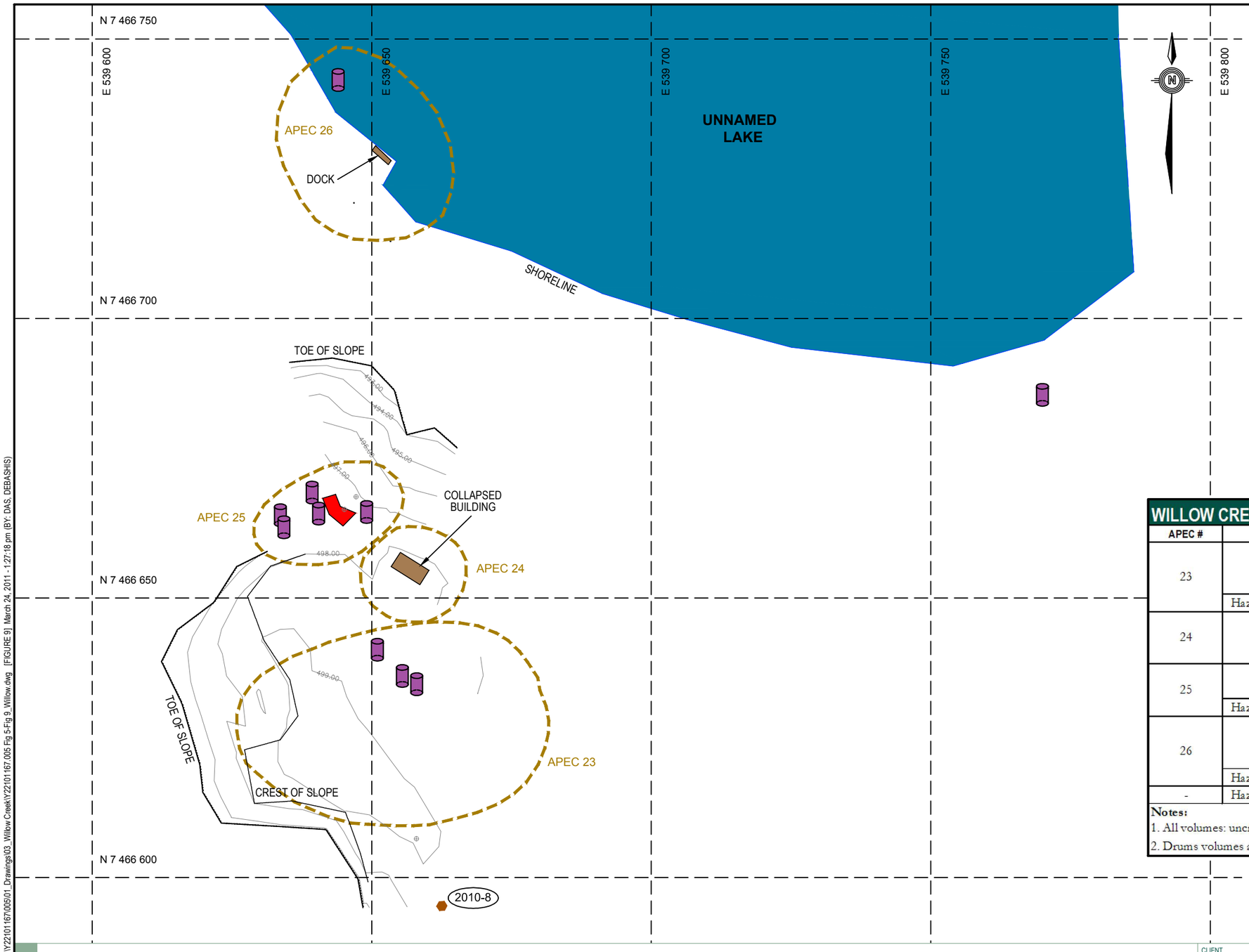
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

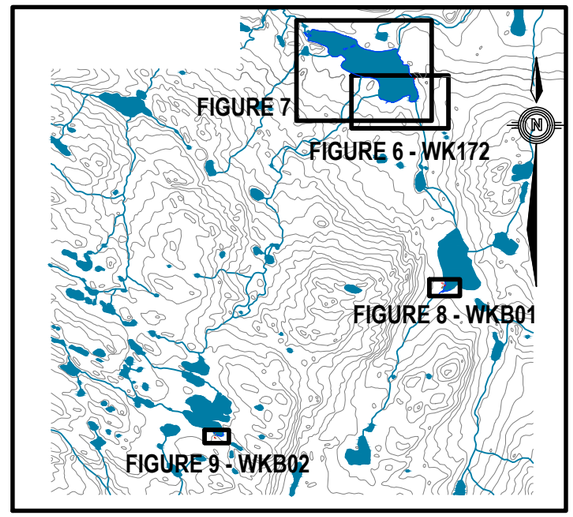
DETAIL A
(FIGURE 8)

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD/EL	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 8A





KEY PLAN

WILLOW CREEK SOUTHWEST CABIN SITE WKB02 INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
23	Non-Hazardous	Wood Debris	8
		Metal Debris	4
		Plastic	0.5
	Hazardous (Leachable lead paint)	Drums (205 L)	4 drums
24	Non-Hazardous	Wood Debris	10
		Metal Debris	1
		Cores	5
25	Non-Hazardous	Wood Debris	2
		Drums (205 L)	2 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	24 drums
26	Non-Hazardous	Wood Debris	1.8
		Metal Debris	0.5
		Drums (205 L)	5 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	1 drum
-	Hazardous (Leachable lead paint)	Drums (205 L)	1 drum

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- SURVEY CONTROL POINT
- DRUM CACHE
- STRUCTURE

0 25 m
Scale (m)

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

OVERALL WILLOW CREEK WKB02 SITE PLAN

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0

OFFICE: EBA-EDM
DATE: March, 2011

Figure 9

E 522 000
E 523 000
E 524 000
E 525 000
E 526 000
N 7 480 500
N 7 479 500
N 7 478 500
HOPE LAKE
FIGURE 13
(APEC 3)
FIGURE 15
(APEC 4)
FIGURE 11
(APEC 1)
FIGURE 12
(APEC 2)
FIGURE 14
(APEC 3V)
FIGURE 16
(APEC 5)
FIGURE 17
(APEC 6)
FIGURE 18
(APEC 6B, APEC 7)
FIGURE 19
(APEC 7)
ISSUED FOR USE

REFERENCES:

1) BASE DRAWING: NTS MAP NO. 86N09, ZONE 11 W. UTM NAD 83

2) SURVEY DRAWING: PROVIDED BY SUB-ARCTIC SYRVEYS LTD. FILE NO. 10-079-HOPE LAKE; UTM COORDINATES, ZONE 11 W, CENTRAL MERIDIAN 117° WEST (NAD 83, CSRS, PPP), ORTHOMETRIC ELEVATION

0 500
Scale (m)

LEGEND:

- APPROXIMATE LOCATION OF INUIT OWNED LAND

CLIENT

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

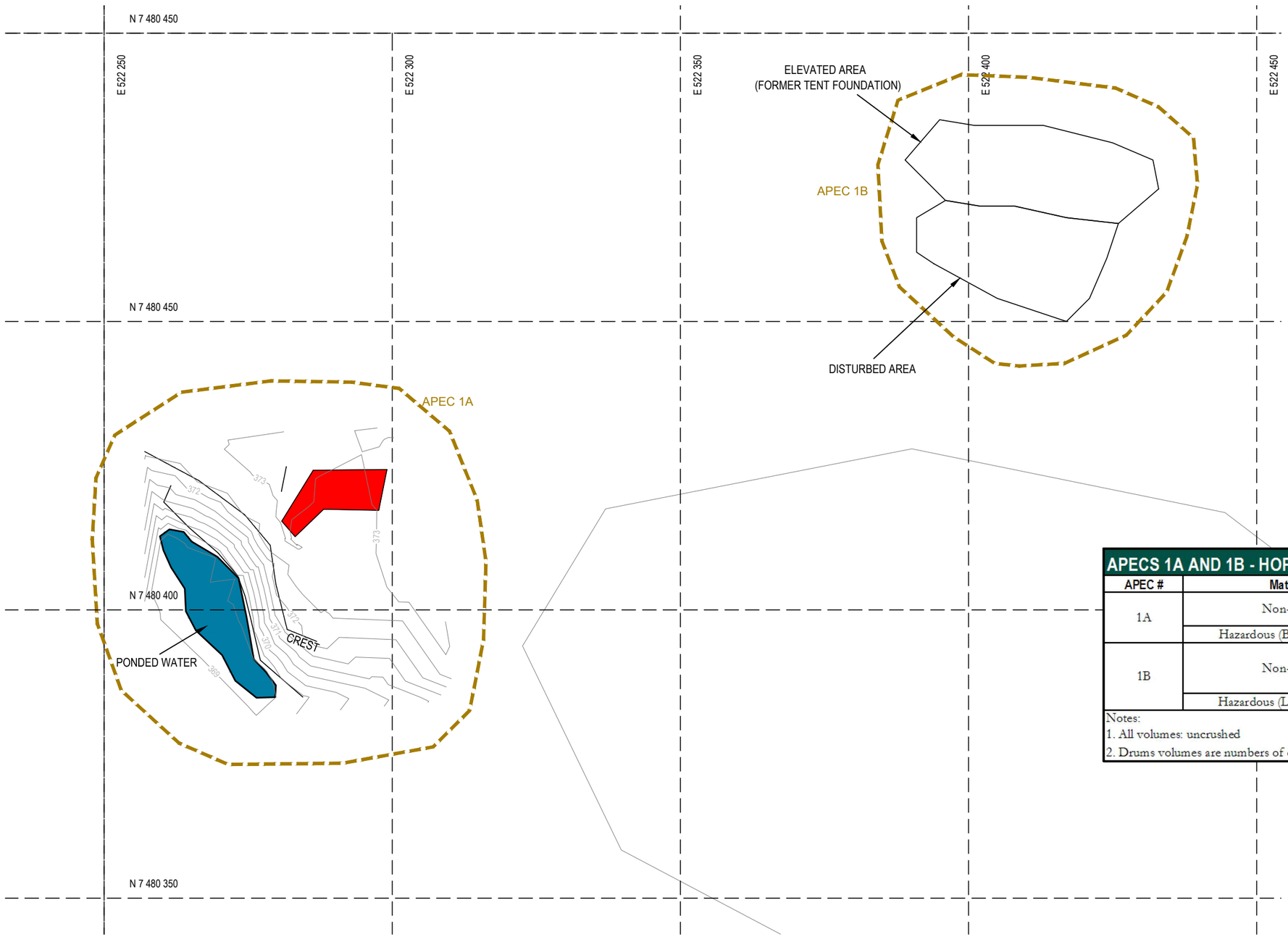
HOPE LAKE OVERALL SITE PLAN

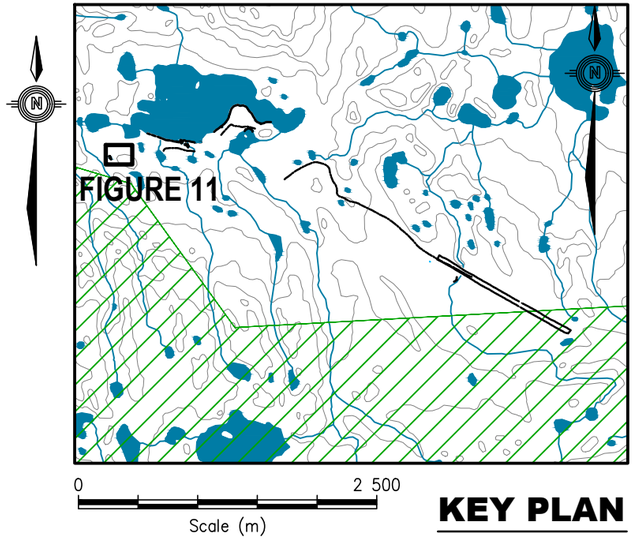
EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 10

Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y22\1\Y22101167\005\01_Drawings\04_Hope Lake\Y22101167.005 Fig 10-Fig 19_Hope.dwg [FIGURE 10] March 25, 2011 - 1:07:51 pm (BY: DAS, DEBASHIS)





KEY PLAN

APECS 1A AND 1B - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
1A	Non-Hazardous	Metal Debris	5
		Small Drums (20 L)	200 drums
	Hazardous (Battery components)	Battery	0.1
1B	Non-Hazardous	Wood Debris	4.4
		Metal Debris	0.1
		Drums (205 L)	6 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	2 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- APPROXIMATE LOCATION OF INUIT OWNED LAND
- DRUM CACHE

0 25
Scale (m)

NOTE:

IMPACTED SOIL AREA TOO SMALL TO SHOW ON FIGURE

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

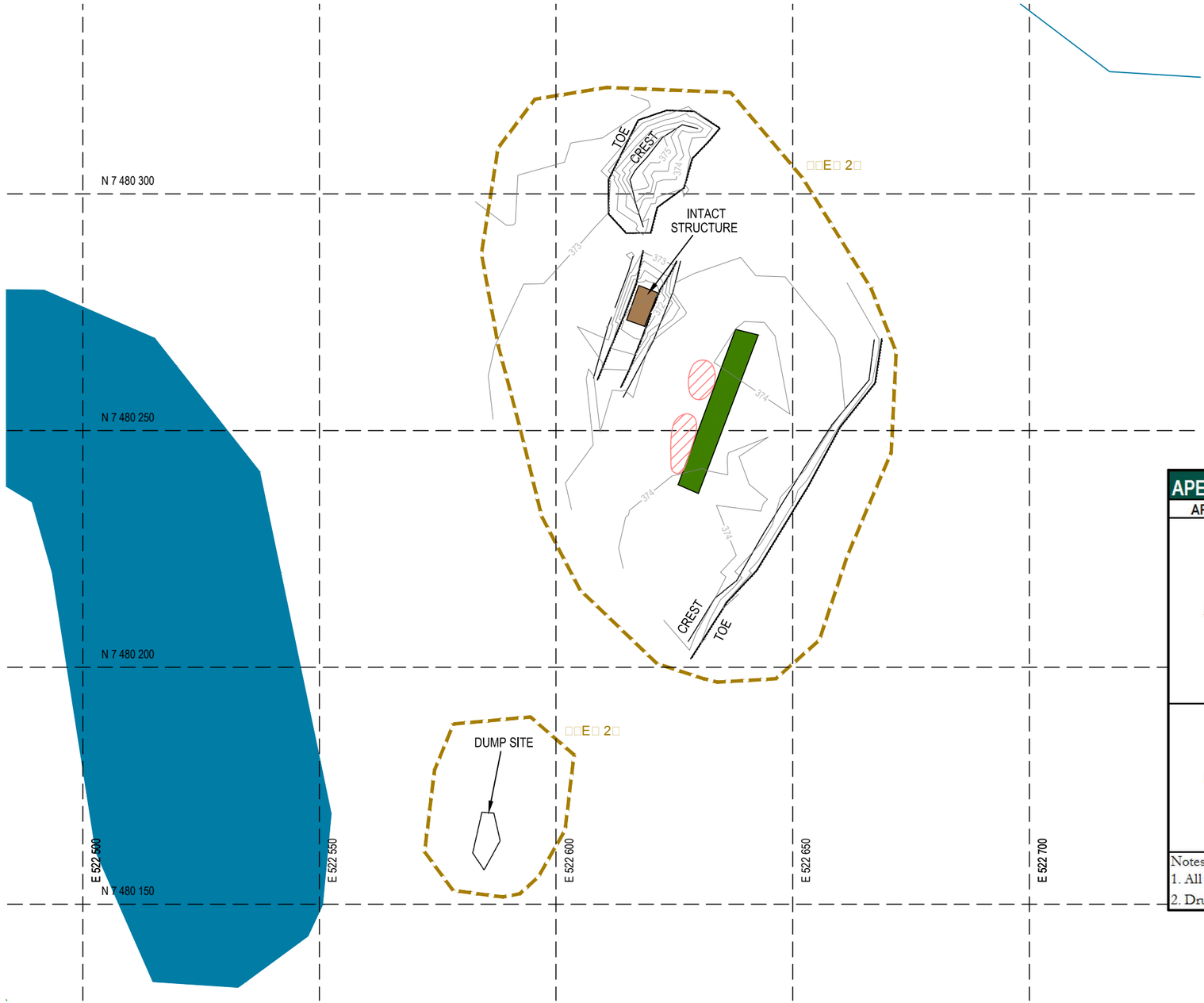
HOPE LAKE - APEC 1A AND 1B

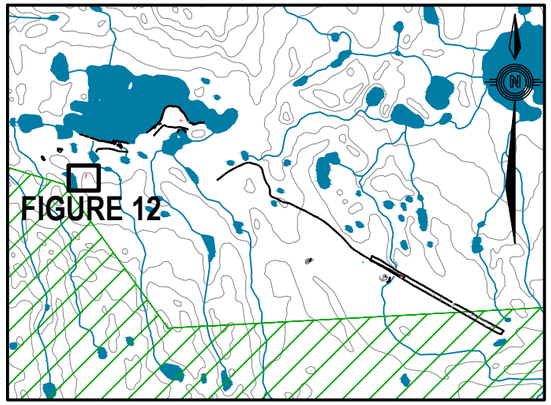
EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0

OFFICE: EBA-EDM
DATE: March, 2011

Figure 11





APECS 2A AND 2B - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
2A	Non-Hazardous	Wood Debris	16
		Metal Debris	2
		Insulation	0.5
		Canvas	3
	Hazardous (Leachable lead paint and asbestos containing lower gaskets)	75,000 L Diesel Silver painted, Steel tanks, 15 cm off the ground, rubber gaskets on top (1 m^3), 4 asbestos containing grey gaskets on lower valves (1 m^3).	450
2B	Non-Hazardous	Metal Debris	2
		Glass	0.1
		Plastic	1
		Rubber Debris	0.1
		Drums (205 L)	4 drums
		Small Drums (20 L)	5 drums
		Small Drums (35L)	2 drums
	Hazardous (Battery components)	Battery	0.1

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND
- IMPACTED AREA
- STRUCTURE
- TANK(S)
- APPROXIMATE LOCATION OF INUIT OWNED LAND

0 50
Scale (m)

CLIENT
Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

HOPE LAKE - APEC 2A AND 2B

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 12

E 522 650
E 522 700
E 522 750
E 522 800
E 522 850
E 522 900
E 522 950

N 7 480 550
N 7 480 500
N 7 480 450
N 7 480 400

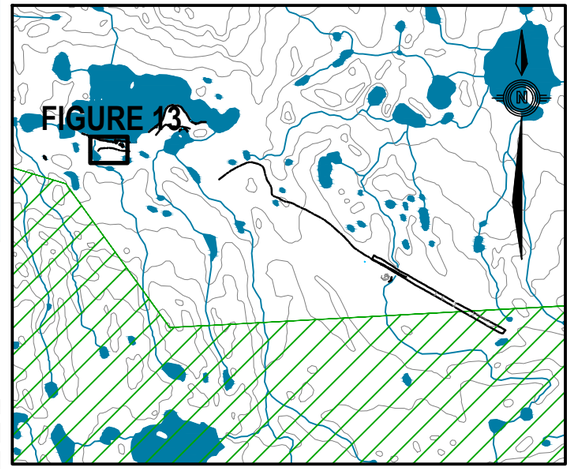
APEC 3S (HOPE LAKE)
SHORELINE
SHORELINE

APEC 3A
APEC 3B
APEC 3C
APEC 3D
APEC 3E
APEC 3F
APEC 3G
APEC 3H
APEC 3I
APEC 3J
APEC 3K
APEC 3L
APEC 3M
APEC 3N
APEC 3O
APEC 3P
APEC 3Q
APEC 3R
APEC 3T
APEC 3W

TOE
CREST
TOE
CREST
TOE
CREST
SWAMP

COLLAPSED BUILDING
COLLAPSED OUTHOUSE
COLLAPSED BUILDING
COLLAPSED BUILDING
COLLAPSED BUILDING
COLLAPSED BUILDING
COLLAPSED BUILDING
COLLAPSED BUILDING
COLLAPSED BUILDING
COLLAPSED BUILDING
COLLAPSED BUILDING
BUILDING
INTACT BUILDING

SEE DETAIL A (FIGURE 13A)
SEE DETAIL B (FIGURE 13B)
SEE DETAIL C (FIGURE 13C)
SEE DETAIL D (FIGURE 13D)
SEE DETAIL E (FIGURE 13E)



0 2 500
Scale (m)

KEY PLAN

LEGEND

- DRUM CACHE
- STRUCTURE
- TANK(S)
- APPROXIMATE LOCATION OF INUIT OWNED LAND

0 50
Scale (m)

ISSUED FOR USE

CLIENT

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

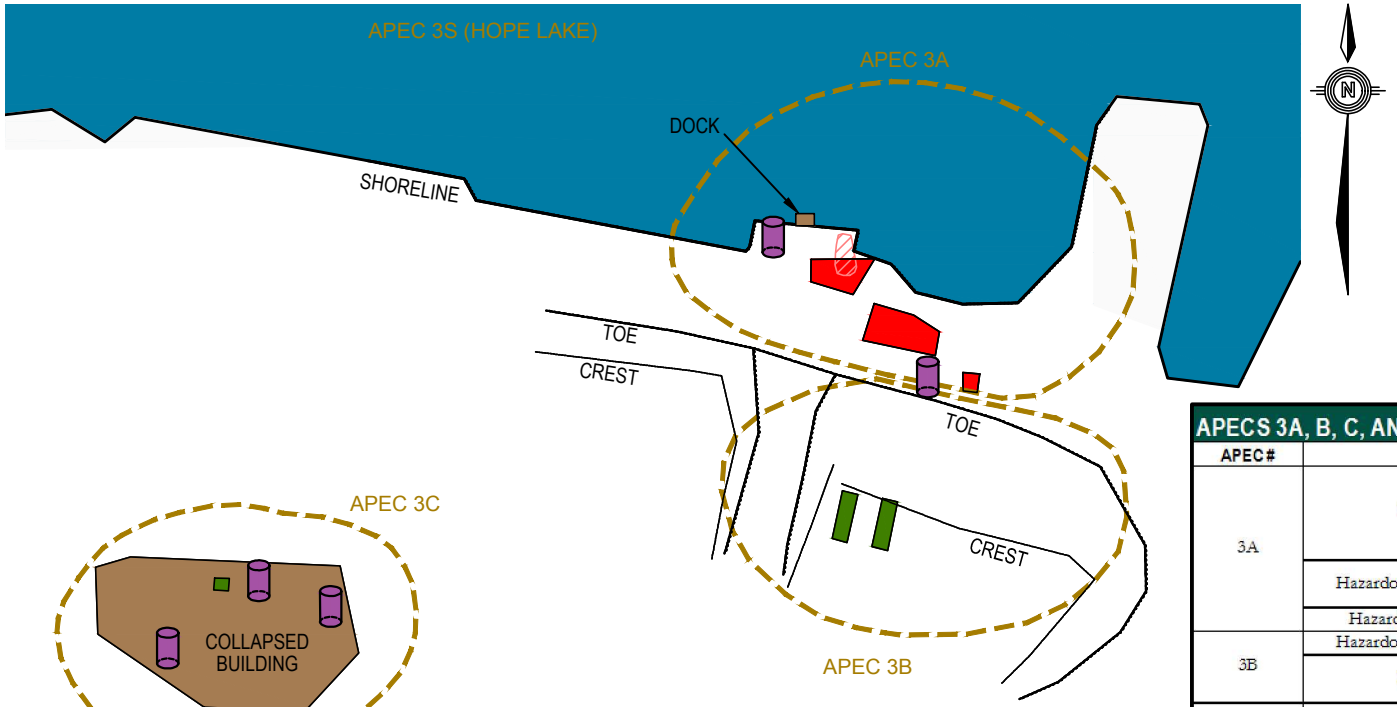
HOPE LAKE - APEC 3A-3R, 3T, 3W

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 13

Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y221\Y22101167\005\01_Drawings\04_Hope Lake\Y22101167.005 Fig 10-Fig 19_Hope.dwg, [FIGURE 13], March 25, 2011 - 1:15:28 pm (BY: DAS, DEBASHIS)



APECS 3A, B, C, AND S - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
3A	Non-Hazardous	Wood Debris	7
		Metal Debris	0.5
		Plastic	0.1
		Drums (205 L)	4 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	40 drums
		Small Drum (80L)	1 drum
	Hazardous (Organic Content)	Drums (205 L)	1 drum
3B	Hazardous (Leachable lead paint)	Tank	9.6
	Non-Hazardous	Tank	9.6
		Wood Debris	7.2
3C	Non-Hazardous	Wood Debris	55
		Metal Debris	0.9
		Insulation	1
		Linoleum	1
		Drums (205 L)	2 drums
	Hazardous (Asbestos containing material)	Mastic	1
3S	Non-Hazardous	Wood Debris	10

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

0 25
Scale (m)

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- DRUM CACHE
- STRUCTURE
- TANK(S)
- IMPACTED AREA

NOTE:

SOME IMPACTED AREAS TOO SMALL TO SHOW ON FIGURE

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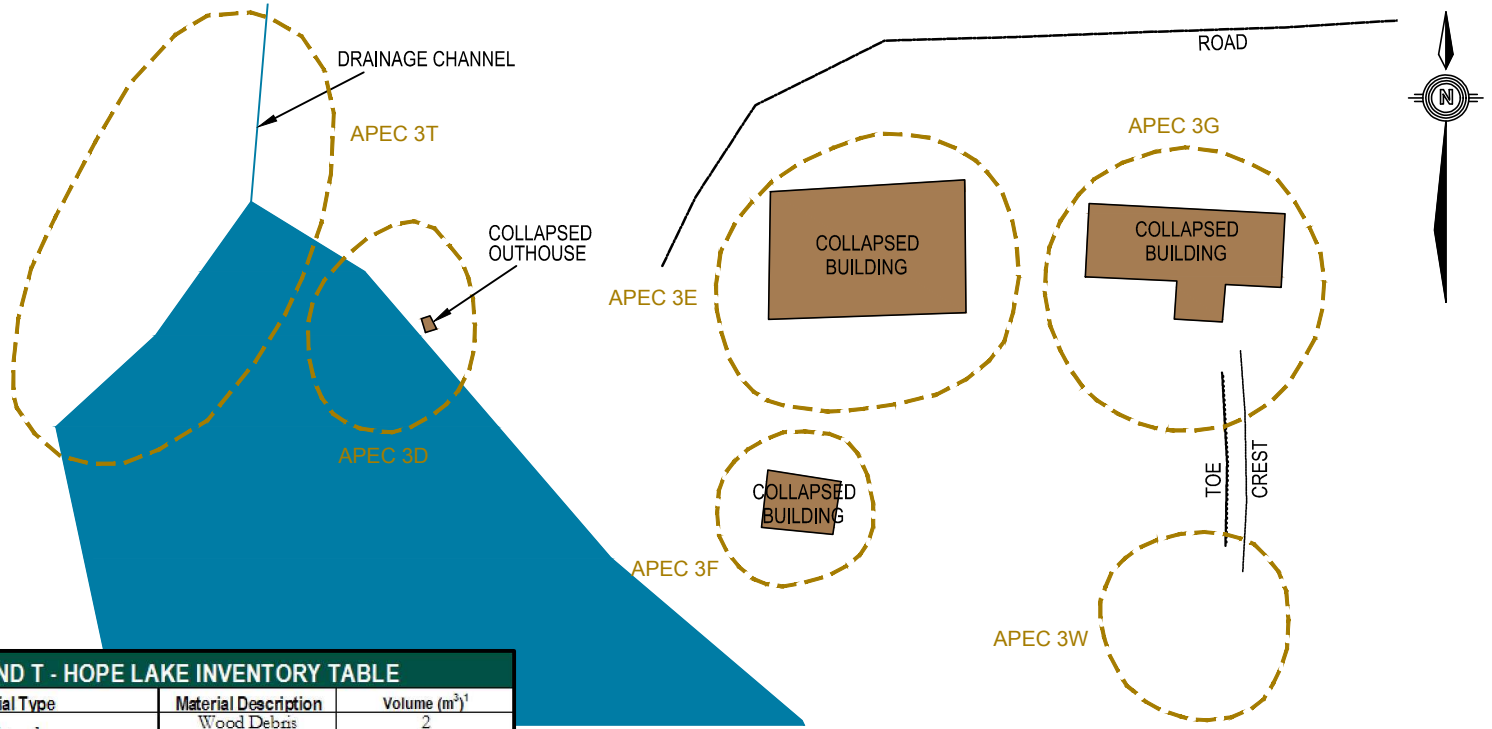
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL A
(FIGURE 13)

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 13A



APECS 3D, E, F, G, W, AND T - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1]
3D	Non-Hazardous	Wood Debris	2
		Metal Debris	1
3E	Non-Hazardous	Wood Debris	51
		Metal Debris	1
		Insulation	8
		Linoleum	0.5
		Tank	6
3F	Non-Hazardous	Wood Debris	3
3G and 3W	Non-Hazardous	Wood Debris	37
		Metal Debris	24
		Insulation	1.5
		Linoleum	0.5
	Hazardous (Asbestos containing material)	Mastic	0.5
3T	N/A	N/A	N/A

Notes:
1. All volumes: uncrushed

ISSUED FOR USE

LEGEND

- STRUCTURE

0 25
Scale (m)

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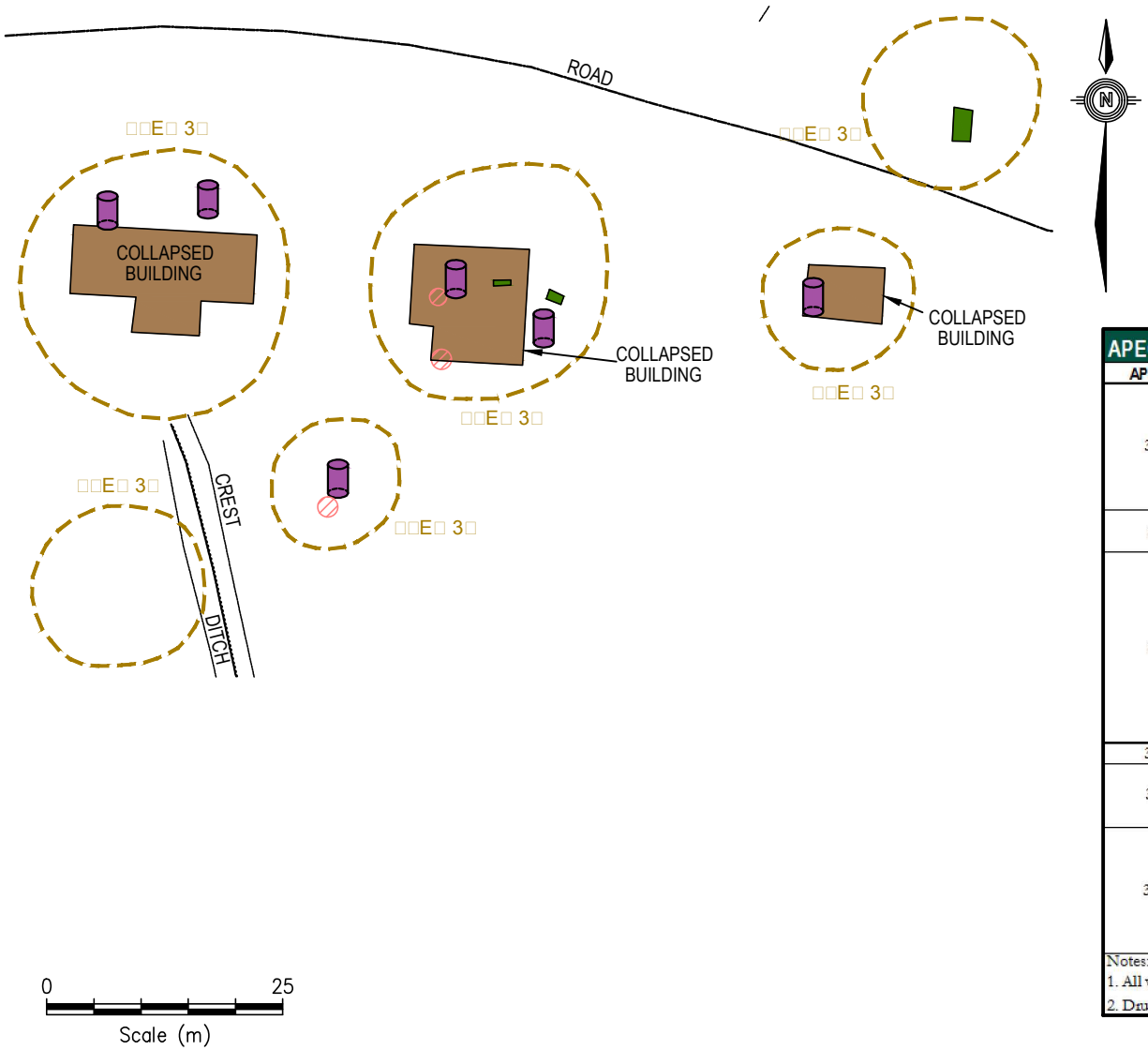
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL B
(FIGURE 13)

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 13B



APECS 3H, I, J, K, L AND M - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
3H	Non-Hazardous	Wood Debris	41.3
		Metal Debris	20
		Canvas	1
		Drums (205 L)	2 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	2 drums
	Hazardous (Asbestos containing material)	Mastic	0.5
3I	Non-Hazardous	Wood Debris	1
		Metal Debris	2
3J	Non-Hazardous	Wood Debris	21
		Metal Debris	10
		Rubber Debris	0.5
		Insulation	2
		Plastic	5
		Drums (205 L)	4 drums
		Tanks	3
	Hazardous (Asbestos containing material)	Mastic	0.5
	Hazardous (PCB containing)	Light Ballasts	0.1
3K	Hazardous (Leachable lead paint)	Drums (205 L)	1 drum
3L	Non-Hazardous	Metal Debris	6.1
		Tanks	4
		Plastic	0.1
3M	Non-Hazardous	Wood Debris	6
		Metal Debris	1
		Insulation	1
		Linoleum	0.5
	Hazardous (Leachable Lead paint)	Drums (205 L)	1 drum
	Hazardous (Asbestos containing material)	Mastic	0.3

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- STRUCTURE
- TANK(S)
- IMPACTED AREA

ISSUED FOR USE

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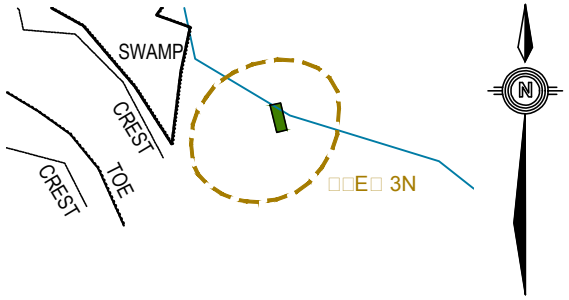
EBA Engineering Consultants Ltd.

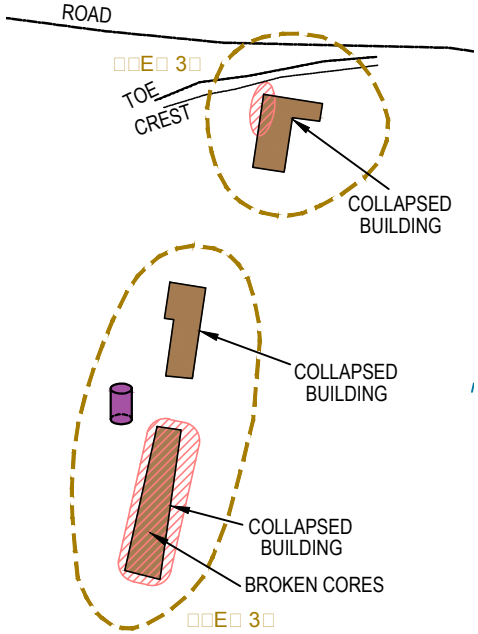
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL C
(FIGURE 13)

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 13C





APECS 3N, O, AND P - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
3N	Non-Hazardous	Wood Debris	1
		Tank	4.5
30	Non-Hazardous	Wood Debris	10
		Metal Debris	2
		Plastic	1
		Insulation	1
	Hazardous (Asbestos containing material)	Electrical Insulators	0.1
3P	Non-Hazardous	Wood Debris	16
		Metal Debris	9
		Core	16
		Drum (205 L)	1 drum

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- STRUCTURE
- TANK(S)
- IMPACTED AREA

0 50
Scale (m)

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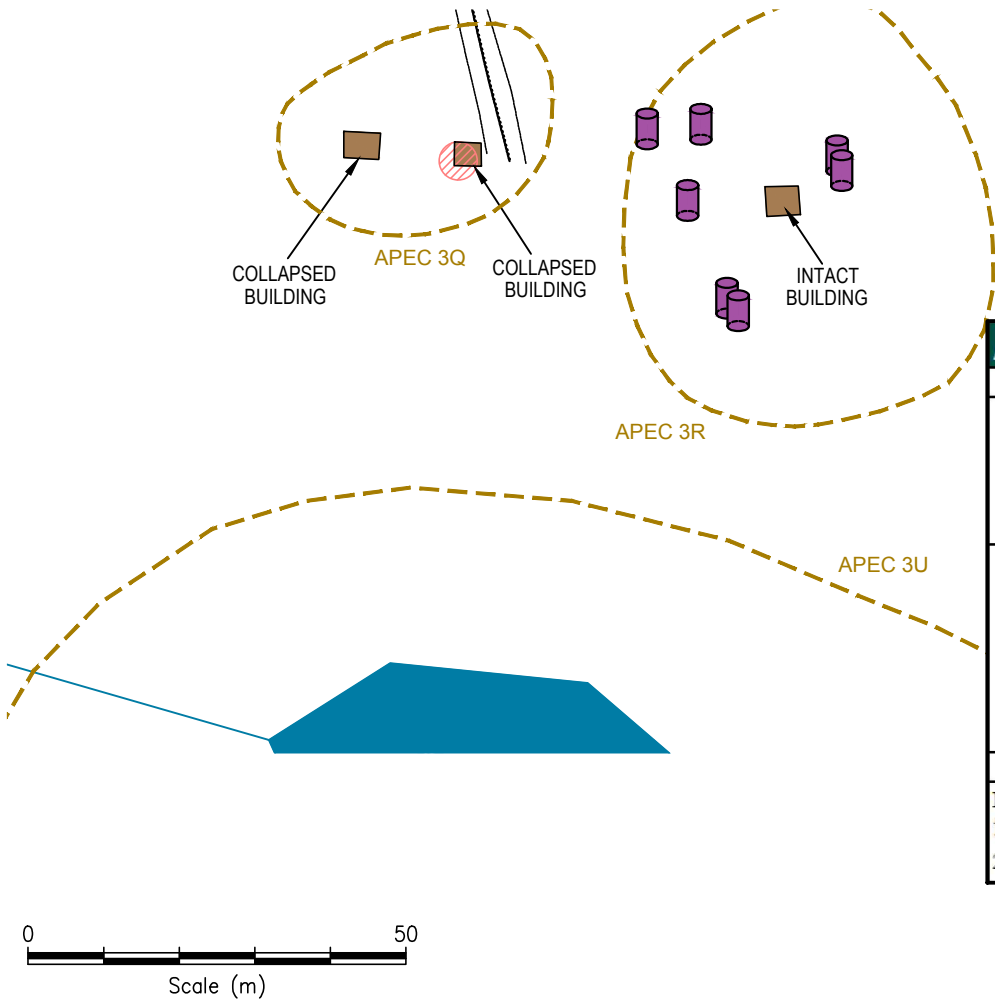
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL D
(FIGURE 13)

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 13D



APECS 3Q, R, AND U - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
3Q	Non-Hazardous	Wood Debris	5.3
		Metal Debris	0.5
		Insulation	0.1
		Plastic	0.1
		Ceramic	1
3R	Non-Hazardous	Wood Debris	30
		Metal Debris	12
		Plastic	2
		Drums (205 L)	6 drums
	Hazardous (Asbestos containing material)	Electrical Insulators	0.1
	Hazardous (Leachable lead paint)	Drums (205 L)	6 drums
3U	N/A	N/A	N/A

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- STRUCTURE
- IMPACTED AREA

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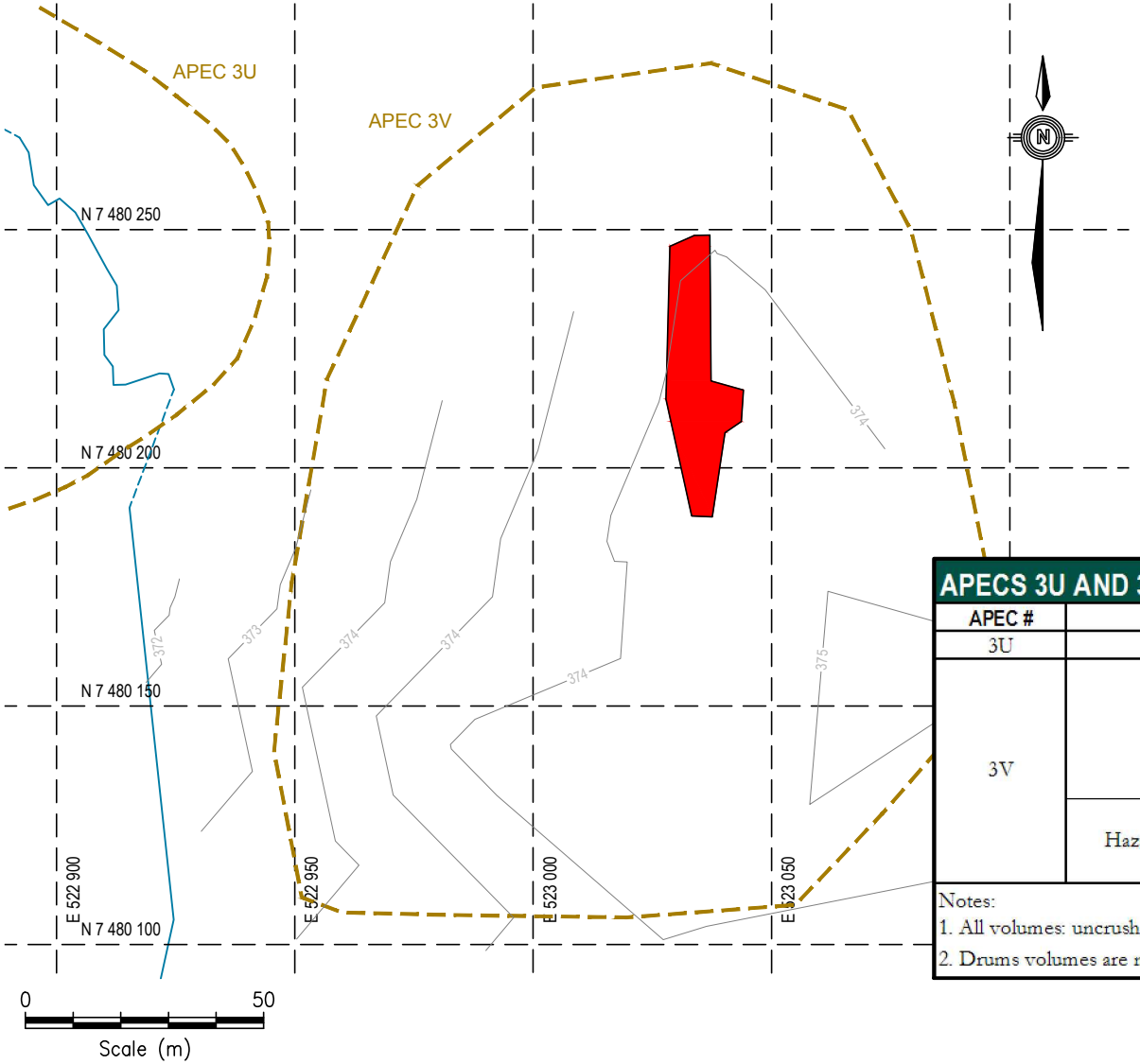
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

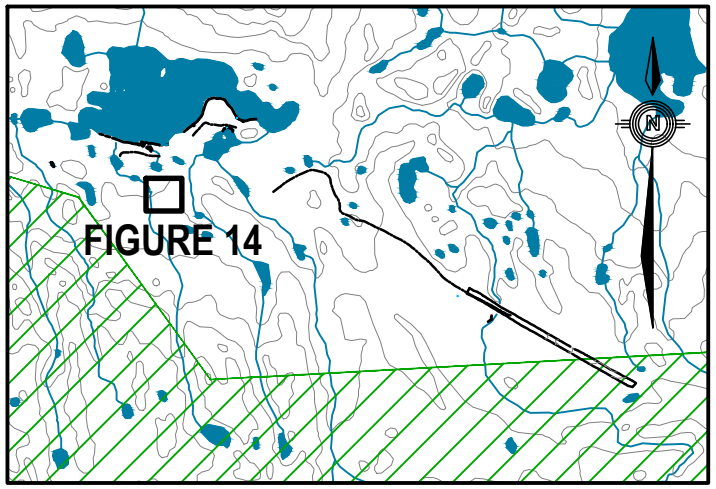
DETAIL E
(FIGURE 13)

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 13E





KEY PLAN

APECS 3U AND 3V - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
3U	N/A	N/A	N/A
3V	Non-Hazardous	Wood Debris	7
		Metal Debris	10
		Insulation	1
		Rubber Debris	5
		Drums (205 L)	40 drums
	Hazardous (Leachable lead paint)	Metal Debris	3
		Drums (205 L)	660 drums
		Small Drums (50L)	20 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- DRUM CACHE
- APPROXIMATE LOCATION OF INUIT OWNED LAND

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

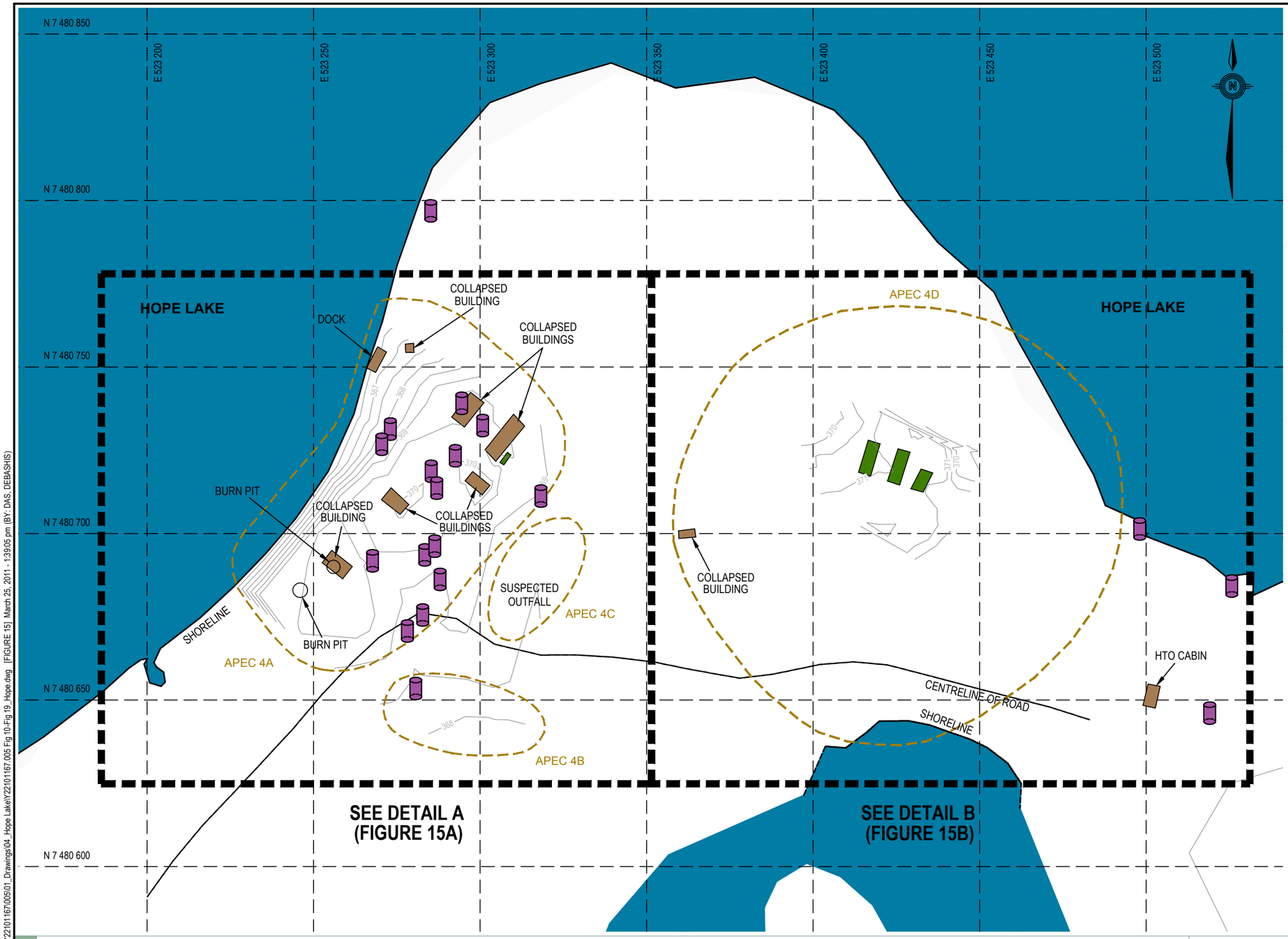
HOPE LAKE - APEC 3U AND 3V

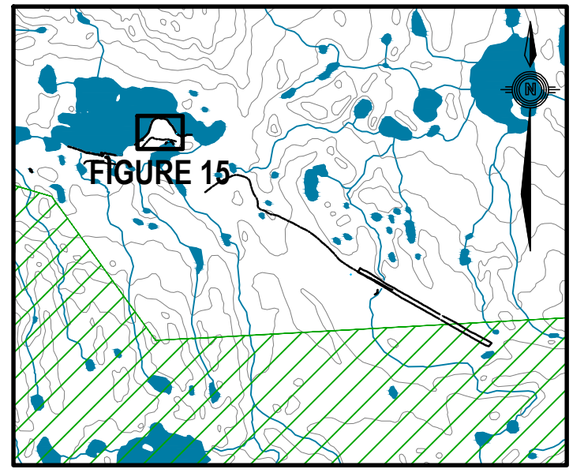
EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0

OFFICE	DATE
EDM	March, 2011

Figure 14





0 2 500
Scale (m)

KEY PLAN

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- STRUCTURE
- TANK(S)
- APPROXIMATE LOCATION OF INUIT OWNED LAND

0 50
Scale (m)

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

HOPE LAKE - APEC 4A-4D

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 15

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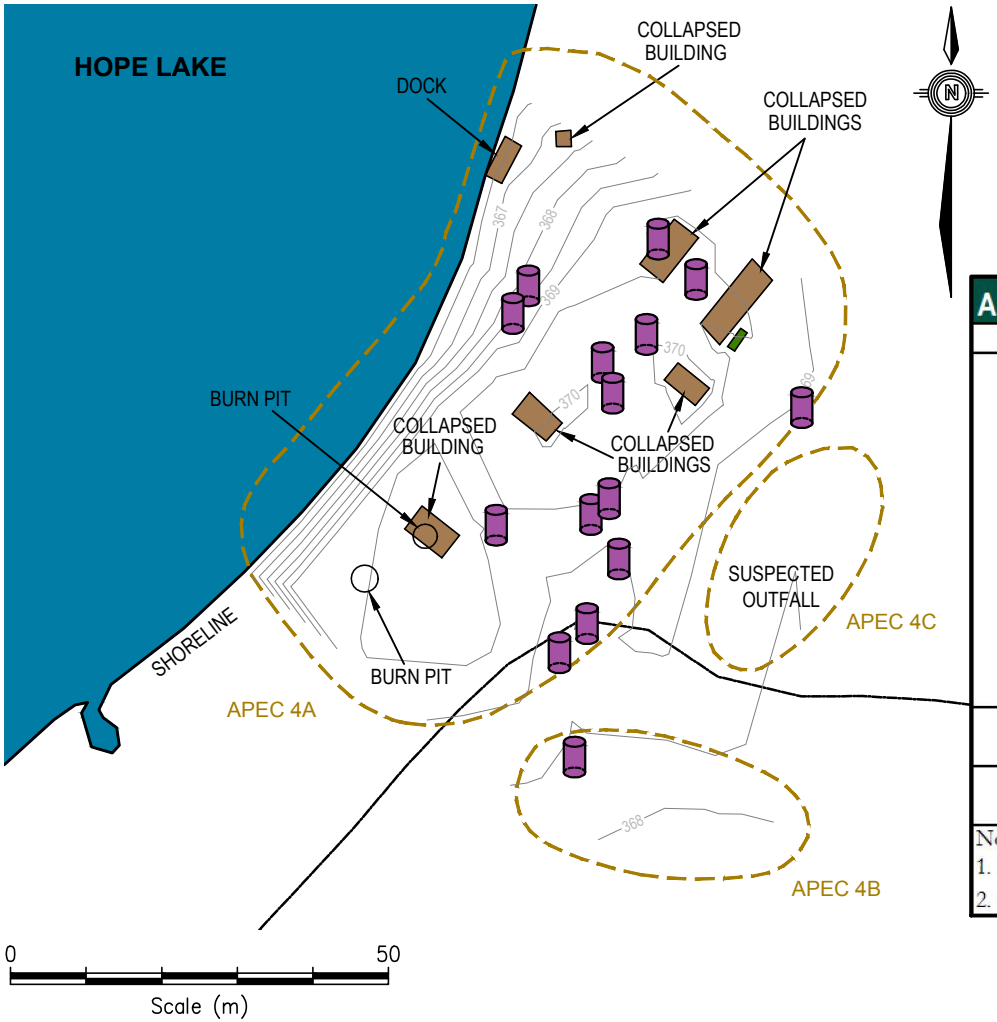

APECS 4A, B, AND C - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
4A	Non-Hazardous	Wood Debris	106
		Metal Debris	14
		Plastic	2.4
		Canvas	0.15
		Ceramic	0.25
		Glass	0.1
		Rubber Debris	0.15
		Insulation	8.7
		Drums (205 L)	14 drums
		Tanks (3700 L)	16
	Hazardous (Battery components)	Battery	0.8
	Hazardous (Leachable lead paint)	Drums (205 L)	16 drums
4B	Non-Hazardous	Wood Debris	5
		Metal Debris	2
4C	Suspected Drainage outfall Southeast of Camp	N/A	N/A

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- STRUCTURE
- TANK(S)
- APPROXIMATE LOCATION OF INUIT OWNED LAND

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL A
(FIGURE 15)

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE	DATE		
EDM	March, 2011		

Figure 15A

APEC 4D - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
4D	Non-Hazardous	Wood Debris	3.5
		Metal Debris	0.5
		Canvas	0.1
		Cores	1
		Glass	0.1
		Tanks (3700 L)	80
		Drums (205 L)	3 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	2 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- STRUCTURE
- TANK
- IMPACTED AREA

0 25
Scale (m)

CLIENT

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

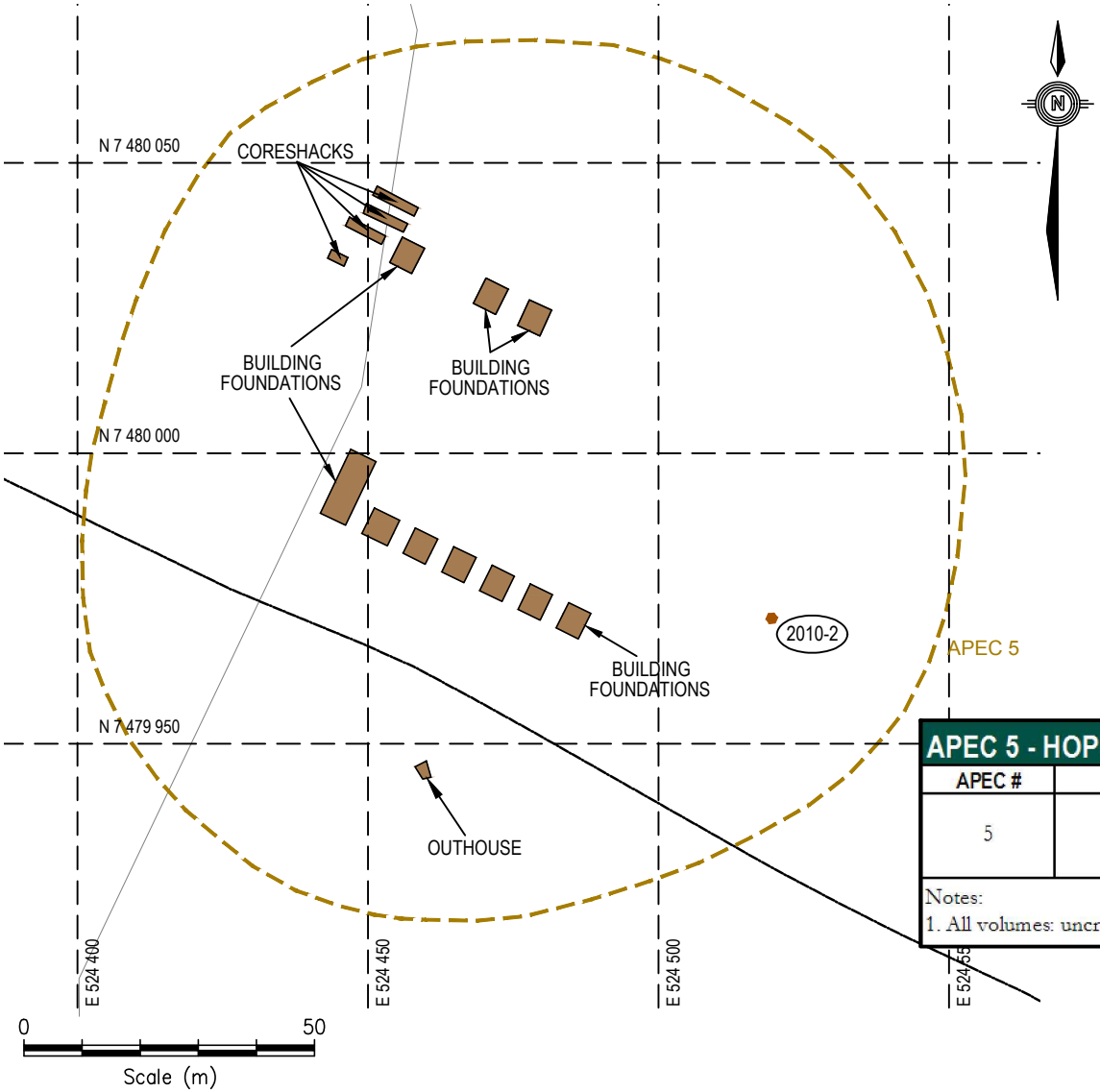
DETAIL B
(FIGURE 15)

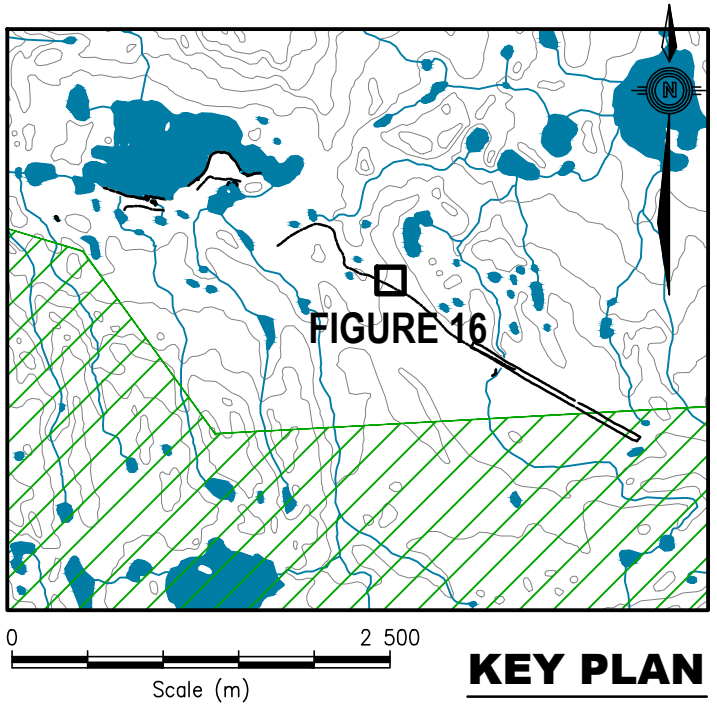
EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0

OFFICE: EBA-EDM
DATE: March, 2011

Figure 15B





KEY PLAN

APEC 5 - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1]
5	Non-Hazardous	Wood Debris	29.4
		Metal Debris	9
		Plastic	1

Notes:
1. All volumes: uncrushed

ISSUED FOR USE

LEGEND

2010-2 - SURVEY CONTROL POINT

- STRUCTURE

- APPROXIMATE LOCATION OF INUIT OWNED LAND

CLIENT

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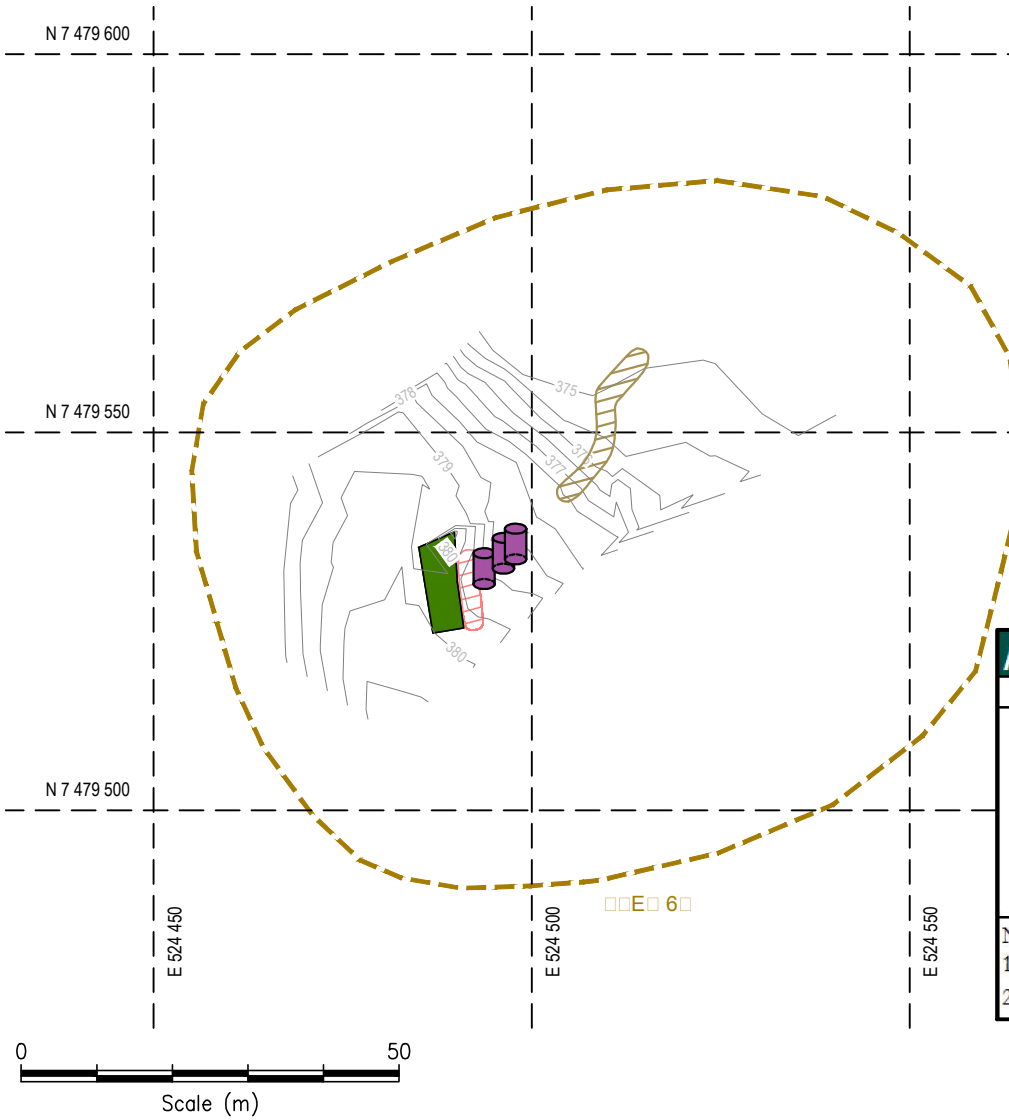
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

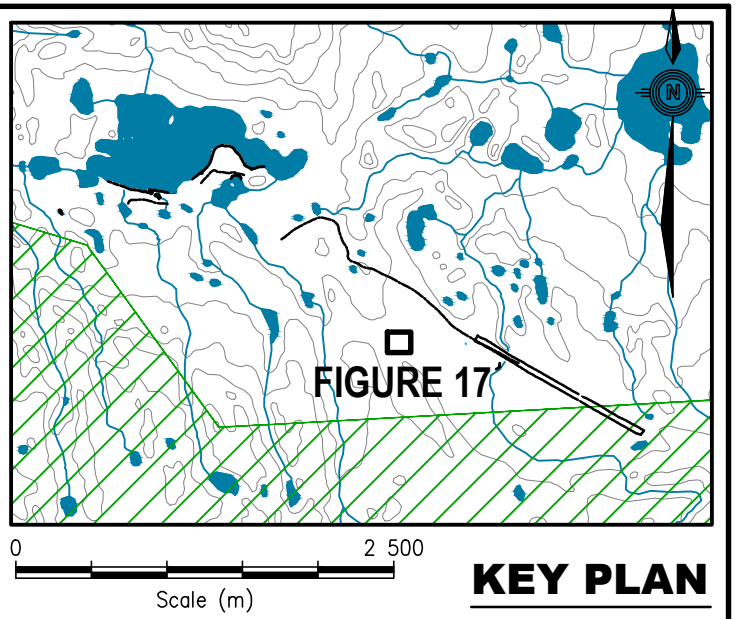
HOPE LAKE - APEC 5

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 16





KEY PLAN

APEC 6A - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
6A	Non-Hazardous	Wood Debris	4
		Metal Debris	1
		Rubber Debris	53
		Textile	7.5
	Hazardous (Leachable lead paint and asbestos containing lower gaskets)	Tank	150
		Gaskets	0.5
		Drums (205 L)	5 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- TANK(S)
- IMPACTED AREA
- APPROXIMATE LOCATION OF INUIT OWNED LAND
- 30 m BUFFER TO BE EXCAVATED FOR WETLAND

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

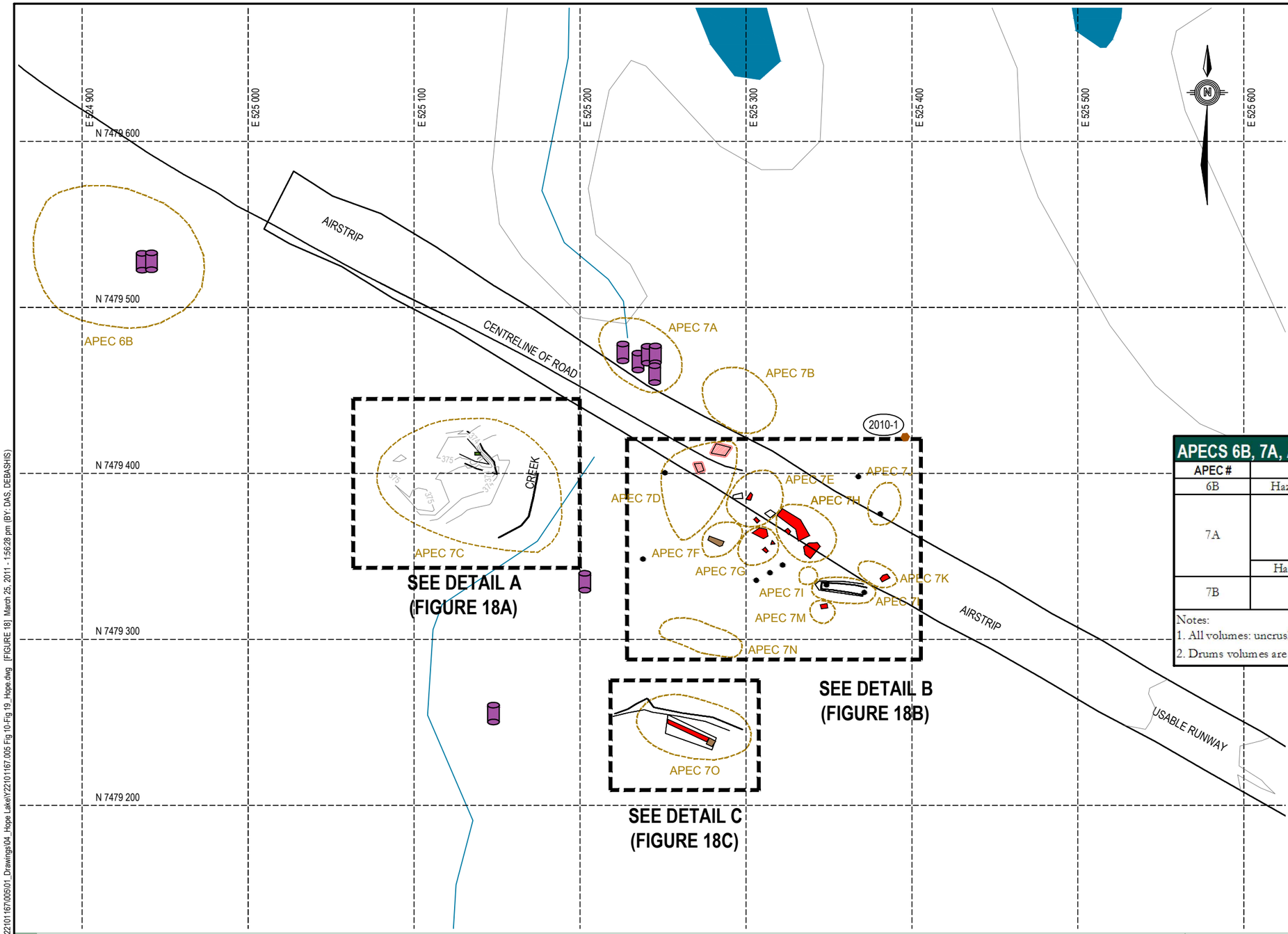
HOPE LAKE - APEC 6A

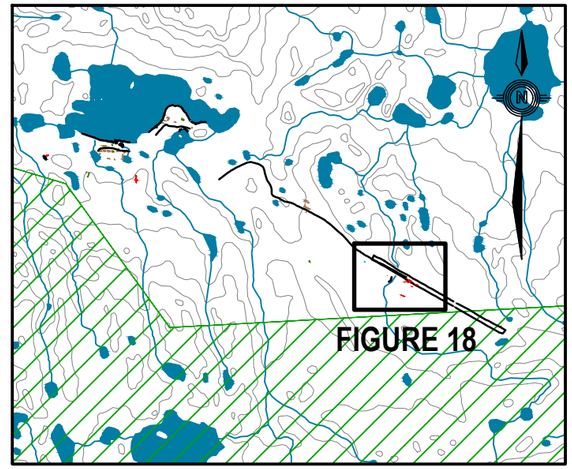
EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0

OFFICE	DATE
EDM	March, 2011

Figure 17





0 2 500
Scale (m)

KEY PLAN

APECS 6B, 7A, AND 7B - HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3)[1,2]
6B	Hazardous (Leachable Lead Paint)	Drums (205 L)	6 drums
7A	Non-Hazardous	Wood Debris	0.5
		Metal Debris	0.5
		Rubber Debris	0.1
		Drums (205 L)	3 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	4 drums
7B	Non-Hazardous	Wood Debris	3
		Metal Debris	3

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- 2010-1 - SURVEY CONTROL POINT
- DRUM CACHE
- STRUCTURE

0 100
Scale (m)

CLIENT

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

HOPE LAKE - APEC 6B AND 7A-7O

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 18

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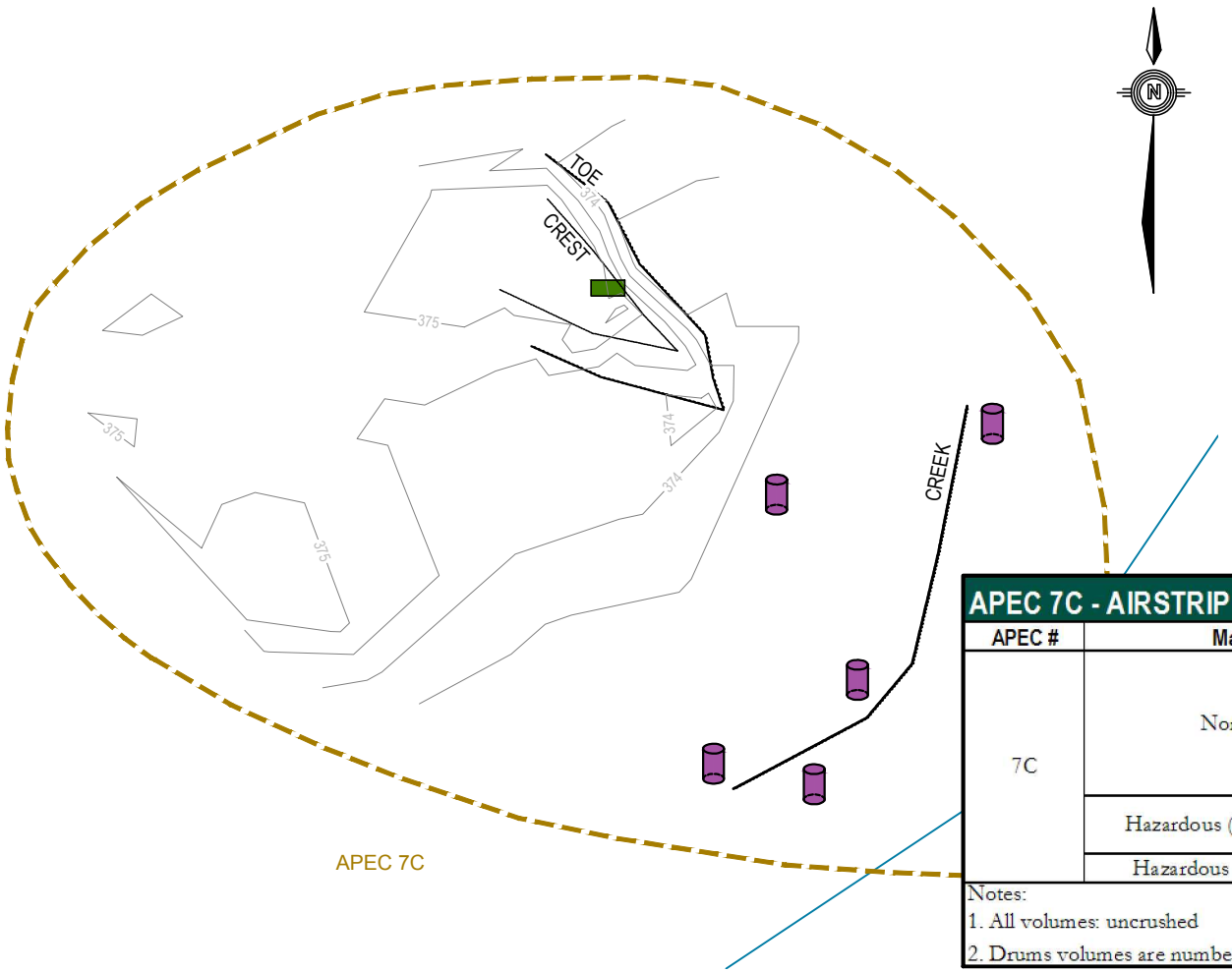

APEC 7C - AIRSTRIP HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3) [1,2]
7C	Non-Hazardous	Wood Debris	1.8
		Metal Debris	1
		Rubber Debris	1
		Small Drums (20 L)	3 drums
		Drums (205 L)	2 drums
	Hazardous (Leachable lead paint)	Tank	9.6
		Drums (205 L)	18 drums
	Hazardous (container contents)	Container	0.1

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

0 25
Scale (m)

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- TANK

CLIENT

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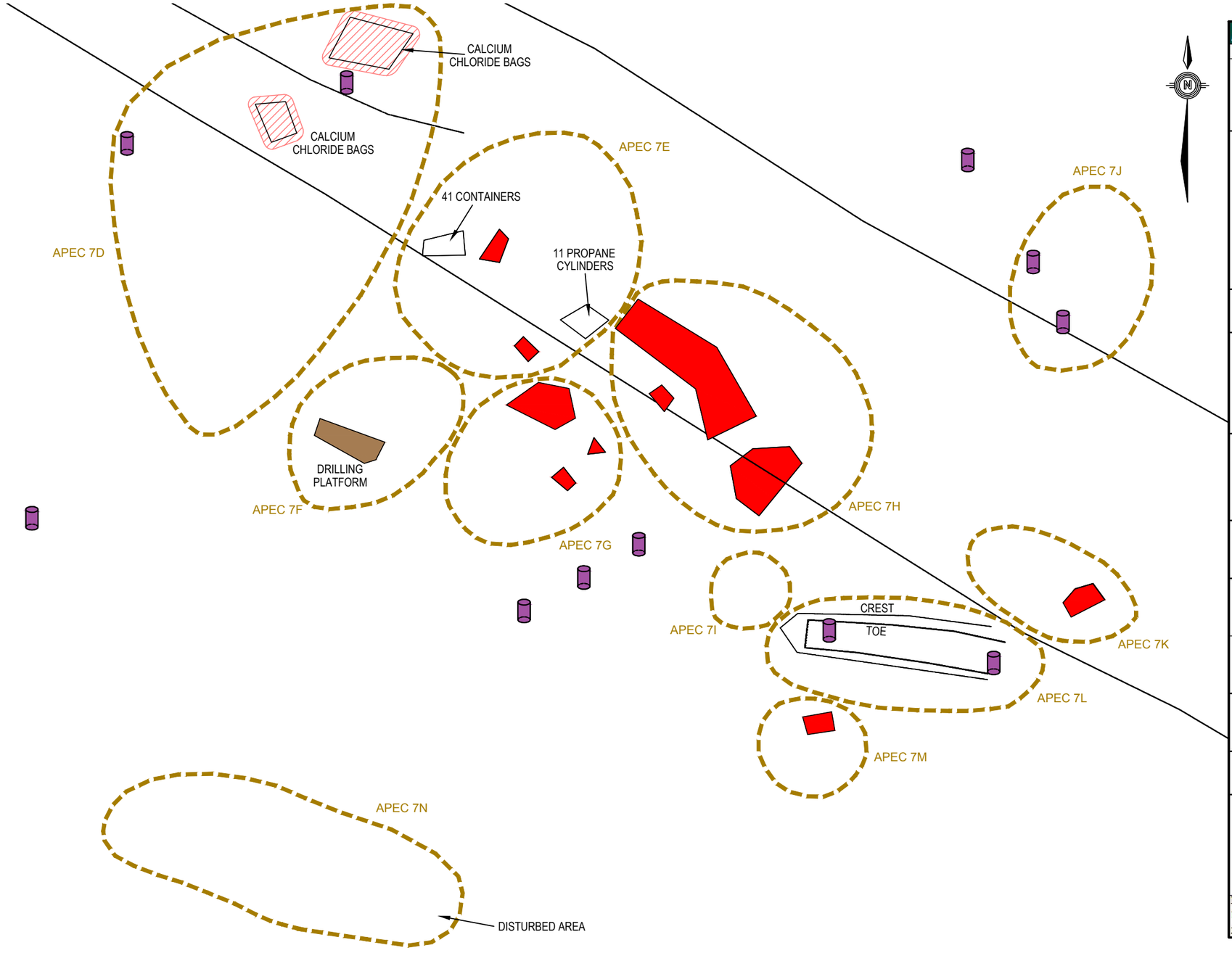
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL A
(FIGURE 18)

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 18A



APEC 7D THROUGH 7N - AIRSTRIP HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3) [1,2]
7D	Non-Hazardous	Wood Debris	5
		Metal Debris	1
		Rubber Debris	0.2
	Hazardous (Leachable lead paint)	Drums (205 L)	2 drums
	Hazardous (Calcium Chloride)	Calcium Chloride bags	4
7E	Non-Hazardous	Wood Debris	1
		Metal Debris	0.5
		Rubber Debris	1.1
		Ballasts	0.1
		Plastic Debris	1
		Drums (205 L)	10 drums
	Hazardous (Drum contents)	Drums (205 L)	15 drums
	Hazardous (Extinguisher contents)	Fire extinguisher	0.2
	Hazardous (Propane)	Propane cylinders	11 cylinders
	Hazardous (Mercury vapour)	Fluorescent lights	0.25
	Hazardous (Contents)	Containers (20 L)	41
7F	Non-Hazardous	Wood Debris	1.4
		Metal Debris	0.2
		Plastic Debris	0.2
7G	Non-Hazardous	Wood Debris	1
		Metal Debris	2
		Plastic Debris	2
		Rubber Debris	2
		Small drums (20 L)	3 drums
		Drums (205 L)	82 drums
	Hazardous (Calcium Chloride)	Calcium Chloride	1
7H	Non-Hazardous	Wood Debris	2
		Metal Debris	3
		Plastic	0.5
		Rubber Debris	0.1
		Drums (205 L)	100 drums
	Hazardous (Drum contents)	Drums (205 L)	52 drums
7I	Non-Hazardous	Wood Debris	1.25
		Metal Debris	0.5
		Plastic Debris	0.1
	Hazardous (Battery components)	Battery	0.1
7J	Non-Hazardous	Wood Debris	1
		Metal Debris	1
		Plastic	0.26
	Hazardous (Drum contents)	Drum (205 L)	3 drums
7K	Non-Hazardous	Wood Debris	2
		Metal Debris	5
		Drums (205 L)	1 drum
	Hazardous (Drum contents)	Drums (205 L)	6 drums
7L	Non-Hazardous	Wood Debris	0.5
		Metal Debris	0.5
	Hazardous (Leachable lead paint)	Drums (205 L)	2 drums
	Hazardous (container contents)	Container	0.5
7M	Non-Hazardous	Metal Debris	4.2
		Plastic	0.1
	Hazardous (Leachable lead paint)	Drums (205 L)	6 drums
7N	Non-Hazardous	N/A	N/A
		Wood Debris	1
		Metal Debris	2
		Drums (205 L)	7 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	1 drum
		Small Drums (40L)	6 drums
	Hazardous (Battery components)	Battery	0.1

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- DRUM CACHE
- STRUCTURE
- IMPACTED AREA

0 25
Scale (m)

NOTE:

SOME IMPACTED AREAS TOO SMALL TO SHOW ON FIGURE

ISSUED FOR USE

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

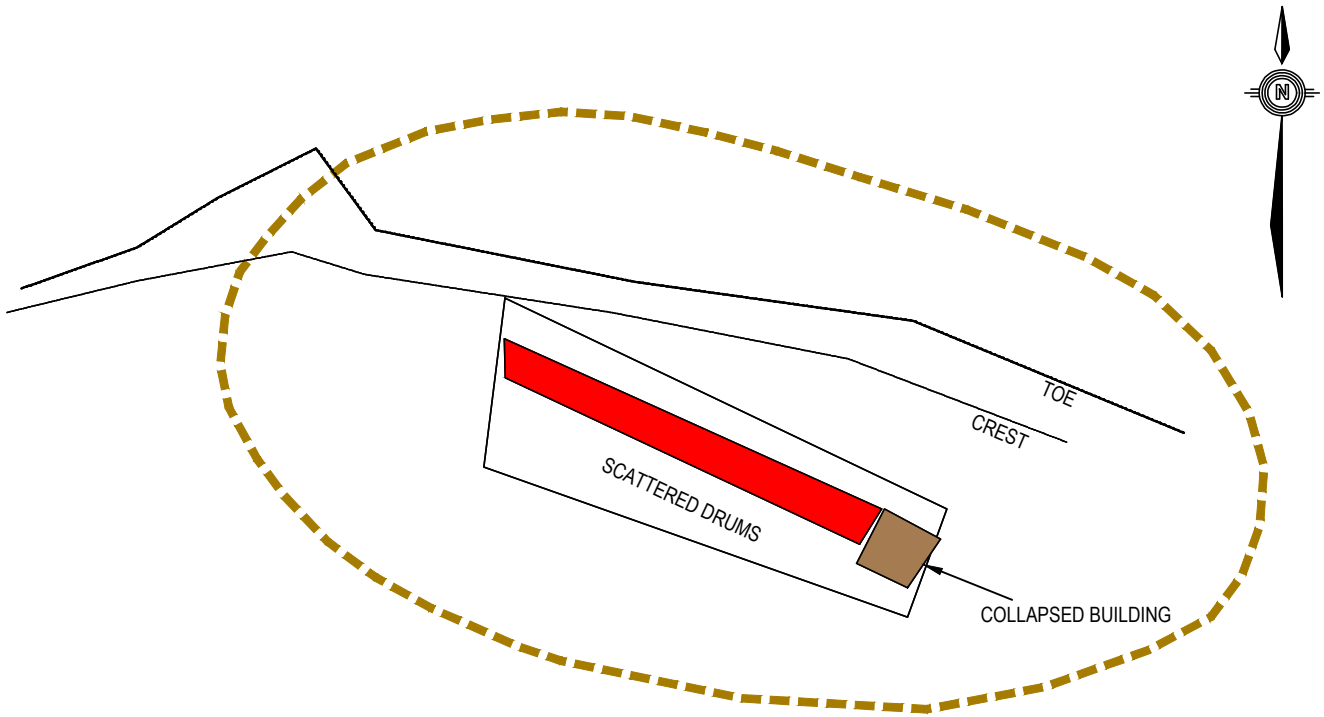
DETAIL B
(FIGURE 18)

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0

OFFICE: EBA-EDM
DATE: March, 2011

Figure 18B



APEC 7O

APEC 7O - AIRSTRIP HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3) [1,2]
7O	Non-Hazardous	Wood Debris	1
		Metal Debris	0.2
	Hazardous (Red and Black leachable lead paint)	Drums (205 L)	400 Drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- DRUM CACHE
- STRUCTURE

0 25
Scale (m)

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

DETAIL C
(FIGURE 18)

EBA Engineering Consultants Ltd.

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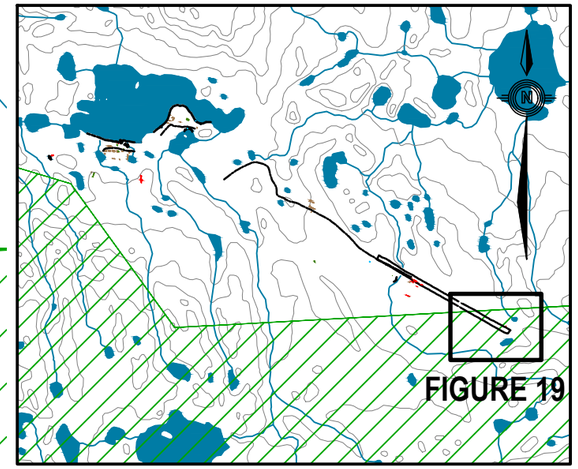
Y22101167.005	DBD	KO	0
OFFICE: EDM	DATE: March, 2011		

Figure 18C

E 525 700
E 525 800
E 525 900
E 526 000
E 526 100
E 526 200
E 526 300
N 7479 200
N 7479 100
N 7479 000
N 7478 900
N 7478 800
AIRSTRIP
CREST
380
375
APEC 7P



0 2 500
Scale (m)

KEY PLAN

APEC 7P - AIRSTRIP HOPE LAKE INVENTORY TABLE

APEC #	Material Type	Material Description	Volume (m^3) [1,2]
7P	Non-Hazardous	Plastic Debris	2
		Drums (205 L)	13 drums
	Hazardous (Leachable lead paint)	Drums (205 L)	19 drums

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3.

ISSUED FOR USE

LEGEND

- APPROXIMATE DRUM(S) LOCATION
- DRUM CACHE
- APPROXIMATE LOCATION OF INUIT OWNED LAND

0 100
Scale (m)

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

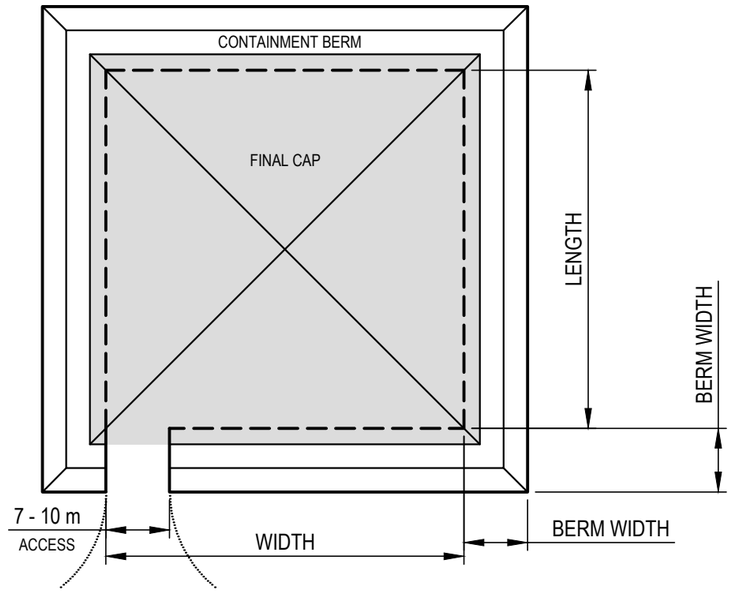
HOPE LAKE - APEC 7P

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 19

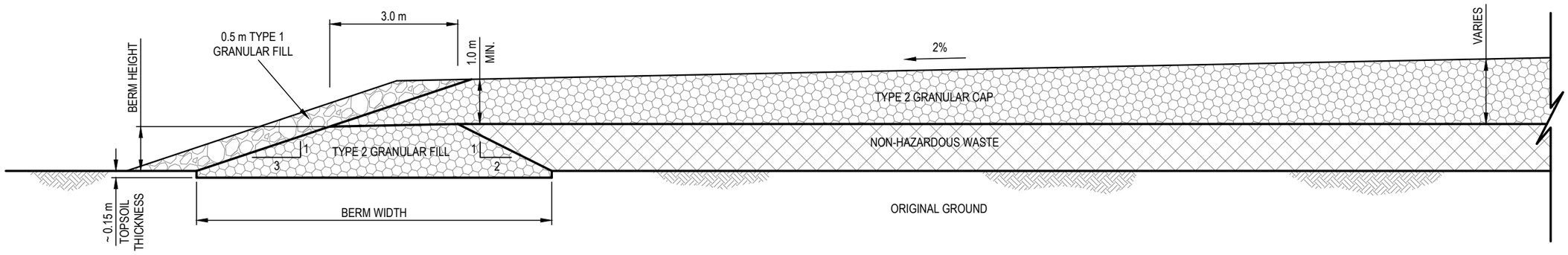
Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y22\Y22101167\005\01_Drawings\04_Hope Lake\Y22101167.005 Fig 10-Fig 19_Hope.dwg [FIGURE 19] March 30, 2011 - 12:43:34 pm (BY: DAS, DEBASHIS)



PLAN

0 25
Scale: 1: 750 (metres)

Non-Hazardous Landfill Specifications								
Landfill Dimensions						Granular Fill Quantities (m^3)		
Nominal Landfill Capacity (m^3)	Proposed Location	Length (m)	Width (m)	Berm Width (m)	Berm Height (m)	Type 1	Type 2	Total
684	LF-2	26	26	8.75	1.15	500	2300	3100
1444	LF-2	39	38	8.75	1.15	650	4200	4850



SECTION

0 5
Scale: 1: 100 (metres)

ISSUED FOR USE

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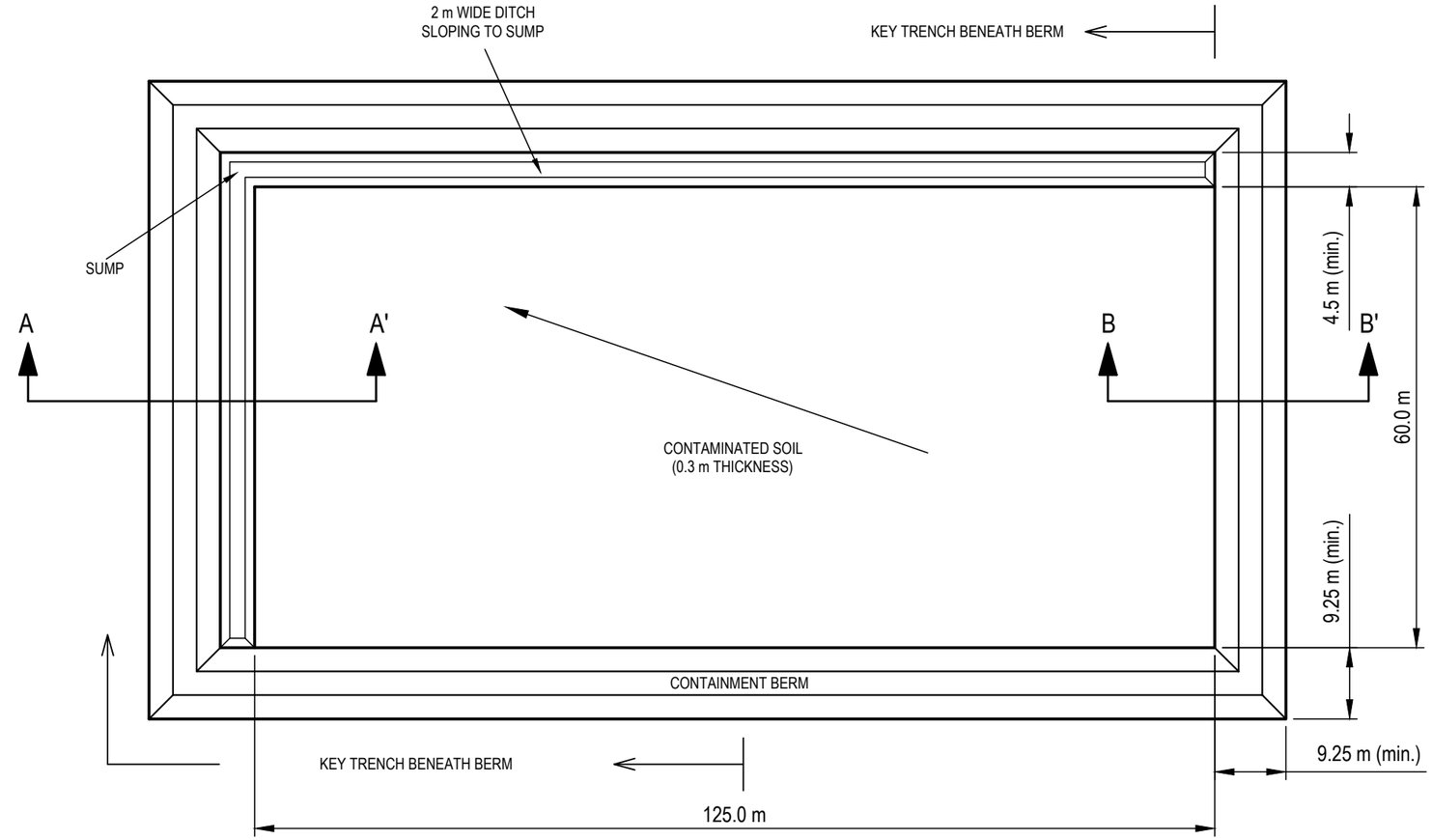
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

NON-HAZARDOUS
HOPE LAKE TYPICAL LANDFILL

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	DB	0
OFFICE: EBA-EDM	DATE: March, 2011		

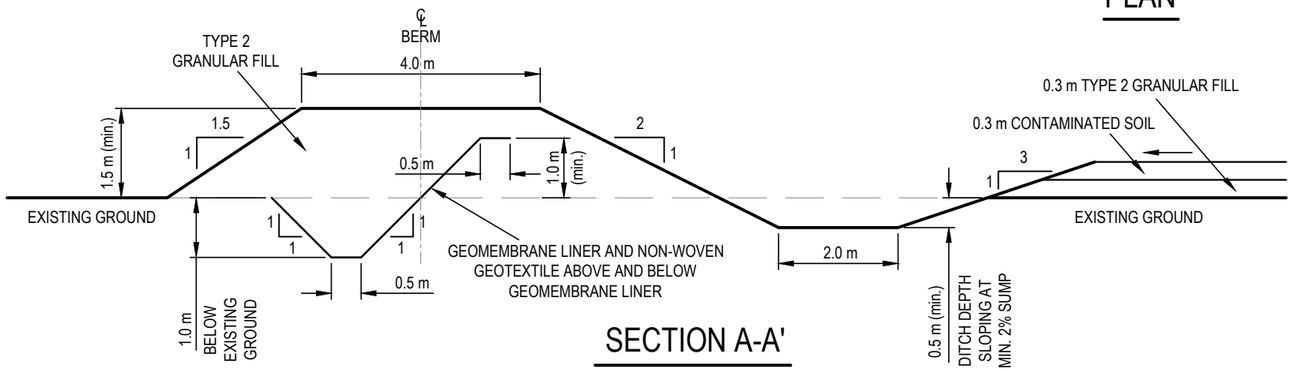
Figure 20

Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y221\Y22101167\005\01_Drawings\05_Geotechnical\Y22101167005_Fig 21.dwg [FIGURE 21] March 23, 2011 - 9:34:06 am (BY: DAS, DEBASHIS)

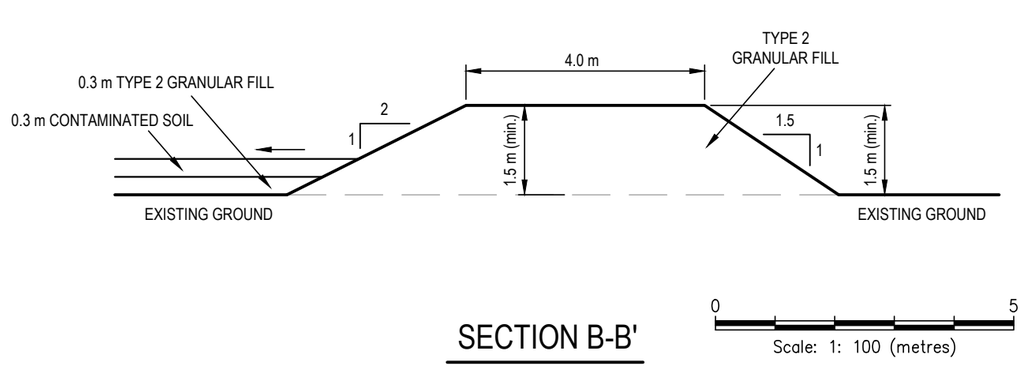


PLAN

0 25
Scale: 1: 750 (metres)



SECTION A-A'



SECTION B-B'

0 5
Scale: 1: 100 (metres)

ISSUED FOR USE

CLIENT

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

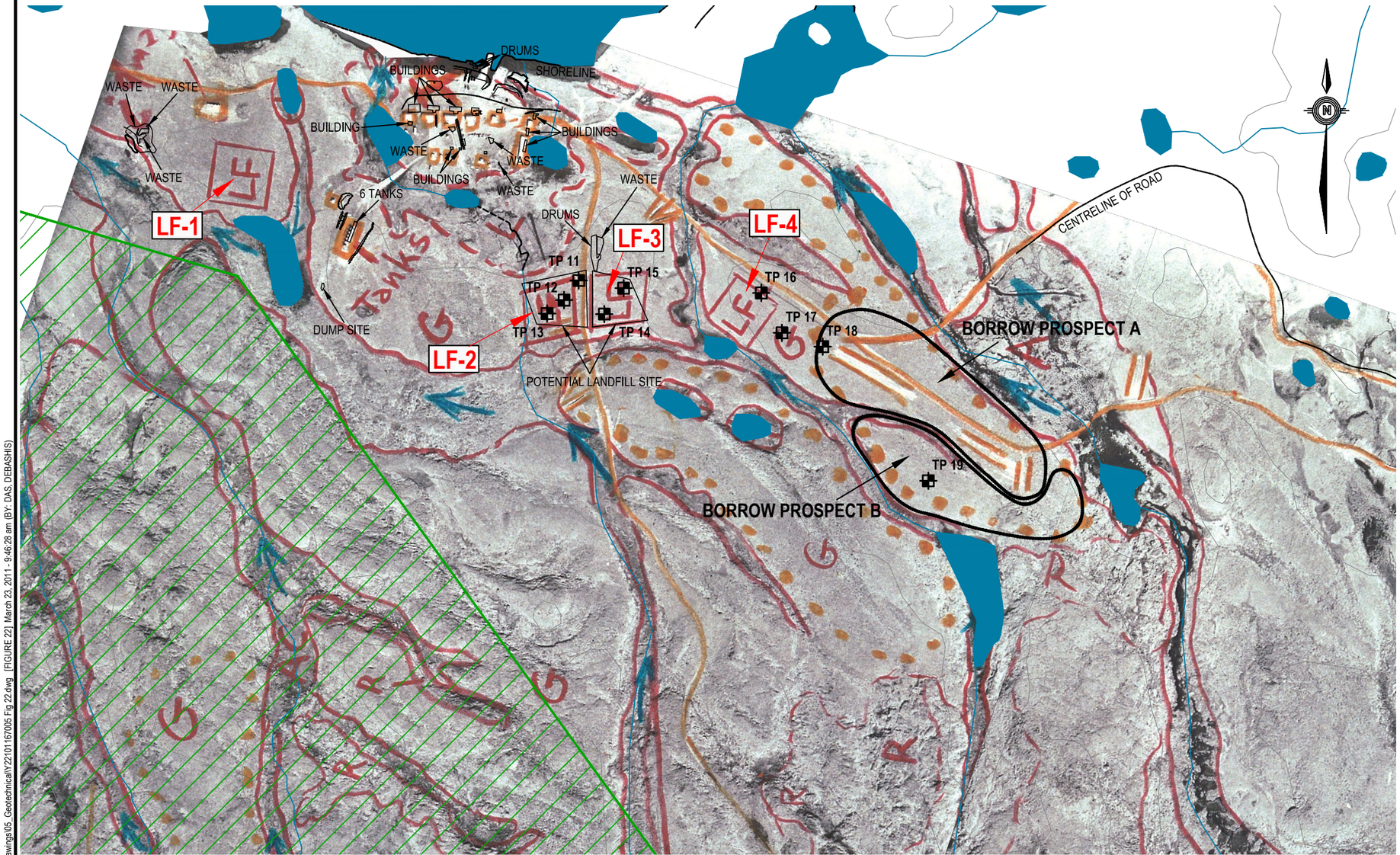
REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

HOPE LAKE TYPICAL LANDFARM

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	DB	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 21



LEGEND

O	Organic Deposits: predominantly peat
pO	Organic Deposits: peatland
O/L	Organic Deposits Underlain by Lacustrine Deposits
C	Colluvial Deposits: unsorted debris
L	Lacustrine Deposits: sand, gravel and silt with numerous lenses of cobbles and boulders
A	Fluvial Deposits (Alluvium): veneer of boulder and cobble lag is common on surface
AC	Fluvial and Colluvial Deposits: undifferentiated in small stream valleys
G	Glaciofluvial Deposits: predominantly gravel and sand with cobbles and boulders disseminated throughout. May include patches of exposed bedrock of felsenmeer (block fields).
Tv	Till Veneer: generally less than 1 m thick. Commonly includes patches of rock outcrops.
Tb	Till Blanket: generally more than 1 m thick
R	Bedrock Outcrops: sedimentary and volcanic successious, gabbro and diabase sills. Locally may be covered with surficial material, i.e.patches of till, colluvium, organics, etc.
	Direction of Drainage
LF	Proposed Landfill Location
	Possible Borrow Source
	Individual Structures: buildings, airstrips, etc.
	Roads, Trails
	Trench
	Mine Site: approximate location
	Meltwater Channel
a / b	Geological Boundary: a -defined; b-approximate
	Esker
	Geological Lineament: fault or fracture (joint) zone
	Scarp
	Ice-Wedge Polygons
	Thaw/Debris Slides
	Thermokarst Depressions
	Stripes on Slopes: undifferentiated sorted and unsorted
	Trail System and/or Infrastructure

ISSUED FOR USE

REFERENCES:

1) BASE DRAWING: NTS MAP NO. 86N09, ZONE 11 W. UTM NAD 83
2) SURVEY DRAWING: PROVIDED BY SUB-ARCTIC SYRVEYS LTD. FILE NO. 10-079-HOPE LAKE; UTM COORDINATES, ZONE 11 W, CENTRAL MERIDIAN 117° WEST (NAD 83, CSRS, PPP), ORTHOMETRIC ELEVATION

0 250
Scale (m)

LEGEND:

- APPROXIMATE LOCATION OF INUIT OWNED LAND
- TESTPIT LOCATION

NOTE:

THE SITE AIR PHOTO MOSAIC IS A COMPOSITE OF 8 SEPERATE AIR PHOTOS. THE MOSAIC HAS NOT BEEN ORTHO-CORRECTED AND PROVIDE NO WARRANTY ABOUT ITS ACCURACY.

CLIENT

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

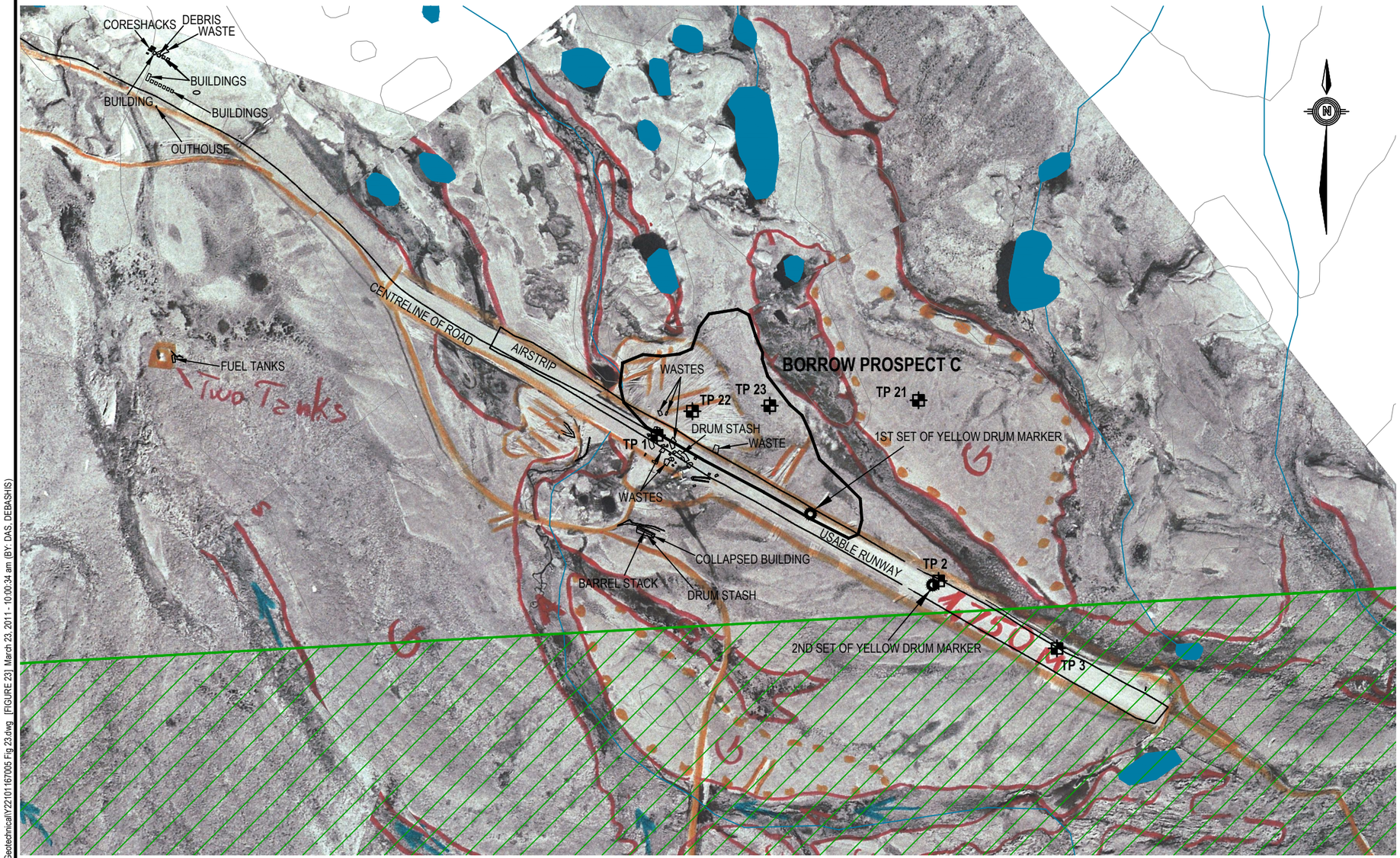
HOPE LAKE - MAIN SITE
SURFICIAL GEOLOGY AND GEOTECHNICAL FEATURES

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y221011167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 22

Q:\Edmonton\Drafting\CIVIL3D\Other Offices\Y221\Y221011167\005\01_Drawings\05_GeotechnicalY221011167005 Fig 22.dwg, [FIGURE 22] March 23, 2011 - 9:46:28 am (BY: DAS, DEBASHIS)



LEGEND

O	Organic Deposits: predominantly peat
pO	Organic Deposits: peatland
O/L	Organic Deposits Underlain by Lacustrine Deposits
C	Colluvial Deposits: unsorted debris
L	Lacustrine Deposits: sand, gravel and silt with numerous lenses of cobbles and boulders
A	Fluvial Deposits (Alluvium): veneer of boulder and cobble lag is common on surface
AC	Fluvial and Colluvial Deposits: undifferentiated in small stream valleys
G	Glaciofluvial Deposits: predominantly gravel and sand with cobbles and boulders disseminated throughout. May include patches of exposed bedrock of felsenmeer (block fields).
Tv	Till Veneer: generally less than 1 m thick. Commonly includes patches of rock outcrops.
Tb	Till Blanket: generally more than 1 m thick
R	Bedrock Outcrops: sedimentary and volcanic successious, gabbro and diabase sills. Locally may be covered with surficial material, i.e.patches of till, colluvium, organics, etc.
	Direction of Drainage
LF	Proposed Landfill Location
	Possible Borrow Source
	Individual Structures: buildings, airstrips, etc.
	Roads, Trails
	Trench
	Mine Site: approximate location
	Meltwater Channel
a b	Geological Boundary: a -defined; b-approximate
	Esker
	Geological Lineament: fault or fracture (joint) zone
	Scarp
	Ice-Wedge Polygons
	Thaw/Debris Slides
	Thermokarst Depressions
	Stripes on Slopes: undifferentiated sorted and unsorted
	Trail System and/or Infrastructure

ISSUED FOR USE

REFERENCES:

1) BASE DRAWING: NTS MAP NO. 86N09, ZONE 11 W. UTM NAD 83

2) SURVEY DRAWING: PROVIDED BY SUB-ARCTIC SYRVEYS LTD. FILE NO. 10-079-HOPE LAKE; UTM COORDINATES, ZONE 11 W, CENTRAL MERIDIAN 117° WEST (NAD 83, CSRS, PPP), ORTHOMETRIC ELEVATION

0 250

Scale (m)

LEGEND:

- APPROXIMATE LOCATION OF INUIT OWNED LAND

- TESTPIT LOCATION

NOTE:

THE SITE AIR PHOTO MOSAIC IS A COMPOSITE OF 8 SEPERATE AIR PHOTOS. THE MOSAIC HAS NOT BEEN ORTHO-CORRECTED AND PROVIDE NO WARRANTY ABOUT ITS ACCURACY.

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REMEDIAL ACTION PLAN
HOPE LAKE, NUNAVUT

HOPE LAKE - AIRSTRIP
SURFICIAL GEOLOGY AND GEOTECHNICAL FEATURES

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
Y22101167.005	DBD	KO	0
OFFICE: EBA-EDM	DATE: March, 2011		

Figure 23

APPENDIX A

APPENDIX A MATERIALS INVENTORY

NORTH CAMP WK197 HUSKY CREEK INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3)[1,2]	Material Items	Condition
7	Debris Area 01	Non-Hazardous	Wood Debris	0.5	Sheets and 2X4s	Good/unpainted
			Metal Debris	2	Vents, frying pan, bed frames and springs, food cans, boxes	Good/rusted
			Plastic Debris	1	Black PVC pipe, 100 m long	Good
			Machinery	15.8	Bombardier Snow Cat (no motor or battery), metal frame, radiator, rubber track and wheels	Good/rusted/roof detached
			Drums (205 L)	2	1: 20 L blue, empty, 1: 205 L rusted, empty	Good/rusted
		Hazardous (Leachable Lead paint)	Drums (205 L)	2	1: black, full, 1: 20 L red and white, 1/6 full	Good/rusted
8	Debris Area 02	Non-Hazardous	Wood Debris (East of APEC 8 on ridge)	2	Wood frame, sheets, 2X4s, etc.	Good/unpainted
			Metal Debris	0.8	Vents	Good/rusted
			Canvas Debris	1.2	Textile, Fabric Canvas	White / slightly shredded
			Rubber Debris	0.1	Rubber hose, black	Good
9a and 9b	Scattered Drums	Non-Hazardous	Wood Debris	0.4	Wood sheets, 2X4s,etc.	Good/unpainted
			Drum (205 L)	1	1: rusted, empty	Poor/rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	2	1: 20 L red and white, empty, 1: 205 L red and yellow, 1/4 full	Good/rusted
TOTALS (m^3)	Non-Hazardous	Wood Debris	2.9			
		Metal Debris	2.8			
		Canvas Debris	1.2			
		Plastic Debris	1			
		Machinery	15.8			
		Drums (205L)	3 drums			
		Drum Content	239.16 L			
	Hazardous (Leachable lead paint)	Drums (205L)	4 drums			

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3

SOUTH CAMP WK197 HUSKY CREEK INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3)[1,2]	Material Items	Condition
1	Debris Area 01	Non-Hazardous	Wood Debris	0.1	2 drill core boxes	Good/unpainted
			Metal Debris	2	Heater, bed frame, food cans, drilling piece	Good/unpainted
			Canvas Debris	0.5	Textile, Fabric Canvas	Good/slightly shredded
		Hazardous (Leachable lead paint[3] and Propane)	Compressed Air Cylinder	1	100 lb. cylinder (slight remains of propane)	Good/rusted
2	Debris Area 02	Non-Hazardous	Wood Debris	3	Logs, pieces of wood, etc.	Good/unpainted
			Metal Debris	3	Heater, food cans, motor, old drill with steel chain, industrial water pump, fire extinguisher, steel post, drill rods cable holder.	Good
3	Drum Cache	Non-Hazardous	Wood Debris	0.5	12 drill core boxes	Good/unpainted
			Metal Debris	0.1	5 L wash bin	Good
		Hazardous (Leachable lead paint)	Drums (205 L)	6	5 black drums (3: empty, 1: 3/4 full, 1: 1/4 full) and 1 empty red drum.	Good/rusted
4a and 4b	Scattered Drums	Non-Hazardous	Wood Debris	4	Posts and plywood	Good/unpainted
			Metal Debris	1	4 (10 L) pails	Good/unpainted
		Hazardous (Leachable lead paint)	Drums (205 L)	3	1 empty and 2 1/4 full red with white lids	Rusted/one punctured
5	Building Foundation	Non-Hazardous	Wood Debris	0.5	Plywood, etc.	Good/unpainted
-	North of Debris Area 01	Non-Hazardous	Metal Debris	0.1	Drill rods	Good/rusted
-	Northwest of Debris Area 01	Non-Hazardous	Metal Debris	0.2	Tin cans, vents from heaters	Good/rusted
TOTALS (m^3)	Non-Hazardous	Wood Debris	8.1	**Notes:** 1. All volumes: uncrushed. 2. Drums/cylinder volumes are numbers of drums/cylinders, not m^3. 3. Total lead in paint exceeds criteria, however, leachable lead analysis was not possible. Assume the paint contains leachable lead.		
		Metal Debris	6.1			
		Canvas Debris	0.5			
		Drums (content)	307.5 L			
	Hazardous	Compressed air cylinder	1			
		Drums (205 L)	9 drums			

WILLOW CREEK SOUTH CABINS SITE WKB01 INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3)[1,2]	Material Items	Condition
17	Debris Area 01	Non-Hazardous	Wood Debris	4.8	Ladder, plywood	Unpainted
			Metal Debris	0.1	Cans and metal camp items	Rusted
N/A	South of APEC 17	Non-Hazardous	Wood Debris	1	2X4s	Unpainted
			Metal Debris	0.5	2 drill rods	Rusted
			Drums (205 L)	2.5	Rusted (no color): 1 (empty), 1 (1/4 full appears to be water), half drum (empty)	Rusted
18	Debris Area 02	Non-Hazardous	Wood Debris	1	50 core boxes	Unpainted
			Cores	1	Cores in core boxes	Broken
19	Structure 01	Non-Hazardous	Wood Debris	4	Platform, collapsed roof and walls: plywood and 2X4s	Unpainted
			Metal Debris	2	Vents, cans, pots, stove	Rusted
		Hazardous (Asbestos containing material)	Insulating Material	1	Insulating material on platform	Deteriorating, friable.
20	Structure 02	Non-Hazardous	Wood Debris	3	2x4s, and leaning structure (3.7 x 2.4 x 4.3 m)	Unpainted
			Metal Debris	1	1: Red, 35L Jerry can, vents, boxes	Rusted
			Drums (205 L)	5	Rusted (no color): 4 (empty), 1 (1/4 full)	Rusted
		Hazardous (Battery components)	Battery	0.1	One battery	-
N/A	North of APEC 20	Non-Hazardous	Wood Debris	0.5	Pile of 2X4s	Unpainted
			Metal Debris	0.3	Rusted food cans, vents	Rusted
			Cans	0.1	2 Cans, 2 L, one empty, one 1/4 full	Good
21	Drum Cache 01	Non-Hazardous	Wood Debris	1	Dock, triangle shape, 2 core boxes	Unpainted
			Metal Debris	0.1	Cable attached to dock, pan, 2 drill rods (one in lake)	Rusted
			Drums (205 L)	9	2: Khaki green (empty), 2: Rusted (full of rocks), 2: Rusted (1/4 full, one appears to be rusted water), 3: Rusted (empty)	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	16	4: Black (1/4 full), 5: Black (empty), 2: Red (1/4 full), 5: Red (empty)	Rusted
		Hazardous (Battery components)	Battery	0.1	One black battery with case	Deteriorating/Broken apart
22	Drum Cache 02	Non-Hazardous	Wood Debris	0.5	Pieces	Unpainted
			Metal Debris	0.1	Steel cable	Unpainted
			Drums (205L)	27	2: Khaki green (1/4 full), 3: Khaki (empty), 22: Rusted (empty)	Rusted
		Hazardous (Asbestos containing material)	Insulating Material	0.5	White insulation around a drum retrofitted with vent, used as a heater, 3 cm thick	Deteriorating, friable.
		Hazardous (Leachable lead paint)	Drums (205 L)	22	11: Black (empty), 6: Black (1/4 full), 4: Red (empty), 1: Red (1/4 full)	Rusted
TOTALS (m^3)	Non-Hazardous	Wood Debris	15.8			
		Metal Debris	4.1			
		Cans	0.1			
		Cores	1			
		Drums	43.5 drums			
		Drums (content)	973.75 L			
	Hazardous	Insulation Material	1.5			
		Drums	38 drums			

Notes:
1. All volumes: uncrushed
2. Drums volumes are numbers of drums, not m^3

WILLOW CREEK SOUTHWEST CABIN SITE WKB02 INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3)[1,2]	Material Items	Condition
23	Debris Area 01	Non-Hazardous	Wood Debris	8	Plywood, 2X4s, collapsed outhouse	Unpainted
			Metal Debris	4	Cans, chair, 10 rebar pieces, vents, drills rods, tin cans	Rusted
			Plastic	0.5	Black PVC pipe	Intact
		Hazardous (Leachable lead paint)	Drums (205 L)	4	1 Black (1/4 full), 2 Black (empty) 1 Red (empty)	Rusted
24	Structure 01	Non-Hazardous	Wood Debris	10	Former drill core storage area (3.5 x 7 x 2.1 m), plywood and 2X4s, 200 core boxes	Unpainted
			Metal Debris	1	Vents, heater front piece	Rusted
			Cores	5	200 full core boxes	Intact
25	Drum Cache 01	Non-Hazardous	Wood Debris	2	Pieces	Unpainted
			Drums (205 L)	2	1 Khaki green, 1 Blue, both empty	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	24	2 Red (1/4 full), 7 Red (empty), 15 Black (empty)	Rusted
26	Float Dock	Non-Hazardous	Wood Debris	1.8	Dock (6 x 1 x 0.3 m)	Unpainted
			Metal Debris	0.5	Rebar	Rusted
			Drums (205 L)	5	3 Rusted (Attached to dock), 1 Rusted (half water submerged), 1 Khaki (empty)	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	1	1 Red (empty)	Rusted
-	South of site	Hazardous (Leachable lead paint)	Drums (205 L)	1	1 Red (1/4 full)	Partially Rusted
TOTALS (m^3)	Non-Hazardous	Wood Debris	21.8	**Notes:** 1. All volumes: uncrushed 2. Drums volumes are numbers of drums, not m^3.		
		Metal Debris	5.5			
		Cores	5			
		Drums (205 L)	7 drums			
		Drums (content)	205 L			
	Hazardous	Drums (205 L)	30 drums			

WILLOW CREEK CENTRAL SITE INVENTORY TABLE						
APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3)	Material Items	Condition
1	Debris Area 04	Non-Hazardous	Wood Debris	4	2x4s, sheets, collapsed outhouse, former storage structure.	Unpainted
			Metal Debris	0.1	Vents, buckets.	Rusted
			Roofing Material	0.1	Pile of black sheet asphalt shingles	N/A
		Hazardous (Leachable lead paint)	Drums (205 L)	7	2: red and white (empty) 4: red and white (1/4 full) 1 Blue (1/4 full).	Good, rusted.
2	Debris Area 5	Non-Hazardous	Wood Debris	4.5	Collapsed structure, drill core storage, 30 drill core boxes, sheets, 2X4s.	Unpainted
			Metal Debris	1	Drill rod, cable, 1/4 burn drum, frying pan, pail, empty camping fuel container, burned tin cans	Rusted
			Rubber Debris	0.1	Tire	Good
			Fibreglass	2	From collapsed structure	Deteriorating
			Drums (205 L)	4	3: Blue (1/4 full), 1: Rusted (empty)	Partially rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	5	3: Red (1/4full), 2: Red (empty)	Partially rusted
3	Drum Cache 1	Non-Hazardous	Wood Debris	0.6	Komatik (sled) and lumber	Unpainted
			Rubber Debris	0.1	Tire	Good
			Drums (205 L)	11	1: Blue (empty), 6: Rusted, Label: Imperial Oil Ltd (2: 1/4 full, 4: empty), 3: 40 L (empty, rusted), 1: rusted, water submerged	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	21	Red and white: 8 (empty), 9 (1/4 full), Black: 1 (empty) 3 (1/4 full)	Rusted
4	Drum Cache 2	Non-Hazardous	Wood Debris	2.4	Pieces, 2x4s, etc.	Unpainted
			Rubber Debris	0.1	Tire	Good
		Hazardous (Leachable lead paint)	Drums (205 L)	9	All red: 2 (empty) 7 (1/4 full)	Good
5	Drum Cache 3	Non-Hazardous	Wood Debris	1.8	Logs, small pieces, etc.	Unpainted
			Cables	1	Black plastic and steel cables (1 mm)	Good
			Drums (205 L)	5	4 Blue (1/4 full) 1: Blue, couldn't move	Good/rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	23	9: Black (empty) 3: Black (1/4 full) 2: Red (1/4 full) 6: Red (empty) 1: Red (punctured, buried) 2: Yellow (empty).	1 red: large tear, 1 red: punctured
6	Debris Area 01 in Main Camp Area	Non-Hazardous	Wood Debris	0.1	Sticks, boards, etc.	Unpainted
			Metal Debris	0.7	Burned tin cans, vents, pipe, spray paint cans (empty)	Unpainted
			Plastic	0.5	PVC pipe (3 pipes, 1 inch, 1 m long)	Good
			Porcelain	0.1	Porcelain sink	Unpainted
			Drums (205 L)	5	3: Blue (empty), 2: Blue halves (empty)	Good/rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	3	1: Red (empty), 2: Black (empty)	Good/rusted
7	Debris Area 2 in Main Camp Area	Non-Hazardous	Metal Debris	4	Dump: food tins, camp cooking implements	Burned/rusted
			Drums (205 L)	1	1: Red (empty)	Good/rusted
8	Drum Cache 04	Non-Hazardous	Wood Debris	3	100 wood stakes	Unpainted
			Metal Debris	1	Vents, cable, drill rods, oil cans (empty Esso Lube Oil), folding chair.	Rusted
			Plastic	1	PVC pipe (1 inch, 5 m long)	Good
			Battery	0.1	Black case	Cracked case
			Drums (205 L)	2	2: Blue (empty)	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	9	Red: 8: (empty) 1: (1/4 full)	Half rusted/Good

WILLOW CREEK CENTRAL SITE INVENTORY TABLE						
APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3)	Material Items	Condition
9	Debris Area 03 (Includes Structures 01,02,03)	Non-Hazardous	Wood Debris	3	Pieces, wood core boxes (400)	Unpainted
			Wood Structure 01: Core Storage, 02, 03	6.7	Each Structure: 3.7 x 6.1 x 0.3	Unpainted
			Metal Debris	5	White and yellow heaters, vents, cans, jugs, pails, 8 wash bucket, 5 cots, wire, kitchen sinks, 37L container labelled Esso Gear Oil (empty), 2 new garbage bins,	Rusted
			Rubber Debris	1	Red rubber pipe with textile layer.	Good
			Tank	0.1	4 L Propane tank (empty)	Rusted
			Textiles	2	Canvas sheet, pipe.	Deteriorating
			Plastic	2	Black PVC pipe	Good
			Cores	3	In core boxes	Good
			Drums (10 L)	4	3: Red (empty), 1: Green (empty)	Rusted
		Hazardous (Battery contents)	Batteries	0.1	Car battery (Label: AUTOLITE Sta-ful Vibration Guarded) and 10 C or D batteries.	Sealed in black case.
		Hazardous (Leachable lead paint)	Drums (205 L)	15	6: Red (empty), 2: Red (1/4 full), 5: Black (empty), 2: Black (in water), 1: Black (half buried).	5 red drums, half rusted.
10	Burn Pit 01	Non-Hazardous	Plastic	0.1	Wiring (1mm thick, 1m long)	Good
		Hazardous (Battery contents)	Batteries	0.1	10 C or D batteries.	Burned
11	Drum Cache 5	Non-Hazardous	Wood Debris	2	Sheets	Unpainted
			Metal Debris	1	Drill rods	Rusted
			Drums (205 L)	1	1: Blue (punctured, couldn't move)	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	17	12: Red (empty), 2: Red (empty), 1 Blue and Black (1/4 full), 1: Black (empty), 1: Black (couldn't move),	Rusted
12	Structure 04 in Northern Fuel Cache Area	Non-Hazardous	Wood Debris	2.9	Collapsed outhouse made of plywood and 2x4s, plastic white seat.	Unpainted
			Plastic	3	Black PVC pipe	
13	Burn Pit 02 in Northern Fuel Cache Area	Non-Hazardous	Metal Debris	0.1	10 tin cans	Burned/rusted
14	Structure 05 in Northern Fuel Cache Area	Non-Hazardous	Wood Debris	3	Hunting Cabin 3x2.4x2.2m: double plywood walls, shelves, stakes, 2x4s, sheets.	Unpainted
			Metal Debris	2	Single metal mattress, heater and vents, wiring, burned cans, pails, fuel pump, motor, Coleman propane (465g).	Rusted
			Fibreglass	1	Fibreglass insulation in all walls of Hunting Cabin	Deteriorating
			Household Items	0.1	Plastic utensils, insulating blanket.	Good
			Rubber Debris	0.1	Dunlop tire with bear claw marks	-
			Tank	0.5	Yellow fuel tank (empty)	Partially rusted
			Drums (205 L)	1	1: Khaki Green (empty)	Rusted
		Hazardous (Leachable Lead paint)	Drums (205 L)	2	1: Red (empty), 1: Red (1/4 full)	Rusted
		Hazardous (Asbestos containing material)	Fibre board	0.1	White insulating fibre board	Deteriorating
15	Drum Cache 06 in Northern Fuel Cache Area	Non-Hazardous	Rubber Debris	1	Black rubber with textile layer pipe	Good
		Hazardous (Leachable lead paint)	Drums (205 L)	12	7: Red (empty), 4: Red (1/4 full), 1: Black (empty)	Rusted, 1: Red punctured.

WILLOW CREEK CENTRAL SITE INVENTORY TABLE						
APEC #	**WESA Feature Designation**	**Material Type**	**Material Description**	**Volume (m^3)**	**Material Items**	**Condition**
16	Drum Cache 07 in Northern Fuel Cache Area	Non-Hazardous	Wood Debris	3	Pieces (2x8s, sheets)	Unpainted
			Metal Debris	2	Drill Rods, motor	Rusted
			Drums (205 L)	39	36: Blue (empty), 2: Khaki (empty), 30L : Red (empty).	Partially rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	138	Black: 27(empty), 1(1/2 full), 3(1/4full), Red: 20 (empty), 6 (1/2 full), 25 (1/4full), 7 (N/A), 1: Red, yellow and blue (1/4 full).	Partially rusted
27	West of site and along the shoreline	Non-Hazardous	Wood Debris	4	Pieces	Unpainted
			Plastic	2	Black PVC pipe	Good
			Drums (205 L)	8	4: Rusted (empty), 3:Blue (empty), 1: Khaki (empty)	Partially rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	9	9: Red (empty)	Partially rusted
		Non-Hazardous	Drums (205 L)	3	Green: 1: empty, 1: (1/4 full), 1: rusted (1/2 full)	Partially rusted
		Hazardous (Leachable Lead paint)	Drums (205 L)	17	Red: 1: (full) 1: (1/2 full, holes),5: (1/2 full), 3: (1/4 full), 3: (empty), 1: Yellow and Black: (1/2 full), 2: Black: (1/2 full), 1: Black (1/4 full).	Partially rusted
Totals: (m3)	Non-Hazardous	Wood Debris	37.8	**Notes:** 1. All volumes: uncrushed 2. Drums volumes are numbers of drums, not m^3		
		Metal Debris	16.9			
		Textiles	2			
		Plastic	8.5			
		Rubber Debris	2.4			
		Fibreglass	3			
		Household Items	0.1			
		Tank	0.1			
		Roofing Materials	0.1			
		Porcelain	0.1			
		Cores	3			
		Drums (205 L)	81 Drums			
		Drums (content)	5689 L			
	Hazardous	Fibreboard	0.1			
		Batteries	0.3			
		Drums (205 L)	287 Drums			

APECS 1 THROUGH 6 - HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
1A	Debris Area 17	Non-Hazardous	Metal Debris	5	Stove, drill cable, food cans, aerosol cans, camp stove, large space heaters, calcium chloride buckets	Rusted
			Small Drums (20 L)	200	In a pile	Rusted/Broken
	Burn Pit 05 (Within DA 17)	Hazardous (Battery components)	Battery	0.1	Burned battery ends	Deteriorating/burned
1B	Structure 29	Non-Hazardous	Wood Debris	4.4	Outhouse, collapsed (2.5 x 1.1 x 1.6 m)	Unpainted
			Metal Debris	0.1	Bed frame and tent frame	Rusted
			Drums (205 L)	6	All empty: 3: Rusted, no lid, 1: Yellow, 2: Rusted, cut in half	Partially rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	2	2: Black (empty)	Partially rusted
2A	Structure 17, Debris Area 08	Non-Hazardous	Wood Debris	16	2 Tanks (2.4 x 1.3 x 0.9 m), building (2.3 x 2 x 4 m), skids (2 x 4 m)	Unpainted
			Metal Debris	2	4 Galvanized sheets, venting and valves	Unpainted
			Insulation	0.5	White and yellow fibreglass	Deteriorating
			Canvas	3	Canvas	-
	Tank 12	Hazardous (Leachable lead paint and asbestos containing lower gaskets)	75,000 L Diesel Silver painted, Steel tanks, 15 cm off the ground, rubber gaskets on top (1 m^3), 4 asbestos containing grey gaskets on lower valves (1 m^3).	450	AV100/130, Last cleaned: June 1962	All empty, except bottom: 0.2 m distance from lowest valve to bottom of tank.
	Tank 13				JP4, Last cleaned: 06/08/62	
	Tank 14				AVGAS 100/130, Last cleaned: 06/08/62	
	Tank 15				F, Last cleaned: 06/08/62	
	Tank 16				Last cleaned: 06/08/62	
	Tank 17				"June 1962"	
2B	Debris Area 07	Non-Hazardous	Metal Debris	2	Tin cans, paint cans, heating ducts	Rusted
			Glass	0.1	Pieces	-
			Plastic	1	Jerry can, oil filters, yellow hull of a sled	Intact
			Rubber Debris	0.1	Inner tire tubing	-
			Drums (205 L)	4	4: empty	Rusted
			Small Drums (20 L)	5	5: empty	Rusted
			Small Drums (35L)	2	2: empty	Rusted
		Hazardous (Battery components)	Battery	0.1	2 car batteries	Intact
3A	Drum Cache 08	Non-Hazardous	Wood Debris	7	Pieces	Unpainted
			Metal Debris	0.5	Drill rods	Good
			Plastic	0.1	Jerry can (empty) 22L, green hose	Good
			Drums (205 L)	4	5 Total: 2: Blue/White (empty), 2: Rusted, half in water (former red)	Partially rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	40	39: Red with white or blue or yellow ore green (empty), 1: Black/yellow (1/4 full)	Partially rusted
			Small Drum (80L)	1	1: Red (empty)	Partially rusted
		Hazardous (Organic Content)	Drums (205 L)	1	1: Blue/white (full of organic fluid)	Partially rusted

APECS 1 THROUGH 6 - HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
3B	Tank 04	Hazardous (Leachable lead paint)	Tank	9.6	Cylindrical Painted blue, appears empty	Labels: AVGAS
	Tank 05	Non-Hazardous	Tank	9.6	Cylindrical Rusted (little red paint left), appears empty	
		Non-Hazardous	Wood Debris	7.2	Platform holding tanks (3.6 x 2 x 1 m)	Unpainted
3C	Structure 10	Non-Hazardous	Wood Debris	55	Watchman's cabin, collapsed (4 x 4 x 4 m)	Unpainted
			Metal Debris	0.9	Heating oil tank #6 (900 L, empty), drill rods, chains, corners, 1 20 L drum (empty)	Rusted
			Insulation	1	White and yellow fibreglass	Deteriorating
			Linoleum	1	Plastic linoleum with a paper backing (sampled and does not contain asbestos)	Torn
			Drums (205 L)	2	Rusted: 1: empty, 1: garbage drum	Rusted
		Hazardous (Asbestos containing material)	Mastic	1	Black mastic on wood where ducts connect.	Not friable
3D	Structure 02	Non-Hazardous	Wood Debris	2	Outhouse, partially collapsed	Unpainted
			Metal Debris	1	Cable, metal under toilet seats, half garbage drum	Rusted
3E	Structure 03	Non-Hazardous	Wood Debris	51	Bunkhouse, collapsed	Unpainted
			Metal Debris	1	Cables, pieces.	Good
			Insulation	8	White and yellow fibreglass	Deteriorating
			Linoleum	0.5	White plastic with black/red tar backing	Ripped
	Tank 03		Tank	6	Square Water tank (6000 L), open	Good
3F	Structure 04	Non-Hazardous	Wood Debris	3	Collapsed shack south of bunkhouse	Unpainted
3G	Structure 05	Non-Hazardous	Wood Debris	37	Collapsed building (150 m^2)	Unpainted
			Metal Debris	15	White: shower, hot water tank and 2 gas stoves. Bed springs, lights, shelving, heater ducting, drain pipe, burning drum	-
			Insulation	1.5	White and yellow fibreglass	Deteriorating
			Linoleum	0.5	White plastic with paper backing	Ripped
	Communication Tower	Non-Hazardous	Metal Debris	9	Steel enforced tower	Unpainted
		Hazardous (Asbestos containing material)	Mastic	0.5	Black mastic on wood where ducts connect.	Good
3H	Structure 06	Non-Hazardous	Wood Debris	5	Storage Structure South of Structure 07 (wood frame building collapsed)	Unpainted
	Structure 06 and 07	Non-Hazardous	Wood Debris	36.3	Collapsed kitchen with office and library	Unpainted
			Metal Debris	20	Stove, 2 stoves painted white, 4 heaters, shelving, cable, 2 black and 1 metal cable combo, square water tank, cigar case, drainage pipe, communication tower, drill rods, heating ducts, food cans	Some rusted
			Canvas	1	Newer	Good
			Drums (205 L)	2	2: Rusted (empty).	Rusted/punctured
		Hazardous (Leachable lead paint)	Drums (205 L)	2	2: Red and yellow (empty)	Partially rusted
		Hazardous (Asbestos containing material)	Mastic	0.5	Black mastic on wood where ducts connect	Good

APECS 1 THROUGH 6 - HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
3I	Debris Area 06	Non-Hazardous	Wood Debris	1	Pieces	Unpainted
			Metal Debris	2	Heater duct, track	Rusted
3J	Structure 11	Non-Hazardous	Wood Debris	21	Collapsed Garage	Unpainted
			Metal Debris	10	Food cans, frame, shelves, heating ducts, drill rods, cable, black and metal combo wiring, two stoves, John Deer engine, light holders, empty oil and solvent cans, electrical box (black paper sampled and does not contain asbestos), 20 L empty drum	Rusted
			Rubber Debris	0.5	2 green hoses, electrical cables	Good
			Insulation	2	White and yellow	Deteriorating
			Plastic	5	PVC pipe	-
			Drums (205 L)	4	All empty and rusted	Rusted
		Hazardous (Asbestos containing material)	Mastic	0.5	Black mastic on wood where ducts connect.	Good
		Hazardous (PCB containing)	Light Ballasts	0.1	2 Light ballasts, not able to read label	Rusted
	Tank 07	Non-Hazardous	Tanks	3	2: Rusted, 1: Silver Heating oil tanks (900 L, empty in Structure 11), 0.05 m of dirty water in one	Good
	Tank 08					
	Tank 09					
3K	Drum 01	Hazardous (Leachable lead paint)	Drums (205 L)	1	1: Red (partially full)	Partially rusted
3L	Tank 10	Non-Hazardous	Metal Debris	6.1	Metal trailer	Rusted
			Tanks	4	4 fuel tanks (900L) on the metal trailer (empty)	Partially rusted
			Plastic	0.1	One jerry can, 1/4 full of water	New
3M	Structure 12	Non-Hazardous	Wood Debris	6	Manager's Quarters, collapsed, pieces	Unpainted
			Metal Debris	1	Heater duct, drill rods, pieces	Rusted
			Insulation	1	White and yellow fibreglass	Deteriorating
			Linoleum	0.5	White plastic with paper backing	Ripped
		Hazardous (Leachable Lead paint)	Drums (205 L)	1	1:Black, empty	Partially rusted
		Hazardous (Asbestos containing material)	Mastic	0.3	Black mastic on wood where ducts connect	Good
3N	Tank 11	Non-Hazardous	Wood Debris	1	Pieces	Unpainted
			Tank	4.5	4,500 L, Rusted	Rusted
30	Structure 13	Non-Hazardous	Wood Debris	10	Geologists Quarters/assay lab, pieces, some in plastic boxes.	Collapsed, unpainted
			Metal Debris	2	Heating ducts, plumbing pipes, water tank, white water heater, ore pulverizer, electrical boxes	-
			Plastic	1	Boxes	Unpainted
			Insulation	1	White and yellow fibreglass	Deteriorating
		Hazardous (Asbestos containing material)	Electrical Insulators	0.1	Black, solid	Not friable
3P	Structure 15	Non-Hazardous	Wood Debris	16	Storage building, core boxes, pieces.	Collapsed, unpainted
			Metal Debris	9	Heating ducts, pipe valves, engine, steering wheel, yellow light fixtures, drill rods, rebar	Rusted
			Core	16	Core in boxes	Good
			Drum (205 L)	1	1: Red, blue and white, empty.	Partially rusted

APECS 1 THROUGH 6 - HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
3Q	Structure 08	Non-Hazardous	Wood Debris	2.3	Platform, pieces, south outhouse	Collapsed, Unpainted
	Structure 14		Wood Debris	3	Potential generator building	Collapsed, Unpainted
			Metal Debris	0.5	3 Drill rod, pieces, cans, one crushed drum, etc.	Rusted
			Insulation	0.1	White and yellow fibreglass	Deteriorating
			Plastic	0.1	Jerry can (empty)	New
			Ceramic	1	Insulators	Good
3R	Structure 09	Non-Hazardous	Wood Debris	30	Drill shack/HTO cabin, pieces, walls intact, the rest is intact	Unpainted
			Metal Debris	12	Cylinder with chain, heating ducts, sheeting, heater, drill rods and racks, pipes, antenna tower, drill machine, electrical boxes, track	Unpainted
			Plastic	2	Black PVC pipe (KF: black tubing??)	Good
			Drums (205 L)	6	2: rusted (empty), 1: 80 L rusted (empty), 1: 120 L rusted (empty), 1: rusted/yellow with burnt debris inside, 1: red/blue/white (empty)	Partially rusted
		Hazardous (Asbestos containing material)	Electrical Insulators	0.1	Black, solid	Not friable
		Hazardous (Leachable lead paint)	Drums (205 L)	6	1: Red/yellow (side missing), 1: 50 L red (empty), 1: red (1/6 full), 1: red/blue (empty), 1: 120 L red (empty), 1: red (empty)	Partially rusted
3S	Float Plane Dock	Non-Hazardous	Wood Debris	10	Half a dock, plywood, beams	Unpainted
3T	Water Ponding West of the Area	N/A	N/A	N/A	N/A	N/A
3U	Suspected Outfall	N/A	N/A	N/A	N/A	N/A
3V	Drum Cache 09 (55 x 5 m, 2-3 drums high, 2-3 drums wide)	Non-Hazardous	Wood Debris	7	4 Wooden platforms, boxes, pieces	Unpainted
			Metal Debris	10	Chains, trailers, vehicle axles, pieces, tracks, 3 water tanks	Rusted
			Insulation	1	White and yellow fibreglass	Deteriorating
			Rubber Debris	5	Wheels on trailers	Good
			Drums (205 L)	40	Most empty:40: Blue	Partially rusted
		Hazardous (Leachable lead paint)	Metal Debris	3	Yellow caterpillar	Partially rusted
			Small Drums (205 L)	660	Most empty: 550: red, 20:Black/yellow, 90:Black	Partially rusted
			Drums (50L)	20	Empty: 20:red	Partially rusted
N/A	Under road between APEC 3 and 4	Non-Hazardous	Drums (205 L)	6	Used as culvert, no top or bottom lids	Rusted
4A	Structure 18	Non-Hazardous	Wood Debris	2	Tent Frame	Collapsed, unpainted
	Burn Pit 04	Hazardous (Battery components)	Battery	0.5	Located between Structures 18 and 19	Broken
	Debris Area 09	Non-Hazardous	Wood Debris	2	Scattered building debris including remnants of canvas, pieces of core boxes, and fibre board	Some metal, shingles here
		Hazardous (Battery components)	Battery	0.1	1: Car battery	Intact

APECS 1 THROUGH 6 - HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
4A	Structure 19	Non-Hazardous	Wood Debris	9	Maintenance area/garage	Unpainted
			Metal Debris	2	Drill rods (44)	Rusted
			Insulation	1	White and yellow fibreglass	Deteriorating
	Debris Area 10		Metal Debris	2	Appliances, pieces	Rusted
		Hazardous (Battery components)	Battery	0.1	2 batteries from bombardier	Broken
	Debris Area 11	Non-Hazardous	Wood Debris	4	Door frame, wall segment, plywood, roof truss	Unpainted
	Debris Area 12		Wood Debris	4	A box with a hinged lid, plywood	Unpainted
	Structure 20		Wood Debris	20	Bunkhouse (wood base tent frame, collapsed), remains of furniture and cooking utensil	Unpainted
			Metal Debris	In 4a total below	A bed/couch frame, a folding table, pots and pans, and a kettle, a pile of aerosol cans with shaving cream, a pile of electrical wiring and a electric motor	Rusted
	Burn Pit 06	Hazardous (Battery components)	Battery	0.1	Within Structure 20, a large number of burnt household batteries	Burnt
	Structure 21	Non-Hazardous	Wood Debris	9	Bunkhouse (wood base tent frame, collapsed), footprint indistinct, plywood	Unpainted
	Structure 22		Wood Debris	9	Office (wood frame building, collapsed), Footprint 25 m^2 and debris	Unpainted
			Metal Debris	In 4a total below	A steel water heater, a shallow metal through, a ventilated metal box	Rusted
	Structure 23		Wood Debris	15	Unknown use (wood base tent frame, collapsed), footprint indistinct, fibreboard, roll of drafting paper, wood frame table, burnt wood.	Unpainted
	Structure 24		Wood Debris	20	Footprint 180 m^2 Kitchen/shower building (wood frame building, collapsed and partially burnt), and wood frame structures, burnt timber, Large quantity of plywood	Unpainted
			Metal Debris	In 4a total below	Westeel water tank (2,750 L), a shower stall, water heater, large metal box, a large cache of rusted food cans	Rusted
	Structure 25		Wood Debris	2	Storage building (wood base tent frame, collapsed)	Unpainted
	Hope Lake	N/A	N/A	N/A	Downgradient of camp	N/A

APECS 1 THROUGH 6 - HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
4A	All 4A Debris Areas	Non-Hazardous	Wood Debris	10	Dock: 3 x 7 m, Outhouse: 4 m^3	Unpainted
			Metal Debris	10	Bed frame, heating ducts, tins (one large pile, one scattered), fire extinguisher, furnace housing, motor piece, drill pipe (3 x 3 x .04 m), water vessel, door handles, light pole (2)	Rusted
			Plastic	2	Electrical wiring	-
			Insulation	7.7	White and yellow fibreglass	Deteriorating
			Canvas	0.15	Tent material, canoe covering	-
			Ceramic	0.25	Urinal, toilets, light fixtures	-
			Glass	0.1	Food jars, windows	-
			Plastic	0.4	Radio, 20L jerry can, motor oil can, electrical wire, PVC pipe	-
			Rubber Debris	0.15	Water hose	-
			Drums (205 L)	14	1: Green (1/4), 12: rusted (empty), 1:blue (empty)	-
			Tanks (3700 L)	16	1: water tank "Westeel 66", 1: Hot water heater, 1: water tank, 1: hot water heater "Patented Turbo Flue Brock Gloss lined water heater" Model # 72 E Serial 507	Unpainted, rusted, appear empty
		Hazardous (Leachable lead paint)	Drums (205 L)	16	Empty (unless marked otherwise): 1: red/black, 1: Black, 4: red, 3:black (1/4), 1:red/yellow, 8: red/white part of float plane dock, 1: 110 L red	Rusted
4B	Structure 26	Non-Hazardous	Wood Debris	5	Outhouse and shack (plywood, 2X4s)	Collapsed, Unpainted
			Metal Debris	2	Heating ducts, pieces	Rusted
4C	Suspected Outfall	Suspected Drainage outfall Southeast of Camp	N/A	N/A	N/A	N/A
4D	Tank 19	Non-Hazardous	Tanks (3700 L)	80	21: horizontal sausage tanks, 3 groups (5, 8, 8), 3 m x 1.5 m, possibly contain sludge	Rusted
4E	At Lake North of cabin	Non-Hazardous	Wood Debris	2.5	Pieces	Unpainted
			Drums (205 L)	3	1: empty rusted, 1: garbage drum, 1: 60 L drum (empty).	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	2	Red empty drums	Rusted
4F	Core Shack	Non-Hazardous	Wood Debris	1	Pieces grounded canoe.	Unpainted
			Metal Debris	0.5	Pieces, burnt in burn pit , panel	Burnt/Rusted
			Canvas	0.1	On canoe	-
			Cores	1	Cores	Broken
			Glass	0.1	Windows	Broken
5	Core Storage	Non-Hazardous	Wood Debris	5	1 large platform with remaining wall supports	Unpainted
			Metal Debris	4	12 drill rods	Rusted
	Wooden Platforms		Wood Debris	20	15 platforms being tent bases, large structure being cooking/eating and showing facility	Unpainted
			Metal Debris	4	Communication Tower (4 m high), heating ducts, drills rods, drill pipe, one 205 L burnt garbage drum	-
	Burn Pit 06		Metal Debris	1	Small burn pit with some metal debris and broken glass	Burnt/Rusted
	Sump		Plastic	1	Small depression downgradient of kitchen/shower structure, 0.3 m deep, PVC pipe	Good
	Privy		Wood Debris	4.4	Frame construction, intact (2.5 x 1.1 x 1.6 m), Graffiti in interior indicating being used in 2005	On its side, unpainted

APECS 1 THROUGH 6 - HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
6A	Tank 20/Tank 21	Non-Hazardous	Wood Debris	4	Pieces, wood beams holding tanks	Unpainted
			Rubber Debris	53	Black hose and green hose (from tanks to road), rubber gaskets	Good
			Textile	7.5	Fire hose	Good
		Hazardous (Leachable lead paint and asbestos containing lower gaskets)	Tank	150	Brought from DEW Line site, cylindrical steel tank, 75,000 L each, the outlets are facing east, covered with silver paint with signs of rust	Good
			Gaskets	0.5	Asbestos containing grey gaskets (0.5 m^3)	Friable, Some on ground, some on tanks
	Drum Cache 10	Non-Hazardous	Metal Debris	1	2 empty: 50 L garbage cans	Good
		Hazardous (Leachable Lead Paint)	Drums (205 L)	5	5: red (1:full, 4:empty)	Rusted
6B	Wetland between 6A and 7	Hazardous (Leachable Lead Paint)	Drums (205 L)	6	Most contents are rusty water. 2: red/yellow (empty), 1: red/yellow (1/2 full), 1: Red/yellow (3/4 full), 1: Red/green (1/4 full), 1: Red/yellow (1/4 full)	Partially rusted
Totals: (Uncrushed/m^3)	Non-Hazardous	Wood Debris	479.1			
		Metal Debris	138.6			
		Canvas	4.25			
		Ceramic	1.25			
		Cores	17			
		Glass	0.3			
		Insulation	24.3			
		Linoleum	2.5			
		Plastic	12.3			
		Rubber Debris	58.75			
		Tanks	123.1			
		Small Drums	207 drums			
		Drums (205 L)	92 drums		**Notes:**	
		Drums (Aqueous content)	854.16 L		1. All volumes: uncrushed	
	Hazardous	Batteries	1		2. Drums volumes are numbers of drums, not m^3	
		Light Ballasts (PCB containing)	0.1			
		Electrical Insulators (Asbestos containing)	0.2			
		Gaskets (Asbestos containing)	1.5			
		Mastic (Asbestos containing)	2.8			
		Caterpillar (Leachable Lead Paint)	3			
		Tanks (Leachable Lead Paint)	609.6			
		Small Drums (Leachable Lead Paint)	21 drums			
		Drums (205 L) (Leachable Lead Paint)	741 drums			
		Drums (205 L) Organic content)	205 L			

APEC 7 - AIRSTRIP HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
7A	Drum Cache 06	Non-Hazardous	Wood Debris	0.5	Signs and posts.	Unpainted
			Metal Debris	0.5	Steel posts	Rusted
			Rubber Debris	0.1	Tire	Good
			Drums (205 L)	3	Both Empty: 1: Green, 2: Rusted	Rusted, 2 in water.
		Hazardous (Leachable lead paint)	Drums (205 L)	4	4: Red (empty)	Rusted
7B	Debris Area 05 (historical)	Non-Hazardous	Wood Debris	3	Frame structure base (5 x 2 m)	Unpainted
			Metal Debris	3	Frame (3 x 5 m) with pole and cable, platform with pole.	Rusted
7C	Tank 02 (historical)	Hazardous (Leachable lead paint)	Tank	9.6	Empty horizontal, cylindrical blue tank (9,600 L), Label: ASTE 90736	Partially Rusted
		Non-Hazardous	Wood Debris	1.8	Stakes, boards attached by screws and bolts, pieces, signs	Unpainted
			Metal Debris	1	Pop cans, heater ducts, pot, shovel, 50 L crushed drum	Rusted
			Rubber Debris	1	Hose with textile insulation, metal ends	Good
			Drums (20 L)	3	2: Yellow (full), 1: Rusted red (1/2 full)	Rusted
			Drums (205 L)	2	Most content is rusty water: 1: Yellow (Full), 1: Black/yellow Label: AVGAS 100LL (1/4 full)	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	18	Most content is rusted water: 1: Black (1/2 full), 1: Red (full), 1: Red (1/4 full), 5: Red (empty), 10: Rusted/in water (empty),	Partially Rusted
		Hazardous (container contents)	Container	0.1	1: 4L: Esso combustible camping fuel (1/2 full)	Partially Rusted
7D	Debris Area 05 (historical)	Non-Hazardous	Wood Debris	4	Pallets, posts, pieces, box, frame.	Unpainted
			Metal Debris	1	Heating ducts, motor (green and rusted)	Rusted
			Rubber Debris	0.1	Hoses, rubber gloves	Good
		Hazardous (Calcium Chloride)	Calcium Chloride bags	1	10, 40 kg bags Label: Panther Industries.	Deteriorating
	Core, Drilling Salt (current)	Non-Hazardous	Wood Debris	1	300 core boxes, pallets	Unpainted
			Rubber Debris	0.1	Hose	Deteriorating
		Hazardous (Leachable lead paint)	Drums (205 L)	2	1 Blue/yellow/red (3/4 full), 1 Yellow and red (1/4 full).	Good/Rusted
		Hazardous (Calcium Chloride)	Calcium Chloride bags	3	30, 40 kg bags Label: Panther Industries	Deteriorating
7E	Tank 01 (current)	Non-Hazardous	Ballasts	0.1	3: Label: Advance Transformer Co.	No PCBs
			Drum (205 L)	1	1: Jet B	Good
		Hazardous (Propane)	Propane cylinders	11	36 cylinders 180 lb each, white.	New/Good, unknown content amount.
		Hazardous (Mercury vapour)	Fluorescent lights	0.25	6 Sylvania "Supersaver" bulbs, with silver ends	4 intact, 2 broken
	Drum Cache 03 (historical/current)	Non-Hazardous	Wood Debris	0.5	22 core boxes, pallets	Unpainted
			Metal Debris	0.5	Water trough, propeller, wire, pieces.	Good
			Rubber Debris	0.1	Black hydraulic hose	Good
			Drums (205 L)	5	2: Blue/yellow, Jet B with Anti-Icing Additive (empty), 2; Rusted yellow (empty), 1: Red and green (empty)	Partially Rusted
		Hazardous (Drum contents)	Drums (205 L)	15	15: Diesel (full), 11: Low sulphur Diesel Fuel, 4: Label: 29/06/08 - RL (2: full, 4: 1/4 full, 9: empty)	Good
		Hazardous (Extinguisher contents)	Fire extinguisher	0.1	Dry chemical	Good

APEC 7 - AIRSTRIP HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
7E	Debris Area 03 (current)	Non-Hazardous	Wood Debris	0.5	Timbers, pallets, 2X4s.	Unpainted
			Rubber Debris	1	Bleach red hose	Good
			Plastic Debris	1	Milk containers, plastic bottles, juice containers, pails and lids	Deteriorating
			Drums (205 L)	4	3: Rusted Burn drums full of metal debris, 1: Pink and yellow, regular unleaded gasoline (empty).	Rusted
		Hazardous (Contents)	Containers (20 L)	41	Containers all with various drilling fluids: 19 (empty), 11 (partially full), Diamond Drill fluid: Super G-Gold (1/2 full), Super G-Blue (1/2 full), NUTO H 46 Premium Quality Hydraulic Oil (Esso); Full: MATEX (Control Chemical Corporation, Calgary); SPIRAX HD SAE 75W-90 (Shell Advanced Technology Gear Oil), 11: (some residue) Linseed Soap (West coast Drilling Supplies, Delta BC); Southwest Thread Compound (unknown company, Alberta – black viscous compound, drum open to environment, believed to be used to prevent seizing/corrosion of threaded drill rods).	Good
		Hazardous (Extinguisher contents)	Fire extinguisher	0.1	New, YR-200244	Good
7F	Burn Pit 02 (age unknown)	Non-Hazardous	Wood Debris	0.1	Partially burned wood, box	Burned/unpainted
			Metal Debris	0.1	Metal debris in box and pail	Rusted
			Plastic Debris	0.1	20 L pail	Good
	Burn pit 03 (age unknown)	Non-Hazardous	Wood Debris	0.3	4 pallets, 2 platforms	Unpainted
	Drill Platform (historical)	Non-Hazardous	Wood Debris	1	2 platforms	Unpainted
			Metal Debris	0.1	Garbage inside 20 L pails	Rusted
			Plastic Debris	0.1	13, 20 L pails	Good
7G	Drum Cache 05 (historical)	Non-Hazardous	Wood Debris	1	Pallets and 2x4s on drums, 50 core boxes, platform,	Unpainted
			Metal Debris	2	Structure, drill rods.	Good
			Plastic Debris	2	PVC pipe	Good
			Rubber Debris	2	Bleached red hose	Deteriorating
			Small drums (20 L)	3	3: Red (1/2 full)	Rusted
			Drums (205 L)	82	37 mostly empty drums: Rusted, attached to wood, 45: rusted, Label: Jet B (6), Jet A (1).	Mostly Rusted
		Hazardous (Calcium Chloride)	Calcium Chloride	1	8 bags, 40 kg.	Deteriorating
7H	Drum Cache 01 (current)	Non-Hazardous	Drums (205 L)	27	1: Black Diesel (empty), 26: Blue and Yellow Jet B (empty)	Good, Blue and yellow drums: Label: Triex Kerwin, transported by Discovery.
		Hazardous (Drum contents)	Drums (205 L)	14	13: Black Diesel (full), 1: Blue and yellow Jet 1A (full)	New/Good
	Drum Cache 02 (current)	Non-Hazardous	Drums (205 L)	73	All empty: Blue/yellow Jet B, 35: Black heating oil, 2: Black Low sulphur diesel, 2: Black Diesel. Labels: NU-PW-PPD YR 02 Kugluktuk, NU and Matrix Coronation.	New/Good
		Hazardous (Drum contents)	Drums (205 L)	38	20: Blue/yellow Jet B (1/2 full), 18: Black heating oil (1/2 full)	New/Good
	Burn Pit 01 (age unknown)	Non-Hazardous	Wood Debris	1	2 pallets	Unpainted
			Plastic	0.5	7: 20 L pails empty	Good
	Drills Rods (historical)	Non-hazardous	Wood Debris	1	Piece	Unpainted
			Metal Debris	3	Drill rods (40), lifting cables, shovel,	Good
			Rubber Debris	0.1	One tire	Good

APEC 7 - AIRSTRIP HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
7I	Old Drill (historical)	Non-Hazardous	Wood Debris	1.25	Box, 5 pieces, 2 pallets.	Box: Red on one end
			Metal Debris	0.5	Green/mostly rusted:Boyles Bros. drill on skids, food cans, 8 drill rods, solid donut, cable,	Rusted
			Plastic Debris	0.1	Coca-Cola bottles, air filter.	Rusted/broken
		Hazardous (Battery components)	Battery	0.1	One Battery	Rusted/in pieces
7J	Debris Area 02 (Historical/current)	Non-Hazardous	Wood Debris	1	Frame with walls (2x8s)	Unpainted
			Metal Debris	1	Frame (Drill platform), drill rods	Unpainted
			Plastic	0.26	260 L spill container	Good/yellow
		Hazardous (Drum contents)	Drum (205 L)	3	1: Yellow (1/2 full), 1: Black (1/2 full), 1: Black/yellow, Label: Dept. of the Environment, Kug, NU (full of turbine aviation engine fuel)	Mostly Rusted
7K	Debris Area 01 (current)	Non-Hazardous	Wood Debris	2	200 wood stakes, plywood in trailer, sled.	Unpainted
			Metal Debris	5	8 drill rods, yellow trailer (3.5x1.5m)	Rusted
			Drums (205 L)	1	1: Jet B with Anit-Icing Additive (empty)	Good
		Hazardous (Drum contents)	Drums (205 L)	6	1: Red/yellow (partially full), 3: Black (partially full), 2: Jet B with Anit-Icing Additive (full)	Some Rusted
7L	Disturbed Area 01 (historical)	Non-Hazardous	Wood Debris	0.5	Plywood, 3 pieces	Unpainted
			Metal Debris	0.5	15 rods, rusted oil cans	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	2	2: Green/Red (1/2 full), open. Label:RHEEM	Partially Rusted
		Hazardous (container contents)	Container	0.5	1: Red/yellow Imperial Oil/Exxon Turbo B (1/2 full)	Good
7M	Drum Cache 04 (historical)	Non-Hazardous	Metal Debris	4.2	Yellow frame (2x1.5x1.4), 26 rods	Good
			Plastic	0.1	Tarp	Good
		Hazardous (Leachable lead paint)	Drums (205 L)	6	Red/green/yellow (5 partially full, 1 empty)	Partially Rusted
7N	Disturbed Area 02 (historical) 200 m South of Airstrip	Non-Hazardous	N/A	N/A	No historical building	N/A
			Wood Debris	1	Shelf, table, stakes, 2x4s, plywood, pieces	Unpainted
			Metal Debris	2	200 rusted cans, heating ducts, 20 L pail, 2: Esso fuel cans (empty), kitchen sink, drill rods, 4: 70 L drums (rusted/empty)	Rusted
			Drums (205 L)	7	Rusted, no lid or bottom, attached to act as a culvert, 1: Rusted/empty, Label: Imperial Oil	Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	1	Red/white (1/2 full)	Partially Rusted
			Small Drums (40L)	6	Red (empty)	Partially Rusted
		Hazardous (Battery components)	Battery	0.1	1: battery	Old
70	Drum Cache 07 (historical)	Non-Hazardous	Metal Debris	0.1	100 tins cans	rusted
		Hazardous (Red and Black leachable lead paint)	Drums (205 L)	80 m^3 (400 Drums)	40x5m, 3-4 drums high, 2-3 drums wide. Most common: Red, then red/blue, solid blue, red/yellow, red/white, black, khaki green, blue/white. All accessible drums were empty.	Some Rusted
	Structure 01 (historical)	Non-Hazardous	Wood Debris	1	Collapsed frame (plywood and 2x4s)	Unpainted
			Metal Debris	0.1	Steel cable	Good
7P	-	Non-Hazardous	Plastic Debris	2	1 spill kit, blue	Intact
			Drums (205 L)	3	3 Blue/white (empty)	Partially Rusted
		Hazardous (Leachable lead paint)	Drums (205 L)	19	18 Black (empty), 1 Black (partial),	Partially Rusted
		Hazardous (Contents)	Drums (205 L)	10	9 Black/yellow Jet B Fuel (full), 1 Blue/yellow Jet B Fuel (1/2 full)	Partially Rusted

APEC 7 - AIRSTRIP HOPE LAKE INVENTORY TABLE

APEC #	WESA Feature Designation	Material Type	Material Description	Volume (m^3), except drums	Material Items	Condition
Totals: (Uncrushed / m^3)	Non-Hazardous	Wood Debris	22.45			
		Metal Debris	24.6			
		Calcium Chloride (Contents)	6			
		Plastic	6.4			
		Rubber Debris	4.5			
		Small Drums (20 L)	6 drums			
		Drums (205 L)	135 drums			
		Ballasts	0.1	**Notes:**		
	Hazardous	Batteries (Contents)	0.2	1. All volumes: uncrushed		
		Container (Contents)	342.25 L	2. Drums volumes are numbers of drums, not m^3		
		Fire Extinguisher (Contents)	0.4			
		Fluorescent Lights (Mercury vapour)	0.25			
		Propane cylinders (Propane remains)	11			
		Tank (Leachable lead paint)	9.6			
		Drums (Leachable lead paint)	402 drums			
		Drums (205 L Content)	14093.75 L			
		Small Drums (Leachable lead paint)	3 drums			

APPENDIX B

HUSKY CREEK PHOTO LOG		
RAP Report Photo Numer	**Project Site**	**Comment**
1	Husky Creek	WK197 South Site: aerial view looking south
2	Husky Creek	WK197 South Site: northwest aerial view of terrain west of debris area
3	Husky Creek	WK197 North Site: aerial view looking north
4	Husky Creek	WK197 North Site: northwest aerial view of shoreline with debris area
5	Husky Creek	WK197 South Site: closeup of test pit soilseast of debris area
6	Husky Creek	WK197 South Site: APEC 1, propane tank, heater and miscellaneous debris
7	Husky Creek	WK197 South Site: APEC 2, pump parts, pulley system, heater, and miscellaneous metal and wood debris
8	Husky Creek	WK197 South Site: APEC 3, drums and wood debris, looking south up into APEC 2
9	Husky Creek	WK197 South Site: APEC 3, additional drums
10	Husky Creek	WK197 South Site: APEC 5, collapsed structure
11	Husky Creek	WK197 South Site: APEC 10, can cache
12	Husky Creek	WK197 South Site: leachable lead paint sample
13	Husky Creek	WK197 South Site: drum with red leachable lead paint
14	Husky Creek	WK197 North Site: northwest aerial view of shoreline with debris area
15	Husky Creek	WK197 North Site: south view of shoreline area with debris in background
16	Husky Creek	WK197 North Site: southeast view of upland terrain east of shoreline area
17	Husky Creek	WK197 North Site: APEC 9A, aerial shot
18	Husky Creek	WK197 North Site: APEC 9A, drum and wood debris
19	Husky Creek	WK197 North Site: APEC 7, Bombardier snow machine, drums and miscellaneous wood and metal debris
20	Husky Creek	WK197 North Site: drum with black leachable lead paint

Photo 1
Husky Creek WK197 South Site: aerial view looking south

Photo 2
Husky Creek WK197 South Site: northwest aerial view of terrain west of debris area

Photo 3
Husky Creek WK197 North Site: aerial view looking north

Photo 4
Husky Creek WK197 North Site: northwest aerial view of shoreline with debris area

Photo 5
Husky Creek WK197 South Site: closeup of test pit soils east of debris area

Photo 6
Husky Creek WK197 South Site: APEC 1, propane tank, heater and miscellaneous debris

Photo 7
Husky Creek WK197 South Site: APEC 2, pump parts, pulley system, heater, and miscellaneous metal and wood debris

Photo 8
Husky Creek WK197 South Site: APEC 3, drums and wood debris, looking south up into APEC 2

Photo 9
Husky Creek WK197 South Site: APEC 3, additional drums

Photo 10
Husky Creek WK197 South Site: APEC 5, collapsed structure

Photo 11
Husky Creek WK197 South Site: APEC 10, can cache

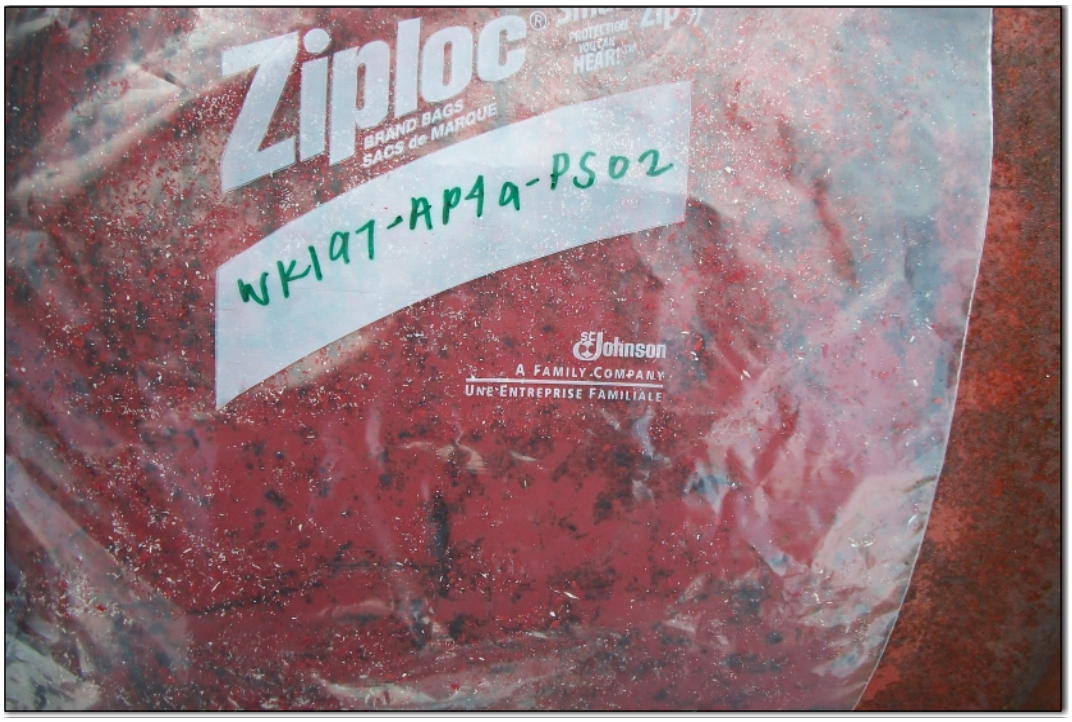


Photo 12
Husky Creek WK197 South Site: leachable lead paint sample

Photo 13
Husky Creek WK197 South Site: drum with red leachable lead paint

Photo 14
Husky Creek WK197 North Site: northwest aerial view of shoreline with debris area

Photo 15
Husky Creek WK197 North Site: south view of shoreline area with debris in background

Photo 16
Husky Creek WK197 North Site: southeast view of upland terrain east of shoreline area

Photo 17
Husky Creek WK197 North Site: APEC 9A, aerial shot

Photo 18
Husky Creek WK197 North Site: APEC 9A, drum and wood debris

Photo 19
Husky Creek WK197 North Site: APEC 7, Bombadier snow machine, drums and miscellaneous wood and metal debris

Photo 20
Husky Creek WK197 North Site: drum with black leachable lead paint

WILLOW CREEK PHOTO LOG		
RAP Report Photo Number	Project Site	Comment
21	Willow Creek	WK172 Main Site: Aerial view of Willow Creek looking south
22	Willow Creek	WK172 Main Site: aerial view of Willow Creek looking west
23	Willow Creek	WK172 Main Site: north aerial view of southern debris area
24	Willow Creek	WK172 Main Site: east aerial view of southern debris area and plateau
25	Willow Creek	WK172 Main Site: northeast view of test pit 4
26	Willow Creek	WK172 Main Site: spoil pile from test pit 4
27	Willow Creek	WK172 Main Site: northeast view of test pit 5
28	Willow Creek	WK172 Main Site: APEC 1, drums and scattered wood debris
29	Willow Creek	WK172 Main Site: APEC 1, black shingles that do not contain asbestos
30	Willow Creek	WK172 Main Site: APEC 2, drums and a collapsed structure
31	Willow Creek	WK172 Main Site: APEC 2, fibreglass insulation that does not contain asbestos
32	Willow Creek	WK172 Main Site: looking north toward APEC 3, 5, and 16
33	Willow Creek	WK172 Main Site: APEC 3, unpainted drums
34	Willow Creek	WK172 Main Site: APEC 3, drums and lumber and APEC 4 drums and wood debris were scattered along the high water mark
35	Willow Creek	WK172 Main Site: aerial view of APECs 5, 6, 7, 8, 9, 10, 11, 12, and 27
36	Willow Creek	WK172 Main Site: APEC 5, wood debris and drums at base of the slope
37	Willow Creek	WK172 Main Site: APEC 7, metal food cans, camp implements, and one empty drum
38	Willow Creek	WK172 Main Site: APEC 9, collapsed core shack with core boxes
39	Willow Creek	WK172 Main Site: APEC 9, area of standing water with partially submerged drums
40	Willow Creek	WK172 Main Site: APEC 9, WK172-AP9-SS03
41	Willow Creek	WK172 Main Site: APEC 9, WK172-AP9-SS04
42	Willow Creek	WK172 Main Site: APEC 9, battery
43	Willow Creek	WK172 Main Site: APEC 9, red hose that does not contain asbestos
44	Willow Creek	WK172 Main Site: APEC 9, Structures 01 and 02 from WESA report
45	Willow Creek	WK172 Main Site: APEC 11, empty drums, wood debris and drill rods
46	Willow Creek	WK172 Main Site: APEC 11, drum, sample below criteria
47	Willow Creek	WK172 Main Site: APEC 11, red drum with leachable lead paint
48	Willow Creek	WK172 Main Site: APEC 12, Structure 04 from WESA report, collapsed outhouse
49	Willow Creek	WK172 Main Site: aerial view of APECs 13, 14, 15, and 16
50	Willow Creek	WK172 Main Site: APEC 14, hunting cabin with mattress, heater and vents inside, fuel pump, 40 litre fuel tank, tire, wiring, one full drum and two partially full drums
51	Willow Creek	WK172 Main Site: APEC 14, Structure 05 from WESA report, asbestos containing fibreboard pieces on the ground
52	Willow Creek	WK172 Main Site: APEC 14, within structure
53	Willow Creek	WK172 Main Site: APEC 16, drum cache, black and red drums with leachable lead paint
54	Willow Creek	WK172 Main Site: looking north toward APEC 14, 15, and 16
55	Willow Creek	WK172 Main Site: APEC 14, Structure 05 from WESA report, asbestos containing fibreboard behind the heater
56	Willow Creek	WK172 Main Site: APEC 27, wood debris and drums
57	Willow Creek	WKB01 South Cabin: aerial view of WKB01
58	Willow Creek	WKB01 South Cabin: looking west toward WKB01
59	Willow Creek	WKB01 South Cabin: looking north toward WKB01
60	Willow Creek	WKB01 South Cabin: southwest aerial view of area
61	Willow Creek	WKB01 South Cabin: Willow Creek Cabin South: northwest aerial view of area
62	Willow Creek	WKB01 South Cabin: aerial view of WKB01, APECs 17 to 22
63	Willow Creek	WKB01 South Cabin: aerial view of WKB01, APECs 18 to 22
64	Willow Creek	WKB01 South Cabin: APEC 17, rusted metal food cans
65	Willow Creek	WKB01 South Cabin: APEC 18, drill core boxes with drill core
66	Willow Creek	WKB01 South Cabin: APEC 19, wood platform with collapsed walls and roof, vents, cans, pots, a wood burning stove, and grey insulation
67	Willow Creek	WKB01 South Cabin: APEC 19, asbestos containing insulating material on platform
68	Willow Creek	WKB01 South Cabin: APEC 20, leaning structure with cable, empty jerry can, car battery, five drums, metal debris and cans
69	Willow Creek	WKB01 South Cabin: APEC 21, drum cache
70	Willow Creek	WKB01 South Cabin: APEC 21, dock and one red drum with leachable lead paint
71	Willow Creek	WKB01 South Cabin: APEC 21, drum and broken battery
72	Willow Creek	WKB01 South Cabin: APEC 21, sediment sample WKB01-AP21-SD01
73	Willow Creek	WKB01 South Cabin: APEC 22, drum cache
74	Willow Creek	WKB01 South Cabin: APEC 22, drum cache and soil samples WKB01-AP22-SS03 and WKB01-AP22-SS04
75	Willow Creek	WKB01 South Cabin: APEC 22, asbestos containing insulating material around drum
76	Willow Creek	WKB02 Southwest Cabin: aerial view of WKB02 looking south
77	Willow Creek	WKB02 Southwest Cabin: Willow Creek Cabin Southwest - east view of debris area from outcrop
78	Willow Creek	WKB02 Southwest Cabin: Willow Creek Cabin Southwest - northwest view of debris area
79	Willow Creek	WKB02 Southwest Cabin: aerial view of WKB02 looking north
80	Willow Creek	WKB02 Southwest Cabin: APEC 23, three empty drums, wood and metal debris
81	Willow Creek	WKB02 Southwest Cabin: APEC 23, collapsed outhouse
82	Willow Creek	WKB02 Southwest Cabin: APEC 23, rusted cans
83	Willow Creek	WKB02 Southwest Cabin: APEC 24, collapsed core shack with numerous core boxes with drill core, wood and metal debris
84	Willow Creek	WKB02 Southwest Cabin: APEC 24, label on cardboard boxes
85	Willow Creek	WKB02 Southwest Cabin: APEC 25, drum cache near the crest of the slope to the unnamed lake
86	Willow Creek	WKB02 Southwest Cabin: APEC 25, drum sampled is below criteria
87	Willow Creek	WKB02 Southwest Cabin: aerial view APEC 26, float plane dock
88	Willow Creek	WKB02 Southwest Cabin: APEC 26, float plane dock

Photo 21
Willow Creek WK172 Main Site: aerial view of Willow Creek looking south

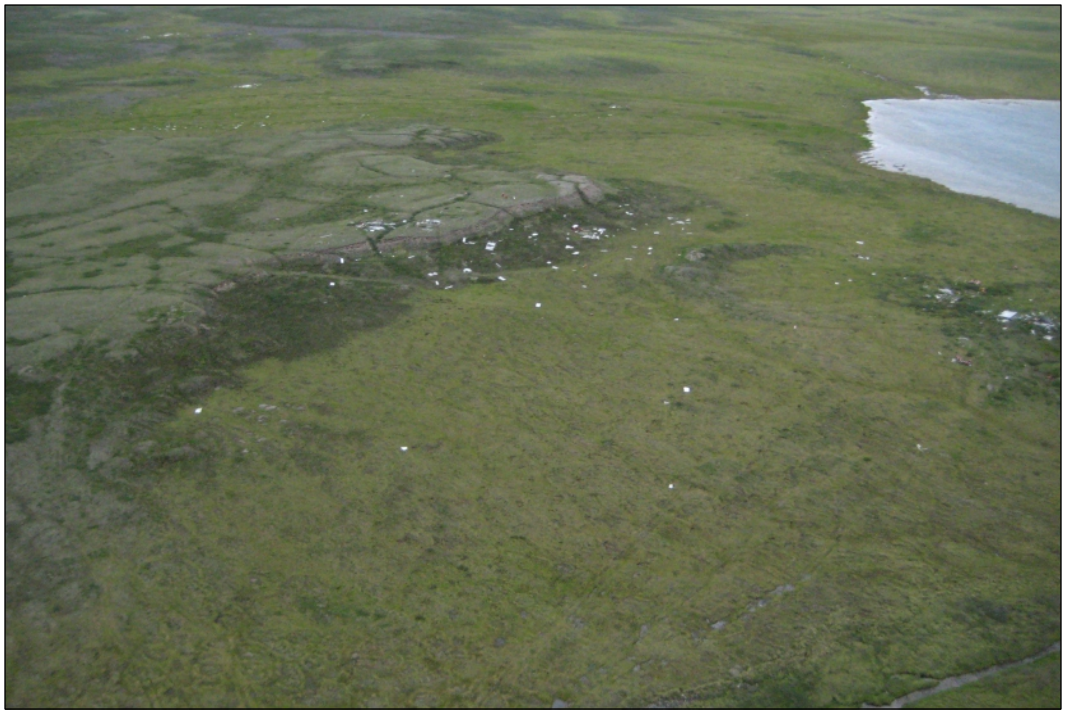


Photo 22
Willow Creek WK172 Main Site: aerial view of Willow Creek looking west

Photo 23
Willow Creek WK172 Main Site: north aerial view of southern debris area

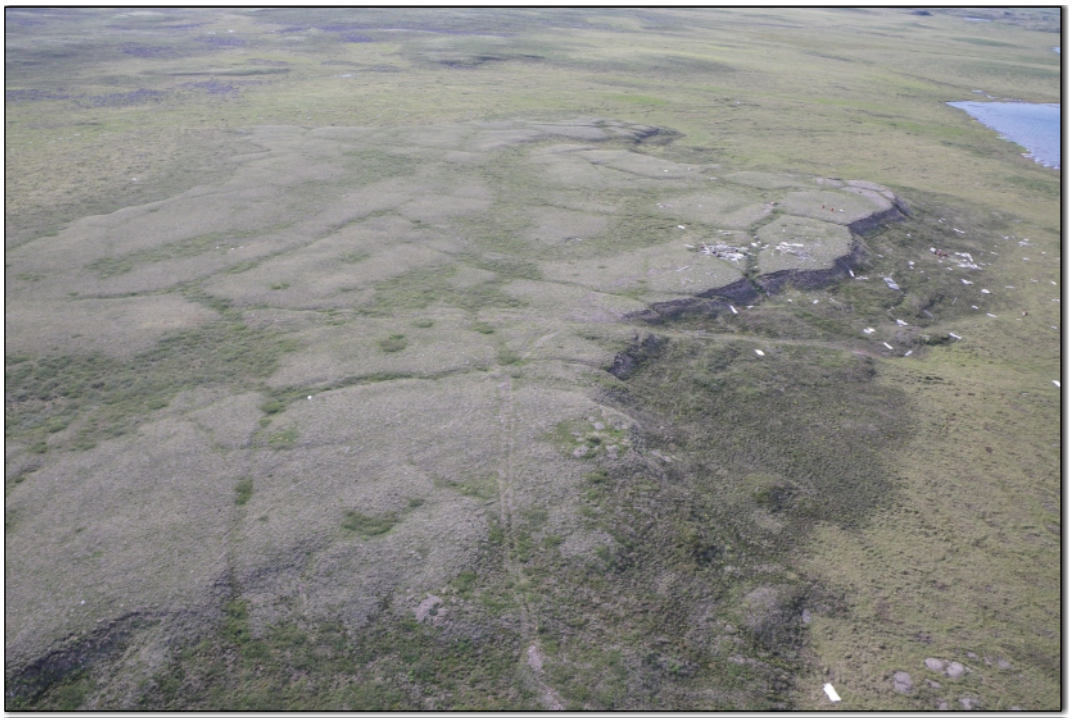


Photo 24
Willow Creek WK172 Main Site: east aerial view of southern debris area and plateau

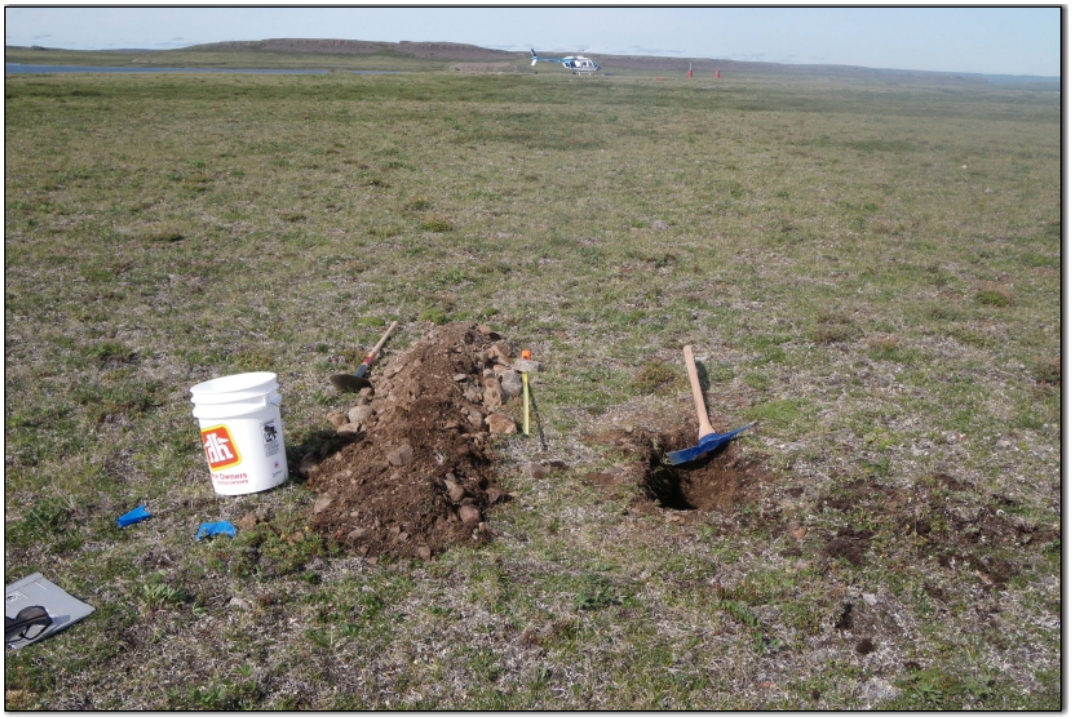


Photo 25
Willow Creek WK172 Main Site: northeast view of test pit 4

Photo 26
Willow Creek WK172 Main Site: spoil pile from test pit 4

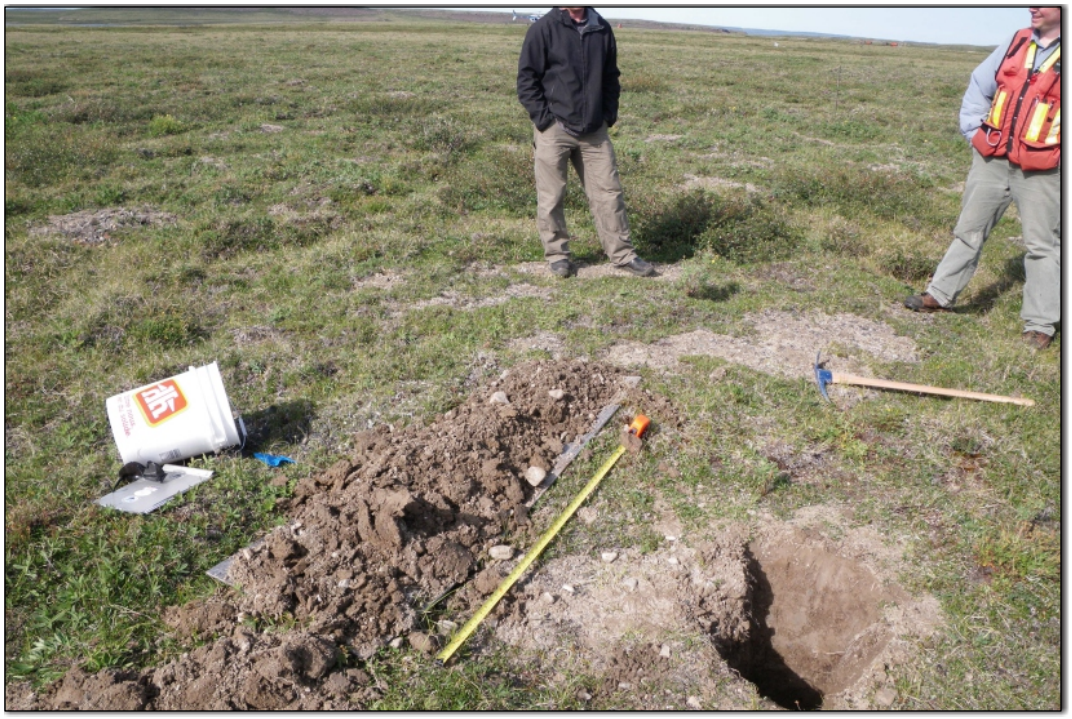


Photo 27
Willow Creek WK172 Main Site: northeast view of test pit 5

Photo 28
Willow Creek WK172 Main Site: APEC 1, drums and scattered wood debris

Photo 29
Willow Creek WK172 Main Site: APEC 1, black shingles that do not contain asbestos

Photo 30
Willow Creek WK172 Main Site: APEC 2, drums and a collapsed structure

Photo 31
Willow Creek WK172 Main Site: APEC 2, fibreglass insulation that does not contain asbestos

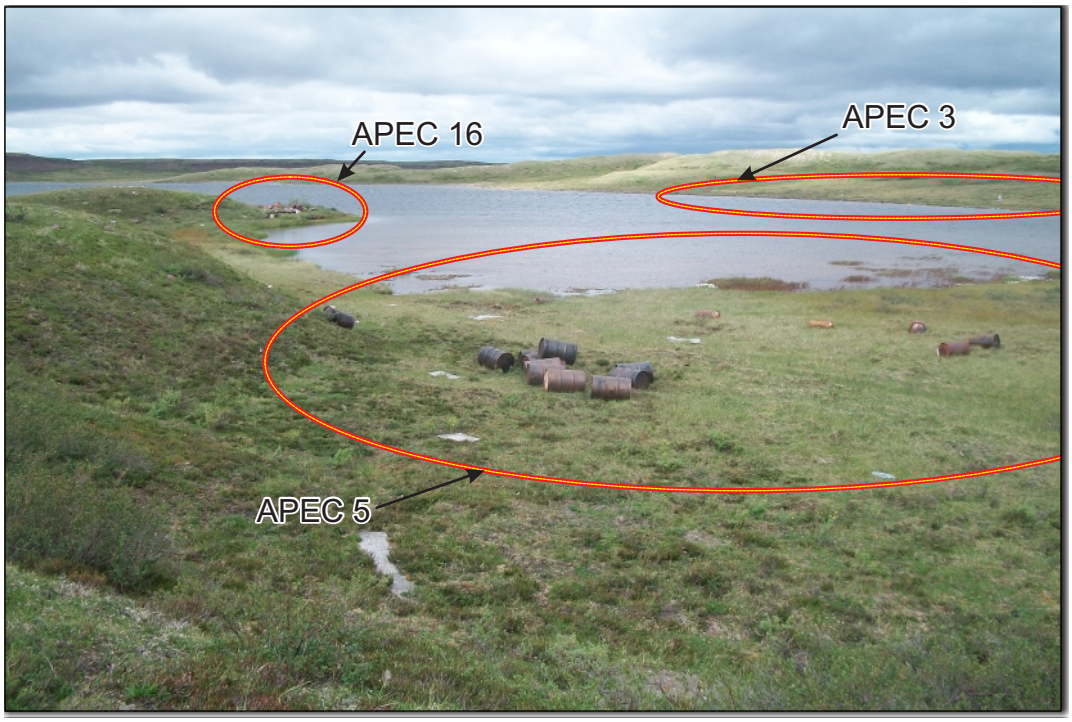


Photo 32
Willow Creek WK172 Main Site: looking north toward APEC 3, 5, and 16

Photo 33
Willow Creek WK172 Main Site: APEC 3, unpainted drums

Photo 34
Willow Creek WK172 Main Site: APEC 3, drums and lumber and APEC 4 drums and wood debris were scattered along the high water mark

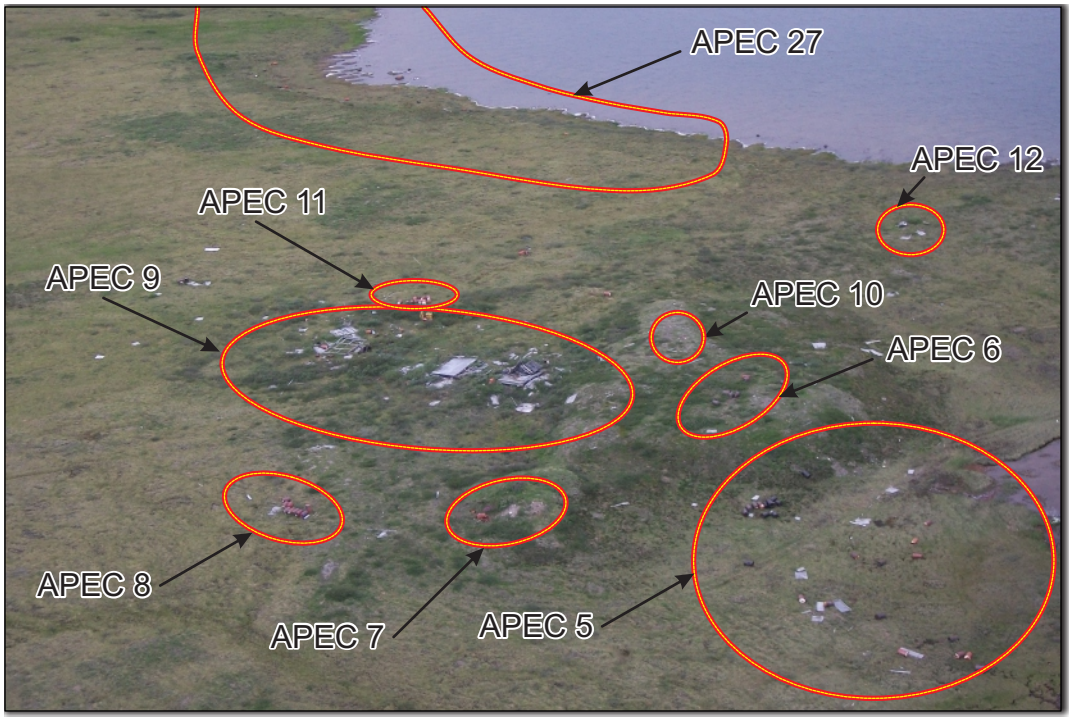


Photo 35
Willow Creek WK172 Main Site: aerial view of APECs 5, 6, 7, 8, 9, 10, 11, 12, and 27

Photo 36
Willow Creek WK172 Main Site: APEC 5, wood debris and drums at base of the slope

Photo 37
Willow Creek WK172 Main Site: APEC 7, metal food cans, camp implements, and one empty drum

Photo 38
Willow Creek WK172 Main Site: APEC 9, collapsed core shack with core boxes

Photo 39
Willow Creek WK172 Main Site: APEC 9, area of standing water with partially submerged drums

Photo 40
Willow Creek WK172 Main Site: APEC 9, WK172-AP9-SS03

Photo 41
Willow Creek WK172 Main Site: APEC 9, WK172-AP9-SS04

Photo 42
Willow Creek WK172 Main Site: APEC 9, battery

Photo 43
Willow Creek WK172 Main Site: APEC 9, red hose that does not contain asbestos

Photo 44
Willow Creek WK172 Main Site: APEC 9, Structures 01 and 02 from WESA report

Photo 45
Willow Creek WK172 Main Site: APEC 11, empty drums, wood debris and drill rods

Photo 46
Willow Creek WK172 Main Site: APEC 11, drum, sample below criteria

Photo 47
Willow Creek WK172 Main Site: APEC 11, red drum with leachable lead paint

Photo 48
Willow Creek WK172 Main Site: APEC 12, Structure 04 from WESA report, collapsed outhouse

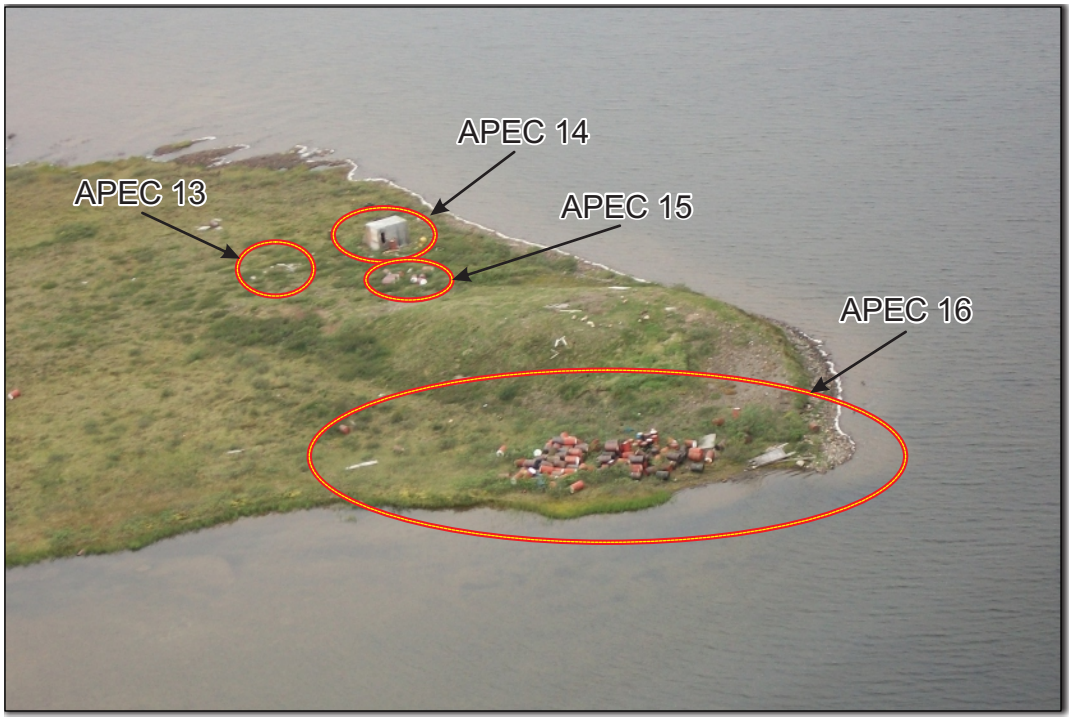


Photo 49
Willow Creek WK172 Main Site: aerial view of APECs 13, 14, 15, and 16

Photo 50
Willow Creek WK172 Main Site: APEC 14, hunting cabin with mattress, heater and vents inside, fuel pump, 40 litre fuel tank, tire, wiring, one full drum and two partially full drums

Photo 51
Willow Creek WK172 Main Site: APEC 14, Structure 05 from WESA report, asbestos containing fibreboard pieces on the ground

Photo 52
Willow Creek WK172 Main Site: APEC 14, within structure

Photo 53
Willow Creek WK172 Main Site: APEC 16, drum cache, black and red drums with leachable lead paint

Photo 54
Willow Creek WK172 Main Site: looking north toward APEC 14, 15, and 16

Photo 55
Willow Creek WK172 Main Site: APEC 14, Structure 05 from WESA report, asbestos containing fibreboard behind the heater

Photo 56
Willow Creek WK172 Main Site: APEC 27, wood debris and drums

Photo 57
Willow Creek WKB01 South Cabin: aerial view of WKB01

Photo 58
Willow Creek WKB01 South Cabin: looking west toward WKB01

Photo 59
Willow Creek WKB01 South Cabin: looking north toward WKB01

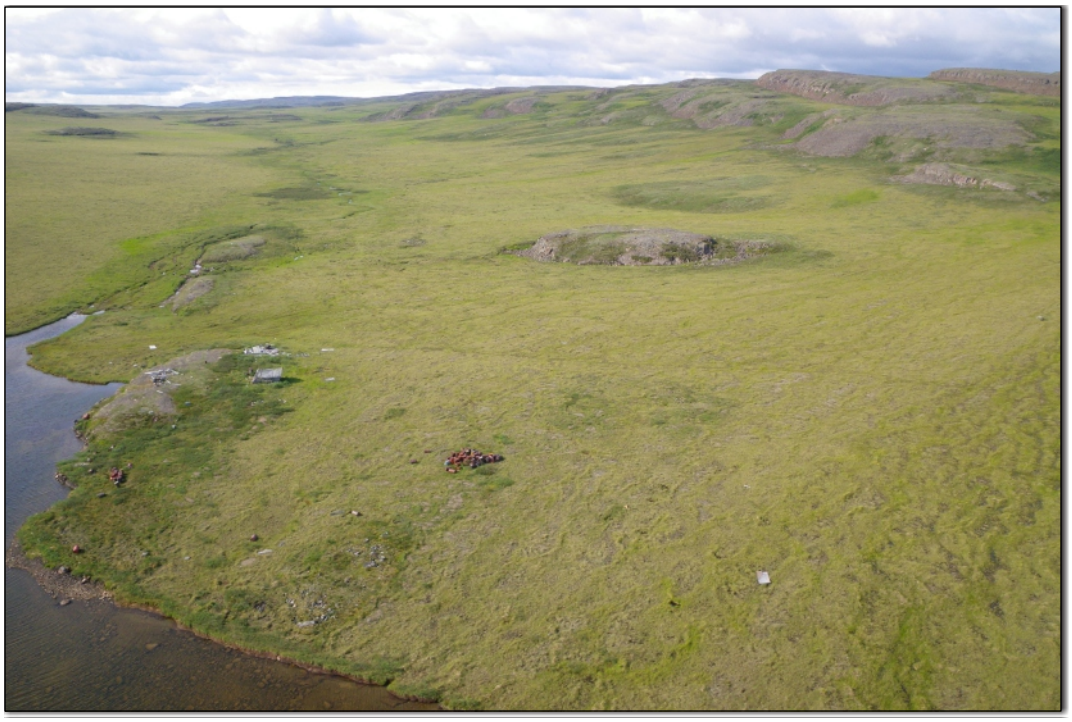


Photo 60
Willow Creek WKB01 South Cabin: southwest aerial view of area

Photo 61
Willow Creek WKB01 South Cabin: Willow Creek Cabin South: northwest aerial view of area

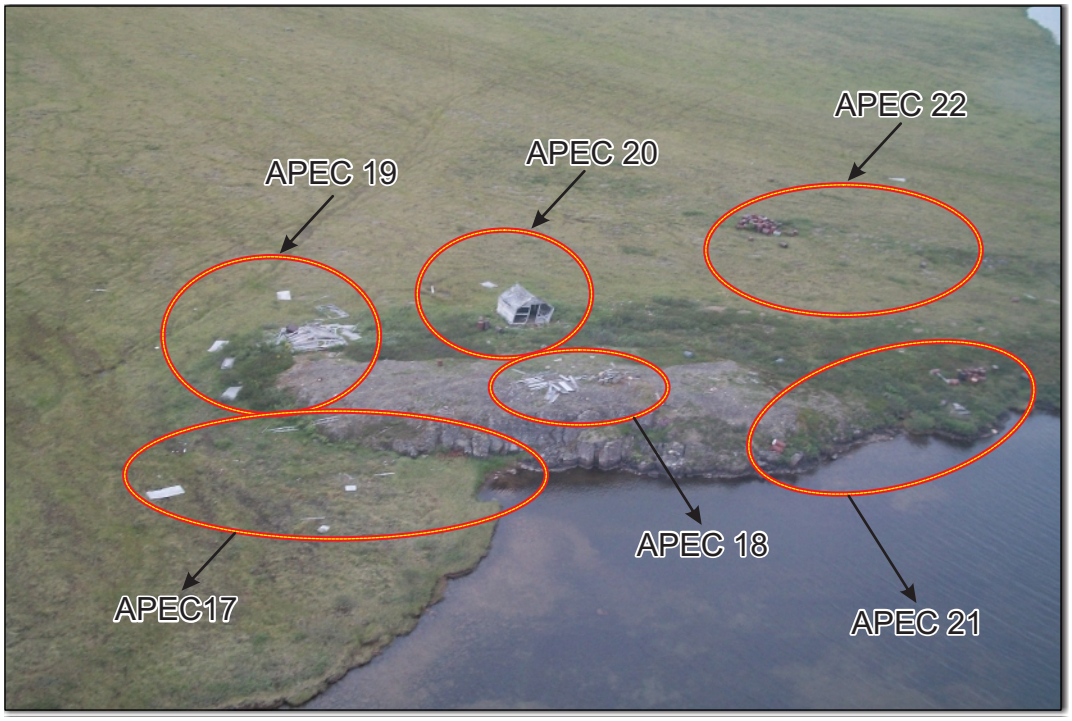


Photo 62
Willow Creek WKB01 South Cabin: aerial view of WKB01, APECs 17 to 22

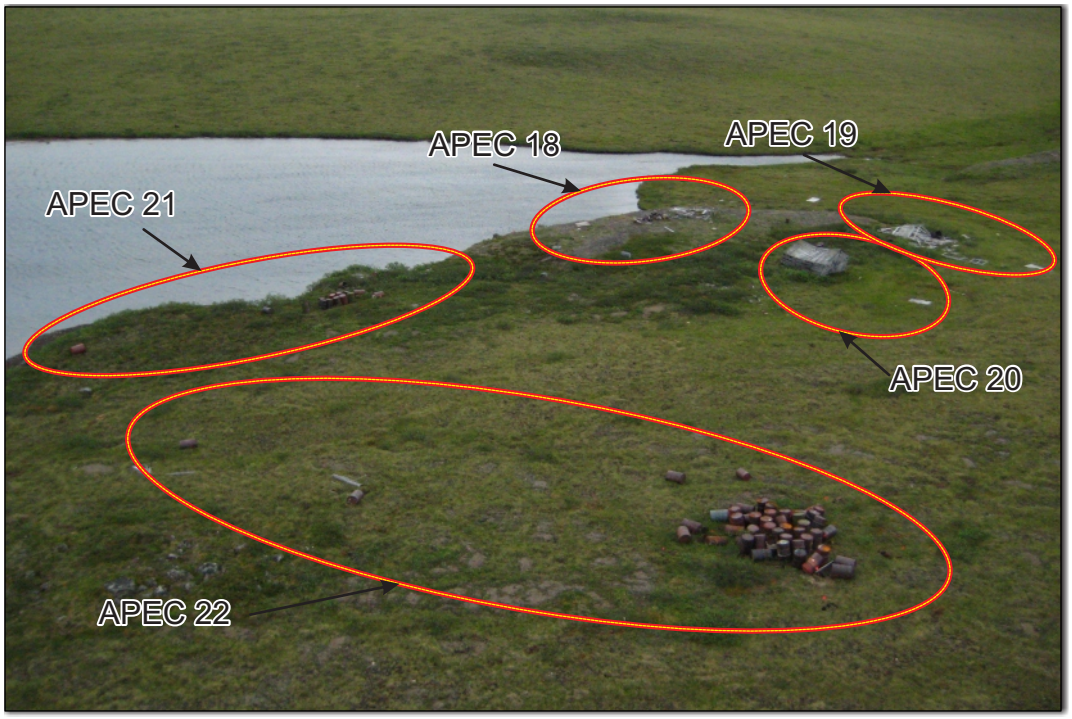


Photo 63
Willow Creek WKB01 South Cabin: aerial view of WKB01, APECs 18 to 22

Photo 64
Willow Creek WKB01 South Cabin: APEC 17, rusted metal food cans

Photo 65
Willow Creek WKB01 South Cabin: APEC 18, drill core boxes with drill core

Photo 66
Willow Creek WKB01 South Cabin: APEC 19, wood platform with collapsed walls and roof, vents, cans, pots, a wood burning stove, and grey insulation

Photo 67
Willow Creek WKB01 South Cabin: APEC 19, asbestos containing insulating material on platform

Photo 68
Willow Creek WKB01 South Cabin: APEC 20, leaning structure with cable, empty jerry can, car battery, five drums, metal debris and cans

Photo 69
Willow Creek WKB01 South Cabin: APEC 21, drum cache

Photo 70
Willow Creek WKB01 South Cabin: APEC 21, dock and one red drum with leachable lead paint

Photo 71
Willow Creek WKB01 South Cabin: APEC 21, drum and broken battery

Photo 72
Willow Creek WKB01 South Cabin: APEC 21, sediment sample WKB01-AP21-SD01

Photo 73
Willow Creek WKB01 South Cabin: APEC 22, drum cache

Photo 74
Willow Creek WKB01 South Cabin: APEC 22, drum cache and soil samples WKB01-AP22-SS03 and WKB01-AP22-SS04

Photo 75
Willow Creek WKB01 South Cabin: APEC 22, asbestos containing insulating material around drum

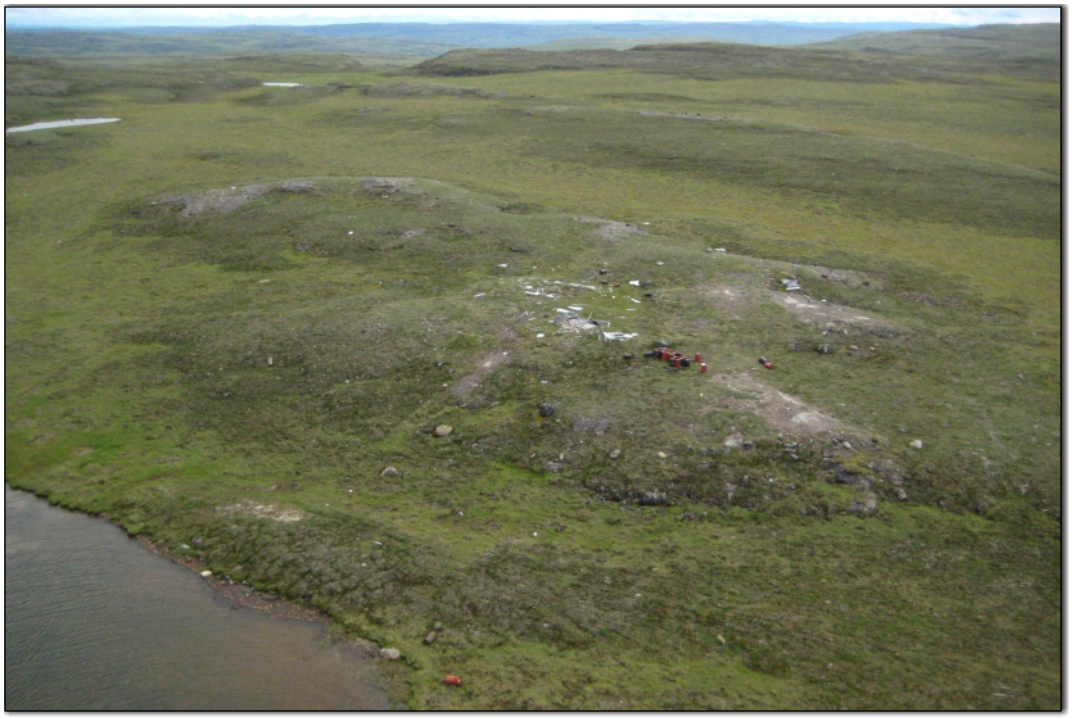


Photo 76
Willow Creek WKB02 Southwest Cabin: aerial view of WKB02 looking south

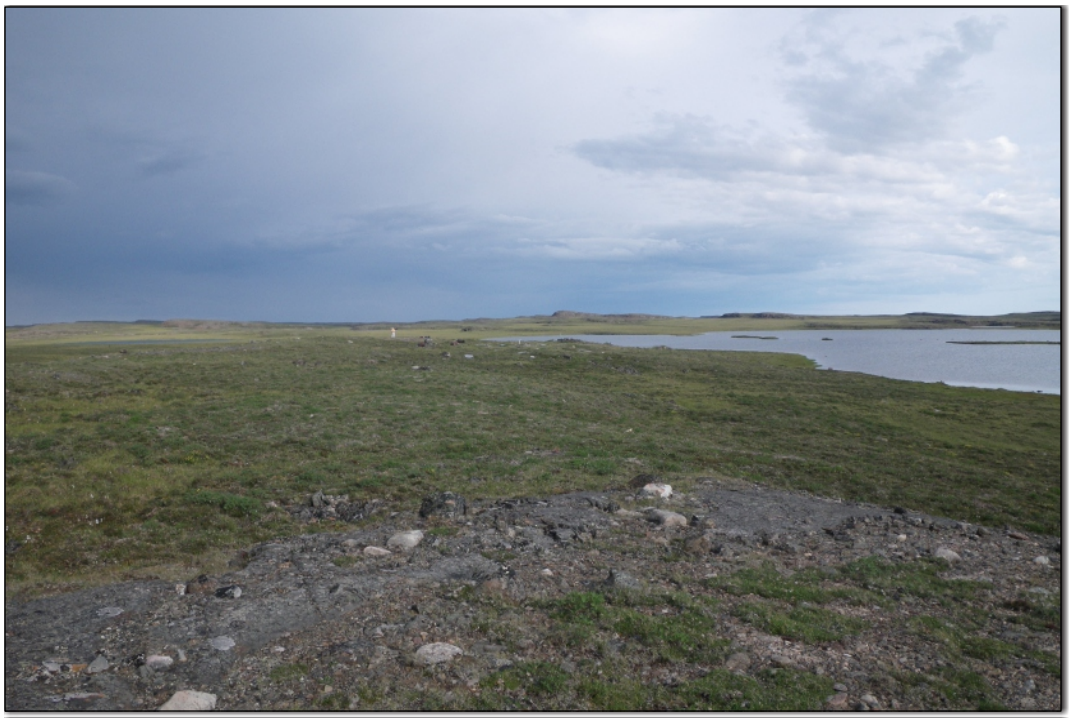


Photo 77
Willow Creek WKB02 Southwest Cabin: Willow Creek Cabin Southwest - east view of debris area from outcrop

Photo 78
Willow Creek WKB02 Southwest Cabin: Willow Creek Cabin Southwest - northwest view of debris area

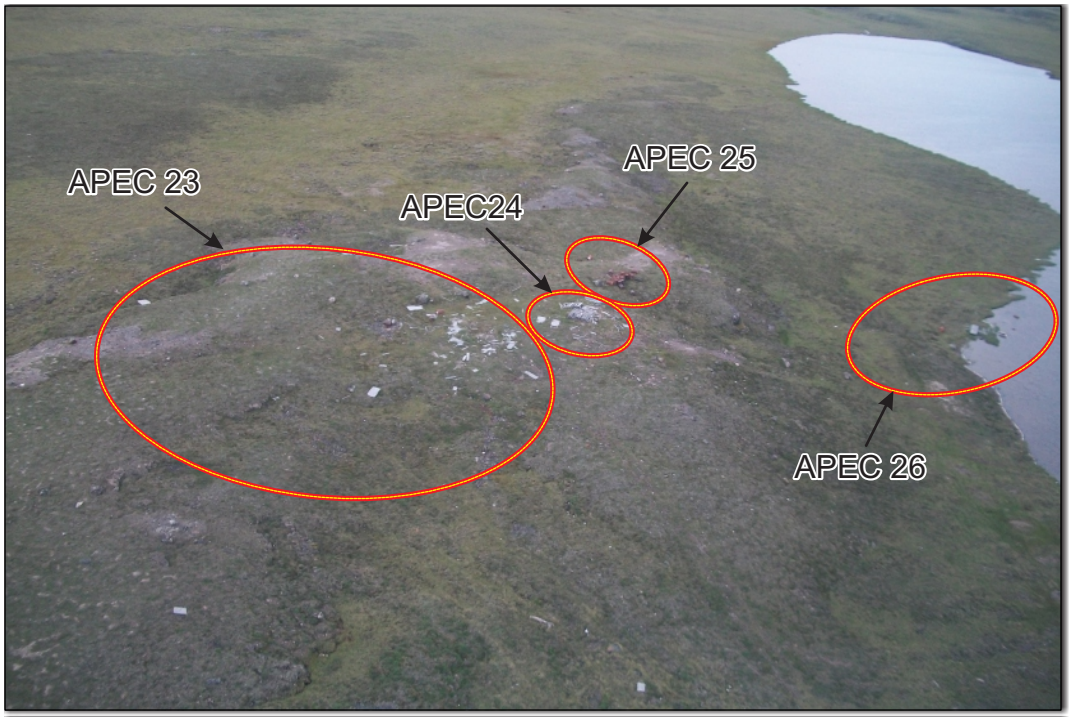


Photo 79
Willow Creek WKB02 Southwest Cabin: aerial view of WKB02 looking north

Photo 80
Willow Creek WKB02 Southwest Cabin: APEC 23, three empty drums, wood and metal debris

Photo 81
Willow Creek WKB02 Southwest Cabin: APEC 23, collapsed outhouse

Photo 82
Willow Creek WKB02 Southwest Cabin: APEC 23, rusted cans

Photo 83
Willow Creek WKB02 Southwest Cabin: APEC 24, collapsed core shack with numerous core boxes with drill core, wood and metal debris

Photo 84
Willow Creek WKB02 Southwest Cabin: APEC 24, label on cardboard boxes

Photo 85
Willow Creek WKB02 Southwest Cabin: APEC 25, drum cache near the crest of the slope to the unnamed lake

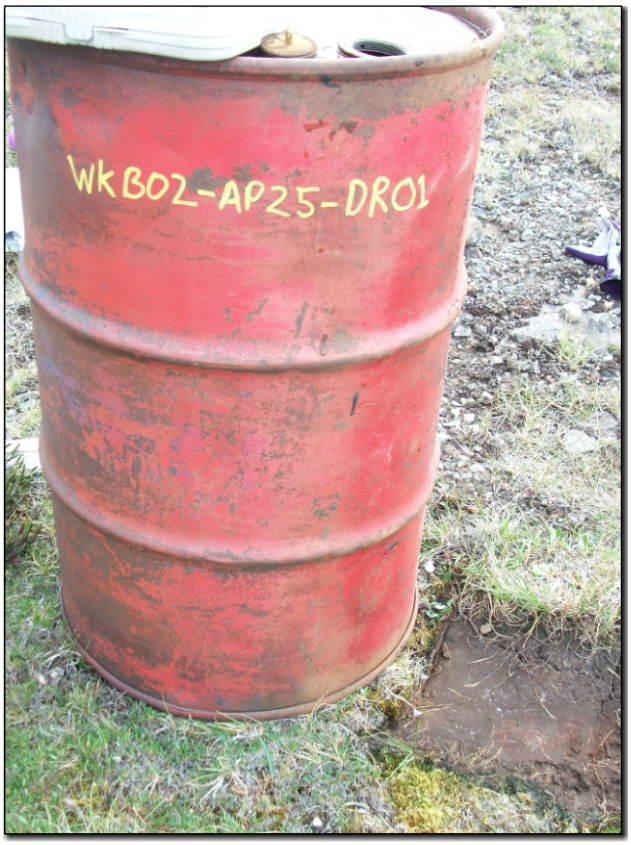


Photo 86
Willow Creek WKB02 Southwest Cabin: APEC 25, drum sampled is below criteria

Photo 87
Willow Creek WKB02 Southwest Cabin: aerial view APEC 26, float plane dock

Photo 88
Willow Creek WKB02 Southwest Cabin: APEC 26, float plane dock

HOPE LAKE PHOTO LOG		
Report Photo Numer	Project Site	Comment
89	Hope Lake	WK027: aerial view of airstrip
90	Hope Lake	WK027: aerial view of trail between airstrip and APEC 5
91	Hope Lake	WK027: aerial view of main camp area and POL tanks
92	Hope Lake	WK027: aerial view of large drum cache and POL tanks
93	Hope Lake	WK027: south aerial view of landfill areas
94	Hope Lake	WK027: south aerial view of landfill areas
95	Hope Lake	WK027: east view of LF-1 with tank farm in background
96	Hope Lake	WK027: east view of LF-2 with barrel cache in background
97	Hope Lake	WK027: northeast view of TP12 at LF-2 with barrel cache in background
98	Hope Lake	WK027: view of TP12 spoil pile at LF-2
99	Hope Lake	WK027: northwest view of TP14 at LF-3 with barrel cache in background
100	Hope Lake	WK027: view of TP14 spoil pile at LF-3
101	Hope Lake	WK027: east view of TP17 at LF-4
102	Hope Lake	WK027: view of TP17 spoil pile at LF-4
103	Hope Lake	WK027: east view of block field southeast of barrel cache
104	Hope Lake	WK027: east view of pre-existing Borrow Prospect A east of LF-4
105	Hope Lake	WK027: east view of TP18 in Borrow Prospect A southeast of LF-4
106	Hope Lake	WK027: view of TP18 spoil pile
107	Hope Lake	WK027: view of TP19 in Borrow Prospect B southeast of Borrow Prospect A
108	Hope Lake	WK027: view of TP19 spoil pile
109	Hope Lake	WK027: southwest view of TP23 at Airstrip Borrow Prospect
110	Hope Lake	WK027: view of TP23 spoil pile
111	Hope Lake	WK027: Hope Lake Road between site and airstrip, vegetated area
112	Hope Lake	WK027: Hope Lake Road between site and airstrip, exposed gravel
113	Hope Lake	WK027: Hope Lake Road between site and airstrip, 4 drum culvert
114	Hope Lake	WK027: Hope Lake Road between site and airstrip, single drum culvert
115	Hope Lake	WK027: Hope Lake Road between site and airstrip, vegetated area
116	Hope Lake	WK027: Hope Lake Road between site and airstrip, ravine area
117	Hope Lake	WK027: Hope Lake Road between site and airstrip, single drum culvert
118	Hope Lake	WK027: Hope Lake Road between site and airstrip, exposed gravel
119	Hope Lake	WK027: Hope Lake to Willow Creek Trail, trail crossing wetland
120	Hope Lake	WK027: Hope Lake to Willow Creek Trail, overland with debris
121	Hope Lake	WK027: Hope Lake to Willow Creek Trail, along a lake shoreline
122	Hope Lake	WK027: Hope Lake to Willow Creek Trail, across tundra
123	Hope Lake	WK027: Hope Lake airstrip, southeast view of northwest boundary of airstrip
124	Hope Lake	WK027: Hope Lake airstrip, southeast view of surface northwest of apron
125	Hope Lake	WK027: Hope Lake airstrip, northwest view of northwest row of yellow drums
126	Hope Lake	WK027: Hope Lake airstrip, north view of airstrip from southeast row of yellow drums
127	Hope Lake	WK027: Hope Lake airstrip, northwest view of vegetation covering surface
128	Hope Lake	WK027: Hope Lake airstrip, northwest view of southeast boundary of airstrip
129	Hope Lake	WK027: APEC 1A, heavily rusted drums and tin cans (looking north)
130	Hope Lake	WK027: APEC 1A, burn pit with battery ends (looking north toward Hope Lake)
131	Hope Lake	WK027: APEC 1A, heavily rusted drums scattered on south facing slope (looking west)
132	Hope Lake	WK027: APEC 1A, close up of drums on slope
133	Hope Lake	WK027: APEC 1A
134	Hope Lake	WK027: APEC 1A , Debris Area 17, mostly metal debris
135	Hope Lake	WK027: APEC 1B, area of former tent foundation (looking east)
136	Hope Lake	WK027: APEC 1B, former outhouse (looking east)
137	Hope Lake	WK027: APEC 1B, black drum leachable lead paint
138	Hope Lake	WK027: APEC 2A, six POL tanks, west side of tanks with leachable lead paint
139	Hope Lake	WK027: APEC 2A, east side of tanks
140	Hope Lake	WK027: APEC 2A, label on one of the tanks
141	Hope Lake	WK027: APEC 2A, tank, gaskets are asbestos containing
142	Hope Lake	WK027: APEC 2A, Structure 17
143	Hope Lake	WK027: APEC 2A, wooden structure in excavated hole with groundwater monitoring well
144	Hope Lake	WK027: APEC 2A, soil sample location WK027-AP2A-SS05
145	Hope Lake	WK027: APEC 2A, groundwater monitoring well

HOPE LAKE PHOTO LOG		
Report Photo Numer	**Project Site**	**Comment**
146	Hope Lake	WK027: APEC 2A, within Structure 17
147	Hope Lake	WK027: APEC 2A, soil sample location WK027-AP2A-SS07
148	Hope Lake	WK027: APEC 2B, soil sample location WK027-AP2B-SS01 upgradient of debris area
149	Hope Lake	WK027: APEC 2B, soil sample location WK027- AP2B-SS02, note sample WK027-AP2B-SS01 in background
150	Hope Lake	WK027: APEC 2B, battery
151	Hope Lake	WK027: APEC 3A, drums and wood debris
152	Hope Lake	WK027: APEC 3A, dock and rusted drum
153	Hope Lake	WK027: APEC 3A, drum content sample below guidelines for organic content
154	Hope Lake	WK027: APEC 3A, leachable lead paint on red drum, drum aqueous content below guidelines
155	Hope Lake	WK027: APEC 3A, red leachable lead paint on drums
156	Hope Lake	WK027: APEC 3B, two 9,600 litre tanks, leachable lead paint on blue tank
157	Hope Lake	WK027: APEC 3B, sample location WK027-AP3B-SS03
158	Hope Lake	WK027: APEC 3C, heating oil tank and wood debris, soil sample locations WK027-AP3C-SS01, 02 and 03
159	Hope Lake	WK027: APEC 3C, soil test pits north toward Hope Lake
160	Hope Lake	WK027: APEC 3C, linoleum sampled and does not contain asbestos
161	Hope Lake	WK027: APEC 3C, mastic asbestos containing material observed in most APEC 3 structures
162	Hope Lake	WK027: APEC 3D, collapsed outhouse
163	Hope Lake	WK027: APEC 3E, soil sample location WK027-AP3E-SS01
164	Hope Lake	WK027: APEC 3E, east view
165	Hope Lake	WK027: APEC 3E, soil sample location WK027-AP3E-SS02
166	Hope Lake	WK027: APEC 3F, collapsed shack and APEC 3Q, scattered wood debris and crushed drum in background
167	Hope Lake	WK027: APEC 3G, soil sample WK027-AP3G-SS02 adjacent to water tank and empty drum
168	Hope Lake	WK027: APEC 3G, communication tower
169	Hope Lake	WK027: APEC 3G, Structure 05, mostly wood debris
170	Hope Lake	WK027: APEC 3H, collapsed structure with stove, tank, and debris
171	Hope Lake	WK027: APEC 3I, heater duct and wood debris
172	Hope Lake	WK027: APEC 3J, soil sample WK027-AP3J-SS02 adjacent to building structure
173	Hope Lake	WK027: APEC 3J, light ballasts containing PCBs
174	Hope Lake	WK027: APEC 3J, paper electrical insulators sampled and do not contain asbestos
175	Hope Lake	WK027: APEC 3J, green hose rubber debris
176	Hope Lake	WK027: APEC 3K, partially full drum
177	Hope Lake	WK027: APEC 3L, four heating oil tanks on trailer, soil sample WK027-AP3L-SS03 in foreground and SS01 and SS02 in background
178	Hope Lake	WK027: APEC 3M, collapsed managers' quarters, leachable lead paint on black drum
179	Hope Lake	WK027: APEC 3N, tank
180	Hope Lake	WK027: APEC 3O, soil sample location WK027-AP3O-SS01 downgradient of former assay lab
181	Hope Lake	WK027: APEC 3O, black and white textile wrap around electrical wiring sampled, does not contain asbestos
182	Hope Lake	WK027: APEC 3O, electrical insulators containing asbestos
183	Hope Lake	WK027: APEC 3P, collapsed core shack
184	Hope Lake	WK027: APEC 3P, core boxes and yellow light fixtures
185	Hope Lake	WK027: APEC 3P, non-hazardous materials, may have been a drilling compound
186	Hope Lake	WK027: APEC 3R, Structure 09
187	Hope Lake	WK027: APEC 3U, suspected outfall area, looking north to APEC 3
188	Hope Lake	WK027: APEC 3V, aerial view of drum cache
189	Hope Lake	WK027: APEC 3V, large drum cache
190	Hope Lake	WK027: APEC 3V, yellow caterpillar
191	Hope Lake	WK027: APEC 3V, yellow caterpillar contains leachable lead paint
192	Hope Lake	WK027: APEC 3V, trailers and drums
193	Hope Lake	WK027: APEC 3W, small area of distressed vegetation
194	Hope Lake	WK027: Drum culvert between APEC 3 and 4
195	Hope Lake	WK027: APEC 4A, burn pit and battery components
196	Hope Lake	WK027: APEC 4A, drums and collapsed building in background
197	Hope Lake	WK027: APEC 4A, tank, furnace, building foundation and miscellaneous debris
198	Hope Lake	WK027: APEC 4A, tin can cache and fibreglass debris
199	Hope Lake	WK027: APEC 4B, area around collapsed outhouse and associated wood debris
200	Hope Lake	WK027: APEC 4C, suspected outfall
201	Hope Lake	WK027: APEC 4D, northeast looking of the sausage tanks with sample WK27-AP4D-SS08

HOPE LAKE PHOTO LOG		
Report Photo Numer	**Project Site**	**Comment**
202	Hope Lake	WK027: APEC 4D, looking southeast at sample points WK27-AP4D-SS04, 07, 10 and 11
203	Hope Lake	WK027: APEC 4D, looking southwest to the tanks and sample point WK27-AP4D-SS06
204	Hope Lake	WK027: APEC 4D, looking northwest
205	Hope Lake	WK027: APEC 4E, debris in Hope Lake, northeast of tanks
206	Hope Lake	WK027: APEC 4E, wood debris and some unpainted drums
207	Hope Lake	WK027: Aerial of APEC 5
208	Hope Lake	WK027: Landscape around APEC 5
209	Hope Lake	WK027: APEC 5, core boxes and building platform
210	Hope Lake	WK027: APEC 5, core boxes
211	Hope Lake	WK027: APEC 5, drum and disturbed vegetation
212	Hope Lake	WK027: APEC 5, building platforms
213	Hope Lake	WK027: APEC 5, building platform in good condition, blue paint sampled doesn't contain lead over guidelines
214	Hope Lake	WK027: APEC 5, metal and wood
215	Hope Lake	WK027: APEC 5, communication tower
216	Hope Lake	WK027: APEC 5, outhouse
217	Hope Lake	WK027: Aerial view of APEC 6A, two POL Tanks and five drums
218	Hope Lake	WK027: APEC 6A, looking toward POL tanks
219	Hope Lake	WK027: APEC 6A, green hose running from POL tanks
220	Hope Lake	WK027: APEC 6A, POL tanks on wood skids
221	Hope Lake	WK027: APEC 6A, test pits down drainage channel
222	Hope Lake	WK027: APEC 6A, WK027-AP6A-SS01 and SS03
223	Hope Lake	WK027: APEC 6A, looking northwest at POL tanks and WK027-AP6A-SS06
224	Hope Lake	WK027: APEC 6A, looking south up-slope towards tanks
225	Hope Lake	WK027: APEC 6A, leachable lead paint on drums and Tanks 20 and 21; asbestos containing gaskets on Tanks 20 and 21 (located at top of slope, out of picture)
226	Hope Lake	WK027: APEC 7, aerial
227	Hope Lake	WK027: APEC 7A, drums in lowland area
228	Hope Lake	WK027: APEC 7C, 200m south of airstrip, metal debris
229	Hope Lake	WK027: APEC 7C, 200m south of airstrip, metal debris
230	Hope Lake	WK027: APEC 7C, 200m south of airstrip, red leachable lead paint on drum
231	Hope Lake	WK027: APEC 7C, tank with blue leachable lead paint
232	Hope Lake	WK027: APEC 7D, calcium chloride bag
233	Hope Lake	WK027: APEC 7D, calcium chloride and core boxes
234	Hope Lake	WK027: APECs 7D, E and F, 7O in the background
235	Hope Lake	WK027: APEC 7E, drums, wood and plastic debris
236	Hope Lake	WK027: APEC 7E, drum cache
237	Hope Lake	WK027: APEC 7E, drum cache, most drums were labelled as diesel
238	Hope Lake	WK027: APEC 7E, fluorescent lights containing mercury vapour, ballasts do not contain PCBs
239	Hope Lake	WK027: APEC 7E, drilling fluids
240	Hope Lake	WK027: APEC 7E, drilling fluid
241	Hope Lake	WK027: APEC 7E, hazardous propane cylinders
242	Hope Lake	WK027: APEC 7E and G, drums, piping, hoses and wood debris
243	Hope Lake	WK027: APEC 7F, drill platform
244	Hope Lake	WK027: APEC 7G, drill rods
245	Hope Lake	WK027: APEC 7H, APEC 7I in foreground and APEC 7O in background
246	Hope Lake	WK027: APEC 7I, old drill, WK027-AP7I-SS01
247	Hope Lake	WK027: APEC 7I, battery parts
248	Hope Lake	WK027: APEC 7I, old drill
249	Hope Lake	WK027: APEC 7J, frame, drill rods, spill container and drum
250	Hope Lake	WK027: APEC 7K, trailer, wood stakes, drill rods, seven drums
251	Hope Lake	WK027: APEC 7L
252	Hope Lake	WK027: APEC 7M, six drums, frame and drill rods
253	Hope Lake	WK027: APEC 7O, drum cache
254	Hope Lake	WK027: APEC 7P, drums
255	Hope Lake	WK027: APEC 7P, new drums at end of airstrip
256	Hope Lake	WK027: APEC 7P, drums at southeast end of airstrip

Photo 89
Hope Lake WK027: aerial view of airstrip

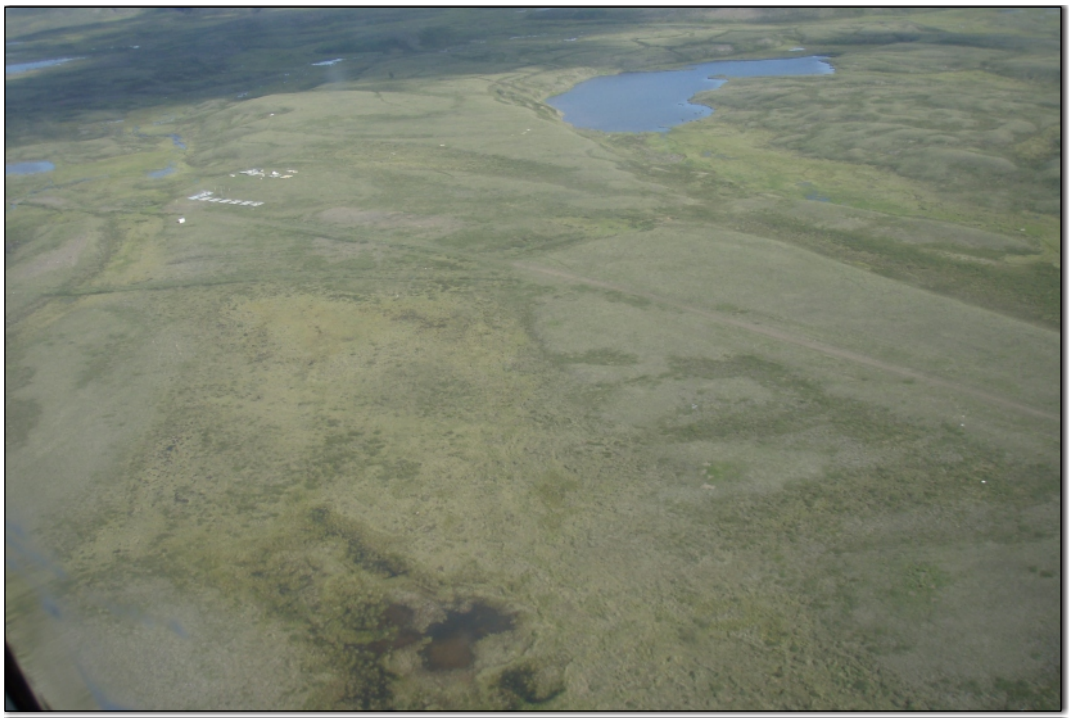
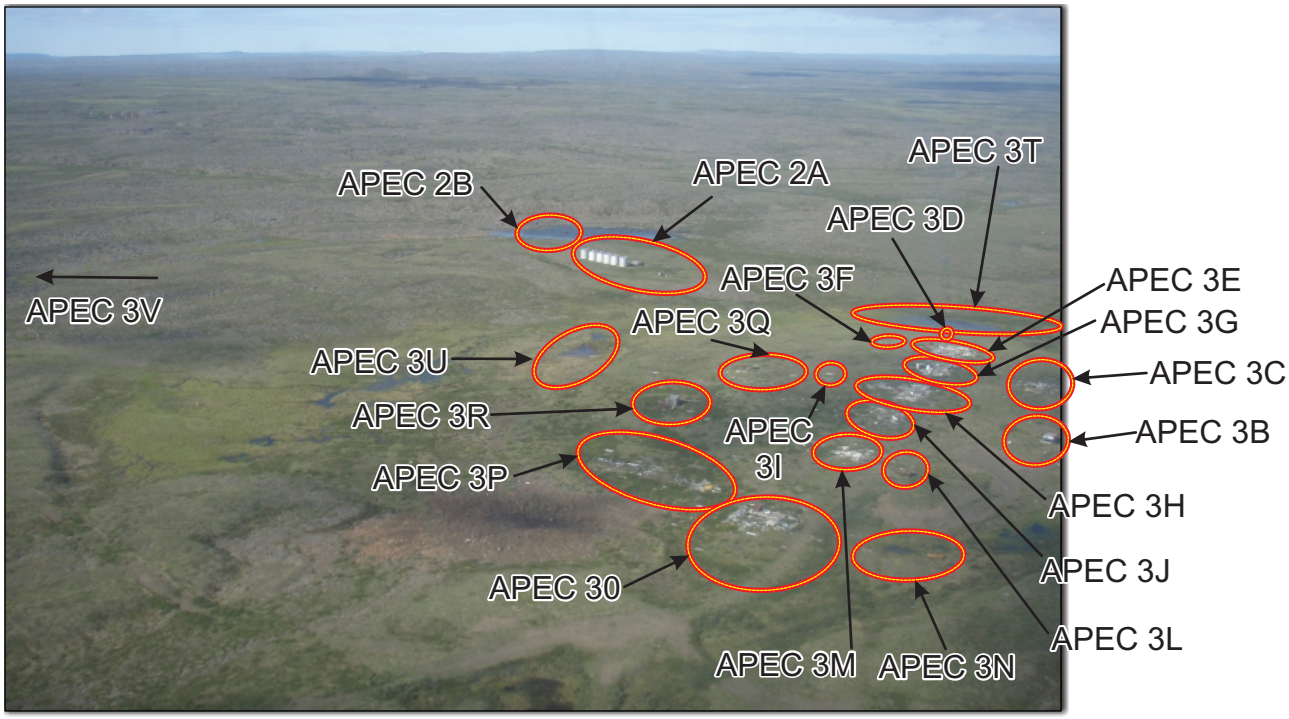


Photo 90
Hope Lake WK027: aerial view of trail between airstrip and APEC 5



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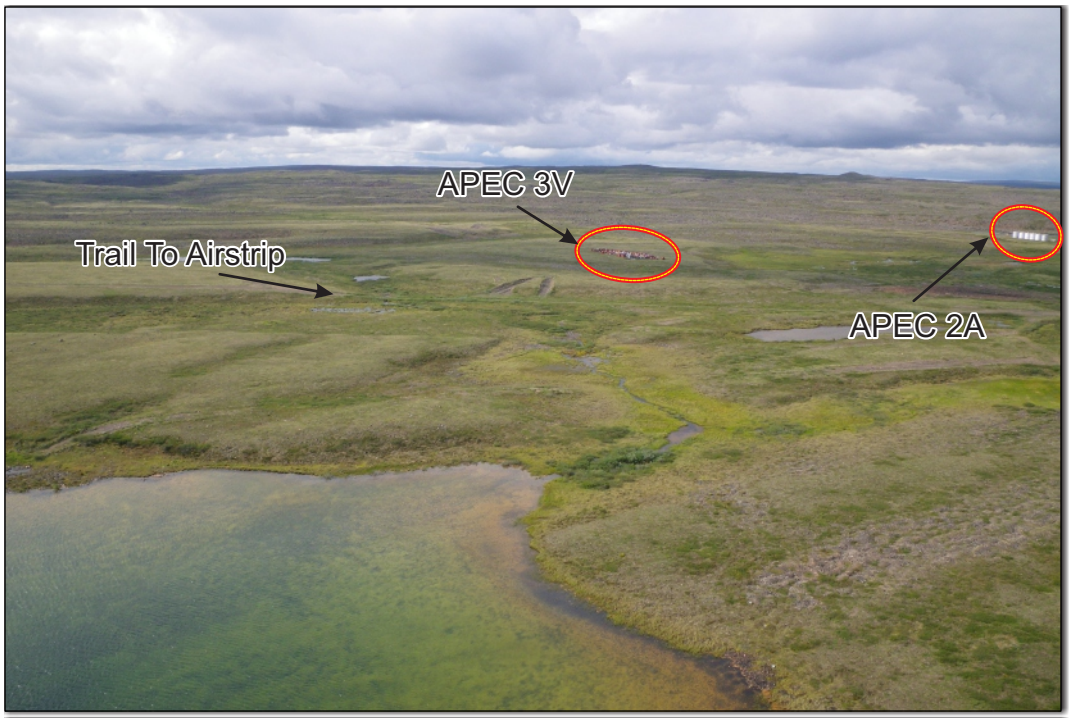

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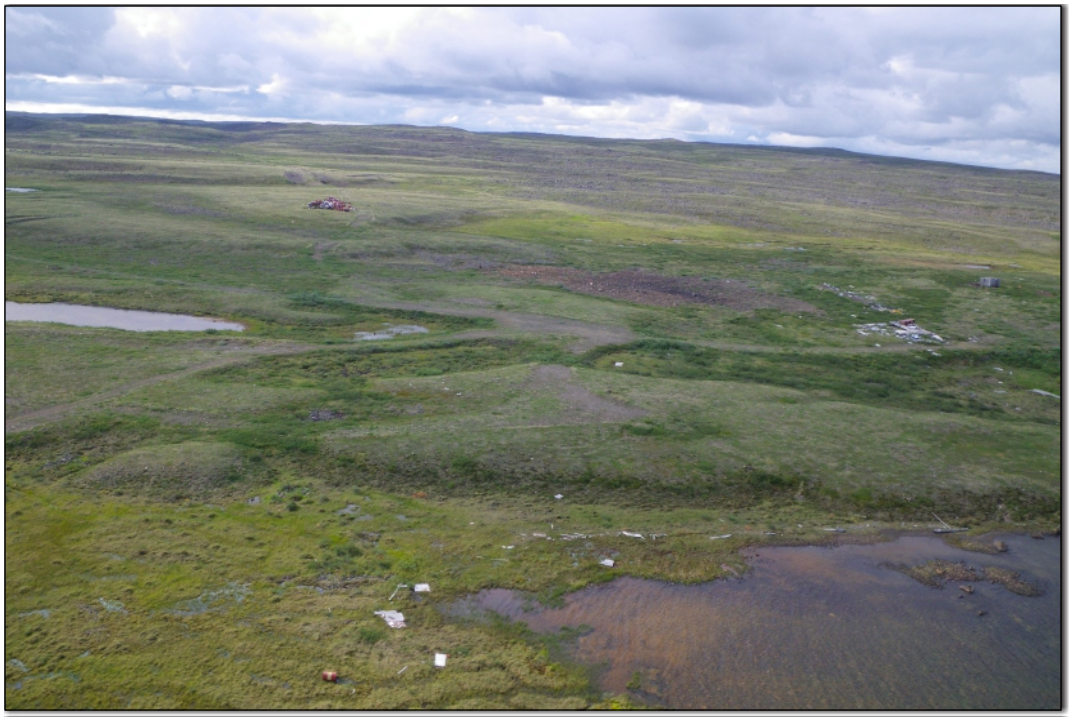

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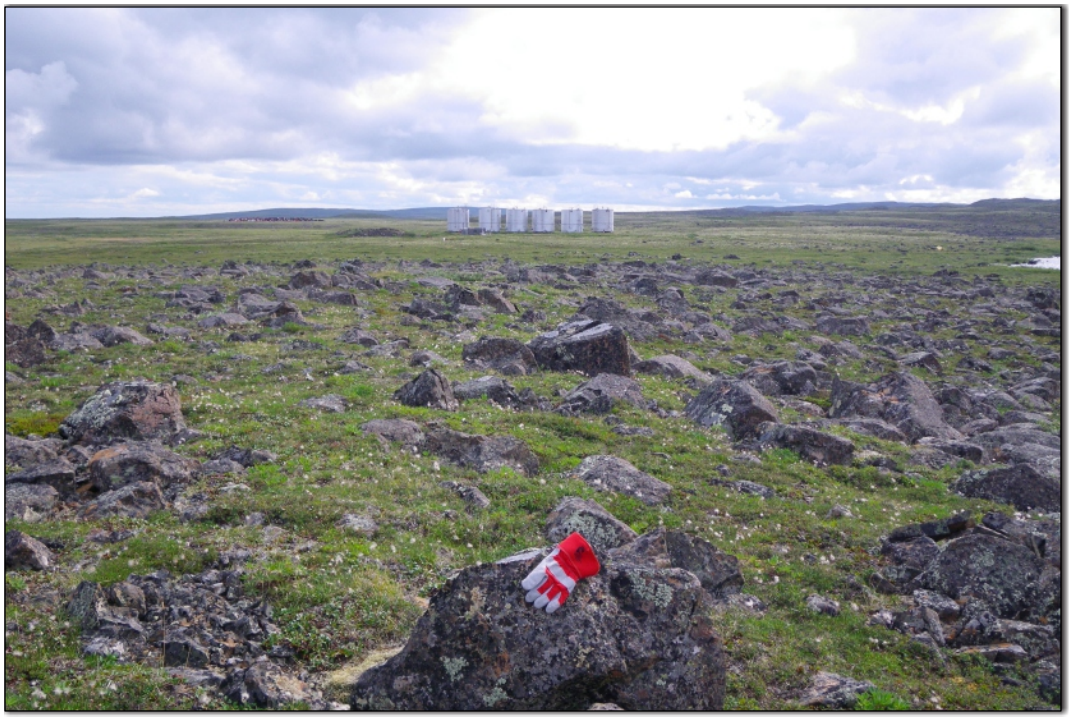

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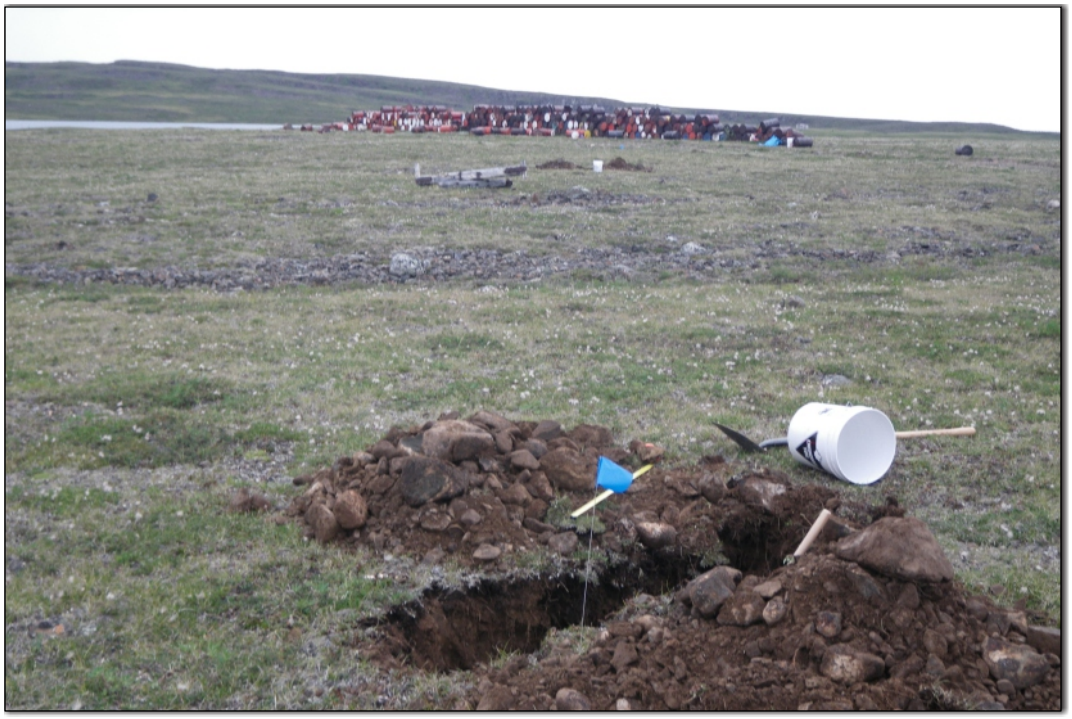

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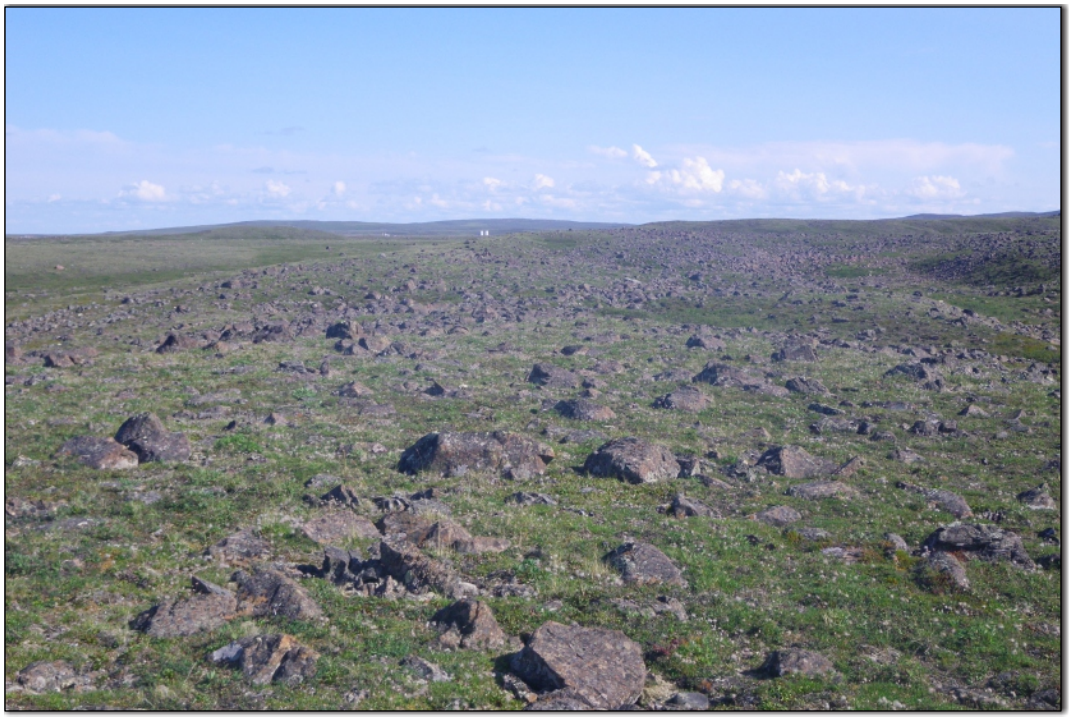

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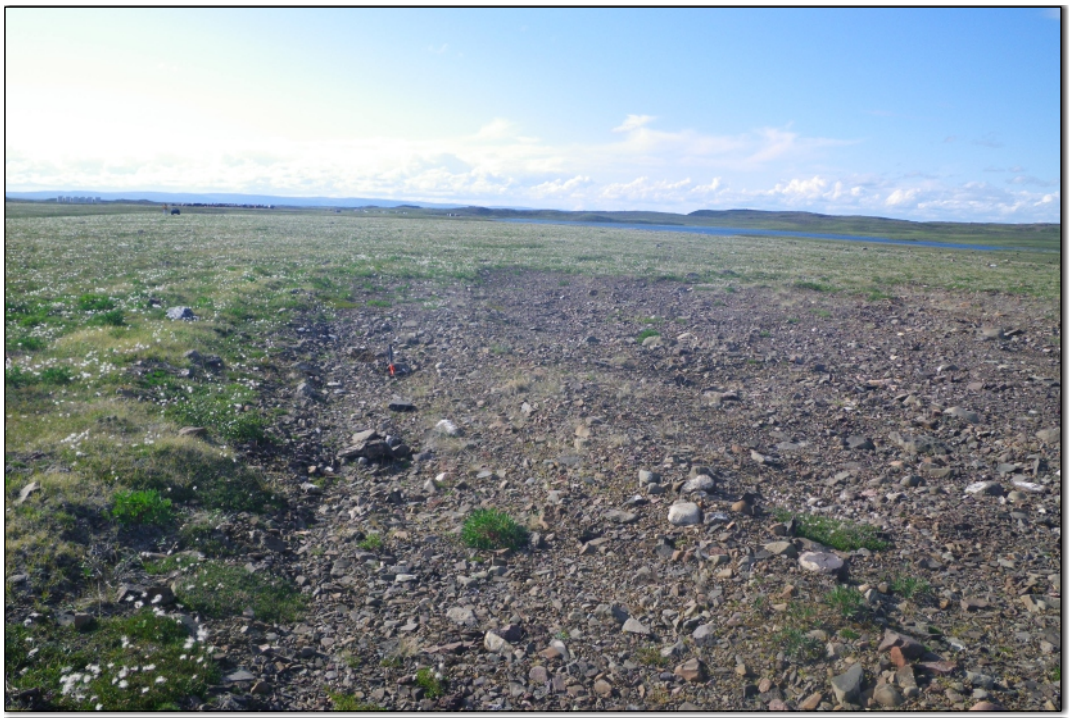

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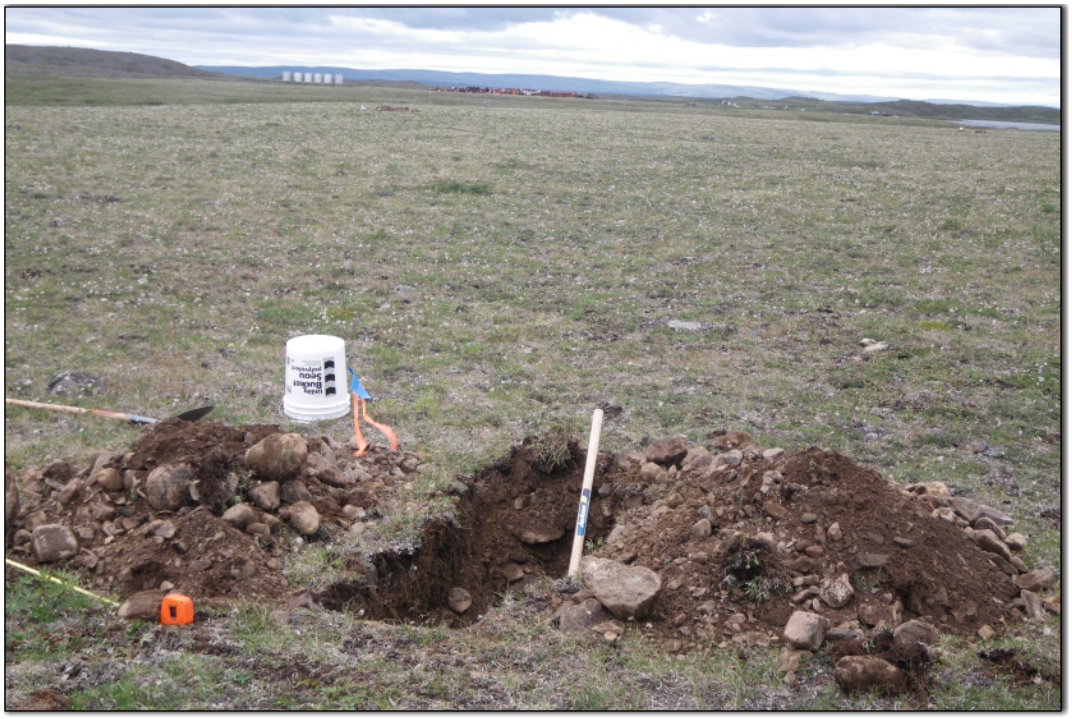

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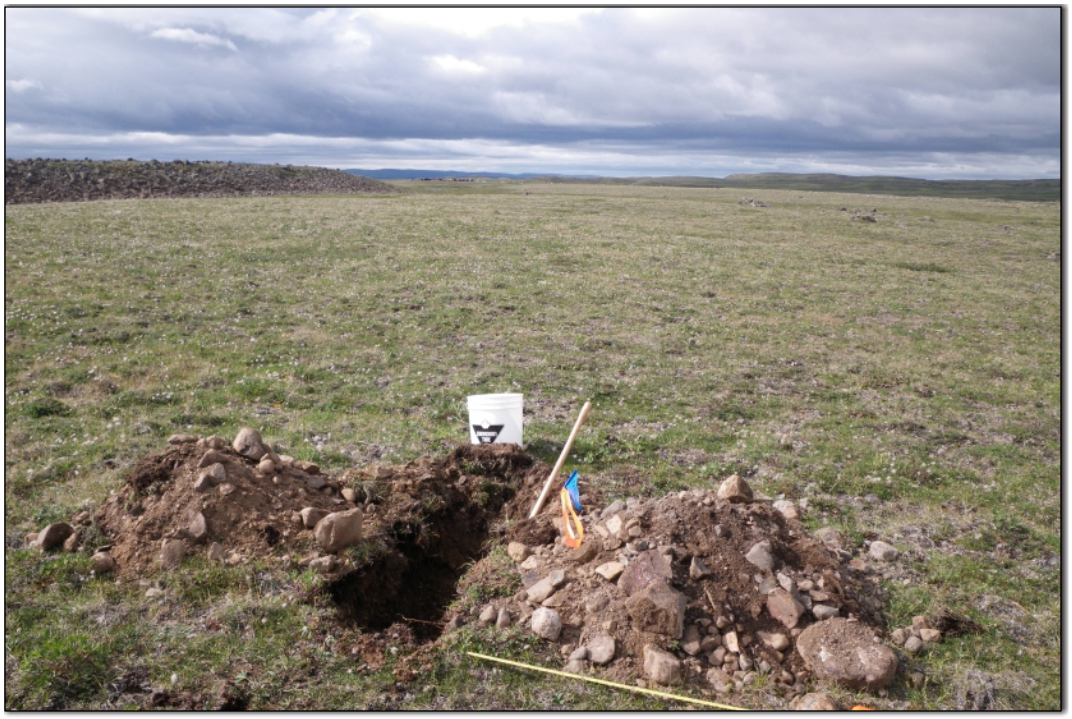

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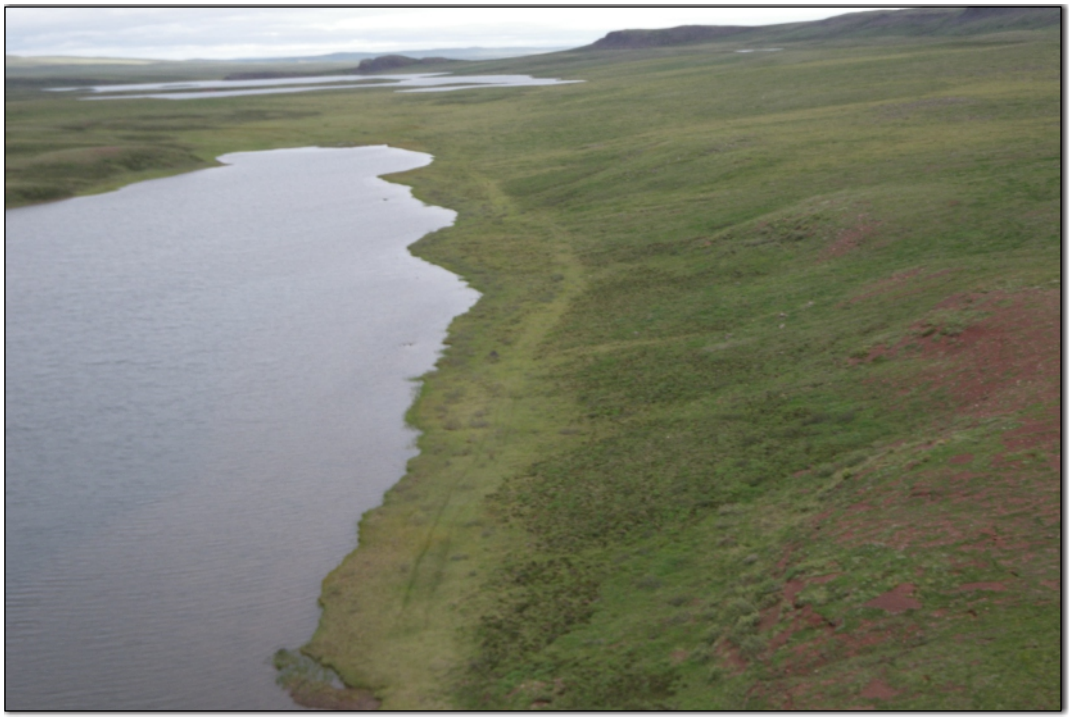

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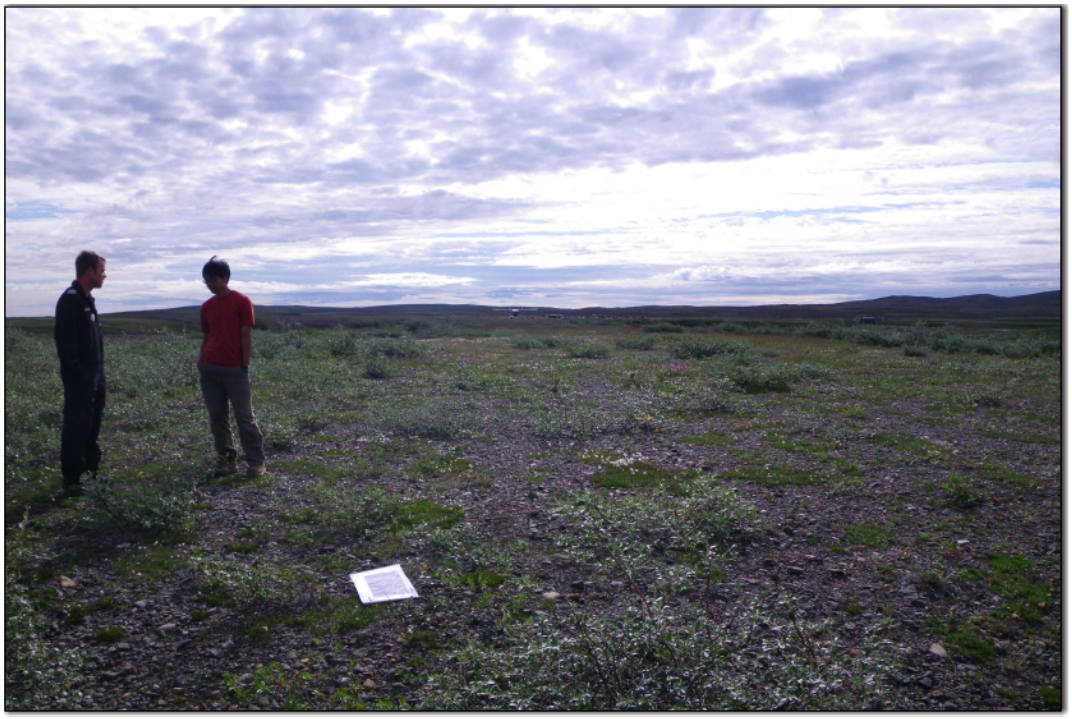

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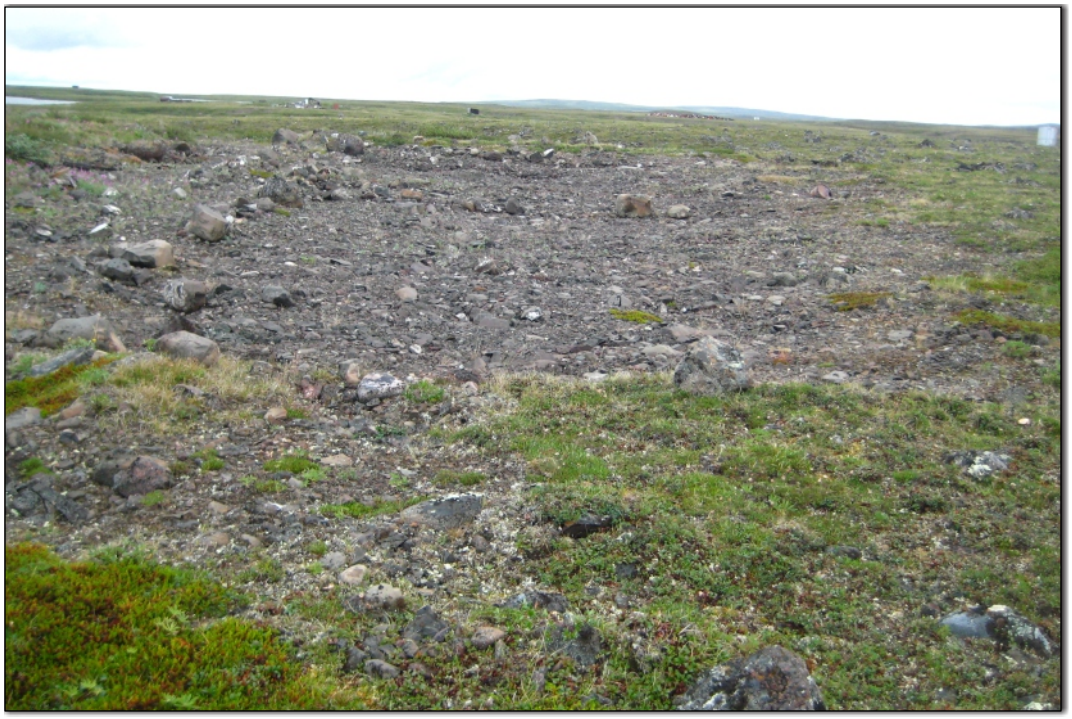

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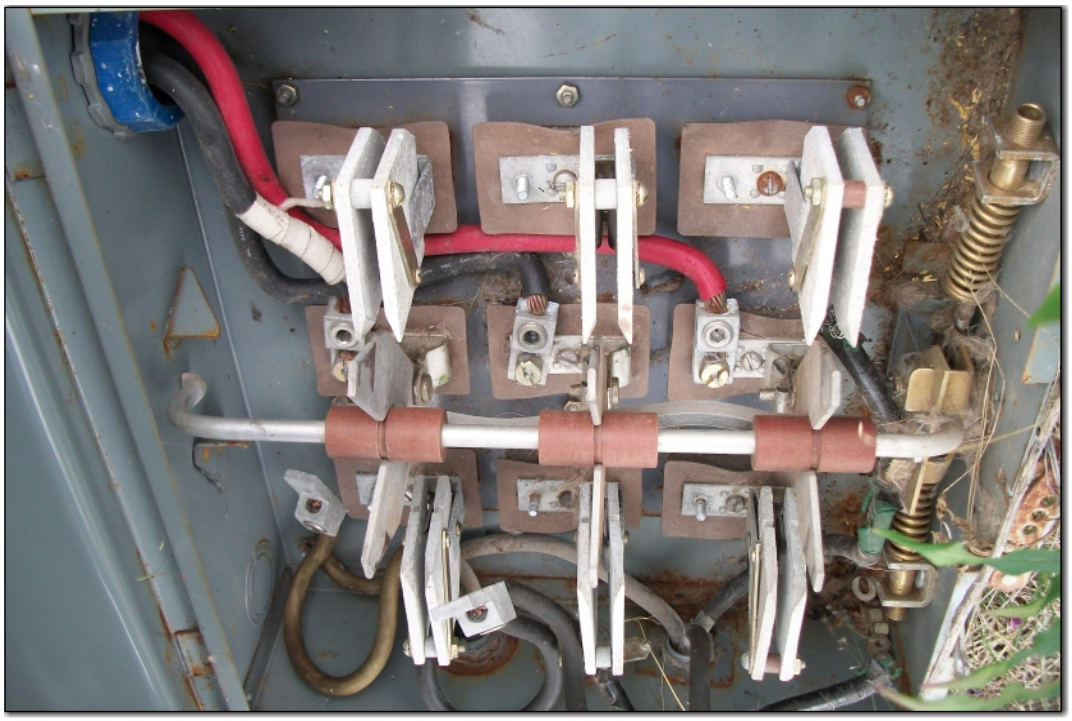

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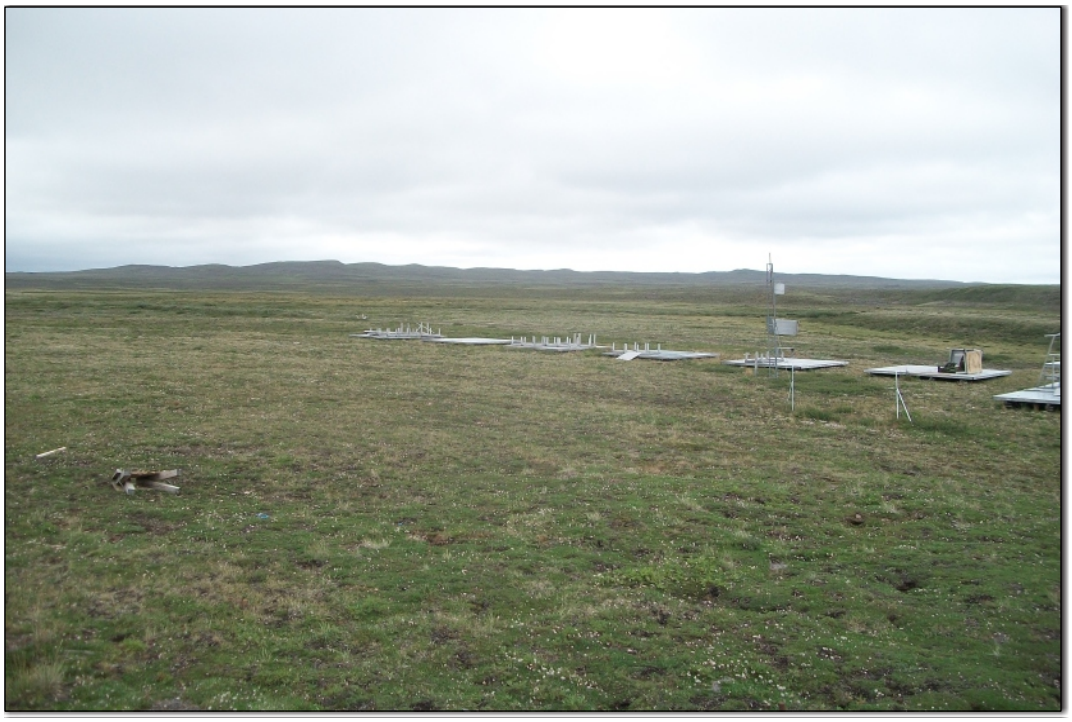

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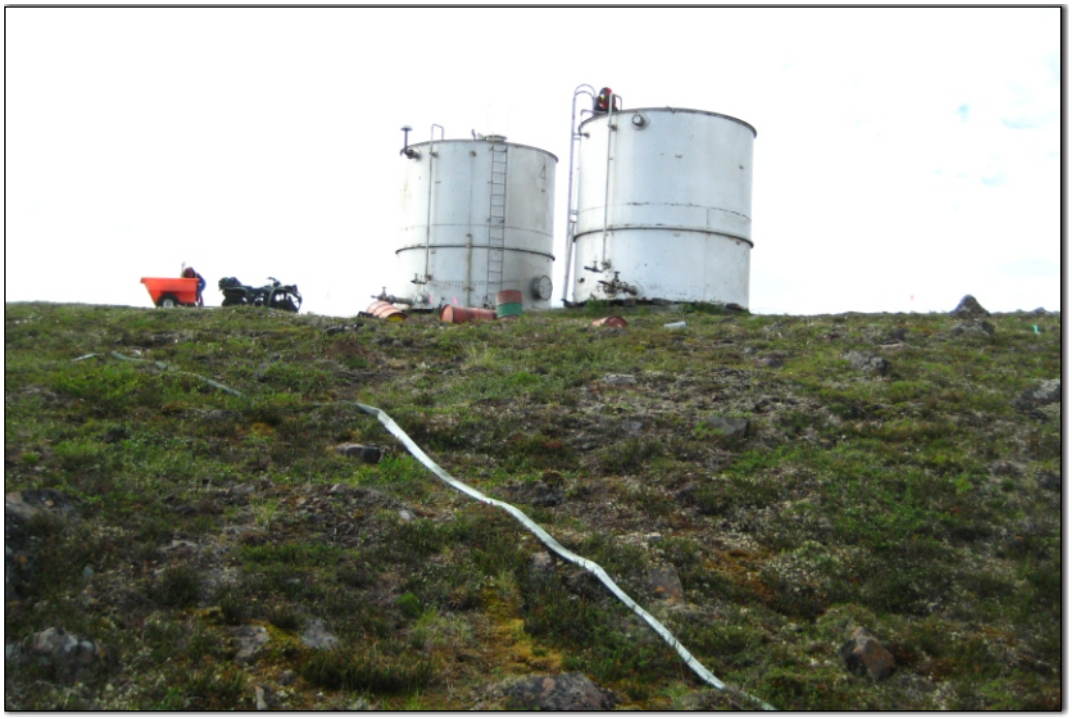

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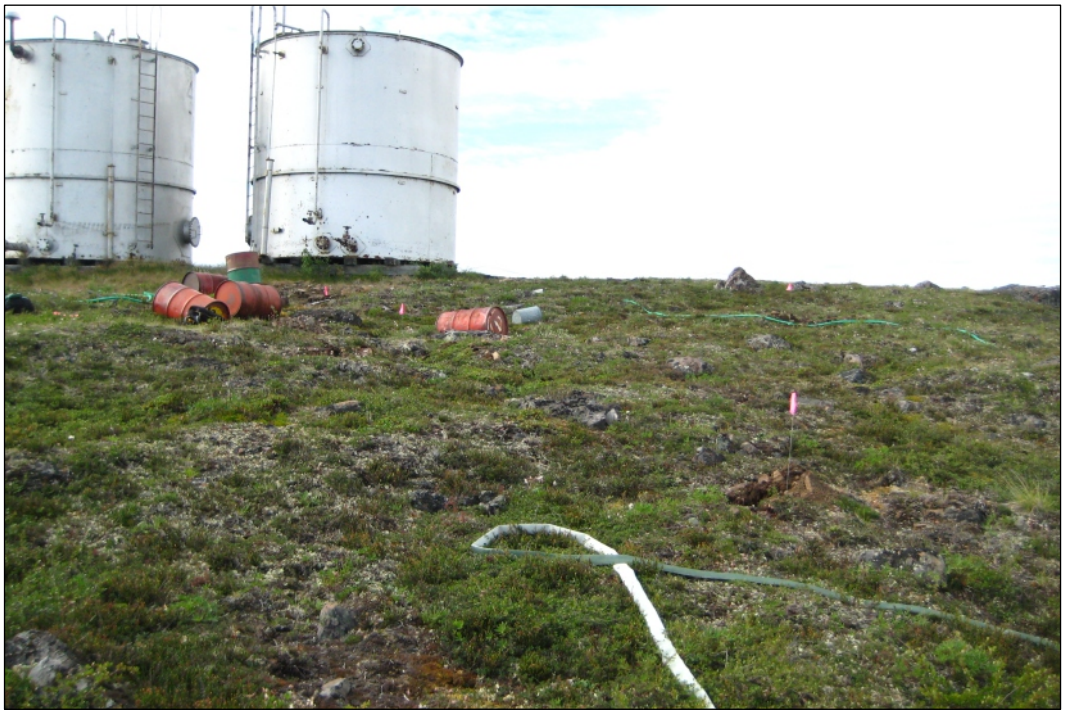

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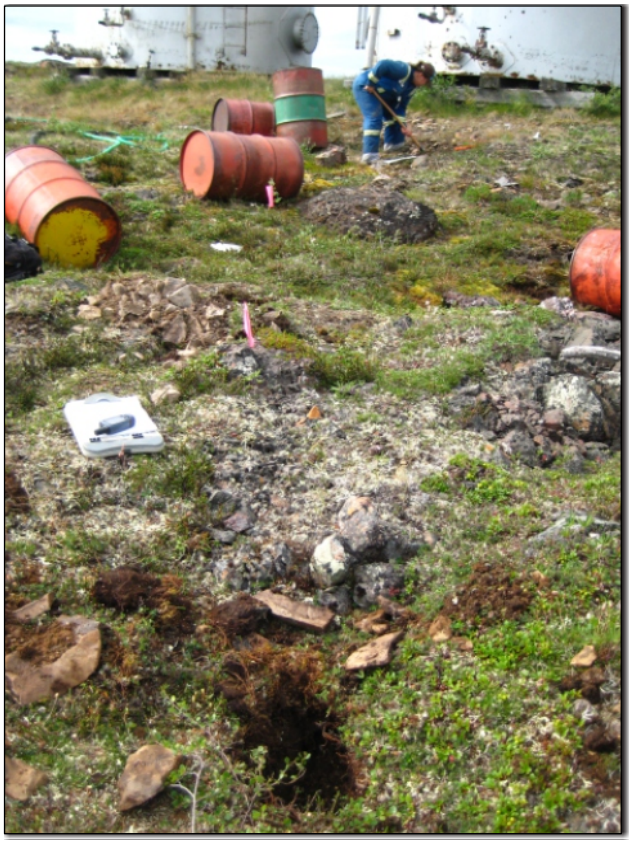

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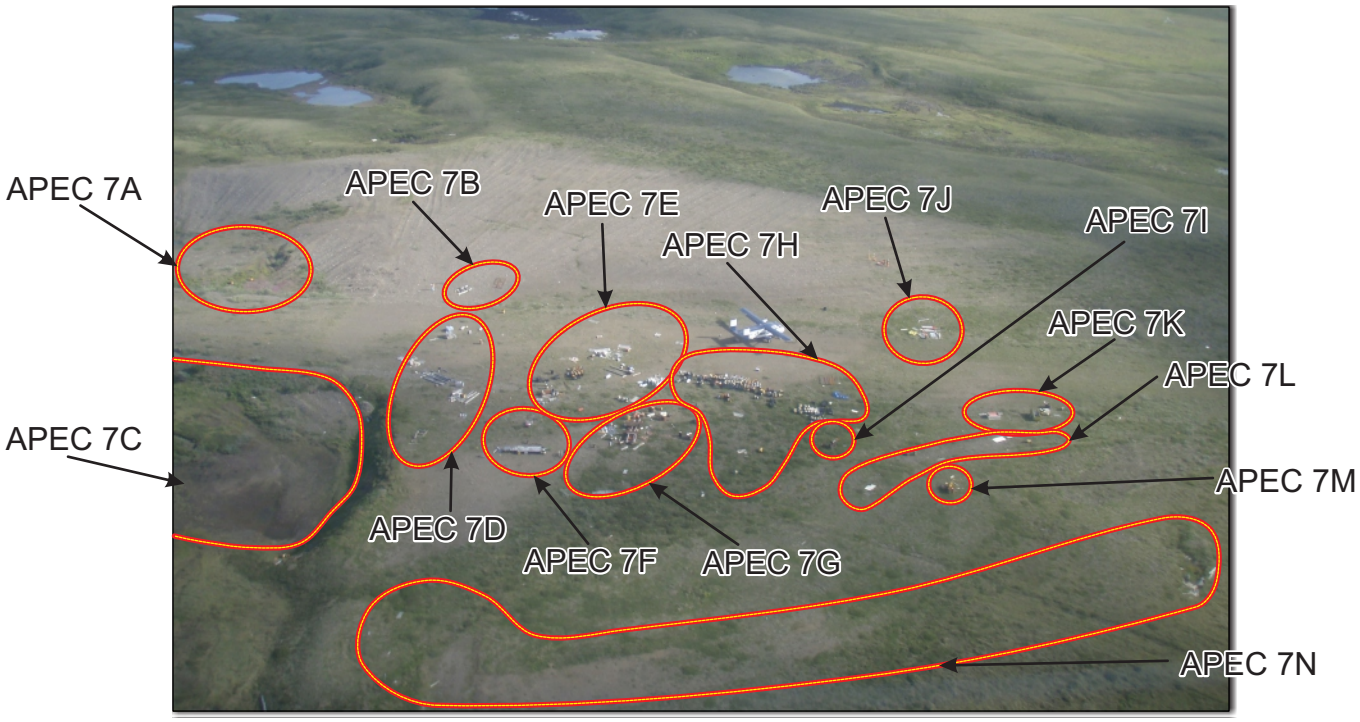

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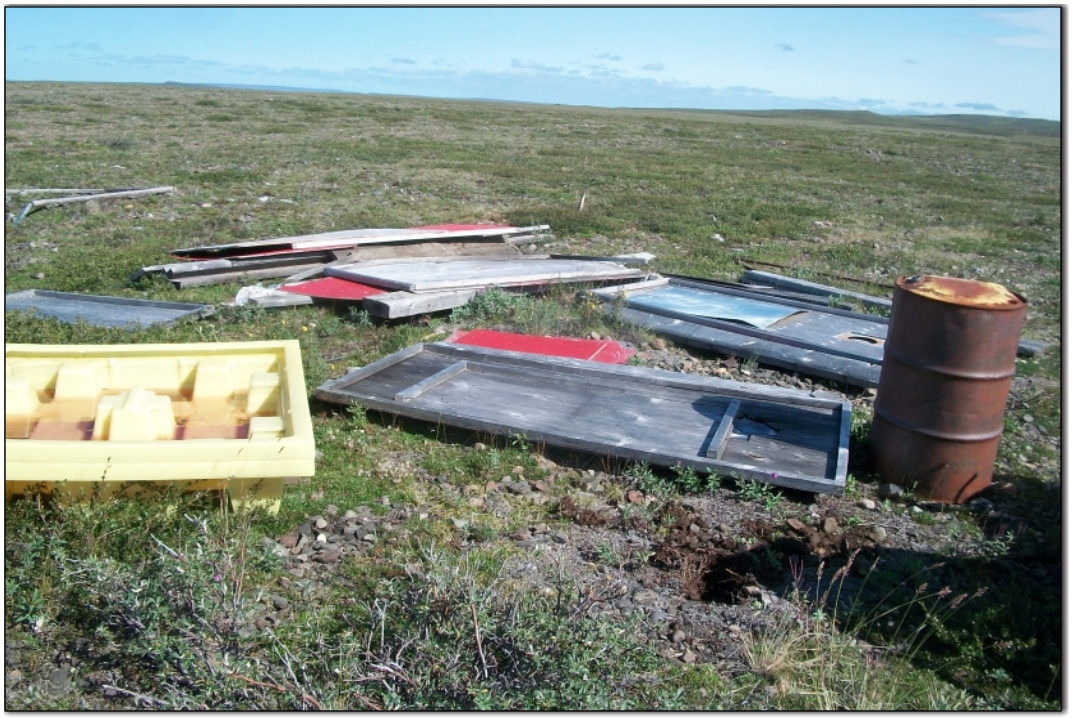

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APPENDIX C

APPENDIX C SITE-SPECIFIC PHC REMEDIATION CRITERIA

Public Works and Government Services Canada

ISSUED FOR USE

DEVELOPMENT OF SITE-SPECIFIC REMEDIATION CRITERIA FOR HYDROCARBONS FOR HOPE LAKE, NUNAVUT

SOLICITATION NUMBER: EW699-110498/001/NCS
PWGSC PROJECT NUMBER: R.040717.012
SUPPLY ARRANGEMENT NUMBER: EW699-100053/003/NCS

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EBA Engineering Consultants Ltd. (EBA) was retained by Public Works and Government Services Canada (PWGSC) to conduct Phase III Environmental Site Assessments (ESAs) at Hope Lake, Willow Creek, and Husky Creek sites in Nunavut (NU), and develop a Remedial Action Plan (RAP) to reclaim the three abandoned exploration camp sites.

As per the terms of the reference, during the ESA stage the environmental criteria for petroleum hydrocarbon (PHC) impacted soil was based on the generic criteria in *Canada-wide Standard for Petroleum Hydrocarbons in Soil* (CCME, 2008). However, as part of the RAP, the development of site-specific PHC remediation criteria (SSRC) to protect the human and ecological health was considered under the specific site conditions and to reduce the environmental footprint of remediation.

1.2 OBJECTIVES

The objectives of the development of SPRC include:

- Review of Phase III ESAs, characterize and quantify major PHC impacts at the site;
- Review of the available guidelines and other site-specific criteria documents;
- Develop site-specific criteria under applicable pathways; and
- Re-evaluate identified PHC impacted area under site-specific criteria, and, if necessary, modify the remediation strategies.

2.0 OVERVIEW OF THE SITE

2.1 SITE DESCRIPTIONS

As described in the Phase III ESA report (EBA, 2010), there were three sites that were assessed for hydrocarbon contamination: Hope Lake, Willow Creek, and Husky Creek. Each site is described below.

Hope Lake (WK027) is 75 km southwest of Kugluktuk and was a mining exploration site with intentions to become an operating mine in 1968. It consists of three separate exploration sites (Coppermine River Ltd. (CRL) Camp, Hearne Camp and New Camp) with numerous metal and building debris, an unmaintained airstrip, trail network, several drum caches, eight petrol, oil and lubricant (POL) tanks, three fuel tanks, 21 horizontal tanks and several drum caches. There are both full and empty fuel drums. The site covers 1,500 hectares. A southern exploration area, south of the main Hope Lake site is currently under a mineral lease but is not part of this investigation as it is situated on Inuit-owned lands.

Willow Creek consists collectively of three small sites, the main site, south cabins site and a southwest cabins site, and is located approximately 65 km south of Kugluktuk. The sites were used for landing float planes. The main site (WK172) is spread out over 16 hectares and consists of seven drum caches, four collapsed structures, one intact structure, two burn pits, seven main debris areas as well as scattered debris. The south cabins site (WKB01) consists of two debris areas, one collapsed and one dilapidated structure, and two drum caches over an area of 0.45 hectares. The southwest cabins site (WKB02) consists of one debris area, one collapsed structure, one drum cache and one float plane dock.

Husky Creek (WK197) is located about 55 km south of Kugluktuk and consists of a south site and north site with site footprints of 0.08 ha and 0.95 ha, respectively. At the south site are a floor platform, wood, a propane cylinder, metal debris, drill core boxes, an old water pump and drill, nine drums with one full, two partially full and six empty. At the north site are a bombardier muskeg vehicle, wood and metal debris, and three drums with one full, one partially full and one empty.

The three sites are currently unoccupied with no ongoing land use since previous exploration activities ceased in the 1970s. The Kugluktuk Hunters and Trappers Organization (HTO) own and manage a cabin at the Hope Lake site, which is used by local hunters. Newer barrels of fuel were observed at the Hope Lake airstrip indicating the airstrip may have been recently used as a fuel cache site. Other than this, the only other known uses of the site have been during the 1960s and 1970s as exploration camps. There are no nearby adjacent land uses, but historically, there has been exploration conducted on surrounding land.

2.2 PHC IMPACTED AREAS AT HOPE LAKE, WILLOW CREEK, AND HUSKY CREEK

Between August 5 and 12, 2008, WESA conducted an integrated Phase I and II ESA field program at the Hope Lake, Willow Creek, and Husky Creek sites. In total, WESA collected 58 soil samples, five surface water samples, and seven sediment samples for hydrocarbon analysis from Hope Lake, nine soil samples, four surface water samples, and three sediment samples for hydrocarbon analysis from Willow Creek, and four soil samples for hydrocarbon analysis from Husky Creek. Between July 27 and August 2, 2010, EBA conducted a Phase III ESA at the Hope Lake, Willow Creek, and Husky Creek sites. In total, EBA collected 73 soil samples, two surface water samples, one groundwater sample, and three sediment samples for hydrocarbon analysis from Hope Lake, four soil samples, two surface water samples, and one sediment sample for hydrocarbon analysis from Willow Creek, and six soil samples for hydrocarbon analysis from Husky Creek. The areas with soil exceeding the applicable CCME criteria were summarized in the table below:

TABLE 1: SUMMARY OF PHC CONTAMINATED SOIL AT HOPE LAKE AND HUSKY

APEC	Description	Contaminant of Concern	Volume of Type A Soil (1)	Volume of Type B Soil (2)
Hope Lake				
1A	Debris Area	PHC: F3 and F4	4 m^3	-
2A	Six POL Tanks	PHC: F2 and F3	-	900 m^3
2B	Debris Area	PHC: F3	0.3 m^3	-
3A	Drum Cache and Dock	PHC: F2	-	2.7 m^3
3B	Two Tanks	PHC: F2 and F3	-	0.5 m^3
3C	Tank and Structure	PHC: F3	2 m^3	-
3J	Structure and Tanks	PHC: F2 to F4	12.5 m^3	-
3K	Drum	PHC: F2 and F3	-	2 m^3
3L	Tank	PHC: F2 and F3	-	2 m^3
4D	Tanks	PHC: F1 to F3	-	600 m^3
6A	Two POL Tanks	PHC: F1 to F3	-	210 m^3
7E	Drum Cache, Debris Area, and Tanks	PHC: F3	0.5 m^3	-
7G	Drum Cache	PHC: F2 and F3	-	2 m^3
7I	Old Drill	PHC: F2 to F4	-	-
22	Drum Cache	PHC: F2	-	16.8 m^3
Husky Creek				
7	Drums	PHC: F1 to F3	-	6 m^3
		Total contaminated soil	**19.8 m^3**	**1,742 m^3**

Note:

1. Type A Soil: Sum of PHC F3 and F4 contaminated soil, representing lubricant oil impacted soil. Soil with exceedance of only F3 or PHC F2 to F4 was also considered as Type A soil.
2. Type B Soil: Sum of PHC F1 to F3 contaminated soil, representing gasoline/diesel/jet fuel impacted soil.
3. Soils are coarse grained at both Hope Lake and Husky Creek.
4. There was not hydrocarbon contaminated soil identified at Willow Creek.

As shown in Table 1, approximately 1,700 m^3 (93%) of the hydrocarbon impacted soil is within APEC 2A, 4D, and 6, where the bulk fuel storage tanks are located. Therefore, the SSRC were developed focusing on these three areas.

It was noted that during the Phase II ESA sampling program, the soil samples were collected directly from the hydrocarbon stained areas; and the analytical results may not represent the true average hydrocarbon concentration in the impacted area. The 95% of upper confidence levels (UCL) is calculated as the representative hydrocarbon concentrations in the specific APEC; these numbers are used as the target during the development of SPRC. However, it is noted that most samples collected during the

Phase II ESA was taken directly from the hydrocarbon stains, and may not represent the true contamination level in the impacted area. The following tables summarize the 95% UCL in APEC 2A, 4D and 6:

TABLE 2: SAMPLE INFORMATION AND CONTAMINANT CHARATERISTICS

	APEC 2A			APEC 4D			APEC 6		
	PHC F1	PHC F2	PHC F3	PHC F1	PHC F2	PHC F3	PHC F1	PHC F2	PHC F3
Analyzed Population	13	18	18	19	23	23	13	13	13
Detectable Population (1)	4	10	12	7	12	12	5	6	11
Detection Limits (mg/kg)	10	20 to 100	20 to 100	10	20 to 100	20 to 100	10	20-100	20-100
Harmonic Mean (mg/kg)	162	3,455	1,315	339	5,090	3,253	1,000	5,823	648
Median (mg/kg)	110	2,750	731	174	1,190	807	950	4,750	110
Maximum Concentration (mg/kg)	410	9,700	6,700	1,300	20,000	16,000	2,400	15,000	5,300
95% UCL (3) (mg/kg)	332 (4)	5,608	2,417	680 (4)	8,964	6,216	1,780 (4)	10,123 (4)	1,566

Note:

1. Only detectable values were used in mean and 95 % UCL calculations.
2. *Canada-wide Standard for Petroleum Hydrocarbons in Soil* (CCME, 2008), agricultural land use, coarse grained material, and eco-contact pathways.
3. UCL – upper confidence limit.
4. Population is not sufficient (n<10) to calculate 95% UCL.

2.3 HUMAN ACCESS

The site is situated at a relatively remote location; and no road was present between the site and the closest community, Kugluktuk. The access to the site was via helicopter or airplane. The airstrip at the site is in relatively good condition, and was used during the 2010 Phase III ESA field program. The Hope Lake can be accessed by float plane; however, no functional dock was present.

A trail system exists throughout the Hope Lake site linking infrastructure on-site; however, this is primarily a quad trail. Kugluktuk residents indicated that local hunters used a winter trail to access to the Hope Lake site. During the summer 2010 field program, no all season trail was observed from the air indicating summer access to the site is limited.

2.4 ECOLOGICAL CONDITIONS

The project is located in the southern Arctic ecozone (Ecological Stratification Working Group [ESWG] 1996) that encounters long cold winters and short cool summers with the mean annual temperature ranging from -11°C to -7°C. Average summer temperatures range from 4°C to 6°C while average winter temperatures -28°C to -17.5°C. The cool summers have a short growing season but are enhanced by long periods of daylight that average 750 growing degree-days with annual precipitation ranging from 200 to 500 mm. The prevailing northwest winds are strongest in fall and winter and most of the precipitation occurs as rain during the summer, peaking in July and August (Nunavut Planning Commission [NPC] 2005). Within the southern Arctic ecozone all sites are located in the Coronation Hills ecoregion (ESWG 1996). This ecoregion is located in a cooler and dryer portion (classified as a low arctic ecoclimate) of the southern Arctic ecozone as the mean annual temperature is -11°C with a summer mean of 5°C and a winter mean of -26°C. Precipitation ranges from 200 to 300 mm per year.

The southern Arctic ecozone is a transition from the boreal forest plant communities in the south and the Arctic tundra plant communities in the north. The upland overstory is characterized by dwarf shrubs. Typical species of dwarf shrubs include dwarf birch (*Betula nana* and *Betula glandulosa*), willow (*Salix spp.*), Labrador tea (*Rhododendron groenlandicum*) and heather species (*Ericaceae* family). The upland understory includes a wide variety of grasses, herbs, mosses, and lichens. Low lying wet areas are dominated by avens (*Dryas spp.*), sedges (*Carex spp.*), and mosses. Large rivers, such as the Coppermine and Thelon, can support stunted tree species such as white spruce (*Picea glauca*).

A wide variety of wildlife species can be expected to be encountered in the vicinity of the proposed project. Wildlife in the area includes, but is not limited to, the following species: shrews (*Sorex spp.*), grizzly bears (*Ursus arctos*), lemming (*Dicrostonyx spp.*), snowshoe hare (*Lepus americanus*), weasels (*Mustela spp.*), wolves (*Canis lupus*), lynx (*Lynx canadensis*), arctic fox (*Alopex lagopus*), wolverine (*Gulo gulo*), moose (*Alces alces*), caribou (*Rangifer tarandus*), ptarmigan (*Lagopus spp.*), arctic loon (*Gavia arctica*), tundra swan (*Cygnus columbianus*), semi-palmated plover (*Charadrius semipalmatus*), northern pintail (*Anas acuta*), green-winged teal (*Anas crecca*), red-necked phalarope (*Phalaropus lobatus*), short-eared owl (*Asio falmmeus*), ringed seals (*Pusa hispida*), bearded seals (*Erignathus barbatus*), beluga whales (*Delphinapterus leucas*), and polar bears (*Ursus maritimus*). Of these species, the grizzly bear and short-eared owl are listed as species of 'Special Concern' according to the Committee on the Status of Endangered Wildlife in Canada (accessed 2010).

3.0 REVIEW OF REFERENCE DOCUMENTS

3.1 GUIDELINE DOCUMENTS

The *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* (PEHH) (CCME, 2007) provided generic guideline values for benzene, toluene, ethylbenzene, and xylene. The *Canada-Wide Standard (CWS) for Petroleum Hydrocarbons in Soil* (CCME, 2008) provided generic guideline values for PHCs fractions F1 through F4. The soil analytical results for hydrocarbons are compared to the PEHH and CWS guidelines.

The guideline values in the *Nunavut Environmental Guideline for Contaminated Site Remediation* (Government of Nunavut 2009) were adapted directly from the generic CCME PEHH and CWS. This document was reviewed, but was not included in the discussion of this report.

As discussed in the Phase III ESA report (EBA, 2010), the applied criteria from the CCME guidelines were based on agricultural land use, coarse soil grain size, and surface soil. The generic pathway based criteria under the aforementioned criteria are summarized in the following table:

TABLE 3: PATHWAY-SPECIFIC TIER 1 LEVEL FOR PHC IN COARSE-GRAINED SURFACE SOIL (1)

Exposure Pathway		F1 (C6-C10)	F2 (>C10-C16)	F3 (>C16-C34)	F4 (>C34)
Human Health	Direct Contact (ingestion + Dermal Contact)	12,000	6,800	15,000	21,000
	Vapour Inhalation (indoor, basement) (2)	40	190	N/A	N/A
	Vapour Inhalation (indoor, slab-on-grade) (2)	30	150	N/A	N/A
	Protection of Portable GW	240	320	N/A	N/A
Ecological Environment	Protection of GW for Aquatic Life	970	380	N/A	N/A
	Protection of GW for Livestock/Wildlife Watering	5,300	14,000	N/A	N/A
	Eco Soil Contact (3)	210	150	300	2,800
Management Limit (4)		700	1,000	2,500	10,000

Note:

1. Modified from agricultural land use category in Table 2 of CCME CWS for PHC in Soil (CCME, 2008).
2. Vapour inhalation and portable groundwater pathways (grey highlighted) were excluded in the Phase III ESA (also see Section 5.0).
3. Eco soil contact pathway (underline and bold) was used in the Phase III ESA.
4. Includes additional considerations such as free phase formation, explosive hazards, and buried infrastructure effects.

With the exclusion of vapour inhalation and portable groundwater pathways, the guideline values under the eco soil contact pathway is the most stringent criteria and was used in the Phase III ESA report (EBA, 2010).

The *CWS for PHC in Soil: Scientific Rationale – Supporting Technical Document* (CCME, 2008) detailed the assumptions, deviation equations, and input baseline parameters for developing the CCME guideline values. The SPRC was derived based the information, where applicable, provided in this document.

3.2 INAC ABANDONED MILITARY SITE REMEDIATION PROTOCOL (2008)

The Chapter 4 – Protocol for Evaluation of Hydrocarbon Impacted Areas in the *Abandoned Military Site Remediation Protocol (AMSRP), Volume II – Technical Supporting Documentation (INAC, 2008)* was prepared by EBA, and is intended to provide modified hydrocarbon remediation criteria for the DEW Lines sites in the arctic region. As the Hope Lake site is located in the similar human and ecological environment as the DEW Lines sites, the criteria developed in this document and the modified baseline parameters are incorporated in the development of the SPRC, and are detailed in Section 4.0.

The PHC remediation targets in the AMSRP were summarized in the table below:

TABLE 4: INAC ABANDONED MILITARY SITES REMEDIAL OBJECTIVES FOR PHC IMPACTED SOIL (1)

Exposure Pathway	F1	F2	F3	F4	Type B Hydrocarbon Contamination (2)	Type A Hydrocarbon Concentration (2)
Protection of Freshwater Aquatic Life	1,290 (3)	330	N/A	N/A	330	NA
Direct Soil Eco-Contact	Not utilized					
Protection of Terrestrial Wildlife	N/A	N/A	N/A	N/A	2,500(4)	N/A
Human Health	N/A	11,000	20,000	N/A	N/A	20,000
Management Limit	N/A	N/A	N/A	N/A	5,000(5)	N/A

Notes:
1. Modified from Table 14 in Abandoned Military Site Remediation Protocol – Volume II, Chapter 4 (INAC, 2008).
2. Type A Soil: Sum of PHC F3 and F4; Type B Soil: Sum of PHC F1 to F3.
3. Within 30 m of a water body.
4. For surface soils to 0.5 m depth.
5. Below 0.5 m depth, a value of 5,000 mg/kg may be applied based on professional judgment.

3.3 OTHER SITE-SPECIFIC REMEDIATION CRITERIA DOCUMENTS

During the development of the current SPRC, EBA also reviewed other relevant documents including:

- Development of Cleanup Criteria for Petroleum Hydrocarbons for Silver Bear, Contact Lake and El Bonanz and Sawmill Bay sites (SENES, 2008).
- Site-Specific Risk Assessment, Ruth Mine-SM282, Northwest Territories (Franz, 2009).

The methodologies and interpretations in these two documents were also incorporated into the current SPRC.

4.0 SITE-SPECIFIC CRITERIA FOR HUMAN HEALTH

As indicated in Table 3, the human health pathways under the CCME CWS guidelines included the generic guideline values for direct human contact (dermal contact and ingestion), vapour inhalation, and protection of portable groundwater. The produce, meat, and milk ingestion pathway was not included.

4.1 DIRECT HUMAN CONTACT PATHWAYS

The PHC criteria in the CCME CWS guidelines are shown in Table 3. The 95% UCLs of PHC F2 in APECs 4D and 6 (8,964 mg/kg and 10,123 mg/kg, shown in Table 2) exceed the generic guideline value of 6,800 mg/kg. However, during the winter season, when the local hunters travel to the site via winter trail access, the ground is covered by snow, and the active layer is frozen to the ground level. Given this, the potential human exposure to the PHC impacted areas is minimal in the winter. As indicated in Section 2.3, the summer access to the site by local hunters are limited due to the lack of all season access. During the future remediation project at the site, the workers will be required to wear adequate personal protection equipment when working in the hydrocarbon impacted area. The potential human exposure to the PHC impacted areas is minimal in the summer. The direct human contact pathway was therefore not considered during the development of SPRC.

4.2 VAPOUR INHALATION PATHWAYS

As discussed in the Phase III ESA report, no existing buildings or planned buildings are within 30 m of APEC 2A, 4D, or 6. In addition, infrastructure constructed in permafrost areas are typically built on piles above the ground to prevent the heat transfer to the permafrost. The pathways of vapour inhalation through building foundation are not applicable to the site.

4.3 PROTECTION OF PORTABLE GROUNDWATER

No portable groundwater wells were found at the Hope Lake site. In addition, the site is located in a continuous permafrost zone, no shallow portable groundwater source is likely to present at the site. The protection of portable groundwater pathway is not applicable to the site.

5.0 SITE-SPECIFIC CRITERIA FOR ECOLOGICAL ENVIRONMENT

Due to the uniqueness of the ecological community and landscape of the arctic, the CCME guidelines are not always applicable; therefore, site specific criteria is commonly used to develop target levels tailored for the surrounding landscape. There has been work completed in the north to determine site specific criteria (INAC 2008, SENES 2008, Franz 2009) that can be used as a guide for the Hope Lake site.

As indicated in Table 3, the ecological environment pathways under the CCME CWS guidelines included the generic guideline values for direct eco contact, protection of groundwater for aquatic life, and protection of groundwater for livestock/wildlife watering. The pathways of nutrient cycling and eco soil ingestion were not included.

Below is a discussion on the applicable pathways at Hope Lake and how

5.1 DIRECT SOIL ECO CONTACT

The direct eco soil contact pathway includes two groups of organisms: soil invertebrates and vegetation. The direct eco soil contact pathway is the most stringent of CCME guideline pathways for hydrocarbons, and therefore is the most complete exposure pathway likely associated with the highest degree of potential risk, logically directing the development of site specific criteria.

Soil Invertebrates

The 2008 CCME guideline was derived using data from earthworms as the target species for eco-toxicity tests to develop the target levels for soil eco contact. Earthworms are not a suitable species to use for site specific criteria at the Hope Lake site because their distribution is limited to southern Canada. Populations of earthworms have only been found at a few northern outposts, including Inuvik, NT. However, these populations are believed to have been introduced anthropogenically in gardens. Therefore, it is assumed that earthworms are not a native species in northern climates and as such are not the most logical target species if developing northern site specific criteria. Native soil invertebrates common to northern climates include collembolan (springtails), mites, dipteran larvae, enchytraeids, and nematodes (EBA, 2008). Collembolan and nematodes have similar life cycles and diets to earthworms, and are more representative of terrestrial invertebrate species likely present at Hope Lake and at northern sites. Due to the lack of literature on comparative earthworm and nematode soil eco-toxicity tests, data on springtails was reviewed to determine their sensitivity to hydrocarbons compared to earthworms. Literature on hydrocarbon eco-toxicity tests on earthworms and springtails has shown that springtails are similarly or more sensitive than earthworms to hydrocarbons (Eom *et. al.* and Lors *et al.*). For this reason, calculating new target levels for collembolan would likely not increase the acceptable levels of hydrocarbons to use as criteria for direct soil contact.

From the Phase III ESA (EBA, 2010), it can be determined that the levels of hydrocarbon contamination at Hope Lake would likely killed the terrestrial invertebrate community present at the time of contamination or the invertebrate community would have avoided the

areas of contamination and found more suitable habitat. Eco-toxicity tests have shown that earthworm survival in sandy soils with weathered hydrocarbon contamination is less than 13% when TPH exceeds 7,433 mg/kg and is 0% when TPH exceeds 44,465 mg/kg (CCME, 2008). Therefore, protection of the terrestrial invertebrate community exposed to the soil eco contact pathway is no longer achievable for APECs where TPH exceeds these levels. It can be assumed that most soil invertebrates will survive in or will be able to avoid APECs with TPH levels lower than 7,433 mg/kg.

Another factor that should be considered for the Hope Lake site, is weathering of the hydrocarbon contamination. The CCME guideline was developed for 'fresh' contaminants, which refers to the state at which the contaminant is in at the time of the original release. Weathering of contaminants is not considered in the CCME guidelines because it can be variable and is dependant on the conditions of the receiving environment. Some studies have shown that weathered hydrocarbon contaminated soils are less toxic to soil invertebrates (Salanitro *et al.*, 1997). This is important for the Hope Lake site because the active layer for soil invertebrates in the arctic is approximately 10 cm (pers. comm. R.Ring); which is also the depth at which most weathering will occur. Topsoil in the arctic is subjected to the heat of the sun in summer (24 hours of daylight) and strong winds; both factors contribute to weathering of hydrocarbons, particularly lighter end hydrocarbons (F1 and F2), which are the most toxic. The hydrocarbons at Hope Lake are primarily F2 and F3 fractions. It can be assumed that over time, due to weathering, most of the site (with the exception of the source areas) will decrease in toxicity.

Vegetation

The terrestrial vegetation community are also key receptors that CCME requires be assessed for when exposure is complete for the eco soil contact pathway. Vegetation manifests exposure to hydrocarbon contamination by either; phytotoxicity - which harms the vegetation directly, or by hyper-accumulation of hydrocarbons in plant tissues- which may harm the plant (growth or survival inhibition) or be harmful to grazing wildlife. Contaminants are considered to be phytotoxic to a plant when a plant is caused harm in the form of necrosis, chlorosis, or signification change to physical or biochemical properties by at least 5% (as compared to a control) (Ontario Ministry of Energy and Environment, 1993). Hyper-accumulation in plants can lead to bioaccumulation within the food chain for higher dwelling trophic species.

Upon visual survey during the Phase III ESA, the health of the plants growing in the hydrocarbon contaminated soil was not impaired, except at the point source of some APECs. Changes in vegetation community and poor vegetation health were noted at the point source of a few APECs. Most notable was the amount of exposed soil, the lack of crytogramic crusts and plant diversity in areas with high soil hydrocarbon contamination. This would indicate that this receptor group is being adversely impacted due to PHC exposure through the soil eco contact pathway. In order to mitigate for these effects, it is

recommended that these point source areas be removed in areas showing vegetation distress.

5.2 ECO SOIL CONTACT INGESTION - WILDLIFE

In addition to soil invertebrates and vegetation, wildlife needs to be considered as part of the eco soil contact pathway. The CCME guideline does not calculate the eco soil contact ingestion pathway due to the variability between target species. However, it is recommended that site specific management consider the pathway and develop a target level for the site. This is done during a risk assessment which is beyond the scope of this project. We reviewed existing literature to determine what information exists and if there was a study that could be used to determine a SSRC for wildlife.

Wildlife comes in contact with soil by foraging vegetation and invertebrates off of the ground. Foraging off of the ground causes these wildlife species to indirectly ingest soil. Common northern species that come in contact with soil by ingestion include lemmings, voles, rock ptarmigan, arctic hare, arctic fox, hawks, and falcons (EBA, 2008).

At the Hope Lake site, rock ptarmigan were determined to be the most sensitive species to hydrocarbon contamination, and therefore research using the rock ptarmigan was reviewed. Rock ptarmigan are the most sensitive species because ecological risk assessments have shown avian species to be of particular concern when evaluating hydrocarbon contamination, rock ptarmigan have a small home range compared to other avian species (24 ha for rock ptarmigan versus 100 ha for snowy owl) (EBA, 2008), and rock ptarmigan have a higher potential total daily intake (TDI) of hydrocarbons than other avian species found in the area.

Site-specific target levels for protection of wildlife were developed for two INAC DEW Line sites using rock ptarmigan (EBA, 2008). The target levels developed for these sites were 2,500 mg/kg for TPH (F1 to F3) at a depth of 0.5 m. These levels are very conservative, considering the Alberta Environment 2007 guideline sets a target limit of 8,400 to 11,000 mg/kg TPH for the protection of wildlife. While the DEW Line sites are further north than Hope Lake, the terrain and wildlife is similar and the hydrocarbon source is the same. Utilizing this guideline number is consistent with other work that has been completed in the area.

To protect sensitive receptors, it is recommended that the site specific target levels for rock ptarmigan (2,500 mg/kg for TPH to a depth of 0.5 m) be used for the protection of wildlife at the Hope Lake site. Where TPH exceeds this target level, it's recommended that the contaminated soil be removed to a depth of 0.5 m and the area re-graded.

5.3 PROTECTION OF GROUNDWATER FOR AQUATIC LIFE

As shown in Tables 2 and 3, the 95% UCLs of PHC F1 and F2 in APECs 2A, 4D, and 6 exceed the generic guideline values under the protection of groundwater for aquatic life pathway. Water bodies are present within 100 m of all of three APECs. As indicated in

AMSRP (INAC, 2008), this pathway is typically not the limiting pathway. However, in the case that other more stringent pathways, such as direct eco contact, are eliminated, the protection of groundwater for aquatic life may be left as governing pathway. The development of SSRC for this pathway is warranted in these situations.

The processes and input parameters for recalculating the SSRC for the protection of groundwater for aquatic life pathway were based on those described in CCME (2008a) and INAC (2008b). The general steps were as follows:

- To establish the water quality benchmarks for protection of aquatic life;
- To reconstruct the appropriate contaminant transport model based on the site-specific hydrogeological conditions; and
- To establish the contaminant concentration in soil based on the allowable contaminant concentration in groundwater at the source area.

As a conservative approach, the water quality benchmarks were based on the values used in the deviation of the CCME soil quality guidelines for the protection of groundwater for aquatic life (See Appendix A). The criteria were developed based on potential chronic adverse effects using the Critical Body Residue approach. The contaminant transport model and the calculation of soil quality criteria are shown in Appendix A.

As described in INAC (2008b), input parameters, including soil organic fractions, Henry's law constants, and decay constants, were adjusted based on the arctic environment. The distances to the water bodies and hydraulic gradients were adjusted based on the site specific conditions in each APEC. Based on the soil concentrations and the distance to the closest water body, the SPRC for this pathway is greater than the maximum concentrations, thus this pathway is eliminated for APEC 2A. For APEC 4, if the point source concentrations are removed the value the soil falls within the 95% UCL.

5.4 PROTECTION OF GROUNDWATER FOR LIVESTOCK/WILDLIFE WATERING

As shown in Tables 2 and 3, the 95% UCLs of PHC F1 and F2 in APECs 2A, 4D, and 6 are all below the generic guideline values under the protection of groundwater for livestock/wildlife. No SSRC is required under this pathway.

6.0 APPLICATION OF SITE SPECIFIC-BASED CRITERIA

6.1 DIRECT ECO SOIL CONTACT

There was little research that supported using a higher criteria number at Hope Lake. Site specific criteria would have to be developed for Hope Lake and that is beyond the scope of this project. Despite this, EBA recommends that the contaminated areas, with the exception of the point source areas, be left in-situ to naturally attenuate for the following reasons:

- The soil profile and permafrost at the site very sensitive and could take hundreds of years to restore. It can be argued that it would take longer for soil invertebrate habitat to be restored at the local level if the contaminated areas are removed, rather than leaving the contaminants to naturally attenuate. If soil was treated on-site, the disturbance footprint would be high with development of a land farm and borrow sources.
- At the time of release, the contaminants exceeded the level where mortality to soil invertebrates could be avoided. Therefore, any organisms that were at the source at the time of release were either killed or have already avoided the area.
- Due to weathering, the toxicity of the contaminants will be reduced over time and soil invertebrates will be able to inhabitat in the surface soils again.
- The potential for the contaminants to migrate horizontally and contaminate more soil in the top 10 cm is very low as this material is weathered and there is no ongoing, contributing source of hydrocarbon.

6.2 ECO SOIL CONTACT INGESTION – WILDLIFE

Site specific remediation criteria from other studies using rock ptarmigan as the target species were reviewed for the eco soil contact ingestion pathway. Based on existing studies, the target level determined for the Hope Lake site is 2,500 mg/kg TPH (F1 to F3) at 0.5 m depth. It is recommended that any areas that exceed this target level be removed from site in order to protect wildlife.

6.3 PROTECTION OF GROUNDWATER FOR AQUATIC LIFE

The SSRC of each PHC fraction for each site are calculated in Appendix A, and summarized Table 5.

- The calculated SSRCs of PHC F1 and F2 in soil and groundwater for APEC 2A are greater than the maximum possible concentrations. Therefore, the pathway for protection of aquatic life is eliminated.
- The calculated SPRCs of PHC F1 and F2 in soil for APEC 4D are less than the 95% UCL for PHC F2.

However, it was noted that the samples collected during the Phase II ESA were directly obtained at the point source areas. If the Phase II ESA sample locations were excluded in Table 2 (i.e., the soil at the stained area is removed during the site remediation), the 95% of UCL of the remaining samples for PHC F2 is 1,215 mg/kg, less than the SSRCs of 1,250 mg/kg.

- Since the analytical results of the Phase III ESA showed hydrocarbons has already migrated to the toe of the slope to the waterbodies, no SPRCs were calculated for APEC 6.

Please see Table 5 attached.

7.0 RECOMMENDATION

We recommend setting a criteria limit of 2,500 mg/kg for TPH as a remediation target. All soil above this level should be removed. This is not protective of eco-soil contact, but as explained in Section 6.1, the ecological impact of removing is soil is great. This concentration is protective of wildlife in the area as well as protection of ground water for fresh water aquatics.

8.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

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TABLE

TABLE 5: REMEDIAL TARGETS - HYDROCARBON CONTAMINATED SOIL												
APECs	2A				4D				6			
PHC Fraction	F1	F2	F3	Type B	F1	F2	F3	Type B	F1	F2	F3	Type B
95% UCL	332	5,608	2,417	7,163	680	8,964	6,216	13,589	1,780	10,123	1,566	8,049
Pathways												
Direct Eco Soil Contact	**210**	**150**	**300**	N/A	**210**	**150**	**300**	N/A	**210**	**150**	**300**	N/A
Eco Soil Ingestion	N/A	N/A	N/A	**2,500**	N/A	N/A	N/A	**2,500**	N/A	N/A	N/A	**2,500**
Protection of Groundwater for Aquatic Life	>1 million	>1 million	N/A	N/A	6,260	**1,140**	N/A	N/A	N/A	N/A	N/A	N/A
Protection of Groundwater for Livestock/Wildlife Watering	5,300	14,000	N/A	N/A	5,300	14,000	N/A	N/A	5,300	14,000	N/A	N/A

Note:
1. Remedial targets less than the 95% UCLs were bold and underlined, and explained in Section 6.0.

APPENDIX C1

APPENDIX C1 GROUNDWATER FOR AQUATIC LIFE PATHWAY CALCULATIONS

Equations (CCME, 2008a)

$$SPRC_{Fraction} = \sum \frac{1}{\frac{MF_{Sub-Fraction}}{SPRC_{Sub-Fraction}}}$$ **Equation 1**

$SPRC_{Fraction}$ Site-specific Remediation Criteria for each PHC fraction

$MF_{Sub-Fraction}$ Mass fraction of each PHC sub-fraction

$SPRC_{Sub-Fraction}$ Site-specific Remediation Criteria for each PHC sub-fraction

$$SPRC_{Sub-Fraction} = C_w \times DF1 \times DF2 \times DF3 \times DF4$$ **Equation 2**

C_w Surface water quality benchmark (mg/L)

DF1 Dilution Factor 1 – Three-phase equilibrium partitioning model, as follows

$$DF1 = K_d + \frac{n_W + H' \cdot n_A}{\rho_B}$$ **Equation 3**

DF2 Dilution Factor 2 – Leachate and pore water concentration equilibrium, assume to be 1 (INAC, 2008).

DF3 Dilution Factor 3 – Pore water and groundwater concentration equilibrium, assume to be 1 (INAC, 2008).

DF4 Dilution Factor 4 – Two-dimensional groundwater transport model, as follows

$$DF4 = \frac{2}{\exp\left\{\left(\frac{x}{2\partial_x}\right)\left[1-\left(1+\frac{4L_s\partial_x}{v}\right)^{1/2}\right]\right\}\left\{erf\left[\frac{y+Y/2}{2(\partial_y x)^{1/2}}\right]-erf\left[\frac{y-Y/2}{2(\partial_y x)^{1/2}}\right]\right\}}$$ **Equation 4**

∂_x Logitudinal Dispersivity $\partial_x = 0.1x$ **Equation 5**

∂_y Lateral Dispersivity $\partial_y = 0.1\partial_x$ **Equation 6**

ρ_B Soil Bulk Density (kg/m^3)

d Depth of Groundwater (m)

f_{oc} Organic Carbon Fraction

H' Henry's Law Constant

i Hydraulic Gradient

K_d Distribution coefficient (mL/g), as $K_d = K_{oc} \cdot f_{oc}$ **Equation 7**

K_{oc} Organic Carbon Partition Coefficient (unitless)

K_H Saturated Hydraulic Conductivity (m/yr)

L_s Decay Constant (yr^{-1}), as $L_s = \frac{10.6931}{t_{1/2}}\left(e^{-0.07d}\right)$ **Equation 8**

n Total Porosity

n_W Water Filled Porosit

n_A Air Filled Porosity

R_f Retardation Factor, as $R_f = 1 + \frac{\rho_b}{n} K_d$ **Equation 9**

$t_{1/2}$ Biodegradation Half-life (yr)

v_d Darcy Velocity (m/yr), as $v_d = K_H\, i$ **Equation 10**

v Velocity of contaminant (m/yr), as $v = \frac{v_d}{nR_f}$ **Equation 11**

x Distance to surface water (m)

y Cartesian coordiantes (m)

Y Source Width (m)

Modified SPRC for Soil at APEC 2A:

PHC Fractions	Unit	Modified Value	
F1 [2,4]	mg/kg	50,326,000	50,326,000
F2 [2,4]	mg/kg	1,229,000	1,229,000

General Input Parameters

Parameters	Units	Input Values INAC Sites
Y - Source Width [1]	m	40
d - Depth of Groundwater [1]	m	2
x - Distance to surface water [1]	m	80
ρ_B - Soil Bulk Density [2]	kg/m^3	1700
n - Total Porosity [2]	-	0.36
n_W - Water Filled Porosity [2]	-	0.119
n_A - Air Filled Porosity [2]	-	0.241
K_H - Saturated Hydraulic Conductivity [1]	m/y	320
i - Hydraulic Gradient [1]	-	0.025
f_{oc} - Organic Carbon Fraction [3]	g/g	0.0045
∂x - Logitudinal Dispersivity [2,4]	m	8
∂y - Lateral Dispersivity [2,4]	m	0.8
v_d - Darcy Velocity [2,4]	m/year	2.67

PHC Sub-fraction Input Parameters

Parameters	Units	Aliphatics				Aromatics		
		F1		F2		F1	F2	
		C>6-C8	C>8-C10	C>10-C12	C>12-C16	C>8-C10	C>10-C12	C<12-C16
H' - Modified Henry's Law Constant [3]	-	13.1	15.7	18.3	66.5	0.0939	0.0213	0.00678
K_{oc} - Organic Carbon Partition Coefficient [2]	mL/g	3,980	31,600	251,000	5,010,000	1,580	2,510	5,010
K_d - Distribution coeffieicnet [4]	mL/g	17.91	142.2	1,130	22,545	7.11	11.295	22.545
$t_{1/2}$ - Modified Biodegradation Half-life [3]	years	5.85	5.85	14.4	14.4	5.85	14.4	14.4
L_s - Decay Constant [4]	y-1	0.103	0.103	0.042	0.042	0.103	0.042	0.042
R_f - Retardation Factor [4]	n/a	85.6	672.5	5334.8	106463.5	34.6	54.3	107.5
v - Velocity of contaminant [4]	m/y	0.09	0.01	0.00	0.00	0.21	0.14	0.07
C_w - Water Quality Benchmark [2]	mg/L	0.0465	0.0076	0.00118	0.000074	0.14	0.096	0.0554
MF - Mass Fraction [2]	-	0.55	0.36	0.36	0.44	0.09	0.09	0.11

Back Calculations

Dilution Factors	Unit	Aliphatics				Aromatics		
		F1		F2		F1	F2	
		C>6-C8	C>8-C10	C>10-C12	C>12-C16	C>8-C10	C>10-C12	C<12-C16
DF1 [3,4]	L/kg	19.84	144.50	1132.16	22554.50	7.19	11.37	22.62
DF2 [3]	-	1	1	1	1	1	1	1
DF3 [3]	-	1	1	1	1	1	1	1
DF4 [3,4]	-	2.74E+11	3.08E+35	2.14E+65	1.29E+299	4.50E+06	1.02E+05	4.76E+07
SPRC for Sub-fraction [2,4]	mg/kg	2.53E+11	3.39E+35	2.86E+65	2.16E+299	4.53E+06	1.11E+05	5.96E+07

Note:

1. Site-specific value
2. Value or equation obtained from CCME (2008a).
3. Value or equation obtained from INAC (2008b).
4. Calculated based on equation from CCME (2008a) or INAC (2008b).

Modified SPRC for Groundwater at APEC 2A:

PHC Fractions	Unit	Modified Value
F1 [2,4]	mg/L	6,995,000
F2 [2,4]	mg/L	108,000

General Input Parameters

Parameters	Units	Input Values INAC Sites
Y - Source Width [1]	m	40
d - Depth of Groundwater [1]	m	2
x - Distance to surface water [1]	m	80
ρ_B - Soil Bulk Density [2]	kg/m^3	1700
n - Total Porosity [2]	-	0.36
n_W - Water Filled Porosity [2]	-	0.119
n_A - Air Filled Porosity [2]	-	0.241
K_H - Saturated Hydraulic Conductivity [1]	m/y	320
i - Hydraulic Gradient [1]	-	0.025
f_{oc} - Organic Carbon Fraction [3]	g/g	0.0045
∂x - Logitudinal Dispersivity [2,4]	m	8
∂y - Lateral Dispersivity [2,4]	m	0.8
v_d - Darcy Velocity [2,4]	m/year	2.67

PHC Sub-fraction Input Parameters

Parameters	Units	Aliphatics				Aromatics		
		F1		F2		F1	F2	
		C>6-C8	C>8-C10	C>10-C12	C>12-C16	C>8-C10	C>10-C12	C<12-C16
H' - Modified Henry's Law Constant [3]	-	13.1	15.7	18.3	66.5	0.0939	0.0213	0.00678
K_{oc} - Organic Carbon Partition Coefficient [2]	mL/g	3,980	31,600	251,000	5,010,000	1,580	2,510	5,010
K_d - Distribution coeffieicnet [4]	mL/g	17.91	142.2	1,130	22,545	7.11	11.295	22.545
$t_{1/2}$ - Modified Biodegradation Half-life [3]	years	5.85	5.85	14.4	14.4	5.85	14.4	14.4
L_s - Decay Constant [4]	y-1	0.103	0.103	0.042	0.042	0.103	0.042	0.042
R_f - Retardation Factor [4]	n/a	85.6	672.5	5334.8	106463.5	34.6	54.3	107.5
v - Velocity of contaminant [4]	m/y	0.09	0.01	0.00	0.00	0.21	0.14	0.07
C_w - Water Quality Benchmark [2]	mg/L	0.0465	0.0076	0.00118	0.000074	0.14	0.096	0.0554
MF - Mass Fraction [2]	-	0.55	0.36	0.36	0.44	0.09	0.09	0.11

Back Calculations

Dilution Factors	Unit	Aliphatics				Aromatics		
		F1		F2		F1	F2	
		C>6-C8	C>8-C10	C>10-C12	C>12-C16	C>8-C10	C>10-C12	C<12-C16
DF2 [3]	-	1	1	1	1	1	1	1
DF3 [3]	-	1	1	1	1	1	1	1
DF4 [3,4]	-	2.74E+11	3.08E+35	2.14E+65	1.29E+299	4.50E+06	1.02E+05	4.76E+07
SPRC for Sub-fraction [2,4]	mg/kg	1.27E+10	2.34E+33	2.53E+62	9.56E+294	6.30E+05	9.75E+03	2.63E+06

Note:

1. Site-specific value
2. Value or equation obtained from CCME (2008a).
3. Value or equation obtained from INAC (2008b).
4. Calculated based on equation from CCME (2008a) or INAC (2008b).

Modified SPRC for Soil at APEC 4D:

PHC Fractions	Unit	Modified Value
F1 [2,4]	mg/kg	6,840
F2 [2,4]	mg/kg	1,250

General Input Parameters

Parameters	Units	Input Values INAC Sites
Y - Source Width [1]	m	17
d - Depth of Groundwater [1]	m	2
x - Distance to surface water [1]	m	50
ρ_B - Soil Bulk Density [2]	kg/m^3	1700
n - Total Porosity [2]	-	0.36
n_W - Water Filled Porosity [2]	-	0.119
n_A - Air Filled Porosity [2]	-	0.241
K_H - Saturated Hydraulic Conductivity [1]	m/y	320
i - Hydraulic Gradient [1]	-	0.060
f_{oc} - Organic Carbon Fraction [3]	g/g	0.0045
∂x - Logitudinal Dispersivity [2,4]	m	5
∂y - Lateral Dispersivity [2,4]	m	0.5
v_d - Darcy Velocity [2,4]	m/year	6.40

PHC Sub-fraction Input Parameters

Parameters	Units	Aliphatics				Aromatics		
		F1		F2		F1	F2	
		C>6-C8	C>8-C10	C>10-C12	C>12-C16	C>8-C10	C>10-C12	C<12-C16
H' - Modified Henry's Law Constant [3]	-	13.1	15.7	18.3	66.5	0.0939	0.0213	0.00678
K_{oc} - Organic Carbon Partition Coefficient [2]	mL/g	3,980	31,600	251,000	5,010,000	1,580	2,510	5,010
K_d - Distribution coeffieicnet [4]	mL/g	17.91	142.2	1,130	22,545	7.11	11.295	22.545
$t_{1/2}$ - Modified Biodegradation Half-life [3]	years	5.85	5.85	14.4	14.4	5.85	14.4	14.4
L_s - Decay Constant [4]	y-1	0.103	0.103	0.042	0.042	0.103	0.042	0.042
R_f - Retardation Factor [4]	n/a	85.6	672.5	5334.8	106463.5	34.6	54.3	107.5
v - Velocity of contaminant [4]	m/y	0.21	0.03	0.00	0.00	0.51	0.33	0.17
C_w - Water Quality Benchmark [2]	mg/L	0.0465	0.0076	0.00118	0.000074	0.14	0.096	0.0554
MF - Mass Fraction [2]	-	0.55	0.36	0.36	0.44	0.09	0.09	0.11

Back Calculations

Dilution Factors	Unit	Aliphatics				Aromatics		
		F1		F2		F1	F2	
		C>6-C8	C>8-C10	C>10-C12	C>12-C16	C>8-C10	C>10-C12	C<12-C16
DF1 [3,4]	L/kg	19.84	144.50	1132.16	22554.50	7.19	11.37	22.62
DF2 [3]	-	1	1	1	1	1	1	1
DF3 [3]	-	1	1	1	1	1	1	1
DF4 [3,4]	-	1.31E+05	1.71E+17	2.64E+32	4.82E+151	6.31E+02	1.09E+02	1.93E+03
SPRC for Sub-fraction [2,4]	mg/kg	1.21E+05	1.88E+17	3.53E+32	8.04E+151	6.36E+02	1.19E+02	2.42E+03

Note:

1. Site-specific value
2. Value or equation obtained from CCME (2008a).
3. Value or equation obtained from INAC (2008b).
4. Calculated based on equation from CCME (2008a) or INAC (2008b).