FINAL REPORT

ENVIRONMENTAL SCREENING OF THE
REMEDIATION PROGRAM FOR THE
SIMPSON LAKE FORMER
CAM-D DEW LINE SITE

PROJECT NO. 1023321

Jacques Whitford AXYS

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FINAL REPORT TO: **Public Works and Government Services Canada, Western Region**
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FOR: **Environmental Screening of the Remediation Program for the Simpson Lake Former CAM-D DEW Line Site**

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EXECUTIVE SUMMARY

Public Works and Government Services Canada (PWGSC) Environmental Services, on behalf of Indian and Northern Affairs Canada (INAC) is planning to implement a remedial action plan for the former CAM-D Intermediate Distant Early Warning (DEW) Line Site (CAM-D DEW Line site) at Simpson Lake, Nunavut. As required under the *Nunavut Land Claim Agreement* (NLCA) and the *Canadian Environmental Assessment Act* (CEAA), the activities proposed for the CAM-D DEW Line site remediation must undergo an environmental screening.

The CAM-D DEW Line Site remedial action plan will involve excavating, sorting and containerizing 371 m^3 of contaminated soil for shipment off site to a licensed disposal facility. Approximately 2,034 m^3 of hydrocarbon impacted soil will be treated on site. Hydrocarbon impacted soil below INAC criteria, but with elevated F1 and F2 fraction hydrocarbons, BTEX and/or PAHs will be remediated in-situ by aerating through excavating in place and adding amendments to accelerate the bioremediation process. Hydrocarbon impacted soils below INAC criteria, but showing elevated F3 and/or F4 fraction hydrocarbons, will preferably be used as intermediate fill for the new non-hazardous waste landfill to be constructed on site.

Approximately 18 m^3 of hazardous materials, such as lead batteries, lead and PCB-contaminated paint materials, will be dismantled and/or collected, containerized and shipped off site for disposal as per INAC protocol for disposing of hazardous materials. Asbestos will be properly abated, according to territorial and federal regulations and guidelines, and placed in sealed, properly labeled containers and disposed in the new on-site landfill. POL fluids will be incinerated.

Non-hazardous site debris will be collected and disposed in the new engineered landfill to be constructed on site. All remaining structures on the site will be demolished and debris disposed in the new landfill.

Associated activities for the project consist of establishing a work camp and upgrading some site infrastructure to facilitate the remediation activities. The airstrip and some of the existing roads will require repair and upgrading to allow equipment and vehicle movement; the road between the main station area and the airstrip and Murchison River borrow source area will require repair and upgrading. A temporary road will be constructed between the existing main dump and the new landfill site to be constructed at the main station area to facilitate transport of material from the old main dump to the new landfill. A non-hazardous waste landfill will be constructed near the main station area and a temporary waste handling facility will be established.

The CAM-D DEW Line site remediation is scheduled to occur during the summer of 2009, with equipment and supply transport to the site occurring in spring 2009 and demobilization from the site occurring in spring 2010.

The remediation activities at the CAM-D DEW Line site will interact with the environment through vehicle and machinery emissions, waste disposal, surface disturbance and employing area residents. There is also the potential for spills of fuel or hazardous materials. The activities will be carried out following standard good operating practices for northern Canada, with spill prevention practices and contingency plans in place. The environmental effects of the activities are assessed as being of low

magnitude and not significant. The activities will benefit the area through the short-term employment of local individuals and through the ultimate clean up of the site.

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1.0 INTRODUCTION

The former CAM-D Intermediate Distant Early Warning (DEW) Line Site (CAM-D DEW Line Site) at Simpson Lake, Nunavut is located on the Boothia Peninsula between Sheppard Bay and Pelly Bay, approximately 120 km southeast of Taloyoak, 100 km east of Gjoa Haven and 120 km west of Kugaaruk, Nunavut (Figure 1-1). The facility was operational between 1957 and 1963, and was abandoned after that period. The site has been subject to various stages of clean up since 1985.

Indian and Northern Affairs Canada (INAC), through its responsibility for federal lands in Canada's North, is now responsible for the site. Under the Contaminated Sites Program (CSP), INAC has made the cleanup of contaminated sites in northern Canada a priority. The CAM-D DEW Line site was classified as a high priority site, requiring an additional assessment to quantify contaminated soil volumes, and identify and assess remaining hazardous and non-hazardous materials on the site. As a result, INAC requested Public Works and Government Services Canada (PWGSC) to take action to remediate the site. A remedial action plan was prepared for the site by Earth Tech Canada Inc. (Earth Tech 2007), following a detailed site investigation in 2005.

This environmental screening assesses the potential effects associated with implementing the proposed remedial action plan for the former CAM-D DEW Line Site.

Figure 1-1: CAM-D DEW Line Site Location

Source: Earth Tech Canada Inc. 2007

2.0 REGULATORY CONTEXT

The Project is subject to requirements of several Nunavut boards and regulatory processes, as established by the Nunavut Land Claim Agreement (NLCA), as well as the *Canadian Environmental Assessment Act* (CEAA).

2.1 Permits, Licenses and Authorizations Required

The Project will involve a number of distinct undertakings and activities, requiring authorizations from a variety of federal, territorial, Inuit and resource co-management agencies. Table 2-1 provides a preliminary listing of permits, licenses, and authorizations that may be required to develop the Project. The specific permits, licenses, and authorizations that will be required will depend on the final configuration of the Project and all related activities, and may include others not listed here. Regulatory procedures that must be followed differ for each permitting, licensing, or authorizing agency. The application for a permit, license, or authorization will usually initiate a review of the Project under one or more environmental assessment processes, unless the proposed activity has been explicitly exempted from assessment.

Within Nunavut, INAC regulates land use on Crown (or federal) lands, whereas Nunavut Tungavik Incorporated (NTI) and the regional Inuit associations regulate subsurface and surface land use on Inuit Owned Lands. The Nunavut Water Board regulates water use in Nunavut. Environmental screening and assessment is the responsibility of the Nunavut Impact Review Board (NIRB). The NLCA established these new boards and regulatory processes, with the *Nunavut Land Claim Settlement Act* and the *Nunavut Act* being the federal legislation enabling the implementation of the provisions of the NLCA. Environmental screening and assessment also has to accommodate the requirements of CEAA, in addition to the requirements of NIRB.

Table 2-1: Permits, Licenses, and Authorizations That May Be Required

Activity	Permit/Approval	Legislation	Agency
Archaeological research and investigations	Archaeological Research Permit	*Nunavut Archaeological Sites Regulations, Nunavut Land Claims Agreement Heritage Canada*	Government of Nunavut
Camp, laydown and staging areas	Land Use Permit	*Territorial Lands Act* and Territorial Land Use Regulations*	Lands Division INAC
Water use and waste water disposal at camps	Water License	*Nunavut Waters Act and Nunavut Surface Rights Tribunal Act*	Nunavut Water Board
Sewage disposal, food premises, sanitation at camps	Permit	*Public Health Act* (*Nunavut*)	Nunavut Department of Health and Social Services
Borrow Sources	Quarry Permit	Territorial Quarrying Regulations*	Lands Division INAC

Table 2-1: Permits, Licenses, and Authorizations That May Be Required

Activity	Permit/Approval	Legislation	Agency
Watercourse Crossing Construction	Water License, Authorization or Letter of Advice for Works or Undertakings Affecting Fish Habitat	*Nunavut Waters Act and Nunavut Surface Rights Tribunal Act, Fisheries Act*	Nunavut Water Board, Fisheries and Oceans Canada (through NIRB process)
Cat Train Route to Site	Permit to Access Inuit Owned Land, Land Use Permit	*Nunavut Land Claims Settlement Act, Territorial Lands Act* and Territorial Land Use Regulations*	Nunavut Tungavik Incorporated, Lands Division INAC
Transportation, use of heavy equipment	Vehicle Registration or Permit	*Motor Vehicles Act* (*Nunavut*)	Nunavut Department of Community Government and Transportation
Transportation of dangerous goods	Certificate / Permit	*Transportation of Dangerous Goods Act*	Transport Canada Nunavut Department of Sustainable Development
Fuel cache (supplies for remediation program) - >4,000 L	Land Use Permit**	*Territorial Lands Act* and Territorial Land Use Regulations*	Lands Division INAC
Constructing a new landfill	Land Use Permit	*Territorial Lands Act* and Regulations*	Lands Division INAC
Airstrip repair and upgrading, and road repair and upgrading	Land Use Permit	*Territorial Lands Act* and Regulations*	Lands Division INAC

* indicates permits triggering *CEAA*

** If less than 4000 L but greater than 400 L, must notify INAC Land Administration in writing noting the volume, type, size of containers, method of storage, and proposed date of renewal.

2.2 Environmental Assessment and Review Process

This section provides a summary of the typical regulatory provisions for environmental assessment pursuant to the NLCA and the CEAA, as outlined in the agreement, enabling legislation, guidelines, and operational procedures, which may apply to any project within Nunavut.

Article 12 of the NLCA establishes processes for the screening and review of project proposals on land and marine areas within the Nunavut Settlement Area (including Inuit Owned Lands, Commissioners lands, and Crown lands) and to the Outer Land Fast Ice Zone. The NIRB was established in 1996, under Article 12.2.1 of the NLCA, as an institution of public government with responsibilities for environmental assessment. The NIRB's primary functions are to screen and review the environmental and socio-economic effects of project proposals, and to make recommendations to the federal or territorial Minister(s) responsible for authorizing such projects to proceed. The NIRB can also issue recommendations for monitoring of project effects, but the responsibility for enforcement of such provisions lies with the agency issuing a permit, license, or authorization. The NIRB's objectives are to protect the ecosystemic integrity of Nunavut, and to protect and promote the existing and future well-being of the residents and communities of Nunavut, and of Canada.

The CAM-D DEW Line site is on federal lands that are regulated by INAC. As the Responsible Authority, INAC requires that an environmental screening be conducted in accordance with Section 18 of the CEAA. Where a proposed project in Nunavut involves a CEAA trigger, federal and territorial

governments and the NIRB work together to harmonize the environmental screening process. This process is intended to provide information for the federal authorities to support the screening of the project pursuant to the requirements of CEAA. As such, the study has been conducted in a manner that is consistent with the NLCA and CEAA and the guidance documentation of the NIRB, the Canadian Environmental Assessment Agency and INAC.

The initial step in obtaining approval for a project proposal within the Nunavut Settlement Area is the submission of an application for a permit, license, lease, or approval to an authorizing agency (*i.e.*, government department, Designated Inuit Organization, regulatory board). It is important to note that more than one authorization may be required for undertakings and activities on land or water.

The authorizing agency is responsible for initial processing of the application. Where regional land use plans are in place, the application is forwarded to the Nunavut Planning Commission (NPC) for review of conformity with the land use plan. Where a project proposal conforms to an approved land use plan, or if a variance has been approved, the NPC forwards the project proposal application to the NIRB for screening. If no approved land use plans exist, project proposal applications are referred directly by the authorizing agency to the NIRB for screening.

The initial steps of the screening involve notifying the proponent and authorizing agencies, establishing a timeline for a screening determination (where not specified by regulation), and distributing the project proposal application to appropriate stakeholders. Taking into account all comments received from stakeholders regarding the project proposal, existing scientific information, Inuit traditional knowledge, and the information provided by the proponent, the NIRB then reviews the potential effects of the project and the level of public concern about and/or support for the project proposal. Once the screening has been completed, the NIRB will produce a Screening Decision Report that documents its determination as to whether the project proposal should be approved without further review, abandoned or modified by the proponent, or subject to review under Part 5 or 6 of the NLCA.

If the NIRB determines that the project proposal should proceed without further review, the NIRB may include in its Screening Decision Report terms and conditions to be attached to the authorizations to be issued. The authorizing agency will include the NIRB terms and conditions in the final authorization. However, where the authorizing agency disagrees with the recommended terms and conditions, the agency must provide the NIRB with a rationale for omissions from the final authorization. Monitoring of adherence to terms and conditions is the responsibility of the authorizing agency. The NIRB will complete its screening and issue its Screening Decision Report to the authorizing agency (or agencies) within applicable legislated timelines to allow the agencies to meet their legislative requirements. However, should an agency have no legislated time limits regarding the issuance of permits, NIRB will provide its Screening Decision Report within “an acceptable time period”.

When the Screening Decision Report indicates that a review is required, the Minister may:

- refer the proposal to the Minister of Environment for review by a federal environmental assessment panel;
- refer the proposal back to the NIRB for a review of environmental and socio-economic effects; or
- inform the proponent that the proposal should be abandoned or modified and resubmitted to NIRB.

The scope of the project has been determined pursuant to Section 15(1) of the *CEAA*. The scope of the project and environmental screening, and Valued Ecosystem Components (VECs) has been established. Factors considered in the environmental screening include those prescribed in Section 16(1) (a) to (e) of *CEAA*, listed below:

(a) the environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
(b) the significance of the effects referred to in paragraph (a);
(c) comments from the public that are received in accordance with this Act and the regulations;
(d) measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project; and
(e) any other matter relevant to the screening, comprehensive study, mediation or assessment by a review panel, such as the need for the project and alternatives to project, that the responsible authority or, in the case of a screening, the Minister after consulting with the responsible authority may require to be considered.

Cumulative environmental effects have been considered pursuant to Section 16(1)(a) of *CEAA* for likely future projects. No additional factors have been prescribed under Section 16(1)(e) by INAC for inclusion in the potential cumulative environmental effects assessment analysis.

The existing conditions of the project area environment, with respect to the identified VECs, are characterized in this report. Potential interactions of specific project activities with the environment are identified and the environmental effects are evaluated in consideration of appropriate mitigation measures.

3.0 ENVIRONMENTAL ASSESSMENT CONTACTS

Responsible Authority Contact: Lou Spagnuolo Contaminated Sites Project Officer Nunavut Regional Office Bldg. 969, P.O. Box 2200 Iqaluit, NU X0A 0H0 Phone: (867) 979-7936 Fax: (867) 979-7939	***CEAA Contact:*** David J. Robinson Senior Manager Canadian Environmental Assessment Agency 160 Elgin Street, 22nd Floor, Ottawa, ON K1A 0H3 Phone: (613) 957-0024
Proponent Contact: Sonia Nobrega Contaminated Sites Project Officer Nunavut Regional Office Bldg. 969, P.O. Box 2200 Iqaluit, NU X0A 0H0 Phone: (867) 979-7936 Fax: (867) 979-7939	***Nunavut Impact Review Board:*** Gladys Journey Manager, Environmental Administration P.O. Box 2379 Cambridge Bay, NU X0B 0C0 Phone: (867) 983-4611 Fax: (867) 983-2594 e-mail: jkomak@nirb.nunavut.ca
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4.0 PROJECT DESCRIPTION

INAC plans to implement a remedial action plan at the former CAM-D DEW Line site located at Simpson Lake, Nunavut in 2009. The main tasks involved in the remedial action plan include:

- demolishing existing structures;
- collecting non-hazardous materials for disposal in an on-site facility;
- collecting, containerizing and disposing hazardous materials off-site at an approved facility; and
- excavating, containerizing and disposing contaminated soils off-site at an approved facility.

4.1 Project Location

The CAM-D DEW Line site is located at 68º35' N, 91º57' W on the Boothia Peninsula between Sheppard Bay and Pelly Bay, Nunavut, approximately 120 km southeast of Taloyoak, 100 km east of Gjoa Haven and 120 km west of Kugaaruk, Nunavut (Figure 1-1).

4.2 Site History

The former CAM-D DEW Line site was constructed in 1957 and operated until it was taken out of service in 1963. INAC assumed responsibility for the site in 1965. Sometime between 1963 and 1994, one petroleum, oil and lubricants (POL) tank was removed from the site, along with the concrete foundation and berm.

In 1985, a partial cleanup by the Department of National Defence (DND) and Environment Canada involved removing contaminants such as polychlorinated biphenyls (PCBs) and POLs, and identifying areas of buried materials that could pose environmental risks in the future. Various pieces of PCB-containing equipment were removed from electrical cabinets at the site. Soil samples collected from beneath the cabinets indicated PCB contamination. Various debris remained scattered around the site.

DND constructed a Short Range Radar (SRR) facility near the site (approximately 1 km east) between 1992 and 1995. Gravel from the CAM-D DEW Line site was used to construct the gravel pad for the SRR facility. Infrastructure at this unmanned station includes a technical services building, emergency shelter, diesel tanks, helipad, communication domes, a shack and an accommodation module.

In 1994, the Environmental Sciences Group of Royal Roads Military College conducted a detailed investigation concentrating on soil, water and vegetation to determine the presence, migration and dispersion of contamination (not including hydrocarbon contamination) resulting from former site activities. The study concluded that there was contamination that could migrate off-site and there were other areas showing signs of contamination that required further investigation (ESG 1994). While areas of concern were identified, there were no estimates made of the volume of affected material.

In August 2005, Earth Tech completed a detailed site assessment at the CAM-D DEW Line site, including determining contaminated soil volumes, and identifying and assessing the remaining

hazardous and non-hazardous materials on the site. The results of this program provided the information for preparing a comprehensive remedial action plan for the site.

4.3 Site Description

The site consists of the main station area, SRR station, airstrip area, Simpson Lake, Freshwater Lake, plumbers dump area, and borrow source areas (Figure 4.0 in Appendix A). Detailed drawings showing the location of each area and types of contaminates and wastes found at each located are provided in Appendix A.

The main station is situated in the Ross Hills at an elevation of 370 m above sea level. Terrain around the site consists of rolling grassy hills cut by rock outcrops (Indian and Northern Affairs Canada 2005). The site is landlocked and inaccessible by sea-lift, so the transportation of heavy equipment to the site will have to be completed by CAT Train in the winter.

4.3.1 Main Station Area

At the main station area, the only remaining structures left in place on the site are a garage, one POL tank and fuel pump shed, and warehouse foundation. These remaining structures have been left standing on steep gravel mounds because much of the gravel was removed from the site to construct the SRR station. Other infrastructure that remained on the site has been demolished and partially buried. Refer to Figures 5.0 to 5.11 in Appendix A for more detail.

The Doppler antenna has fallen down and is lying just off the southwest corner of the module train pad. Located to the northeast of the garage are several electrical cabinets with most of their components removed.

To the southeast of the garage are some abandoned vehicles and several large stacks of empty barrels (about 5000 in total). The pallet storage line is located northeast of the main station area. The storage line contains approximately 1000 barrels most of which are empty and stacked, although some full and partially full barrels, associated with dark staining were noted.

Five dump or debris areas have been identified at the main station area:

- The Main Dump is located north of the station within a shallow depression in the bedrock. Debris within this dump includes heavy equipment, domestic waste and approximately 2000 barrels;
- The Barrel Dump is located north of the station and consists of two distinct piles of barrels. Approximately 245 barrels were identified in this area; six of them were left open and upright and contain some liquid;
- The Vehicle and Debris Dump is located southeast of the station and contains various pieces of heavy equipment and vehicles as well as 10 empty barrels, assorted metal debris and a battery;
- The Large Barrel Dump, which is located east of the station, contains approximately 5100 empty barrels. Of the barrels inspected here in 1994, all were either empty or contained a small volume of rusty water; and

- The Pallet Line Area is located northeast of the station and contains approximately 1000 barrels and other miscellaneous waste. The assessment in 1994 showed that fifteen of these barrels were either full or partially full and identified heavy soil staining associated with this dump.

4.3.2 Short Range Radar Facility

The SRR facility was constructed on a hill 1 km east of the Cam-D DEW Line site. The road to the new radar facility forks off the road connecting the airstrip and the main station area. Gravel used in the construction of this road and the radar station was removed from the original Cam-D DEW Line Site.

4.3.3 Airstrip Area

South of the Main Station Area there is a gravel airstrip that runs in a southwest – northeast direction and is about 1100 m in length (Figures 6.0 to 6.2 in Appendix A). Along the road toward the airstrip are the remains of several collapsed shacks. Further along the road is located a pile of approximately 40 barrels, two portable diesel fuel tanks and the remains of an Inuit house that was destroyed by fire.

The airstrip is considered to be in relatively good condition. However, repairs and upgrading would be necessary before it could be operational. There are two debris areas along the road at the airstrip. On the west, just to the side of the airstrip apron on a bedrock outcrop, is the Vehicle and Debris Area containing various heavy equipment. To the east, on the gravel apron, is the Crane Area containing a large crane.

4.3.4 Simpson Lake

The staging area for the winter airstrip is located approximately 4.7 km northeast of the airstrip on the south shore of Simpson Lake (Figures 7.0 in Appendix A). The path between the lake and airstrip has been completely degraded with only marker barrels remaining. There is approximately 300 barrels located in this area, either randomly stacked in small piles or scattered for approximately 1 km along the shoreline east of the staging area.

4.3.5 Freshwater Lake and Plumbers Dump Area

Freshwater Lake, approximately 750 m south of the airstrip, is thought to have been the drinking water source when the CAM-D DEW Line Site was operational. There is debris scattered along its eastern shore.

Southwest of Freshwater Lake and approximately 1.5 km southwest of the airstrip, along the north shore of a smaller lake, is an area referred to as the Plumbers Dump. The site appears to have been the drop location for supplies that were never transported to the main station area. Debris remains on the slope up from the lake about 10 m from the shoreline.

Refer to Figures 8.0 to 8.2 in Appendix A for details on these areas.

4.3.6 Borrow Source Areas

There are various potential borrow sources for the project, including at the main station area and approximately 3 km south of the main station area at Murchison River (Figure 4.0 in Appendix A). Debris in the Murchison River location consists of caches of empty barrels, approximately 200 barrels in total.

4.4 Objectives of the Remedial Action Plan

Remediation options were identified and evaluated for each waste stream, and recommendations made for the preferred approach for handling each waste stream (Table 4-1). The remediation options were presented at community meetings, led by PWGSC and INAC, in Taloyoak, Gjoa Haven and Kugaaruk to obtain input on the proposed options.

The remedial action plan was designed to meet the requirements and standard environmental management practices of INAC's Abandoned Military Site Remediation Protocol (refer to Appendix B), as well as its Contaminated Sites Management Policy (INAC 2002). The objectives of the remedial action plan are to restore the site to as near pre-disturbance conditions as possible while minimizing the potential for contaminants to enter the ecosystem, remove physical hazards that pose a risk to human health and safety, and carry out a cost-effective remediation program.

Table 4-1: Environmental and Human Health Concerns Identified at the CAM-D DEW Line Site

Environmental/Health Concern	Site Assessment Findings	Recommended Remediation Method
Contaminated Soil		
PCB Contaminated Soil	3 m^3 of soil with PCB concentrations (co-contaminated with Tier II heavy metals) was found at the outfall area of the module train building location. The concentrations exceeded Tier I INAC Abandoned Military Site Remediation Protocol criteria. However, PCB concentrations did not exceed Tier II criteria.	Excavate contaminated soil, containerize and ship off site to a licensed disposal facility.
Metals Contaminated Soil	42 m^3 of soil with metal concentrations of As, Cd and Zn (some of which was co-contaminated with PCB contaminated soil), exceeding Tier II INAC Abandoned Military Site Remediation Protocol criteria, was found at electrical cabinet area, airstrip, plumbers dump and Simpson Lake.	Excavate contaminated soil, containerize and ship off site to a licensed disposal facility.
Hydrocarbon Contaminated Soil	Approximately 326m^3 of hydrocarbon contaminated soil, exceeding INAC Abandoned Military Site Remediation Protocol for PHC soil, was found at POL tank area and Pallet Line area.	Excavate contaminated soil, containerize and ship off site to a licensed disposal facility.
Hydrocarbon Impacted Soil	2,034 m^3 of soil with elevated PHC and PAH concentrations were found at the garage, burn pit, POL tank, Pallet Line and Portable Fuel Tank areas. While this soil is not classified as contaminated under the INAC protocol and does not require remediation, INAC as a measure of environmental stewardship, will address these soils during the remediation program.	PHC impacted soil below INAC criteria, but exhibiting elevated F1 and F2 fraction hydrocarbons, BTEX and/or PAHs, will be remediated in-situ by aerating through excavating in place and adding amendments to accelerate the bioremediation process. PHC impacted soil below INAC

Table 4-1: Environmental and Human Health Concerns Identified at the CAM-D DEW Line Site

Environmental/Health Concern	Site Assessment Findings	Recommended Remediation Method
		criteria, but exhibiting elevated F3 and/or F4 fraction hydrocarbons, will preferentially be used as intermediate fill for the non-hazardous waste landfill.
Hazardous Materials		
Hazardous Materials	Approximately 18 m^3 of hazardous materials (i.e., lead acid batteries, lead and PCB contaminated paint materials, and asbestos). There is also a potential 7 m^3 of hazardous materials within the buried waste at the Main Station Area.	Containerize and dispose all hazardous materials (except for asbestos containing materials and POL fluids) according to INAC protocol. Unearth buried hazardous material near the warehouse, and sort and dispose accordingly.
Asbestos	Asbestos containing materials were limited to the Main Station Area, both in the remaining structures and buried debris piles.	Asbestos will be properly abated, according to federal and territorial regulations and guidelines, and placed in sealed, airtight container clearly labeled "ASBESTOS." The containers will be placed in the engineered on-site landfill.
PCB/Lead Contaminated Paint Items	Approximately 58 m^3 of PCB/lead contaminated paint materials were inventoried on the site. There is also a potential 200 m^3 of PCB/lead contaminated paint materials within the buried waste at the Main Station Area.	Dismantle contaminated paint items and ship off site to a licensed disposal facility.
POL Fluids	Approximately 16,400 L of POL fluids were found on the site.	Incinerate POL fluids that meet incineration criteria (< 2 ppm PCB and Cd,<10 ppm Cr, < 100 ppm lead and < 1,000 ppm Cl). Treat as hazardous waste all fluids not meeting the criteria.
Non-hazardous Materials		
Non-hazardous Site Debris	Approximately 2,400 m^3 of non-hazardous debris (i.e., heavy equipment, barrels, scrap construction materials, steel, concrete and buried debris from previous demolition activities) was inventoried around the site. Approximately 1,600 m^3 of this material is partially buried at the Main Station Area, while the remaining 800 m^3 is not buried.	Consolidate and dispose of in an on site non-hazardous waste landfill. Handle barrels according to DND protocol.
Remaining Site Structures	Remaining structures include the garage, warehouse foundation, POL tank and pump shed.	Demolish all existing buildings and infrastructure to their foundations, except for the garage foundation which should be removed for safety reasons and to access the PHC contaminated soils underneath. Dispose of all non-hazardous materials in the on-site non-hazardous waste landfill.

4.5 Scope of Work

The scope of work to be carried out at the CAM-D DEW Line Site for the undertaking of the remedial action plan is described in this section.

4.5.1 Planning and Design

A detailed review of all previous site information was conducted to determine any information gaps and identify additional site information required for preparing a remediation specification. Applicable previous site information includes the assessment completed in 1994 by Environmental Sciences Group of Royal Roads Military College (ESG 1994) and the Earth Tech (2006) report on its 2006 Phase III site investigation and waste audit.

Area communities have been consulted on the remedial action plan. A draft copy of the plan was provided to NTI, and the communities of Taloyoak, Gjoa Haven and Kugaruuk for review and comment. INAC and PWGSC project managers hosted open community meetings in all three communities in April 2006 to meet with community members to gather their comments and concerns regarding site remediation and gain a better understanding of their current use of the facilities. Notes from the community meetings are provided in Appendix C.

The community consultation component of the project will continue for the duration of the project to ensure community members are kept informed about the activities, results and plans regarding the site and are active participants in the remedial action plan development.

When the detailed scope of work has been finalized, permit applications will be prepared. The final component of the planning phase will be preparing a tender document for the supply of a camp, heavy machinery and labourers for support services during all site activities.

4.5.2 Field Program

The field program will involve preparing the site for the planned remediation work, including building a temporary work camp and related facilities, and repairing and upgrading the airstrip and select site roads, and conducting the planned remediation activities.

A number of human health and environmental concerns were identified at the CAM-D DEW Line Site during the Earth Tech investigation and waste audit conducted in 2005. Table 4-1 provides a summary of the concerns along with details on the site assessment findings and the recommended remediation methods for addressing each concern. Specific concerns to be addressed during the remediation program include:

- 371 m^3 of contaminated soil;
- 2,034 m^3 of hydrocarbon impacted soil with elevated petroleum hydrocarbons (PHC) and polycyclic aromatic (PAH) concentrations;
- approximately 18 m^3 of hazardous materials (i.e., lead acid batteries, lead and PCB contaminated paint materials, and asbestos);

- approximately 58 m^3 of PCB/lead contaminated paint materials;
- approximately 16,400 L of POL fluids;
- asbestos containing materials;
- 2400 m^3 of non-hazardous debris; and
- removal of remaining site structures.

4.6 Project Activities

The proposed activities at the CAM-D DEW Line Site include:

- equipment, materials and personnel for the project will be moved to the site by Cat Train and/or air;
- the airstrip, select existing roads and access to the Murchison River borrow source will be upgraded to facilitate vehicle and equipment access;
- a temporary work camp with associated facilities (*i.e.,* water supply, sewage disposal and utilities) will be established for the work crew;
- an engineered non-hazardous waste landfill and a temporary waste handling facility will be constructed;
- a temporary road will be constructed between the main dump area and new landfill at the main station area to facilitate hauling of debris to the waste handling facility;
- hazardous materials will be collected, sorted, containerized and shipped off site for disposal at a licensed disposal facility;
- hydrocarbon impacted soil and POL fluids that meet INAC criteria will be remediated on site (those not meeting the criteria will be treated as hazardous waste);
- non-hazardous materials (including materials from the existing buildings that will be demolished) will be collected and disposed in the new on-site landfill;
- at the end of the clean-up, project facilities will be removed and area reclaimed (i.e., the work camp and associated facilities, temporary road between the main dump and new landfill, and the waste handling facility will be removed and areas reclaimed); and
- all project equipment and materials, as well as the hazardous materials containerized for offsite disposal will be moved from the site by Cat Train.

4.6.1 Remediation Activities

The remediation measures outlined in Table 4-2 are the activities that will be undertaken for the project.

Table 4-2: CAM-D DEW Line Site Remediation Activities

Material to be Addressed	Remediation Activities
Contaminated Soil	
PCB Contaminated Soil	• Excavate contaminated soil, containerize and ship off site to a licensed disposal facility.
Metals Contaminated Soil	• Excavate contaminated soil, containerize and ship off site to a licensed disposal facility.
Hydrocarbon Contaminated Soil	• Excavate contaminated soil, containerize and ship off site to a licensed disposal facility.

Table 4-2: CAM-D DEW Line Site Remediation Activities

Material to be Addressed	Remediation Activities
Hydrocarbon Impacted Soil	• PHC impacted soil below INAC criteria, but exhibiting elevated F1 and F2 fraction hydrocarbons, BTEX and/or PAHs, will be remediated in-situ by aerating through excavating in place and adding amendments to accelerate the bioremediation process. • PHC impacted soil below INAC criteria, but exhibiting elevated F3 and/or F4 fraction hydrocarbons, will preferably be used as intermediate fill for the non-hazardous waste landfill.
Hazardous Materials	
Hazardous Materials	• Containerize and dispose all hazardous materials (except for asbestos containing materials and POL fluids) according to INAC protocol. • Unearth buried hazardous material near the warehouse, and sort and dispose accordingly. • Asbestos will be properly abated, according to federal and territorial regulations and guidelines, and placed in sealed, airtight container clearly labeled "ASBESTOS." The containers will be placed in the engineered on-site landfill.
PCB/Lead Contaminated Paint Items	• Dismantle contaminated paint items and ship off site to a licensed disposal facility.
POL Fluids	• Incinerate POL fluids that meet incineration criteria (< 2 ppm PCB and Cd,<10 ppm Cr, < 100 ppm lead and < 1000 ppm Cl). Treat as hazardous waste all fluids not meeting the criteria.
Non-hazardous Materials	
Non-hazardous Site Debris	• Consolidate and dispose of in an on site non-hazardous waste landfill. Handle barrels according to DND protocol.
Remaining Site Structures	• Demolish all existing buildings and infrastructure to their foundations, except for the garage foundation which should be removed for safety reasons and to access the PHC contaminated soils underneath.

4.6.2 Temporary Work Camp

A temporary camp will be established to provide accommodations for up to 30 site workers and three to five camp staff. The camp will be owned and operated by the primary contractor, and will include a potable water supply, sewage collection and treatment according to all applicable guidelines and regulations, bear safety measures, emergency rations and an emergency rescue contingency plan.

The work camp, including its facilities, utilities, services, location and operation will be operated in accordance with applicable federal, territorial, and local codes, regulations, and requirements governing camps, including environmental regulatory requirements and Water Use Licenses.

Prior to the installation of camp facilities, all necessary work will be completed to ensure protection of the environment. Additionally, consideration will be given to possible wildlife encounters when determining the camp layout. Bear and other wildlife safety will be considered when selecting the location of the kitchen, food storage, washroom, and sleeping facilities.

Wastes will be disposed of in an environmentally responsible manner and in accordance with relevant regulations. For example, an incinerator will be used to destroy all combustible waste. As well, liquid waste in the form of wash water, meltwater collection, rinse water from the cleaning of fuel tanks and

pipelines, water from dewatering contaminated soil areas, and/or any other liquid effluent stream will be released onto the ground, following testing to ensure that it meets criteria, at a location that is a minimum of 30 m from natural drainage courses and 100 m from fish-bearing waters. Liquid waste will be discharged following appropriate testing to ensure it meets all applicable federal and territorial water quality legislation standards and guidelines, and any approvals or permits to operate.

Any liquid effluent not conforming to these guidelines will be disposed as hazardous material according to INAC's Abandoned Military Site Remediation Protocol (Appendix B). All hazardous material will be removed from the site and transported to a licensed facility.

Sewage from the temporary work camp will be collected for offsite disposal, and disposed according to appropriate guidelines and regulations, such as the Water License, and the *Public Health Act* (Nunavut). Should construction of a lagoon be necessary, it will be sized accordingly to provide wastewater storage for the duration of the construction phase of the Project. Maximum fluid depth will not exceed 1 m.

A fire extinguisher will be provided for each camp facility. A carbon monoxide detector will be provided for each facility that is equipped with an oil-burning heater. All flammable liquids will be handled and stored according to the current National Fire Code of Canada.

Basic camp rules will be established for the benefit of all occupants. The rules will cover subjects such as property damage, smoking, use of alcoholic beverages, drugs, firearms, security, nuisance, and any other matter related to the management of the camp operation. A copy of the camp rules will be provided to all occupants upon arrival to camp. Camp rules will prohibit the consumption of alcoholic beverages on site.

4.6.3 Infrastructure and Roads

If the airstrip at the CAM-D DEW Line Site is to be used, the runway condition will be evaluated by the contractor and any necessary repairs made prior to use. The airstrip will be continually evaluated by the operational pilots and staff at CAM-D. Any excessive erosion or rutting noted will be repaired immediately as required and to the satisfaction of the operational pilots.

Due to lack of upkeep and erosion, some of the existing roads to be used during the remediation activities will require repair and upgrading (Figure 9.0 in Appendix A). The main road between the airstrip and main station area will be repaired with borrow material from the main station area and the Murchison River borrow source area. Borrow materials will not be taken from the SRR station or the road leading to the station.

A temporary road will be constructed between the main dump area and the new landfill site at the main station area, so materials in the main dump can be removed and disposed in the new landfill. This road will also be constructed with borrow material from the main station area and Murchison River borrow source area. At the end of the remediation project, the road be removed and area reclaimed.

4.6.4 Borrow Source Development

Borrow material will first be taken from the borrow source at the main station area and, if required, additional requirements for borrow material being met with material from the Murchison River borrow source area (Figure 4.0 in Appendix A). The clay borrow source, approximately 14,000 m^3, at Murchison River is considered adequate to meet the remediation requirements. All borrow sources will be developed according to INAC's Abandoned Military Site Remediation Protocol (Appendix B).

To access the borrow source at Murchison River a series of culverts will be constructed across the drainage pattern at the base of the shallow valley to prevent silting of the water flow through the drainage area and into the Murchison River (Figure 11.0 in Appendix A). The culverts will be covered with gravel to allow equipment to cross the drainage to access the borrow material.

When the site remediation is complete, all borrow sources will be recontoured to restore the natural drainage, match surrounding topography and minimize any changes to permafrost.

4.6.5 Non-hazardous Waste Landfill

An engineered, non-hazardous waste landfill will be constructed at the main station area (Figure 10.0 in Appendix A). This site was chosen because it is located on a hill, minimizing the potential for erosion and infiltration, and it minimizes the transportation involved in moving material from the main dump area to the new landfill and moving borrow material to the site.

The landfill will be constructed in a controlled manner with minimal lifts to control compaction and settlement. Site grading will be done in such a manner so as to prevent ponding and seepage into the landfill. The landfill design will take into consideration the cap angles to ensure that the design does not encourage erosion of capping material.

Leachate control measures to be incorporated include placing only dry, stable material in the landfill and preventing water infiltration into the landfill to avoid leachate generation. Fill material used will be "frost stable" and placed outside the high groundwater or constant surface water recharge area. Placing thin lifts (0.15 m) and compacting/vibrating to fill voids will be used to prevent settling of the landfill surface. The thickness of debris in the landfill will not exceed 3 m and the landfill cap will be compacted to 95 percent of the maximum density.

Berms will be constructed inside and outside the landfill, the inside berm will be constructed at 1.5H:1V and outside berm at 3H:1V. The berms will have minimum cover of 0.5 m of gravel and cobbles, with the top of being a minimum width of 2 m.

4.6.6 Waste Handling Facility

A waste handling facility will be constructed to the southwest of the main station area for receiving and sorting the various waste items found on the site (Figure 10.0 in Appendix A). A temporary road around the facility will provide access to the vehicles and equipment required for transporting and sorting the waste.

The fluids handling area of the facility will be lined with an engineered clay/synthetic liner to prevent the migration of contaminants resulting from any accidental spills, and liner will have fill cover to protect the liner integrity. The area will also be bermed.

At the end of the remediation project, the facility will be decommissioned and the ground beneath the facility sampled for confirmatory purposes.

4.6.7 Project Schedule

The proposed schedule for the project is presented in Table 4-3 and based on the assumption that the work will be tendered in Fall 2007.

Table 4-3: Proposed Project Schedule

Activity/Milestone	Date
Community Meetings	Spring 2006
Permitting	Spring 2007
Bidders Site Meeting	Summer 2007
Contract Tender	Fall 2007
Contract Award	Winter 2007
Sea-lift Equipment Mobilization to Nunavut Community	Summer 2008
Mobilization to Site by Cat Train	Spring 2009
Camp Construction	Summer 2009
Road Improvement and Construction	Summer 2009
Engineered Non-hazardous Landfill Construction	Summer 2009
Removal of Lead and PCB-based Paint Items	Summer 2009
Removal of All Remaining Hazardous Materials	Summer 2009
Demolition of Structures and Placement in New Landfill	Summer 2009
Collection and Off-site Disposal of Metal, PCB and Hydrocarbon Contaminated Soils	Summer 2009
Demobilization from Site by Cat Train	Spring 2010
Sea-lift Equipment Demobilization from Nunavut Community	Spring 2010

4.6.8 Personnel

The site restoration team will include the remediation contractor, a site project manager, an environmental expert, and PWGSC and INAC representatives periodically. Based on previous experience with DEW Line clean-up projects, the personnel compliment on site is expected to consist of the following:

- one Site Engineer;
- one Biologist (part time); and
- Construction Contractor which includes:
  - Site Superintendent;
  - Hazardous Waste Specialist;
  - Backhoe operator;
  - Five quad drivers;
  - Three Wildlife Monitors;
  - Mechanic;

- Two Journeymen;
- Four labourers;
- Cook and helper;
- Health and Safety Coordinator; and
- Medic.

4.6.9 Equipment

Equipment, materials and supplies required for the 2009 site restoration activities include, but are not necessarily limited to:

- one 307B tracked excavator or equivalent;
- one bulldozer;
- three dump trucks;
- one packer;
- five quads with trailers;
- one water pump;
- Water tank;
- Sewage treatment tank;
- Solid waste incinerator;
- one portable generator;
- one boat and motor, if required;
- cutting torches;
- adequate fuel in drums, oil, grease, antifreeze, etc.;
- safety supplies (*e.g.,* tyvek suits, nitrile gloves, hard hats, respirators);
- portable radios, satellite phone, GPS;
- spill kit and absorbent material;
- over pack drums; and
- camp.

4.6.10 Project and Long-Term Monitoring

Throughout the project, quantities of all site materials being remediated will be estimated, tracked and measured, as appropriate, to ensure compliance with the clean-up objectives and criteria. Contaminated areas that are excavated will be confirmed clean by field screening methods and samples taken for laboratory confirmation. After the remediation program is complete, long-term monitoring will include inspections of the new landfill and sampling as required.

5.0 ENVIRONMENTAL ASSESSMENT METHODOLOGY

5.1 Overview and Approach

The assessment of the potential environmental effects of the proposed project has been carried out using a rigorous methodological framework developed on the basis of current, accepted practice and professional experience of the study team. The potential environmental effects of activities associated with the project on each VEC selected for consideration has been evaluated. Mitigation measures to address and minimize any potential environmental effects are also identified and discussed. The potential environmental effects resulting from malfunctions and accidents associated with the work plan have been evaluated. As well, the cumulative environmental effects of past, present and planned future activities have been assessed.

The assessment of project effects is determined through the following procedure:

- VEC definition;
- determination of boundaries;
- potential interactions, assessment of effects and mitigation analysis;
- summary of residual environmental effects; and
- summary of mitigation and monitoring.

Each of these steps is described in further detail below.

5.2 VEC Definition and Selection

Standard environmental assessment practice uses a scoping exercise to focus assessments on those environmental issues of greatest importance, referred to as Valued Environmental Components (VECs). Identifying key issues through stakeholder consultation, literature review and site assessment is a critical step in scoping, ensuring that the assessment focuses on those matters of primary concern to regulatory authorities, stakeholders and the assessor.

VECs are components of the environment that are valued by society, and upon which the environmental assessment is focused. Potential environmental issues of concern that may be associated with the proposed project have been identified through consultation with Indian and Northern Affairs Canada (INAC), the Government of Nunavut, stakeholders, and the professional judgement of the study team.

Based on existing environmental conditions, the scope of the screening includes environmental effects on physical, biological, social and environmental components of value. The scope excludes the effects of accidental events on worker safety and the effects of burning fossil fuels by machinery used during the site remediation on the atmospheric environment (including greenhouse gases levels and climate change). The scope of the socio-economic assessment is limited to the basic requirements of the *CEAA* Screening process whereby the assessment of socio-economic effects is limited to "*any change that the project may cause in the environment, including any such change on health and*

socio-economic conditions". The VECs identified for the project take in to consideration the nature, and temporal and spatial scope of the project and anticipated potential-environmental interactions. VECs selected and the rational for their selection is provided in Table 5-1. Table 3 summarizes the interaction and potential effects between VECs and the various activities associated with the clean up.

Table 5-1: VEC Selection Rational

VEC	Rationale For Selection		
	Public/Stakeholder Concerns	**Regulatory Considerations(*)**	**Professional Judgement**
Air Quality	√	√	√
Terrain		√	√
Soil Quality	√	√	√
Water Quality	√	√	√
Terrestrial Animals and Habitat	√	√	√
Aquatic Animals and Habitat	√	√	√
Archaeological and Heritage Resources	√	√	√
Aesthetics	√	√	√
Socio-economic Environment	√	√	√
Health and Safety	√	√	√

(*) Includes federal and territorial regulations.

5.3 Identification of Cumulative Environmental Effects

Cumulative effects have been defined as changes to the biophysical, social, cultural or economic environments caused by a project component in combination with any ongoing, past or future activities. Cumulative effects can occur as interactions between project components (either from the same or more than one site) and/or between environmental components. Effects can occur in one of four ways:

- physical or chemical transport mechanisms;
- "nibbling loss" (i.e., gradual disturbance);
- spatial or temporal crowding; and
- growth induction initiated by a project.

5.4 Environmental Effects Analysis

The four steps in the environmental effects analysis include scoping, analysis of effects, mitigation measures, and significance.

Scoping: Scoping includes the identification of issues of potential concern, VECs that could be affected and boundary setting. The activities considered include the remediation activities for cleaning up the CAM-D DEW Line Site. Temporal and spatial boundaries encompass those periods during, and areas within which, the VECs are likely to interact with, or be influenced by project activities. The spatial boundaries include effects over a larger (regional) area including the crossing of jurisdictional

boundaries. As the landfills will remain on site, temporal boundaries extend beyond the time frame required to complete the clean up. Other boundaries to be considered as appropriate include administrative and technical boundaries imposed by factors such as finite resources of data, time, cost, and labour, as well as technical, political, or administrative and jurisdictional considerations.

Analysis of Effects: This section identifies the specific nature and extent of the interactions between the project and the VECs. Where appropriate, the assessment includes a summary of major concerns or hypotheses of relevance regarding the effect of each activity on the VECs being considered. Where existing knowledge or the application of standard mitigation indicates that an interaction is not likely to result in an effect, certain issues may warrant only limited analysis.

Mitigation Measures: For each interaction, options available for mitigation are considered in the effects analysis.

Significance: The environmental assessment considers activities associated with project activities that could result in adverse environmental effects in consideration of their likelihood of occurring, and taking into account appropriate mitigation measures. In determining whether there are adverse environmental effects, the following factors are considered:

- negative effects on the health of biota;
- loss of rare or endangered species;
- reductions in biological diversity;
- loss of critical/productive habitat;
- fragmentation of habitat or interruption of movement corridors and migration routes;
- transformation of natural landscapes;
- discharge or presence of persistent and/or toxic chemicals;
- toxicity effects on human health; and
- effects on cultural issues.

5.5 Identification of Mitigation Measures, Residual Effects and Monitoring

Mitigation measures resulting in a reduction or elimination of likely environmental effects associated with the clean up are identified. Section 6 discusses each VEC, the associated potential adverse environmental effects, the mitigation, and residual environmental effects. Taking into account the mitigation measures, the significance or anticipated residual effects are identified for all potential effects.

Monitoring will be required in the future to ensure compliance with agreement commitments and that the mitigation measures in place are effective. This methodology also allows INAC to be able to establish baseline conditions for the project at the time of initiation. The implementation of recommended mitigation and monitoring will allow future activities to be compared to the current conditions identified by this assessment.

6.0 ENVIRONMENTAL ASSESSMENT

This section describes the potential interactions of specific project activities with the existing environmental conditions. Planned appropriate mitigation activities are identified and an analysis of the potential residual environmental effects (after mitigation is applied), including cumulative environmental effects, is conducted.

6.1 Regional Setting

CAM-D DEW Line Site is located on the Boothia Peninsula, 4.5 km south of Simpson Lake. The site is located approximately halfway between Shepherd Bay and Pelly Bay, 425 km west of Hall Beach (FOX-M) and 120 km southeast of Taloyoak (Spence Bay). The site is located within the Boothia Peninsula Plateau Ecoregion. This ecoregion is characterized by mean annual temperatures of approximately -12.5°C with a summer mean of 4°C and a winter mean of -28°C. Mean annual precipitation ranges from 100 mm to more than 200 mm with the higher values occurring on the central Boothia Plain. Vegetation within the ecoregion is discontinuous, and dominated by such tundra species as purple saxifrage, *Dryas spp.*, and Arctic willow, along with alpine foxtail, wood rush and other saxifrage. The ecoregion is underlain by crystalline gneiss forming a narrow north-trending prong of the Precambrian Shield, partly covered by outliers of Palaeozoic strata. Turbic Cryosols developed on hummocky, thin, discontinuous sandy moraine are the dominant soils in the ecoregion. Permafrost is continuous and of low ice content. (Ecological Stratification Working Group, 1995).

6.2 Public Consultation

Community consultation was conducted on the proposed remedial action plan. A draft copy of the plan was provided to Nunavut Tunngavik Incorporated, and the communities of Taloyoak, Gjoa Haven and Kugaruuk for review and comment. INAC hosted open community meetings in April 2006 in all three communities to hear their comments and concerns associated with the remediation of the site and to gain a better understanding of their current use of the facilities. Notes of the discussions at the community meetings are provided in Appendix C. The community consultation component of this project will continue throughout the duration of the project to ensure that the community is informed about the activities, results, and plans regarding the site.

6.3 Air Quality

6.3.1 Existing Environment

The climate on the Boothia Peninsula is a typical polar climate characteristic of other high arctic sites. The mean annual temperature is approximately -12.5°C with a summer mean of 4°C and a winter mean of -28°C. The mean annual precipitation ranges from 100 mm to 200 mm.

6.3.2 Environmental Effects Analysis – Air Quality

6.3.2.1 Study Area Boundaries

The spatial boundary for the assessment of project effects on air quality is the airshed of the Boothia Peninsula. The temporal boundary for air quality is the time period for the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization and extending to the monitoring period following the completion of the remediation project.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA for review by NIRB and other federal departments through the normal CEAA process. Technical boundaries of the air quality assessment are the lack of site-specific meteorological data and the limited time frame associated with the environmental assessment.

6.3.2.2 Identification of Issues, Interactions and Potential Effects

During the remediation activities, there will be minor emissions of greenhouse gases, nitrogen oxides (NO_x), sulphur dioxide (SO_2) particulate matter (PM) and carbon monoxide (CO) due to combustion of diesel fuel or gasoline in vehicles. There is also the potential for dust generation during vehicle movement. These emissions will be of short-term duration and will be restricted to the local area around the site. Table 6-1 is an environmental assessment matrix for the Air Quality VEC.

Table 6-1: Environmental Effects Assessment Matrix: Air Quality

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Environmental Effects				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Remediation	Emissions of greenhouse gases, nitrous oxides, sulphur dioxide, particulate matter, and carbon monoxide from vehicles (A).	• None	1	2	2/5	R	1
	Vehicle movement will generate dust (A).	• Dust control measures will be implemented. Water will be used for dust suppression. Exposed soil piles will be covered.	1	2	2/5	R	1
Hazardous Materials Removal	The removal of the contaminated soil from the environment will reduce the risk of effects on air quality due to dust generation from these soils (P).	• N/A					

Table 6-1: Environmental Effects Assessment Matrix: Air Quality

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Environmental Effects				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context

KEY

Magnitude:

1 = Low: emissions predicted to be within the CCME National Ambient Air Quality Objectives
3 = High: Emissions predicted to exceed the CCME National Ambient Air Quality Objectives

Geographic Extent:

1 = <1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101-1000 km²
5 = 1001-10,000 km²
6 = >10,000 km²

Duration:

1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.3.2.3 Mitigation

Mitigative measures for controlling fugitive dust emissions during the project activities will be detailed in procedures that the contractors will be required to follow (*i.e.,* watering down roads and exposed portions of the project site, covering exposed soil piles). Windblown dust during project activities is expected to be negligible.

6.3.2.4 Residual Environmental Effects

Definition of Significance

Significant Effects to the atmospheric environment are defined to occur when ground-level concentrations associated with emissions from activities exceed ambient air quality standards that have been established by the government to protect human health and the environment. In this case, the National Ambient Air Quality Objectives from the Canadian Council of Ministers of the Environment (CCME 1999) are the standards used.

Residual Environmental Effects Summary

Table 6-2 summarizes the residual environmental effects of the project activities on air quality. The effects of vehicle and equipment emissions during the remediation activities are not expected to exceed CCME ambient air quality objectives, although no monitoring of emissions has been carried out. Emissions will be short term and intermittent and will not be unlike those from low traffic volumes in a city such as Iqaluit. Dust generation is expected to also be low in volume and infrequent.

Table 6-2: Residual Environmental Effects Summary Matrix: Air Quality

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
General Remediation	NS		
Hazardous Materials Removal	P		

KEY

Residual Environmental Effects Rating:

S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect
P = Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a = effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.3.2.5 Summary of Environmental Effects on Air Quality

Remediation activities at the CAM-D DEW Line Site will not have a significant effect on the air quality. The CAM-D DEW Line Site remediation will have a positive effect on air quality due to the removal of contaminated soil from the environment, thereby reducing the risk of dust from this soil affecting air quality.

6.4 Terrain

The terrain VEC includes surficial geology, soils and vegetation. The soils component refers to the physical characteristics of the surficial material; soil quality is addressed as a separate VEC in Section 6.5.

6.4.1 Existing Environment

6.4.1.1 Geology and Soils

Surficial Geology

The geology on the Boothia Peninsula is underlain by crystalline gneiss forming a narrow north-trending prong of the Precambrian Shield, partly covered by outliers of Palaeozoic strata. In the south, where the CAM-D DEW Line Site is located, it merges with the Wager Plateau at about 760 m asl and slopes gently northward.

The exposed bedrock around the site is characterized by faulted and fractured granite outcrops. Much of the ground surrounding the site consists of a thin layer of weathered and frost-shattered rock over the bedrock. There is a ridge that rises up southeast of the site beyond the freshwater lake.

Soils

The dominant soil on the Boothia Peninsula is Turbic Cryosols developed on hummocky, thin, discontinuous sandy moraine. Bedrock outcroppings are common and the permafrost in the area is continuous and of low ice content.

6.4.1.2 Vegetation

The mid-arctic climate limits the vegetation to herbaceous species only. The region is characterized by discontinuous tundra vegetation such as purple saxifrage, *Dryas spp.*, and arctic willow, along with alpine foxtail, wood rush, and saxifrage. Wet areas have a continuous cover of sedge, cottongrass, saxifrage, and moss (Ecological Stratification Working Group 1995). No trees are found in the area.

Away from the rock outcrops on the site, the vegetation is plentiful and consists mostly of mosses, willows (*Salix* sp.), sedges (Carex sp., *Eriophorum* sp.), grasses (*Arctagrostis* sp., *Deschampsia* sp., *Poa* sp.) and flowering herbs.

The sever scarification of the terrain around the station that could be seen in aerial photographs from 1964, has been mostly covered by encroaching vegetation (RRU 1995). During the 1994 site visit, the Environmental Services Group at Royal Roads Military College found that many of the old track roads were difficult to locate as they were completely covered with vegetation.

There are over 1000 species of vascular plants in Nunavut. Of these only 18 species have been reviewed as to their general status in the territory. To date no rare or endangered vegetation species have been identified (Department of Sustainable Development 2001).

6.4.2 Environmental Effects Analysis - Terrain

6.4.2.1 Study Area Boundaries

The spatial boundary for the assessment of the effects of project activities on the terrain of the area includes the area immediately surrounding the CAM-D DEW Line Site facilities. The temporal boundary for terrain is the time period for the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization and extending to the monitoring period following the completion of the remediation project.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA for review by NIRB and other federal departments through the normal CEAA process. Technical boundaries of the terrain assessment are the lack of site-specific terrain data and the limited time frame associated with the environmental assessment.

6.4.2.2 Identification of Issues, Interactions and Potential Effects

The majority of the terrain in the immediate vicinity of the site facilities has been previously disturbed. Efforts have been made to use existing borrow sources and construct the new landfill within or close to the facility footprint. However, excavation for the new landfill, closing of existing dumps, and excavation and removal of contaminated soil areas have the potential to degrade permafrost. The extraction of granular material will also alter the terrain of the borrow areas.

During the remediation activities, interactions with the terrain will be restricted to disruption by vehicle or equipment movement and excavation of contaminated soils and buried (or partially buried) debris. Movement, as much as possible, will be restricted to existing tracks and already-disturbed areas as much as possible. Specific routes will be upgraded to accommodate the vehicles and equipment necessary to remove the various wastes found on the site. Most of the waste appears to have been deposited directly on the ground and only minor quantities have been buried. Thus, the amount of excavation required will be minimized.

Away from the rock outcrops at the site, the plant life is plentiful. Revegetation had obscured most previous disturbances around the site. Site clean up and remediation will allow further revegetation to occur. However, during the clean up and remediation activities, local vegetation may be affected by fugitive dust. Mitigation measures used to reduce the levels of fugitive dust should reduce any effects to local vegetation.

Table 6-3 is an environmental assessment matrix for the Terrain VEC.

Table 6-3: Environmental Effects Assessment Matrix: Terrain

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Landfill Construction/ Landfill Closure	Excavation required for developing and capping of the new landfill, and closure of existing waste dumps has the potential to degrade permafrost (A).	• The duration of permafrost exposure will be minimized. • The surface area of exposed permafrost or active zone will be minimized. • Smoothing and contouring of the surface will be minimized (unless required for drainage purposes) to create microsites that will encourage vegetation growth.	1	2	3/1	R	2
Site Debris Disposal	The removal of site debris has the potential to further disturb the existing terrain (A)	• Disturbed area will be graded and reshaped to match existing terrain and drainage paths. • Existing tracks will be used for movement around the site.	1	2	3/1	R	2
Site Grading	Drainage will be improved as a result of grading disturbed areas. Previously disturbed areas will blend into the natural environment (P).	• Smoothing and contouring of the surface will be minimized (unless required for drainage purposes) to create microsites that will encourage vegetation growth.					

Table 6-3: Environmental Effects Assessment Matrix: Terrain

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Borrow Source Development	The extraction of granular material will alter the terrain of the borrow area (A).	• Disturbed area will be graded and reshaped to match existing terrain and drainage paths.	1	2	2/1	R	1
Contaminated Soil Excavation	The excavation and removal of contaminated soil has the potential to degrade permafrost (A).	• The duration of permafrost exposure will be minimized. • The surface area of exposed permafrost or active zone will be minimized. • Disturbed area will be graded and reshaped to match existing terrain and drainage paths. • Existing tracks will be used for movement around the site.	1	2	3/1	R	2
Temporary Work Camp	Camp construction may destroy landforms and disturb vegetation (A).	• Camp and related facilities/infrastructure will be set in previously disturbed areas.	1	1	3/1	R	2
Contractor Support	Movement of contractor's equipment and personnel around the site has the potential to disturb the tundra (A).	• Movement will be restricted to existing tracks and already-disturbed areas as much as possible.	1	1	2/1	R	2
Cat Train Mobilization/ Demobilization Activities	Potential for interaction with terrain outside the project site (A).	• Mobilization and demobilization activities will be conducted during the spring over snow cover.	1	4	1/1	R	1

KEY

Magnitude:

1 = Low: Erosion, permafrost degradation and destruction of vegetation is minor and limited in extent.

2 = Medium: Erosion, permafrost degradation and destruction of vegetation is more intense and widespread.

3 = High: Extensive erosion, permafrost degradation and destruction of vegetation.

Geographic Extent:

1 = <1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101-1000 km²
5 = 1001-10,000 km²
6 = >10,000 km²

Duration:

1 = <1 month
2 = 1-7 months
3 = 8-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.4.2.3 Mitigation

During the remediation activities, vehicles and workers will use existing tracks for travel, whenever possible. Intrusive remediation activities will be carried out in a manner that minimizes the extent of disturbance and the potential for erosion.

Removal of contaminated soil is not expected to affect terrain contours as contaminated soils exist in gullies and valleys only. Therefore, no re-contouring of the site is required. Disturbed areas will be graded and reshaped to match existing terrain and drainage patterns. Unless required for drainage purposes (*i.e.,* the landfill cap), smoothing and contouring of the surface will be minimized to create microsites that will encourage vegetation growth. Project activities will be carried out to ensure that the time and area of permafrost exposure is minimized.

Mitigation measures to reduce to levels of fugitive dust will also benefit local terrestrial vegetation.

6.4.2.4 Residual Environmental Effects

Definition of Significance

A significant environmental effect on the terrain VEC is one that results in permafrost degradation, surface erosion, sliding or slumping such that a significant effect results upon one of the water quality, biological, heritage resource, or socio-economic VECs or when the population of a vegetation species is sufficiently affected to cause a decline in abundance and/or change in distribution beyond which natural recruitment would not return the population to its former level within several growing seasons.

Residual Environmental Effects Summary

Table 6-4 summarizes the residual environmental effects of the project activities on terrain. Activities during remediation are not expected to affect terrain significantly. Some landforms will be disturbed during the contaminated soil removal but the disturbance is assessed as not significant.

Table 6-4: Residual Environmental Effects Summary Matrix: Terrain

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
Landfill Construction/Landfill Closure	NS		
Site Debris Disposal	NS		
Site Grading	P		
Borrow Source Development	NS		
Contaminated Soil Excavation	NS		
Temporary Work Camp	NS		
Contractor Support	NS		
Cat Train Mobilization/ Demobilization Activities	NS		

KEY

Residual Environmental Effects Rating:

S =Significant Adverse Environmental Effect
NS =Not Significant Adverse Environmental Effect
P = Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a = effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.4.2.5 Summary of Environmental Effects on Terrain

Remediation activities are assessed as not having significant effects on the terrain of the area around the CAM-D DEW Line Site.

Contaminated soil removal will result in minor terrain disturbance. The removal of site debris has the potential to further disturb the existing terrain. Vehicles and workers will use existing tracks for movement around the site to minimize disturbance to the tundra.

6.5 Soil Quality

6.5.1 Existing Environment

Soils in the CAM-D DEW Line Site area are typically Turbic Cryosols developed on hummocky thin discontinuous sandy moraines. Information on soil quality is lacking.

6.5.2 Environmental Effects Analysis - Soil Quality

6.5.2.1 Study Area Boundaries

The spatial boundary for the assessment of project effects on soil quality is the CAM-D DEW Line Site and the extent beyond the site in which soil contaminates may be expected to migrate. The temporal

boundary for terrain is the time period for the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA for review by NIRB and other federal departments through the normal CEAA process. Technical boundaries of the soil quality assessment are the lack of site-specific soil data and the limited time frame associated with the environmental assessment.

6.5.2.2 Identification of Issues, Interactions and Potential Effects

The remediation activities have the potential to interact with soil quality through the exposure of hazardous materials and contaminated soil to leaching during the excavating of contaminated soils, aerating the hydrocarbon impacted soils, handling of hazardous materials and through accidental events such as spills. There is also the potential for spills to occur during mobilization and demobilization of the cat train. The operation of the work camp will include treatment and disposal of waste, which could negatively affect soil quality if not carried out properly. Table 6-5 is an environmental assessment matrix for the Soil Quality VEC.

6.5.2.3 Mitigation

During the remediation activities, Project personnel will be appraised of known locations of hazardous materials and disturbance of these sites will be kept to a minimum. Spill prevention and spill contingency plans will be in effect during all activities.

Proper handling procedures will be implemented for the storage and transportation of hazardous materials. All workers will be trained to properly handle all hazardous materials on site and no hazardous materials or fuel will be stored near waterbodies. Contingency plans for spills will be followed, and will be available on site, and all fuel will be handled in accordance with the contingency plan.

Hazardous materials will not be disposed of in the camp waste system. The disposal of all sewage will be in accordance with applicable regulations and guidelines.

Table 6-5: Environmental Effects Assessment Matrix: Soil Quality

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Environmental Effects				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Remediation	Hazardous materials or contaminated soils may be exposed to leaching during excavating and handling (A).	• Investigators will have reviewed previous site assessments and activities near known areas of contamination will be carried out in a manner to minimize disturbance to the contaminated materials.	1	1	2/1	R	2
	The removal of the contaminated soil and hazardous materials from contact with the environment will improve soil quality (P).	• NA					
	Accidental spills of hazardous materials, contaminated soil or fuel may result in soil degradation (A).	• Proper handling, storage and transportation procedures for hazardous materials will be implemented. • All workers will be trained in proper handling procedures for all hazardous materials on site. • Hazardous materials or fuel will not be stored near water sources. • Spill contingency plans have been developed and will be implemented as necessary. • Contingency plans related to all materials and equipment will be available on site. • All fuel will be handled in accordance with the Contingency Plan.	1	1	2/1	R	2
Landfill Development	Migration of contaminants from improperly constructed landfill could result in soil degradation (A).	• Leachate control measures will be incorporated into the landfill. These include using frost-stable fill material placed outside the high groundwater or constant surface water recharge area	1	1	5/6	R	2
Equipment and Vehicle Movements	Movement of contractor's equipment and personnel around the site has the potential to disturb the tundra (A).	• Existing roads will be used for movement around the site.	1	1	2/1	R	2
Work Camp	The operation of the construction camp will include treatment and disposal of waste, which could degrade soil quality (A).	• Hazardous materials will not be disposed of in the camp waste system. • All hazardous materials will be removed from the site for disposal. • All sewage will be disposed of in accordance with applicable regulations and guidelines.	1	1	2/1	R	2

Table 6-5: Environmental Effects Assessment Matrix: Soil Quality

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Environmental Effects				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context

KEY

Magnitude:

1 = Low: Soil chemical composition is not altered to the extent that vegetation currently present is affected.
2 = Moderate: Soil chemical composition is altered such that a moderate percentage of the vegetation is affected.
3 = High: Soil chemical composition is altered such that all vegetation is degraded and/or contaminants leach to groundwater.

Geographic Extent:

1 = <1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101-1000 km²
5 = 1001-10,000 km²
6 = >10,000 km²

Duration:

1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.5.2.4 Residual Environmental Effects

Definition of Significance

Significant effects are defined as those altering soil such that one or both of the following occurs:

- soil chemical composition is altered such that it will not support vegetation in areas where vegetation previously grew and the extent is greater than 1 km from the facility; and
- Soil chemical composition is altered such that it is a threat to groundwater and surface water.

Residual Environmental Effects Summary

Table 6-6 summarizes the residual environmental effects of project activities on soil quality. Activities during the remediation program are expected to have a positive effect on soil quality or not to affect soil quality significantly.

Table 6-6 Residual Environmental Effects Summary Matrix: Soil Quality

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
General Remediation	NS/P		
Landfill Development	NS		
Equipment and Vehicle Movements	NS		
Work Camp	NS		

KEY

Residual Environmental Effects Rating:

S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect
P = Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a = effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.5.2.5 Summary of Environmental Effects on Soil Quality

Activities associated with the remediation program for the CAM-D DEW Line Site are assessed as not having a significant effect on the environment.

The potential exists for an accidental release of hazardous materials, contaminated soil and/or fuels that could affect soil quality. However, proper handling procedures for hazardous materials will be implemented for their storage and transportation. Also, all workers will be trained to properly handle hazardous materials on site and no hazardous materials or fuel will be stored in close proximity to water bodies. Spill contingency plans will be followed, and will be available on site. All fuel will be handled in accordance with the contingency plan.

The operation of the work camp will include the treatment and disposal of waste, and has the potential to degrade soil quality. However, hazardous materials will not be disposed of in the camp waste system, and the disposal of all sewage will be in accordance with applicable regulations and guidelines.

6.6 Water Quality

6.6.1 Existing Environment

Waterbodies in the vicinity of the CAM-D DEW Line Site include Simpson Lake, the Murchison River and numerous smaller lakes and rivers.

6.6.2 Environmental Effects Analysis - Water Quality

6.6.2.1 Study Area Boundaries

The spatial boundary for the assessment of the effects of project activities on the water quality of the area is the local watershed for Simpson Lake. The temporal boundary for terrain is the time period for

the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA for review by NIRB and other federal departments through the normal CEAA process. Technical boundaries of the water quality assessment are the lack of site-specific water quality data and the limited time frame associated with the environmental assessment.

6.6.2.2 Identification of Issues, Interactions and Potential Effects

Interactions between the remediation activities and water quality will be similar to those for the soil quality environment, *i.e.,* the potential for leachates from exposed hazardous materials and contaminated soil, and the potential for spills of fuel and hazardous materials, including the potential of spills during mobilization and demobilization of the cat train.

Table 6-7 is an environmental assessment matrix for the Water Quality VEC.

Table 6-7: Environmental Effects Assessment Matrix: Water Quality

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Remediation	Hazardous materials or contaminated soils may be exposed to leaching during remediation; the leachate may degrade water quality (A).	• Investigators will have reviewed previous site assessments and activities near known areas of contamination will be carried out in a manner to minimize disturbance to the contaminated materials.	1	1	2/1	R	1
	The removal of the contaminated soil and hazardous materials will reduce the risk of contamination to surface water quality (P).	• NA					

Table 6-7: Environmental Effects Assessment Matrix: Water Quality

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Remediation	Accidental spills of hazardous materials, contaminated soils or fuels may result in water quality degradation (A).	• Proper handling, storage and transportation procedures for hazardous materials will be implemented.	1	2	1	R	1
		• All workers will be trained in proper handling procedures for all hazardous materials on site. • Hazardous materials or fuel will not be stored near water sources. • Spill contingency plans have been developed and will be implemented as necessary. • Contingency plans related to all materials and equipment will be available on site. • All fuel will be handled in accordance with the Contingency Plan.	1	1	2/1	R	1
Landfill Development	Migration of contaminants from the new landfill may degrade water quality (A)	• Leachate control measures will be incorporated into the landfill. These include using frost-stable fill material placed outside the high groundwater or constant surface water recharge area	1	1	5/6	R	2
Site Grading / Borrow Source Development	The erosion of soil and sedimentation of water bodies during grading and gravel extraction activities has the potential to degrade water quality (A)	• Siltation will be prevented by use of berms and/or silt fences. • Equipment will not be operated within the wetted perime ter. • Disturbed areas adjacent to water will be stabilized, if required.	1	2	3/1	R	1
	Grading and gravel extraction activities will also alter the terrain, and has the potential to disturb drainage (A)	• Grading and gravel extraction activities will be sited away from natural drainages • Upon completion of gravel extraction activities, the areas will be graded to blend with the natural terrain, and where appropriate, to promote surface runoff.	1	2	3/1	R	1

Table 6-7: Environmental Effects Assessment Matrix: Water Quality

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Placement of culverts	Soil erosion and resulting sedimentation of the stream may occur during placement. (A)	• Culvert placement will take place during periods of low flow in the stream.	1	2	3/2	R	1
Work Camp	The operation of the construction camp will include treatment and disposal of waste, and could degrade water quality (A).	• Hazardous materials will not be disposed of in the camp waste system. • All sewage will be disposed of in accordance with applicable regulations and guidelines.	1	1	2/1	R	1

KEY

Magnitude:

1 = Low: *e.g.,* Minor changes to water quality but not to the extent that aquatic life is affected or water that was previously potable is now non-potable.

2 = Medium: *e.g.,* Moderate changes to water quality, affecting aquatic life at a local level or decreasing the quality of potable water (*e.g.*, odour problem).

3 = High: *e.g.,* Major changes to water quality, affecting aquatic life at a regional level or rendering previously potable water non-potable.

Geographic Extent:

1 = <1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101-1000 km²
5 = 1001-10,000 km²
6 = >10,000 km²

Duration:
1 = <1 month
2 = 1-7 months
3 = 8-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.6.2.3 Mitigation

During the remediation program, disturbance to known areas of hazardous waste will be minimized. Material handling and spill contingency plans will be in place and disposal of camp wastes will meet all regulatory standards.

Proper handling procedures will be implemented for the storage and transportation of hazardous materials. All workers will be trained to properly handle all hazardous materials on site and no hazardous materials or fuel will be stored on the beach area. Contingency plans for spills will be followed, and will be available on site, and all fuel will be handled in accordance with the contingency plan.

Hazardous materials will not be disposed of in the camp waste system. The disposal of all sewage will be in accordance with applicable regulations and guidelines.

6.6.2.4 Residual Environmental Effects

Definition of Significance

A significant effect to water quality is defined as one of sufficient magnitude so as to alter the quantity or quality of water to a degree that will result in a significant effect on aquatic life as defined in the effect significance definitions for other related VECs.

Residual Environmental Effects Summary

Table 6-8 summarizes the residual environmental effects of the project activities on water quality. Activities during the remediation program are not expected to affect water quality significantly.

Table 6-8: Residual Environmental Effects Summary Matrix: Water Quality

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
General Remediation	NS/P		
Landfill Development	NS		
Site Grading / Borrow Source Development	NS		
Placement of Culverts	NS		
Work Camp	NS		

KEY

Residual Environmental Effects Rating:

S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect
P = Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a = effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.6.2.5 Summary of Environmental Effects on Water Quality

The effects of the CAM-D DEW Line Site remediation on water quality will be positive, in the case of removing contaminants or will be not significant.

6.7 Terrestrial and Avian Animals and Habitat

6.7.1 Existing Environment

Wildlife in the region is dependent on suitable habitat for survival and given the sparse presence of vegetation in the region low densities and diversity of wildlife in the area are expected. There are however several species that may use the area for certain life stages such as breeding or migrating. Based on existing information the key wildlife species expected in the area are highlighted below.

It should be noted that most data collected for the area was collected after the CAM-D DEW Line facility was already in place.

6.7.1.1 Mammals

Terrestrial mammals expected to be found in the area include caribou, polar bear, common in coastal areas, Arctic hare, Arctic fox and lemming (Ecological Stratification Working Group 1995).

Polar Bear

The polar bear (*Ursus maritimus*) is considered a sensitive species in Nunavut (Department of Sustainable Development, 2001) and in 2002 it was listed as a species of Special Concern (COSEWIC 2003). Polar bear movements are normally dictated by sea ice characteristics, climate and the presence of prey species, especially ringed seals (Taylor et al. 2001). In Nunavut, polar bears are common in the coastal areas, especially in the summer. They move inland to find denning sites, where females will spend the winter with their new-born young.

CAM-D DEW Line Site is within the Gulf of Boothia polar bear population that is estimated to be just more than 1500 bears (GNU 2002). Population boundaries are based on the movement of tagged bears and the movement of female bears that have been outfitted with satellite collars (Taylor *et. al.,* 2001). Although population data from this area are limited, local hunters report that numbers have remained constant or increased (COSEWIC 2002). Within this population, polar bears exhibit site fidelity to these regions because of discontinuities in movement influenced by land-mass and open-water impediments and poor habitat. While occurrences of polar bears in the CAM-D DEW Line Site region are likely to be low, they could be met there occasionally at any time throughout the year. In recent years the Nunavut Wildlife Management Board increased the quota of polar bears from the Gulf of Boothia population for residents of Gjoa Haven because the population is considered to be healthy.

Caribou

Both Peary caribou (*Rangier tarandus pearyi*) and Barren-ground caribou (*Rangifer tarandus*) occur on the Boothia Peninsula (COSEWIC 2004). Peary caribou calve on the northwest of the peninsula and then summer there or move to southern Somerset Island or Prince of Wales Island before returning to the Taloyoak area for the winter. The barren-ground population calves on the northeast of the peninsula, summers there and returns to an area south of Taloyoak for the winter (COSEWIC 2004). Calving areas of the Boothia Peary caribou population have included the Wrottesley Inlet area on north-western Boothia Peninsula.

There is uncertainty about the amount of harvest on the Boothia Peninsula by hunters from Taloyoak COSEWIC 2004). Hunters from Taloyoak prefer Peary caribou because the meat is more flavourful and tender (COSEWIC 2004). Barren-ground caribou numbers have been increasing on Boothia Peninsula, while Peary caribou numbers have been decreasing (COSEWIC 2004).

The normal range for Peary caribou is entirely within the Arctic Archipelago, except for the population on the Boothia Peninsula (COSEWIC 2004). Some of the individuals in the Boothia population winter

as far south at the Hayes River. Peary caribou live exclusively in Arctic tundra. The Boothia population of Peary Caribou was designated as threatened by COSEWIC in 1991.

Caribou adapt their migrations according to snow conditions and forage availability. They can deplete the food supply in an area, and change their migration routes to utilize new browsing areas. They are particularly sensitive to disturbances during calving and post-calving periods. Little information on caribou movements on Boothia Peninsula is available.

Wolves

Little information exists on the status of wolves (*Canis lupus*) in Nunavut but they are expected to occur in low densities (COSEWIC 2003). Wolves are considered a sensitive species in Nunavut (Department of Sustainable Development 2001) and usually hunted whenever they are seen (Borealis Exploration Limited 1981). They are usually found in association with caribou herds (Ferguson and Vincent 1992). One of the biggest threats to the long-term persistence of wolves is humans and their associated activities that cause habitat alteration and exploitation (Cluff et al., 2002).

Wolverines

The wolverine (*Gulo gulo*) is listed as a species of Special Concern by COSEWIC and is considered sensitive in Nunavut (COSEWIC 2003; Department of Sustainable Development 2001). There are limited data available on the distribution, abundance, and ecology of wolverines in Nunavut (Mulders, 2000). On the Boothia Peninsula, wolverine populations are expected to be at low densities compared to other regions in Nunavut. Like wolves, they are usually found in association with caribou herds; however, odours and waste from human developments have acted as an attraction for these animals.

Fox

The red fox (*Vulpes vulpes*) and the Arctic fox (*Alopex lagopus*) have the potential to occur on the Boothia Peninsula and are considered secure in Nunavut (Department of Sustainable Development 2001). Red foxes have adapted well to arctic tundra habitats and compete with Arctic foxes. In the Arctic, foxes primarily prey upon lemmings and nests of waterfowl species. The cyclic nature of lemming populations influences the populations and behaviour of foxes. They are typically trapped in winter when they are common (Borealis Exploration Limited 1981). Arctic foxes will also trail behind polar bears to scavenge food.

Arctic foxes prefer vegetated soft ground for denning so the potential for dens exists in the CAM-D DEW Line Site region. Arctic foxes are territorial and rarely den less than a mile apart. Density of dens in the Keewatin was one per twenty-seven square miles. If foxes are present in the CAM-D DEW Line Site region, there would likely only be one or two dens (Borealis Exploration Limited 1981).

Arctic Hare

The Arctic hare (*Lepus arcticus*) occurs on the Boothia Peninsula; however, population numbers and density are unknown. They are considered secure in Nunavut (Department of Sustainable Development 2001). They have small home ranges that allow them to build up a series of runways and escape routes from predators (Anand-Wheeler 2002). They are a main prey species for carnivores and are important for maintaining predator-prey relationships in this harsh environment. The presence of arctic hare in a region can act as an indicator to the presence of prey species, such as foxes, in the region.

6.7.1.2 Birds

In the Arctic, the presence of birds is for the most part a seasonal phenomenon. Nunavut contains the northern limits of breeding ranges for numerous species of migratory birds, colonial seabirds, shorebirds and waterfowl. Besides being important for subsistence harvesting, birds are also valuable components of the landscape.

The Rasmussen Lowlands are located just to the west of the CAM-D DEW Line Site. Large numbers of nesting shorebirds, including Red Phalaropes (*Phalaropus fulicaria*), White-rumped Sandpipers (*Calidris fuscicollis*), Pectoral Sandpipers (*Calidris melanotos*), American Golden Plovers (*Pluvialis dominica*), Black-bellied Plovers (*Pluvialis squatarola*) and Semi-palmated Sandpipers (*Calidris pusilla*) have been documented in these lowlands. High numbers of several waterfowl species also occur here. Tundra Swans (*Cynus columbianus*), Greater White-fronted Goose (*Anser albifrons*), Snow Goose (*Chen caerulescens*) and King Eider (*Somateria spectabilis*) breed in the area. Large number of Pacific Loons (*Gavia pacifica*) has also been recorded (Johnston et al. 2000). Yellow-billed loons breed on the western Boothia peninsula.

The escarpment located along the eastern border of the lowlands supports a large population of nesting Peregrine Falcons (Johnston et al. 2000). Their preferred nesting site is on cliffs and outcrops near lakes, ponds and streams. No raptors were observed at the CAM-D DEW Line Site during the ESG (1994) site visit, but they likely occur in the area. The Peregrine Falcon *tundrius* subspecies (*Falco peregrinus tundrius*) that breeds in the tundra regions of Canada is considered a species of Special Concern and is listed on Schedule 3 of the federal *Species at Risk Act* (SARA).

6.7.1.3 Species at Risk

SARA was passed by Parliament on December 12, 2002. As of June 5, 2003 most of the Act had come into force. SARA applies to all aquatic species and migratory birds wherever they are found and to all species listed as endangered, threatened or extirpated species on federal lands (which includes territorial lands) by COSEWIC. In addition, SARA amends the definition of “environmental assessment” in the CEAA to include any change that the project may cause to a listed species, its critical habitat or the residences of individuals of that species. Subsequently, any project requiring an environmental assessment under federal law that is likely to affect a listed species or its critical habitat needs to identify the adverse effects, and if the project goes forward, steps must be taken to avoid or lessen those effects and to monitor them.

The polar bear, Peary caribou, wolverine and peregrine falcon are four wildlife species that are listed by COSEWIC (2003) as species at risk. The status of these species has been highlighted in the subsections above. Peregrine falcons are relatively common on the Boothia Peninsula with the major nesting areas on the escarpment of the Rasmussen Lowlands (Johnston et al. 2000), but as mentioned there has been no documented evidence of peregrines nesting near the CAM-D DEW Line Site. Both the polar bear and wolverine are only expected to occur near the site on an occasional basis. Peary caribou calve in the northwestern section of the peninsula and would only occur near the site during winter.

6.7.2 Environmental Effects Analysis - Terrestrial and Avian Animals and Habitat

6.7.2.1 Study Area Boundaries

Given the wide ranging characteristics of most wildlife species, the spatial boundary for the assessment of the remediation program on the terrestrial animals includes the CAM-D DEW Line Site and the surrounding area, which may extend to the limit of the Boothia Peninsula depending on the type of wildlife species. The temporal boundary for terrain is the time period for the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA for review by NIRB and other federal departments through the normal CEAA process. Technical boundaries of the terrestrial animals and habitat assessment are the limited time frame associated with the environmental assessment.

6.7.2.2 Identification of Issues, Interactions and Potential Effects

Major threats to polar bears are occurring at the global scale. Bio-accumulation of pollutants and climate change are effecting the overall survival of this species. Hunting regulations and sustainable harvesting practices are being implemented to protect the bears. The CAM-D DEW Line Site is not within a major core area for polar bears. Consequently, interaction between the remediation activities and polar bears are expected to be minimal. A strategy for dealing with polar bear interactions will be implemented to ensure that no bears are unnecessarily destroyed as a result of the project.

The movement of Peary caribou on the Boothia Peninsula occurs from the northwestern part of the peninsula to the area south of Taloyoak. Barren ground caribou move from the eastern part of the peninsula to the area south of Taloyoak (Gunn *et al. 2000*). The majority of these movements occur well north of the CAM-D DEW Line Site. The nearest caribou activity to the site would be the wintering areas south of Taloyoak.

Potential interactions with wildlife, such as polar bear, wolves, wolverine and foxes, and the Project exist if proper waste and odour management strategies for the facilities are not implemented. These strategies must identify and describe details of design features, operational measures, employee/contractor staff awareness and training, for handling of food, food waste and other wastes throughout the clean up site and specifically for the incinerator, landfill site, kitchens, camps and personnel quarters.

Most wildlife species are likely to exhibit some degree of sensitivity to human disturbance and from heavy equipment during the detailed site investigation. This sensitivity varies based on aspects of their behaviour, including the degree to which they adapt and habituate to human disturbance. This disturbance could result in temporary displacement of certain species from preferred habitat, abandonment of nests, dens or breeding areas and stress-related reduction in reproductive success.

Accidents, malfunctions and unplanned events such as collisions between wildlife and Project-related vehicles or hazardous materials spill may interact with wildlife in a manner that results in the alteration of habitat, changes in wildlife movement patterns and/or the loss of individual animals.

The remediation of the site will improve wildlife habitat by removing contaminated materials from the island.

Table 6-9 is an environmental assessment matrix for the terrestrial and avian animals VEC.

Table 6-9: Environmental Effects Assessment Matrix: Terrestrial & Avian Animals and Habitat

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Remediation Activities	The movement of humans and vehicles around the site has the potential to disturb wildlife (A).	• Workers will be instructed to avoid encounters with animals. • Vehicle movement will be restricted to existing tracks wherever possible. • Activity timelines will be kept as tight as possible to reduce the amount of time disturbance is occurring. • Nesting areas and SARA species habitat will be avoided or protected.	1	1	2/1	R	2
Work Camp	The operation of the construction camp will include treatment and disposal of waste (A).	• All sewage will be disposed of in accordance with applicable regulations and guidelines. • All solid waste will be properly contained and disposed according to regulations.	1	1	2/1	R	1

Table 6-9: Environmental Effects Assessment Matrix: Terrestrial & Avian Animals and Habitat

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Landfill Developments	Loss of habitat may occur as a result of the development of the new landfills in previously undisturbed areas (A).	• New landfills will be located within the existing facility footprint or adjacent to it wherever possible. • New landfill areas will be graded and reshaped to match existing terrain to facilitate the recovery of ecosystem components.	1	2	3/1	R	1
Facility Demolition	The existing facilities may be used by wildlife as habitat. The demolition of these facilities has the potential to impact availability of habitat (A).	• Facilities will be inspected for use by wildlife prior to demolition. • Facilities will not be demolished in the immediate vicinity of nests while birds are nesting. • Appropriate wildlife officer will be contacted for additional guidance to ensure disturbance of wildlife is minimized.	1	2	3/1	R	1
Borrow Source Development	The extraction of granular material will require the disturbance of the ground and has the potential to impact terrestrial habitat (A).	• Disturbed areas will be graded and reshaped to match existing terrain to facilitate the recovery of ecosystem components.	1	2	3/1	R	1
Soil Remediation	Soil removal could disturb wildlife and destroy habitat (A).	• Activities will be restricted to the contaminated site. • Care will be taken to ensure minimum disturbance. • Nesting areas and SARA species habitat will be avoided or protected.	1	1	2/2	R	2
	Removal of contaminated soil will improve wildlife habitat (P).	• NA					

Table 6-9: Environmental Effects Assessment Matrix: Terrestrial & Avian Animals and Habitat

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Accidental Events	Accidental spills of hazardous materials, contaminated soil or fuel may result in habitat destruction or degradation (A).	• Proper handling, storage and transportation procedures for hazardous materials will be implemented. • All workers will be trained in proper handling procedures for all hazardous materials on site. • Hazardous materials or fuel will not be stored near water sources. • Spill contingency plans have been developed and will be implemented as necessary. • Contingency plans related to all materials and equipment will be available on site. • All fuel will be handled in accordance with the Contingency Plan.	1	1	2/1	R	2

KEY:

Magnitude:

1 = Low: *e.g.,* a few individuals. Species and or habitats affected occasionally.

2 = Medium: *e.g.,* a moderate percentage/number of individuals, species and or habitats affected within the LSA for a period of more than one month.

3 = High: *e.g.,* a large percentage/ number of individuals, species and or habitats within LSA affected for a period of more than one month.

4 = Very High *e.g.*, long-term regional effects on wildlife abundance distribution and biodiversity (*e.g.*, effect to an endangered species).

Geographic Extent:

1 = <1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101-1000 km²
5 = 1001-10,000 km²
6 = >10,000 km²

Duration:
1 = <1 month
2 = 1-7 months
3 = 8-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.7.2.3 Mitigation

To protect migratory birds that may use the project site in some capacity and ensure compliance with the *Migratory Birds Convention Act* (MBCA), a biologist will survey the site prior to any on-site work being initiated. The biologist will be tasked with identifying nesting and foraging birds making use of the project area. Suitable mitigation will be put in place to ensure that there are no MBCA contraventions as follows:

- Nesting birds: nests will be identified and flagged. Depending on the situation and species, the area will either be left undisturbed until the nest is abandoned or it will be moved in a manner that will ensure the viability of the eggs/nestlings;
- Foraging birds: unless a species at risk is identified in the project area, no specific mitigation is proposed for birds using the project area for foraging purposes (no specific requirement for this under MBCA);
- SARA birds: if any SARA species are identified at the site (whether nesting or foraging) steps will be taken to avoid all individuals of this species throughout the project lifecycle; and
- Staging birds: It is highly unlikely that birds use any portion of the project area for migration staging purposes. The potential for this activity on-site will be re-assessed by the project biologist during the site and suitable mitigation proposed for this type of situation if this potential is identified.

During the remediation program, workers will receive wildlife awareness training and will be instructed to avoid wildlife encounters. Wildlife protection measures that include provisions to reduce attractants through proper waste disposal, education and awareness of potential wildlife interactions and hazardous materials and spill contingency procedures will be adhered to.

To reduce disturbance to breeding birds, a small amount of activities will begin prior to the breeding season, with most of the remediation activities occurring after breeding season. Birds will likely move to different areas to begin breeding.

During the Project activities, efforts will be made to avoid known wildlife colonies or bird nesting areas. Where applicable, minimum distance and height restrictions will be used for transportation activities. Also, the appropriate wildlife officer will be contacted for guidance to ensure that the disturbance to wildlife is minimized. Prior to demolition, infrastructure will be examined for the presence of active nests. If found, suitable mitigation measures will be implemented.

Caribou protection measures are likely to be attached to land use permits. These measures will likely state that project activities shall be prohibited within all caribou calving areas during calving season or block or cause substantial diversion to caribou migration. Since CAM-D DEW Line Site is outside of these areas these measures should not affect the project schedule.

All disturbed areas will be re-graded and reshaped to match the existing terrain to facilitate the recovery of the ecosystem components. Prior to demolition, facilities will be inspected for use by wildlife (*i.e.,* nests in structures). Should any active nests be discovered, waste consolidation will be postponed until the nesting is complete. Also, the appropriate wildlife officer will be contacted for guidance to ensure that the disturbance of wildlife is minimized.

Soil remediation will be carried out in a manner that minimizes the extent of disturbance and the potential for erosion.

There is potential for accidental events to adversely affect wildlife and wildlife habitat. To minimize the possibility of an accidental event, including collisions, spills, or fires, an environmental protection plan that contains direction on minimizing and mitigating potential effects of such an event on wildlife and wildlife habitat will be implemented. These include Wildlife Protection Measures and Hazardous Materials and Spill Contingency Procedures.

6.7.2.4 Residual Environmental Effects

Definition of Significance

A significant environmental effect of project activities on terrestrial or avian animals occurs when the population of a species is sufficiently affected by the Project to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its former level within several generations.

Residual Environmental Effects Summary

Table 6-10 summarizes the residual environmental effects of the project activities on terrestrial and avian animals and habitat. Effects of the Project on terrestrial animals and habitat, for remediation activities are assessed as not significant. The removal and disposal of hazardous materials will have a positive effect on terrestrial animals.

Table 6-10: Residual Environmental Effects Summary Matrix: Terrestrial & Avian Animals and Habitat

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
General Remediation	NS		
Work Camp	NS		
Landfill Developments	NS		
Facility Demolition	NS		
Borrow Source Development	NS		
Soil Remediation	NS/P		

KEY

Residual Environmental Effects Rating:

S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect
P = Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a =effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.7.2.5 Summary of Environmental Effects on Terrestrial and Avian Animals and Habitat

The effects of the remediation program on terrestrial animals and their habitat are assessed as not significant, for the most part, with soil remediation having a positive effect.

6.8 Aquatic Animals and Habitat

6.8.1 Existing Environment

One of the more important fish species to the people of the Boothia Peninsula is the Arctic char *(Salvelinus alpinus*). Char are fished during their spring run out of the rivers and during the fall run back into the rivers. Char are usually caught in estuaries as the fish wait there to acclimatise to a change in water salinity. Aquatic field studies were not carried out for this assessment. Consequently, the Murchison River and Simpson Lake were assumed to be fish bearing.

6.8.2 Environmental Effects Analysis - Aquatic Animals and Habitat

6.8.2.1 Study Area Boundaries

The spatial boundary for the assessment of the effects of project activities on the aquatic animals is Simpson Lake and its outlets, and the Murchison River. The temporal boundary for terrain is the time period for the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA for review by NIRB and other federal departments through the normal CEAA process. Technical boundaries of the aquatic animals and habitat assessment are the lack of site-specific information and limited time frame associated with the environmental assessment.

6.8.2.2 Identification of Issues, Interactions and Potential Effects

Drainage at the site runs both in a north-west direction towards Simpson Lake and in a southern direction toward the small waterbodies south of the site. Simpson Lake and the smaller waterbodies then drain into the Murchison River.

The potential exists for an accidental release of hazardous materials, contaminated soil and/or fuels, which could affect aquatic habitat. This includes the potential for spills to occur during mobilization and demobilization of the cat train. Table 6-11 is an environmental assessment matrix for the aquatic animals and habitat VEC.

Table 6-11 : Environmental Effects Assessment Matrix: Aquatic Animals and Habitat

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Remediation	Accidental spills of hazardous materials, contaminated soil, or fuel may enter the aquatic environment (A).	• Spill prevention and spill contingency plans will be in effect during the project activities.	1	2	1/1	R	1
Landfill Development	The proximity of landfills to waterbodies has the potential to affect aquatic habitat, thereby affecting aquatic animals through sediment or hazardous materials entering the water (A).	• Mitigative measures such as berms, silt fences and/or silt booms will be implemented, as needed, to prevent deleterious substances from entering the aquatic environment.	2	2	3/1	R	1
Borrow Development and Site Regrading	The extraction of granular material and grading adjacent to waterbodies has the potential to affect aquatic habitat thereby affecting aquatic animals through sediment entering the water (A).	• Mitigative measures such as berms, silt fences and/or silt booms will be implemented, as needed, to prevent deleterious substances from entering the aquatic environment.	2	2	3/1	R	1
Placement of culverts	Soil erosion and resulting sedimentation of waterbodies may occur during placement. (A)	• Culvert placement will take place during periods of low flow in the stream.	1	2	3/2	R	1
Hazardous Materials and Contaminated Soil Removal	The removal of hazardous materials and contaminated soil from areas close to waterbodies, reduces the risk of exposure to aquatic animals (P).	• N/A					

Table 6-11 : Environmental Effects Assessment Matrix: Aquatic Animals and Habitat

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context

KEY

Magnitude:

1 = Low: <1% loss of critical fish habitat or <1% change in fish population abundance.

2 = Medium: 1-20% loss of critical fish habitat or 1-20% change in fish population abundance.

3 = High: >20% loss of critical fish habitat or >20% change in fish population abundance.

Geographic Extent:

1 = <1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101-1000 km²
5 = 1001-10,000 km²
6 = >10,000 km²

Duration:

1 = <1 month
2 = 1-7 months
3 = 8-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.8.2.3 Mitigation

Effects on aquatic animals and habitat during the remediation program will be mitigated by spill prevention and contingency plans.

6.8.2.4 Residual Environmental Effects

Definition of Significance

A significant environmental effect of the project activities on aquatic animals occurs if a population or portion thereof is affected in such a way as to cause a decline or change in abundance or distribution of the population over one or more generations; natural recruitment may not re-establish the population to its original level. A significant effect on aquatic habitat may alter the valued habitat, physically, chemically or biologically, in quality or extent, to such a degree that there is a decline in the diversity of the habitat. This effect would be reflected by a decline in abundance and/or change in distribution of the benthic community within the bridge area, beyond which natural recruitment would not return that population to its former level within several generations.

Residual Environmental Effects Summary

Table 6-12 summarizes the residual environmental effects of the project activities on aquatic animals and habitat. The implementation of the mitigative measures proposed to protect the aquatic animals and habitat will result in the residual effects being not significant or, in the case of the removal of existing hazardous materials, positive.

Table 6-12 : Residual Environmental Effects Summary Matrix: Aquatic Animals and Habitat

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
General Remediation	NS		
Landfill Development	NS		
Borrow Development and Site Regrading	NS		
Placement of culverts	NS		
Hazardous Materials and Contaminated Soil Removal	P		

KEY

Residual Environmental Effects Rating:

S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect
P = Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a = effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.8.2.5 Summary of Environmental Effects on Aquatic Animals and Habitat

Effects of the Project on aquatic animals and habitat are associated with the potential deposition of eroded material from borrow excavations and water quality effects from landfill leachates and fuel and chemical spills. The implementation of mitigation measures such as berms, silt fences and/or silt booms will prevent deleterious substances from entering the aquatic environment. Spill prevention and contingency plans will mitigate the effects of accidental spills.

6.9 Archaeological and Heritage Resources

6.9.1 Existing Environment

Information on the archaeological and heritage resources of the CAM-D DEW Line Site has not been collected prior to the preparation of this screening document. An archaeological survey of the site is planned for the summer of 2007 and the results of the survey will be provided to the Nunavut Department of Culture, Language, Elders and Youth. The recent history of the site is as a DEW Line facility.

6.9.2 Environmental Effects Analysis - Archaeological and Heritage Resources

6.9.2.1 Study Area Boundaries

The spatial boundary for the assessment of the effects of project activities on archaeology and heritage resources is the facility and access route footprint. The temporal boundary for terrain is the time period for the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA for review by NIRB and other federal departments through the normal CEAA process. Technical boundaries of archaeological and heritage resources assessment are the lack of site-specific information and limited time frame associated with the environmental assessment.

6.9.2.2 Identification of Issues, Interactions and Potential Effects

The presence and movement of people around the site has the potential to disturb archaeological resources if present around the site. Excavations during remediation activities have the potential to disturb or destroy archaeological and heritage resources, but also offer the potential for the discovery of previously unknown sites. Establishing the temporary work camp and completing the associated infrastructure upgrades also have the potential to disturb archaeological remains.

Table 6-13 is an environmental assessment matrix for the archaeology and heritage resources VEC.

Table 6-13: Environmental Effects Assessment Matrix: Archaeology and Heritage Resources

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Remediation	Any excavations associated with activities may disturb archaeological or heritage resources present (A).	• Archival research will be undertaken to prepare a historical summary of the history and development of the station. • An archaeological impact assessment will be completed to identify archaeological sites and document the current condition of the station. • Known archaeological and heritage resource sites will be marked prior to assessment and consolidation activities. • Authorities will be contacted if new artifacts or a site are discovered and work will be stopped until the site can be assessed.	1	1	1/1	I	N/A
	New archaeological or heritage resource sites may be discovered (P).	NA					

Table 6-13: Environmental Effects Assessment Matrix: Archaeology and Heritage Resources

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context

KEY

Magnitude:

1 = Low: *e.g.*, loss of a minor proportion of data at site, local or regional level; after low effect, interpretative capacity of the remains is virtually intact, limited only by loss of minor items and/or features.

2 = Medium: *e.g.,* a proportion of the data at the site, local or regional level is lost but a significant proportion remains unimpaired; after medium effect, the interpretative capacity of the remains is hindered by loss of basic data about cultural descriptions and lifestyles.

3 = High: *e.g.*, a significant proportion of data at the site, local or regional level is lost; interpretative capacity of the remains following effect is minimal.

Geographic Extent:

1 = <1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101-1000 km²
5 = 1001-10,000 km²
6 = >10,000 km²

Duration:
1 = <1 month
2 = 1-7 months
3 = 8-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.9.2.3 Mitigation

To minimize effects on archaeology and heritage resources, an archaeological impact assessment will be undertaken to determine whether use and maintenance activities in the past have disturbed archaeological materials and to identify archaeological sites and features for avoidance during program preparation and remediation activities. All identified archaeological and heritage resources will be clearly marked for avoidance during remediation. Additionally, in the event that a new resource is discovered within the remediation site, or a known resource is disturbed, the work will cease and the Nunavut Department of Culture, Language, Elders and Youth will be contacted. Work will not resume until permission to do so is obtained from the Department. Site workers will be instructed to avoid marked sites and to inform supervisors if a potential archaeological site is discovered during remediation activities.

6.9.2.4 Residual Environmental Effects

Definition of Significance

A significant environmental effect on archaeology and heritage resources would involve destorying or disturbing all or part of an archaeological, historic or palaeontological site considered to be of local, regional territorial, national, or international value. This effect, if not controlled through mitigative

investigation and documentation would result in the permanent loss of part of the non-renewable heritage resource base.

Residual Environmental Effects Summary

Table 6-14 summarizes the residual environmental effects of the project activities on archaeology and heritage resources. Residual effects are assessed as not significant or positive for the remediation program.

Table 6-14: Residual Environmental Effects Summary Matrix: Archaeology and Heritage Resources

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
General Remediation	NS/P		

KEY

Residual Environmental Effects Rating:

S =Significant Adverse Environmental Effect
NS =Not Significant Adverse Environmental Effect
P =Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a= effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.9.2.5 Summary of Environmental Effects on Archaeology and Heritage Resources

The presence and movement of people at the site has the potential to disturb any archaeological and heritage resources identified around the site. Proposed activities also have the potential to facilitate the discovery of new archaeological and heritage resource sites.

To minimize effects to archaeology and heritage resources, an archaeological impact assessment will be undertaken and all known archaeological and heritage resources will be clearly marked so that they can be avoided. This assessment will involve the review of existing information on the history of the station. Additionally, in the event that a new resource is discovered within the remediation site, or a known resource is disturbed, the relevant authorities will be contacted. The effects of the Project on archaeology and heritage resources are assessed as not significant or positive.

6.10 Aesthetics

6.10.1 Existing Environment

The CAM-D DEW Line Site is located on arctic tundra near a lake. The facilities interrupt a natural arctic landscape view with one of a former military operation.

6.10.2 Environmental Effects Analysis - Aesthetics

6.10.2.1 Study Area Boundaries

The spatial boundary for the assessment of the effects of project activities on aesthetics is the CAM-D DEW Line Site facility. The temporal boundary for terrain is the time period for the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA for review by NIRB and other federal departments through the normal CEAA process. No technical boundaries have been recognized for the assessment of the project on aesthetics.

6.10.2.2 Identification of Issues, Interactions and Potential Effects

Ultimately, the clean up activities will improve the aesthetics of the site by removing unsightly debris and restoring the site to a more natural state. Table 6-15 is an environmental assessment matrix for the aesthetics VEC.

Table 6-15: Environmental Effects Assessment Matrix: Aesthetics

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Clean Up Activities	The clean up will improve the aesthetics of the site by removing unsightly debris and restoring the site to a more natural state (P).	• N/A					

KEY

Magnitude:

1 = Low: Little change to the visual landscapes

2 = Medium: Viewsheds are partially obscured or degraded.

3 = High: Most viewsheds are obscured or degraded.

Geographic Extent:

1 = <1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101-1000 km²
5 = 1001-10,000 km²
6 = >10,000 km²

Duration:
1 = <1 month
2 = 1-7 months
3 = 8-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.10.2.3 Mitigation

No mitigation is required since project activities are expected to improve the aesthetics of the area.

6.10.2.4 Residual Environmental Effects

Definition of Significance

A definition of significance for residual effects on aesthetics is not required since effects are positive.

Residual Environmental Effects Summary

Table 6-16 summarizes the residual environmental effects of the project activities on aesthetics.

Table 6-16: Residual Environmental Effects Summary Matrix: Aesthetics

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
Remediation	P		

KEY

Residual Environmental Effects Rating:

S =Significant Adverse Environmental Effect
NS =Not Significant Adverse Environmental Effect
P =Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a = effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.10.2.5 Summary of Environmental Effects on Aesthetics

The remediation activities are expected to have a positive effect on the aesthetic environment.

6.11 Socio-Economic Environment

6.11.1 Existing Environment

CAM-D is located on the Boothia Peninsula, Nunavut. Nearby communities include Taloyoak, Pelly Bay and Gjoa Haven. Population of the communities, according to the 1996 census was 639 in Taloyoak, 542 in Pelly Bay and 900 in Gjoa Haven. The economy of the region is based on hunting and fishing and on the tourist industry.

The CAM-D DEW Line Site facilities have been in place since 1957. Prior to this there were only traditional land use activities in the area. The site was used as an intermediate DEW line site until 1963.

Other land uses in the area are limited to trapping, hunting, and fishing. The main settlement is Taloyoak (130 km to the northwest). There is no other information available on this area at this time.

6.11.2 Environmental Effects Analysis - Socio-Economic Environment

6.11.2.1 Study Area Boundaries

The spatial boundary for the assessment of the effects on socio-economics is Nunavut as labour and equipment may be required from Iqaluit or Cambridge Bay, although most of the effects of the Project will be felt in Taloyoak, Pelly Bay and Gjoa Haven. The spatial boundary for the assessment of the effects of project activities on land use is the Boothia Peninsula.

The temporal boundary for terrain is the time period for the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA and NIRB for review by other federal and territorial departments following the CEAA process with additions to meet the NIRB requirements. No technical boundaries have been recognized for the assessment of the project on the socio-economic environment.

6.11.2.2 Identification of Issues, Interactions and Potential Effects

The Department of National Defence (DND) and Nunavut Tunngavik Incorporated (NTI) have signed a *DND/NTI Agreement for the Clean Up and Restoration of the DEW Line Sites within the Nunavut Settlement Area* outlining the economic provisions. The agreement includes a Minimum Inuit Content (MIC) for the clean up contract and requirements for training, specifically related to the clean up activities. Generally, the contracts for the clean up of DEW Line sites include clauses requiring the contractor to maximize Inuit Involvement. Inuit involvement in the detailed site assessment activities will include both employment and business (contracting) opportunities, and local purchases.

The remediation activities may disturb traditional land use such as hunting and fishing activities that occur during the summer months. Table 6-17 is an environmental assessment matrix for the socio-economic VEC.

Table 6-17: Environmental Effects Assessment Matrix: Socio-Economic Environment

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Remediation	Nunavut residents will have employment opportunities during the field work (P).	• N/A					
	Clean up activities may disturb traditional land use such as hunting and fishing activities that occur during the summer months (A).	• The local hunter and trapper organization will be notified of the scheduling of clean-up activities.	1	2	2/1	R	N/A

KEY

Magnitude:

1 = Low: *e.g.,* Few individuals affected.

2 = Medium: *e.g.,* A moderate number of individuals affected.

3 = High: *e.g.,* A large number of individuals affected.

Geographic Extent:

1 = <1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101-1000 km²
5 = 1001-10,000 km²
6 = >10,000 km²

Duration:

1 = <1 month
2 = 1-7 months
3 = 8-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.11.2.3 Mitigation

During any remediation project, whenever possible, INAC strives to support and enhance the development of healthy, sustainable communities by leveraging local skills and knowledge into their approach to addressing environmental issues associated with contaminated sites. By these means core competencies are maximized and deployed. Whenever possible, the project will also adopt solutions tailored to the northern environment and its inhabitants. This includes leveraging local knowledge and the incorporation of provisions accounting for the unique needs of northerners and the needs of the environment in which they live into the development and implementation of policies and procedures.

To minimize impacts to traditional land use such as hunting and trapping activities, local hunter and trapper organizations will be notified of the scheduling of clean up activities.

6.11.2.4 Residual Environmental Effects

Definition of Significance

A significant environmental effect on the socio-economic environment occurs if traditional land use activities are not permitted to occur. Other effects on the socio-economic environment are expected to be positive.

Residual Environmental Effects Summary

Table 6-18 summarizes the residual environmental effects of project activities on the socio-economic environment.

Table 6-18: Residual Environmental Effects Summary Matrix: Socio-Economic Environment

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
General Remediation	P/NS		

KEY

Residual Environmental Effects Rating:

S =Significant Adverse Environmental Effect
NS =Not Significant Adverse Environmental Effect
P =Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a = effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.11.2.5 Summary of Environmental Effects on the Socio-Economic Environment

The contractor will be required to have a minimum Inuit content in the workforce for the remediation work. This will provide employment benefits and related economic benefits.

Clean up activities may disturb traditional land use such as hunting and fishing activities that occur during the summer months. In order to minimize these effects, local hunter and trapper organizations will be notified of the scheduling of clean-up activities.

The effects of the Project on the socio-economic environment, including land use are assessed as positive (for economic benefits) or not significant (for land uses).

6.12 Health and Safety

6.12.1 Existing Environment

The CAM-D DEW Line Site in its current state poses a number of health and safety issues to the surrounding environment and any people interacting with the site. A number of hazardous materials and contaminated soils have been identified throughout site (Table 4-1).

6.12.2 Environmental Effects Analysis - Health and Safety

6.12.2.1 Study Area Boundaries

The spatial boundary for the assessment of the effects of project activities on health and safety is the CAM-D DEW Line Site and immediate area, and the work camp. The temporal boundary for terrain is the time period for the remediation program, essentially 2009, including the time from moving equipment to the site to demobilization.

The administrative boundaries for the assessment refer to the jurisdictions within which and for which the assessment is being prepared. In this case, the assessment is being prepared under CEAA for review by NIRB and other federal departments through the normal CEAA process. Technical boundaries of the health and safety assessment are the lack of site-specific information and limited time frame associated with the environmental assessment.

6.12.2.2 Identification of Issues, Interactions and Potential Effects

Excavating, moving, sorting and containerizing contaminated soils and hazardous materials during the remediation program have the potential to affect the health and the safety of workers. Ultimately, the removal of contaminated soil and other hazardous materials from the environment reduces the risk of exposure to people. Table 6-19 is an environmental assessment matrix for the Health and Safety VEC.

Table 6-19: Environmental Effects Assessment Matrix: Health and Safety

Project Activity	Potential Positive (P) or Adverse (A) Environmental Effect	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
General Remediation	Disturbance to existing hazardous waste storage areas has the potential to expose workers to hazardous substances (A).	• Workers will be provided with safety training for the handling of the materials expected to be encountered. • Personal Protective Equipment will be provided to all workers. • A comprehensive health and safety plan will be developed and implemented.	1	N/A	1/1	R	N/A
	Removal of hazardous materials from the site (P)	N/A					
All Project Related Activity	Bear/human interactions have the potential to lead to injury of the person(s) involved (A).	• An appropriate waste management system will be installed and maintained. • Bear awareness training will be provided to all staff on-site. • Wildlife monitors will be present on site at all times.	1	N/A	1/1	R	N/A

KEY

Magnitude:

1 = Low: No more than a few individuals are affected with minor, short-term health problems.

2 = Medium: A small portion of the local community is affected with minor, short-term health problems.

3 = High: An individual is affected with a chronic health problem or a large portion of the local community is affected with minor, short-term health problems.

Geographic Extent:

N/A

Duration:

1 = <1 month
2 = 1-7 months
3 = 8-36 months
4 = 37-72 months
5 = >72 months

Frequency:

1 = <11 events/year
2 = 11-50 events/year
3 = 51-100 events/year
4 = 101-200 events/year
5 = >200 events/year
6 = continuous

Reversibility:

R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse effects.

N/A = Not Applicable

6.12.2.3 Mitigation

The transportation of any hazardous materials will be in accordance with the Transportation of Dangerous Goods Regulations. A comprehensive health and safety plan will be developed and

implemented with requirements for workers to wear and use appropriate personal protective equipment. Workers will also be trained in the use of personal protective equipment and proper handling procedures for hazardous materials.

The strategies suggested for avoiding polar bear encounters include avoiding locating the camp in areas that may be attractive to bears, such as long animal movement trails and ensuring that an appropriate waste management system is in place. Wildlife monitors will be onsite at all times.

If meeting a bear is unavoidable and there is an encounter, there are several strategies for dealing with the meeting. All staff will be fully trained in bear awareness, including ways to prevent injury during an encounter. For example, some of the fundamentals of bear training include suggestions such as:

- do not run;
- identify yourself to the bear and let it know that you are human and not a threat;
- talk to the bear in calm tones and wave your arms;
- if the bear approaches or attempts to get closer, become more animated in your movements and make your voice louder and more aggressive sounding; and
- if the bear continues to close in on you even after it has identified you as human, your best chance at survival is to play dead. Lay on your stomach on the ground with your hands behind your neck. Remain motionless for as long as possible until the bear is convinced you are no longer a threat and moves on.

6.12.2.4 Residual Environmental Effects

Definition of Significance

A significant environmental effect of the project activities on health and safety occurs if an individual develops a chronic health problem as a result of working on the Project.

Residual Environmental Effects Summary

Table 6-20 summarizes the residual environmental effects of the project activities on health and safety.

Table 6-20: Residual Environmental Effects Summary Matrix: Health and Safety

Phase	Residual Adverse Environmental Effect Rating	Likelihood (of significant adverse environmental effects)	
		Probability of Occurrence	Scientific Uncertainty
General Remediation	NS/P		

KEY

Residual Environmental Effects Rating:

S =Significant Adverse Environmental Effect
NS =Not Significant Adverse Environmental Effect
P =Positive Environmental Effect

Probability of Occurrence: based on professional judgement:

1 = Low
2 = Medium
3 = High
n/a =effect not predicted to be significant

Scientific Uncertainty: based on scientific information, and statistical analysis or professional judgement:

1 = low level of confidence
2 = medium level of confidence
3 = high level of confidence
n/a = effect not predicted to be significant

6.12.2.5 Summary of Environmental Effects on Health and Safety

The collection and disposal of potentially hazardous debris, removal of hazardous materials from facilities and the general handling of hazardous materials has the potential to affect the health and the safety of workers. To help mitigate this risk, the transportation of any hazardous materials will be in accordance with Transportation of Dangerous Goods Regulations. Additionally, a comprehensive health and safety plan will be developed and implemented, which will require workers to wear and use appropriate personal protective equipment. Workers will also be trained in the use of personal protective equipment, the proper handling procedures for hazardous materials, the procedures to follow to avoid bears and what to do in the event of an encounter with a bear.

The environmental effects of the remediation program are assessed as not significant.

6.13 Summary of Environmental Effects

Table 6-21 is an interaction matrix between the Project and several environmental parameters, showing the effects of the Project on the environment. The parameters listed are those required by the NIRB and those that were not identified as specific VECs in the preceding sections, were included as part of the VECs discussed.

6.14 Cumulative Effects

The effects of the remediation of the former CAM-D DEW Line Site will be cumulative with the effects of other activities in the area. The purpose of the remediation is to return the site to as near pre-disturbance conditions as possible, while minimizing the potential for contaminants to enter the ecosystem. The only other activities occurring at the site that may interact with the Project is traditional land use. Potential cumulative effects identified are the potential for disruption of existing land uses and the placement of pressure on the local labour pool if workers are also being hired for other construction or remediation projects in the area. Interference with traditional land uses such as hunting will be addressed by notifying the local hunter and trapper organization of the schedule of remediation activities. Given the short term of this Project, the cumulative effects on land use and the local labour pool are not expected to be significant.

6.15 Effect of the Environment on the Project

The implementation of a clean up project in an Arctic environment has unique logistical issues. The potential exists for delays in the clean up associated with bad weather. These delays may include work stoppage on-site or delays in the transportation to and from the site of personnel and supplies. Conditions related to the Arctic climate, such as ice and frozen ground may also delay clean up activities. Ice may delay marine transport to and from the site. Clean up activities which are best completed at maximum thaw may be delayed depending on seasonal climate changes.

TABLE 6-21:

NUNAVUT IMPACT REVIEW BOARD
ENVIRONMENTAL INTERACTION MATRIX SIMPSON LAKE CAM-D DEW LINE SITE REMEDIATION

INTERACTION MATRIX		ENVIRONMENTAL COMPONENTS	PHYSICAL	Climate/Weather	Ground Stability	Noise	Sediment Quality	Soil Quality	Air Quality	Water Quality	Hydrology/Limnology	Permafrost	Eskers and Other Unique Landscapes	BIOLOGICAL	Vegetation	Wildlife and Wildlife Habitat	Birds and Habitat	Freshwater Biota and Habitat	Marine Biota and Habitat (Not Applicable)	Protected Areas (Not Applicable)	Land Use	Archaeology & Heritage Resources	Aesthetics	Socio-economic Environment
PROJECT ACTIVITIES																								
SITE PREPARATION	Mobilization of Equipment and Supplies to the Site				M				M															P/M
	Camp and Related Infrastructure Construction				M							M			M	M	M							P/M
	Airstrip Repair and Upgrading				M							M			M	M	M							P/M
	Road Repair and Upgrading				M							M			M	M	M	M						P/M
	New Landfill Construction				M			M				M			M	M	M	M						P/M
	Waste Handling Facility Construction				M							M			M	M	M							P/M
REMEDIATION	Remediation of Existing Dumps and Removal of Debris				M			P/M	M	P/M		M			P/M	P/M	P/M	M				P/M	P	P/M
	Removal and Landfilling of Non-hazardous Physical Debris and Structures							P		P		M			P/M	P/M	P/M					P/M	P	P/M
	Remediation of Contaminated Soils				M			P	P	P/M		M			P/M	P/M	P/M						P	P/M
	Removal of Hazardous Materials (not including Asbestos and POLs)							P/M		P/M					P/M	P/M	P/M	M					P	P/M
	Asbestos Abatement, Containerizing and Landfill Burial							P		P					P/M	P/M	P/M						P	P/M
	POL Incineration							P	M	P														P/M
CLOSURE	Site Closure and Demobilization				M				M														P	P/M

Notes: Please indicate in the matrix cells whether the interaction causes an impact and whether the impact is:

P *Postitive*
N *Negative and non-mitigatable*
M *Negative and mitigatable*
U *Unknown*
If no impact is expected then please leave the cell blank

TABLE 6-21

NUNAVUT IMPACT REVIEW BOARD ENVIRONMENTAL INTERACTION MATRIX
SIMPSON LAKE CAM-D DEW LINE SITE REMEDIATION

	PROPOSED MITIGATION MEASURE	IMPLEMENTATION SCHEDULE	PROPOSED MONITORING SCHEDULE	REPORTING SCHEDULE
IMPACTS (IDENTIFIED IN TABLE 1)				
Ground Stability	See Table 6-3	During site preparation and remediation activities	None proposed	None proposed
Air Quality	See Table 6-1	During site preparation and remediation activities	None proposed	None proposed
Permafrost	See Table 6-3	During site preparation and remediation activities	None proposed	None proposed
Soil Quality	See Table 6-3	During site preparation and remediation activities	None proposed	None proposed
Water Quality	See Table 6-9	During site preparation and remediation activities	Prior to remediation	As required depending on monitoring finds
Aquatic Animals and Habitat	See Table 6-13	During site preparation and remediation activities	During remediation	As required depending on monitoring finds
Socio-economic Environment	See Table 6-5	During site preparation and remediation activities	None proposed	None proposed
Vegetation	See Table 6-7	During site preparation and remediation activities	None proposed	None proposed
~~Wildlife & Birds, including Habitat~~	See Table 6-11	During site preparation and remediation activities	None proposed	None proposed
Archaeology and Heritage Resources	See Table 6-17	During site preparation and remediation activities	None proposed	None proposed

7.0 ASSESSMENT SUMMARY

The remediation activities at the CAM-D DEW Line Site will interact with the environment through vehicle and machinery emissions, waste disposal (removal of hazardous waste, removal of contaminated soil, burial of non-hazardous waste, removal of facilities), surface disturbance and the provision of employment to area residents. There is also the potential for spills of fuel or hazardous materials. The activities will be carried out following standard good operating practices for northern Canada, with spill prevention practices and contingency plans in place. The environmental effects of the activities are assessed as being of low magnitude and not significant. The activities will benefit the area through the short-term employment of local individuals and through the commencement of clean up of the site.

8.0 CLOSURE

This report has been prepared by Jacques Whitford-AXYS for the sole benefit of INAC. The report may not be relied upon by any other person or entity, other than for its intended purposes, without the express written consent of Jacques Whitford-AXYS and INAC.

This report was undertaken exclusively for the purpose outlined herein and is limited to the scope and purpose specifically expressed in this report. This report cannot be used or applied under any circumstances to another location or situation or for any other purpose without further evaluation of the data and related limitations. Any use of this report by a third party, or any reliance on decisions made based upon it, are the responsibility of such third parties. Jacques Whitford-AXYS accepts no responsibility for damages, if any, suffered by any third party because of decisions made or actions taken based on this report.

Jacques Whitford-AXYS makes no representation or warranty with respect to this report, other than the work was undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Any information or facts provided by others and referred to or used in the preparation of this report were assumed by Jacques Whitford-AXYS to be accurate. Conclusions presented in this report should not be construed as legal advice.

The information provided in this report was compiled from existing documents and data provided by INAC, its representatives and consultants, and by applying currently accepted industry standards and principles. This report represents the best professional judgment of Jacques Whitford-AXYS personnel available at the time of its preparation. Jacques Whitford-AXYS reserves the right to modify the contents of this report, in whole or in part, to reflect the any new information that becomes available. If any conditions become apparent that differ substantially from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

This report has been prepared by a team of Jacques Whitford-AXYS professionals on behalf of INAC. If INAC has questions or concerns about this report, please contact the undersigned.

Respectfully submitted,

JACQUES WHITFORD–AXYS

Original signed by James Howell

James D. Howell, M.Sc., P.Geol.
Project Manager

JDH/mg

9.0 REFERENCES

Anand-Wheeler, I. 2002. Terrestrial mammals of Nunavut. Department of Sustainable Development, Iqaluit, NU.

Borealis Exploration Limited. 1981. Initial Environmental Evaluation for the Borealis Exploration Limited Melville Peninsula iron ore development: Discussion draft. Borealis Exploration Limited,

Canadian Council of Ministers of the Environment (CCME). 1999. Canadian Environmental Quality Guidelines. Chapter 1: Canadian National Ambient Air Quality Objectives: Process and Status.

Cluff, H.D., L.R. Walton, and P.C. Paquet. 2002. Movements and habitat use of wolves denning in the central Arctic, Northwest Territories and Nunavut, Canada. Final report to the West Kitikmeot/Slave Study Society, Yellowknife, NT Canada.

COSEWIC, 2005. Canadian Species at Risk,

COSEWIC, 2004. Canadian Species at Risk,

COSEWIC, 2003. Canadian Species at Risk, May 2003. Committee on the Status of Endangered Wildlife in Canada. 43 pp.

Department of Sustainable Development. 2001. Nunavut wild species 2000: general status of wild species in Nunavut. Department of Sustainable Development, Government of Nunavut, Iqaluit, NU.

Earth Tech. 2007. Remedial Action Plan CAM-D DEW Line Site, Simpson Lake, Nunavut. Report prepared for Public Works and Government Services Canada, Edmonton, AB.

Ecological Stratification Working Group. 1995. A National Ecological Framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull. Report and national map at 1:7 500 000 scale.

Environmental Sciences Group. 1994. Environmental Study of Abandoned DEW Line Sites II: Six Intermediate Sites in the Eastern Arctic. Royal Roads Military College, Victoria, BC.

Ferguson, M.A.D., and D.S. Vincent. 1992. Status of caribou on northern Melville Peninsula in June 1982. File Report No. 107, Department of Renewable Resources, Yellowknife, NT. 19 pp.

Government of Northwest Territories Wildlife and Fisheries www.nwtwildlife.rwed.gov.nt.ca/Publications/speciesatriskweb/wolverine.htm (NWT Government 2005).

Government of Nunavut 2002. http://www.gov.nu.ca/jan182002.htm

Indian and Northern Affairs Canada. 2002. Contaminated Sites Management Policy.

Indian and Northern Affairs Canada. 2005. Abandoned Military Site Remediation Protocol.

Jacques Whitford Limited. 2005. Environmental Screening of the Proposed Detailed Site Assessment of CAM-D Simpson Lake Intermediate DEW Line Site, Nunavut. Report prepare for Public Works and Govenrment Services Canada, Calgary, AB.

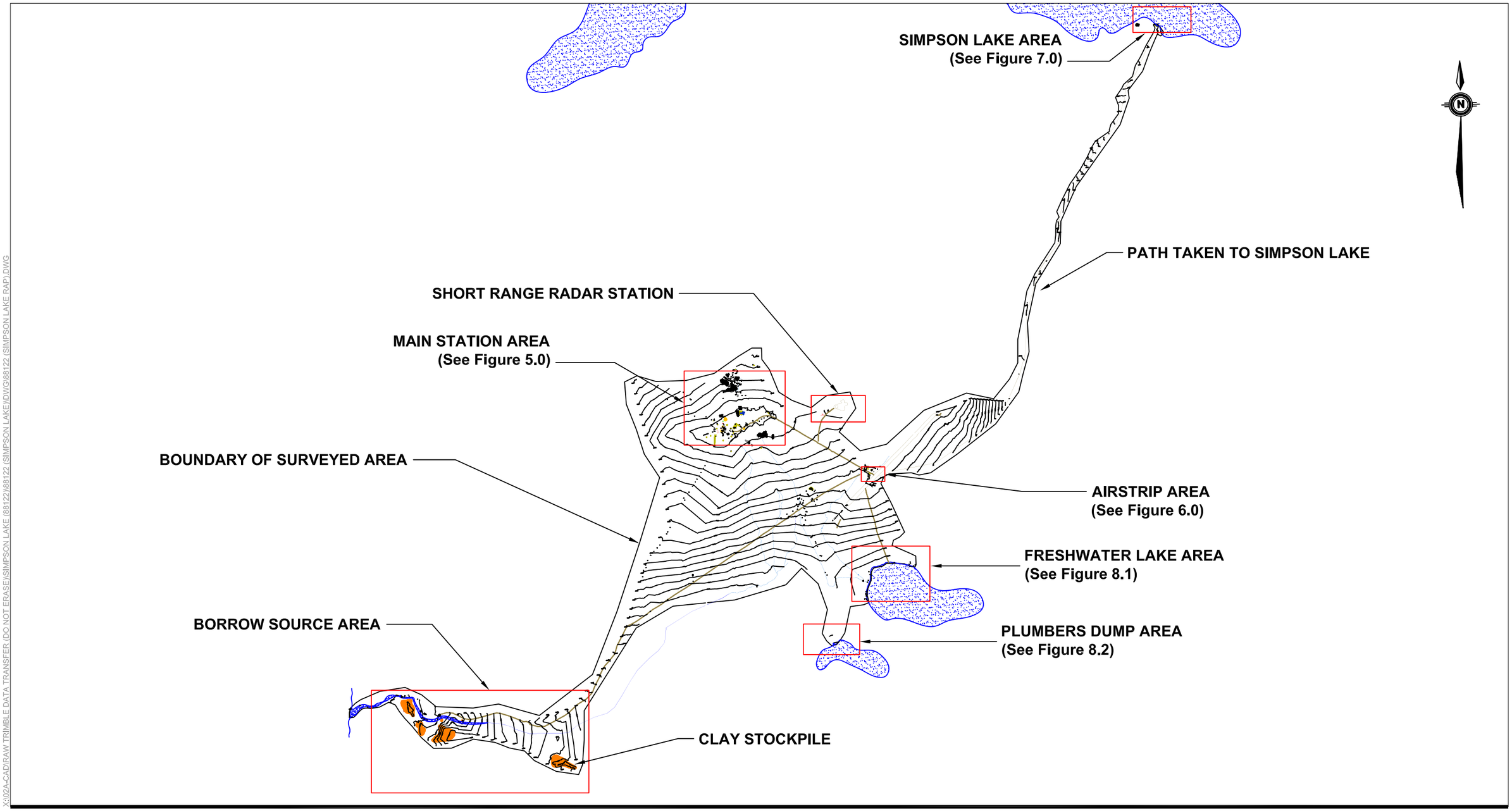
Mulders, R. 2000. Wolverine Ecology, Distribution, and Productivity in the Slave Geological Province. Final report to the West Kitikmeot/Slave Study Society, Yellowknife, NT Canada.

Websites:

1. www.un.org/works/environment/animalplanet/polarbear.html
2. www.chem.ucla.edu/~alice/explorations/churchill/baars/htm
3. www.solcomhouse.com/polarbears.htm
4. http://wildlifedamage.unl.edu/handbook/handbook/allPDF/bearfacts.htm
5. http://www.fs.fed.us/r10/tongass/forest_facts/safety/bearfacts.htm
6. http://pbsg.npolar.no/threats/tourism.htm
7. www.ursusinternational.org/factspolar.htm
8. http://www.dpc.dk/Res&Log/ProjectPlanner/Safety/Wildlife1.html

APPENDIX A

Figures Showing Locations of Areas to be Remediated



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Date: MARCH 17, 2006

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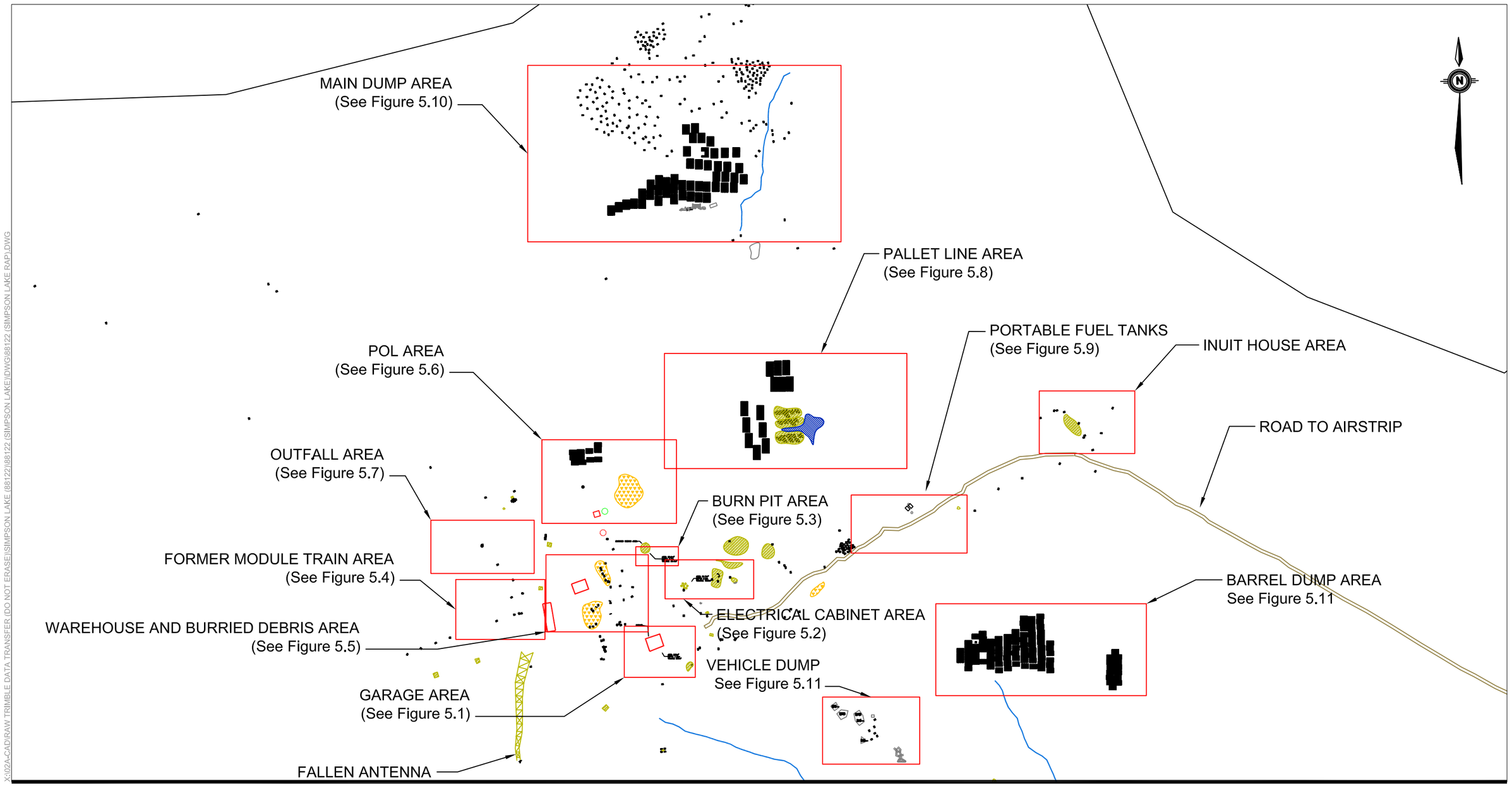
EarthTech
A Tyco International Ltd. Company

PWGSC

CAM–D DEW LINE REMEDIATION ACTION PLAN

SITE PLAN

Figure 4.0



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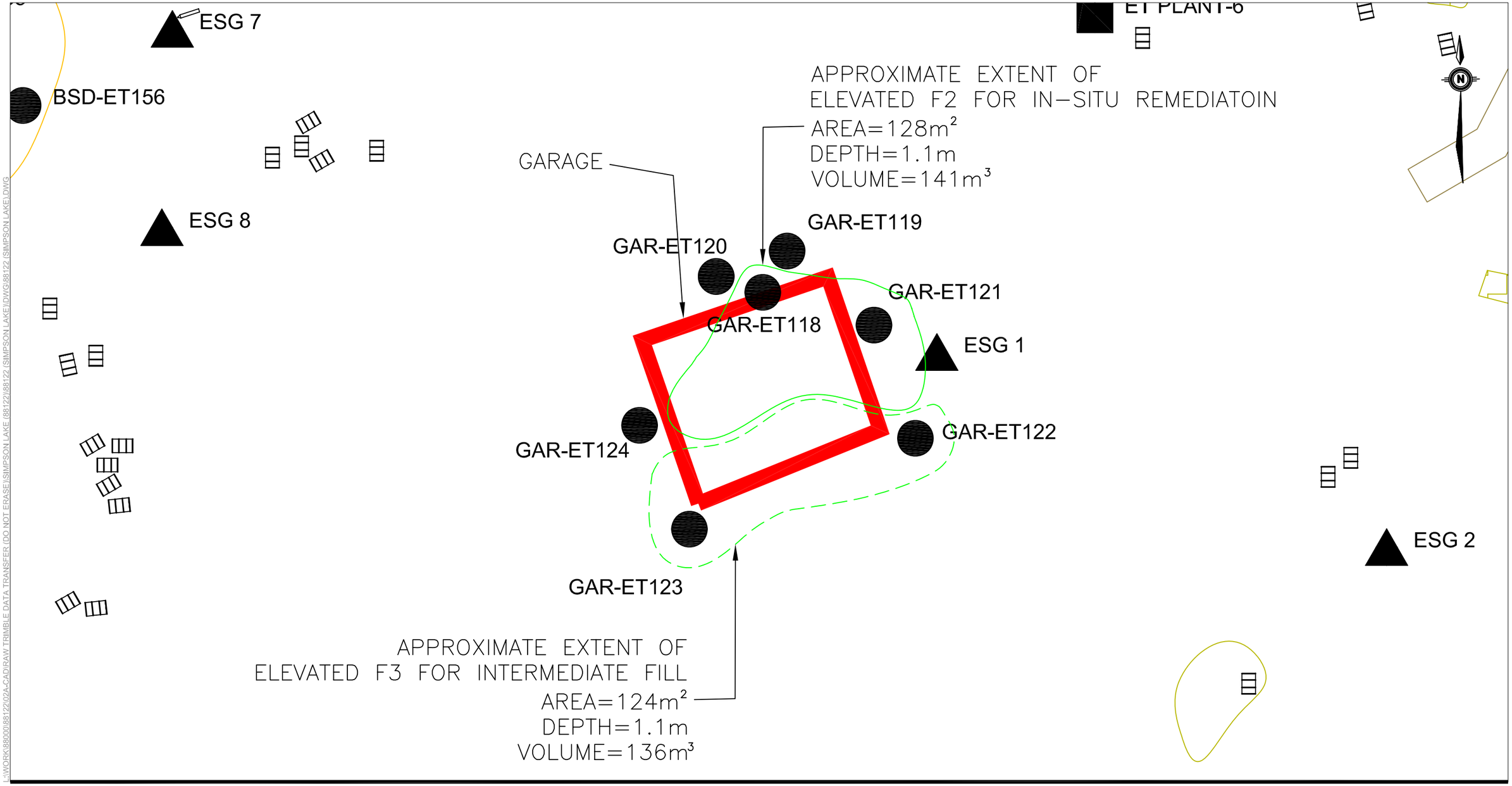
EarthTech
A Tyco International Ltd. Company

PWGSC

CAM–D DEW LINE REMEDIATION ACTION PLAN

MAIN STATION AREA

Figure 5.0



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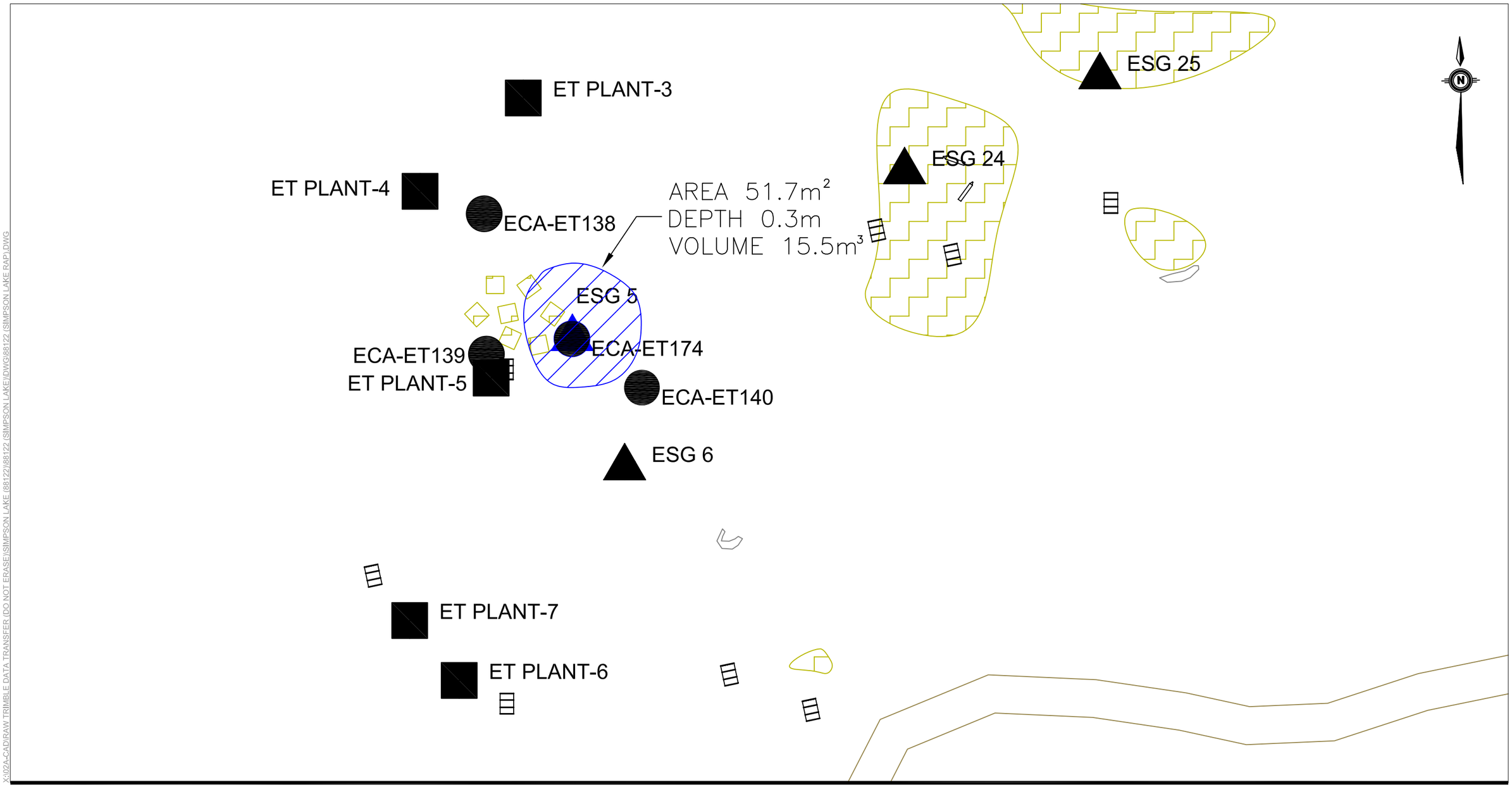
Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM-D DEW LINE REMEDIATION ACTION PLA
GARAGE AREA (0-110 cr
Figure 5.1



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A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
ELECTRICAL CABINET AREA (0–30 cm)
Figure 5.2

POL-ET127

L-ET126

BURRIED DEBRIS AREA

BRN1-ET135

BRN1-ET134

BRN1-ET136

BRN1-ET137

ESG 16

APPROXIMATE EXTENT OF
ELEVATED F2, F3, AND F4 FOR
INTERMEDIATE FILL
AREA 55.8m²
DEPTH 0.7m
VOLUME 39.1m³

WBD-ET161

WBD-ET160

ET159

ET PLANT-3

ET PLANT-4

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Date: APRIL 13, 2006
SCALE:

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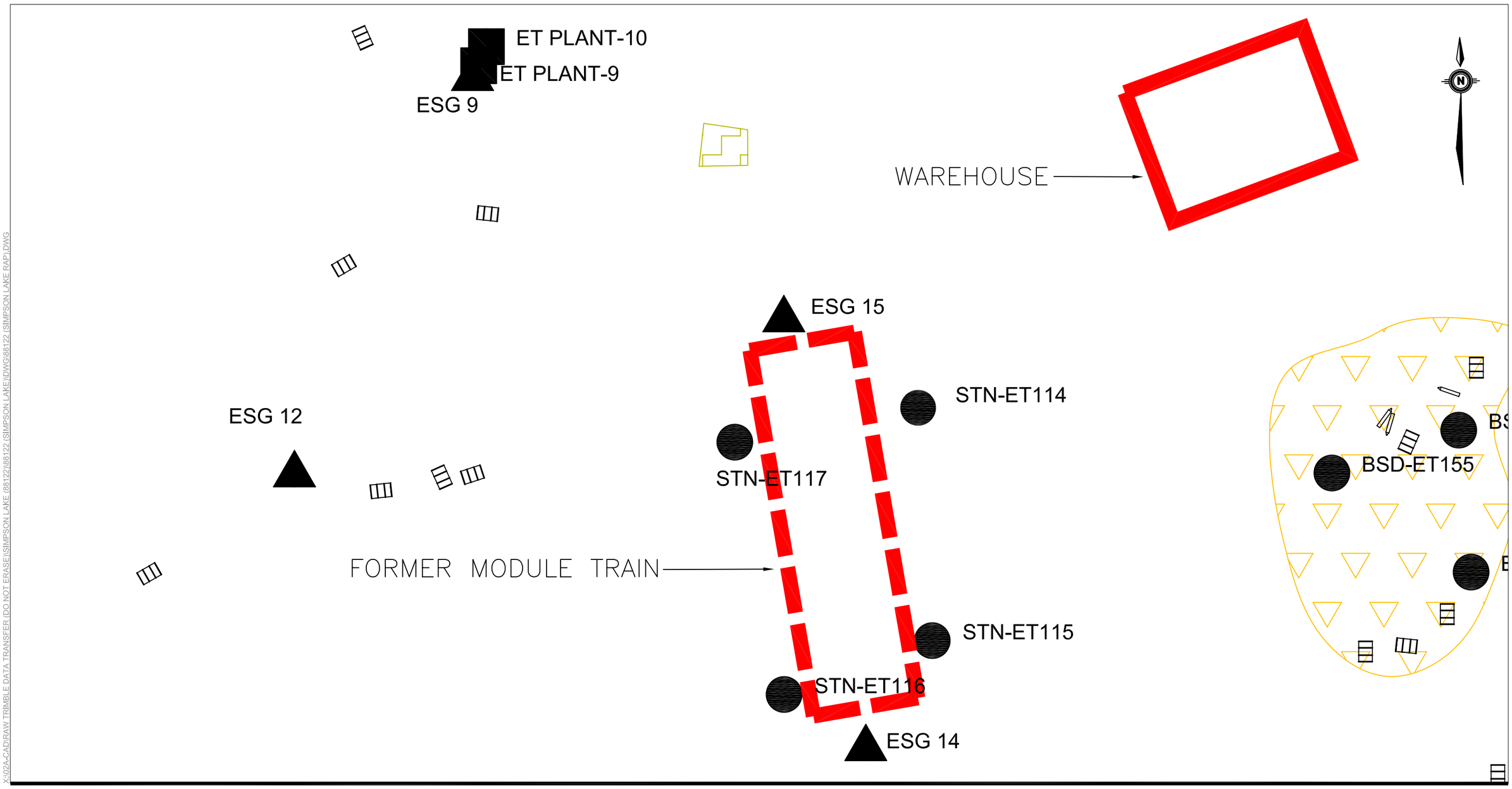
EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLA
BURN PIT AREA (0–70 c
Figure 5.3



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Date: MARCH 17, 2006
SCALE:

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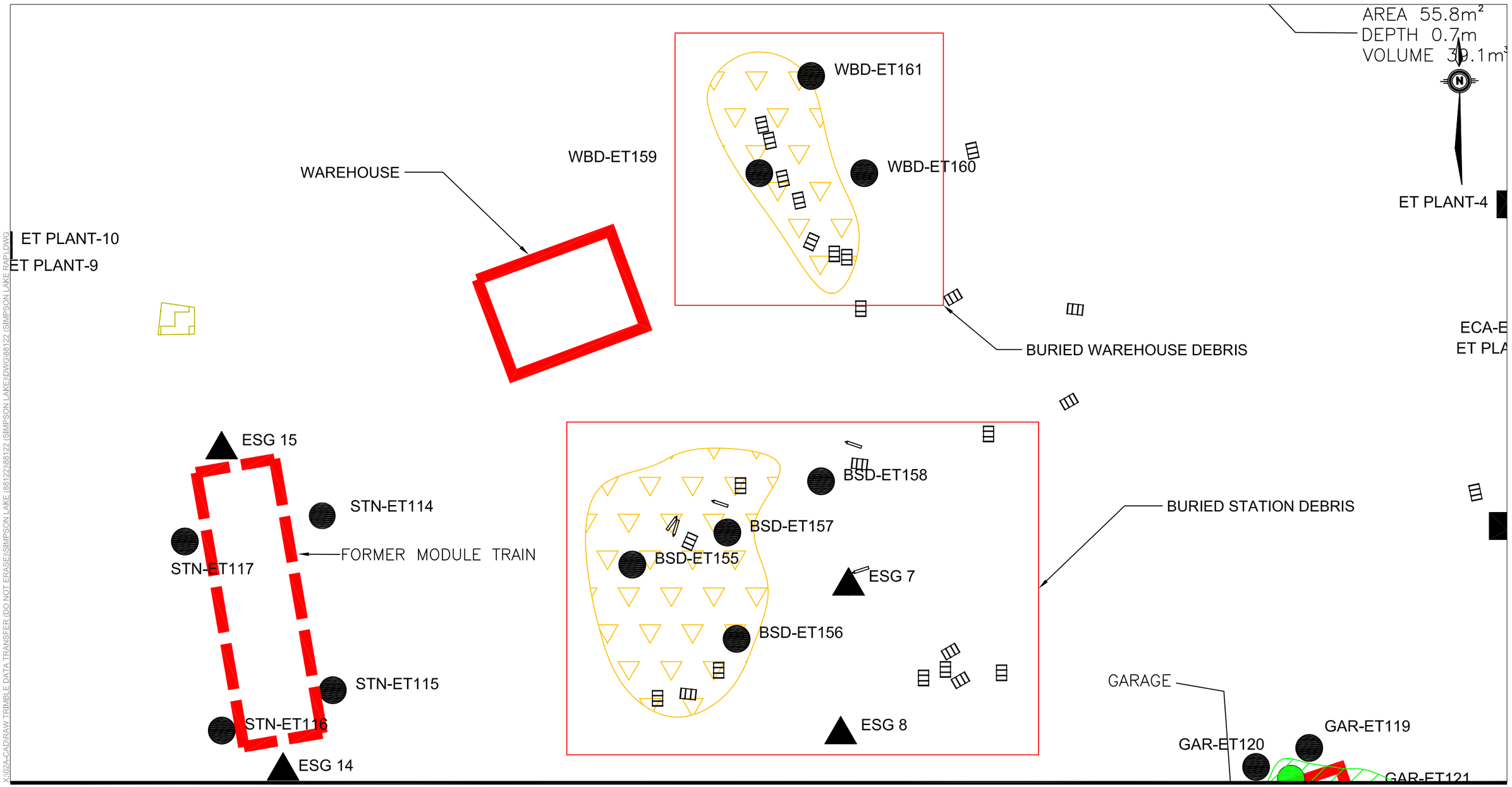
EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
FORMER MODULE TRAIN AREA
Figure 5.4



X:\02A-CAD\RAW TRIMBLE DATA TRANSFER (DO NOT ERASE)\SIMPSON LAKE (88122)\88122 (SIMPSON LAKE RAP).DWG

Date: MARCH 17, 2006
SCALE:

0 5 10
1:300

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC

CAM–D DEW LINE REMEDIATION ACTION PLAN

WAREHOUSE AND BURIED DEBRIS AREAS

Figure 5.5

ESG 19

ESG 22

POLBD-ET164

ESG 23

POL SW

POL-ET132

ET PLANT-8

POL-ET131

AREA 179m²
DEPTH 0.4m
VOLUME 72m³
Hydrocarbon Contamination

POL-ET133

POLBD-ET163

POL-ET128

ESG 18

POL-ET129

POL-ET130

POL TANK

ESG 17

PUMP HOUSE

POL-ET125

POL-ET127

APPROXIMATE EXTENT OF ELEVATED
F2 and PAH'S FOR IN-SITU REMEDIATION
AREA 655m²
DEPTH 1.5m
VOLUME 983m³

POL-ET126

Note: ESG 17 & 18 were
not analyzed for PAH or PHC

Date: APRIL 13, 2006
SCALE:

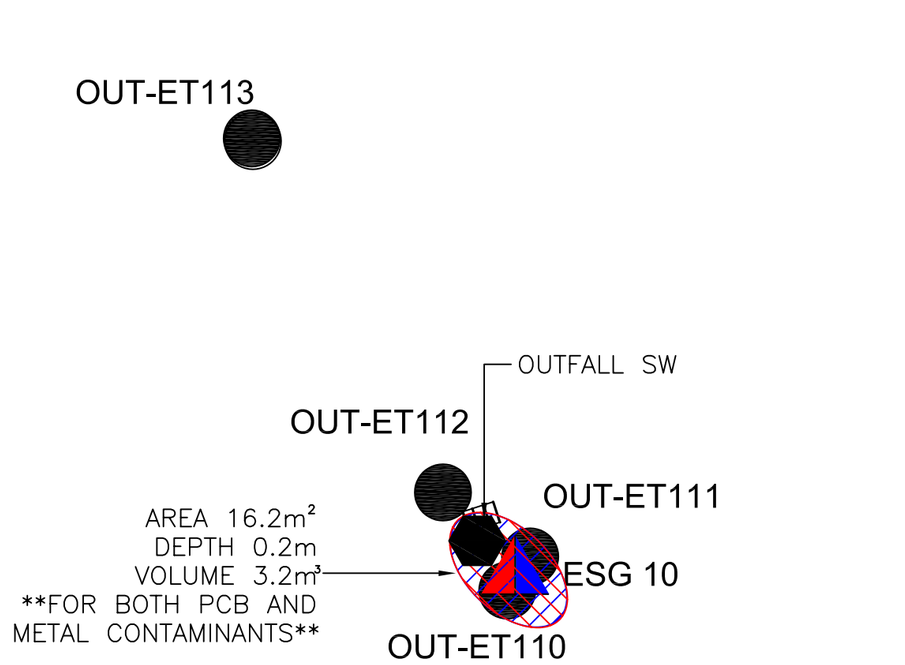
0 5 10
1:250

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM-D DEW LINE REMEDIATION ACTION PLA
POL AREA
Figure 5.6



Date: MARCH 17, 2006
SCALE:

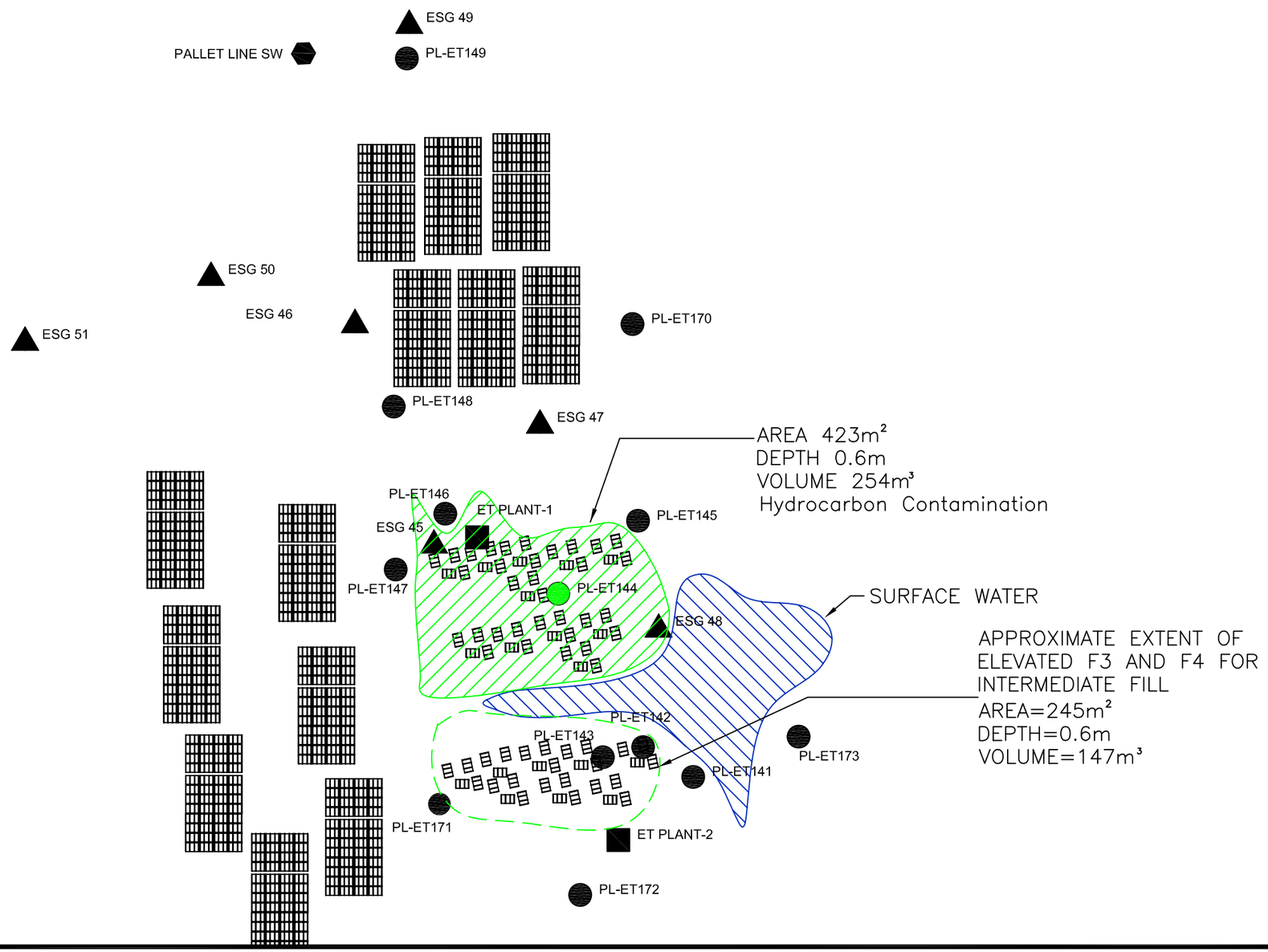
0 5 10
1:250

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
OUTFALL AREA (0–20 cm)
Figure 5.7



Date: APRIL 13, 2006
SCALE:

0 12.5 25
1:500

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLA
PALLET LINE BOREHOLE LOCATIONS (0–60 cm)
Figure 5.8

APPROXIMATE EXTENT OF
ELEVATED F2, F3, BTEX, AND PAH
FOR INTERMEDIATE FILL
AREA 588m²
DEPTH 1.0m
VOLUME 588m³

AREA 265.8m²
DEPTH 1.0m
VOLUME 266m³
PAH CONTAMINATION

ESG 29
FT-ET165
FT-ET168
FT-ET152
ESG 28
FT-ET166
FT-ET153
FT-ET169
ESG 33
FT-ET154

Note: ESG 28 & 29 were
not analyzed for PAH or PHC

BTEX CONTAMINATION

FT-ET167
ESG 30

L:\WORK\88000\88122\02A-CAD\RAW TRIMBLE DATA TRANSFER (DO NOT ERASE)\SIMPSON LAKE (88122)\88122 (SIMPSON LAKE)\DWG\88122 (SIMPSON LAKE).DWG

Date: APRIL 13, 2006
SCALE:

0 5 10
1:250

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLA
PORTABLE FUEL TANKS
Figure 5.9

X:\02A-CAD\RAW TRIMBLE DATA TRANSFER (DO NOT ERASE)\SIMPSON LAKE (88122)\88122\SIMPSON LAKE RAP).DWG

Date: MARCH 17, 2006
SCALE:

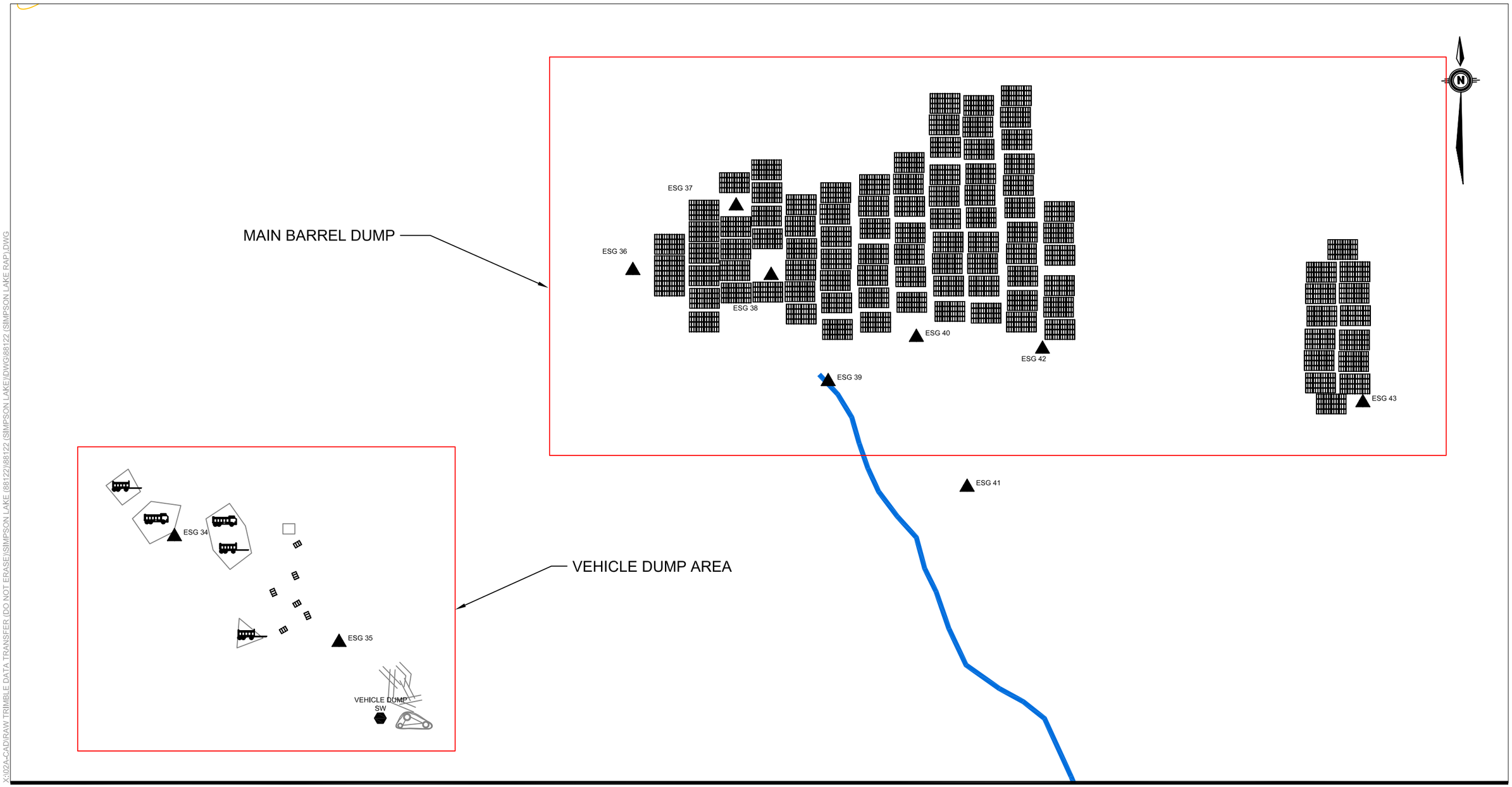
0 25 50
1:750

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
MAIN DUMP AREA
Figure 5.10



X:\02A-CAD\RAW TRIMBLE DATA TRANSFER (DO NOT ERASE)\SIMPSON LAKE (88122)\88122 (SIMPSON LAKE RAP).DWG

Date: MARCH 17, 2006
SCALE:

0 25 50

1:750

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

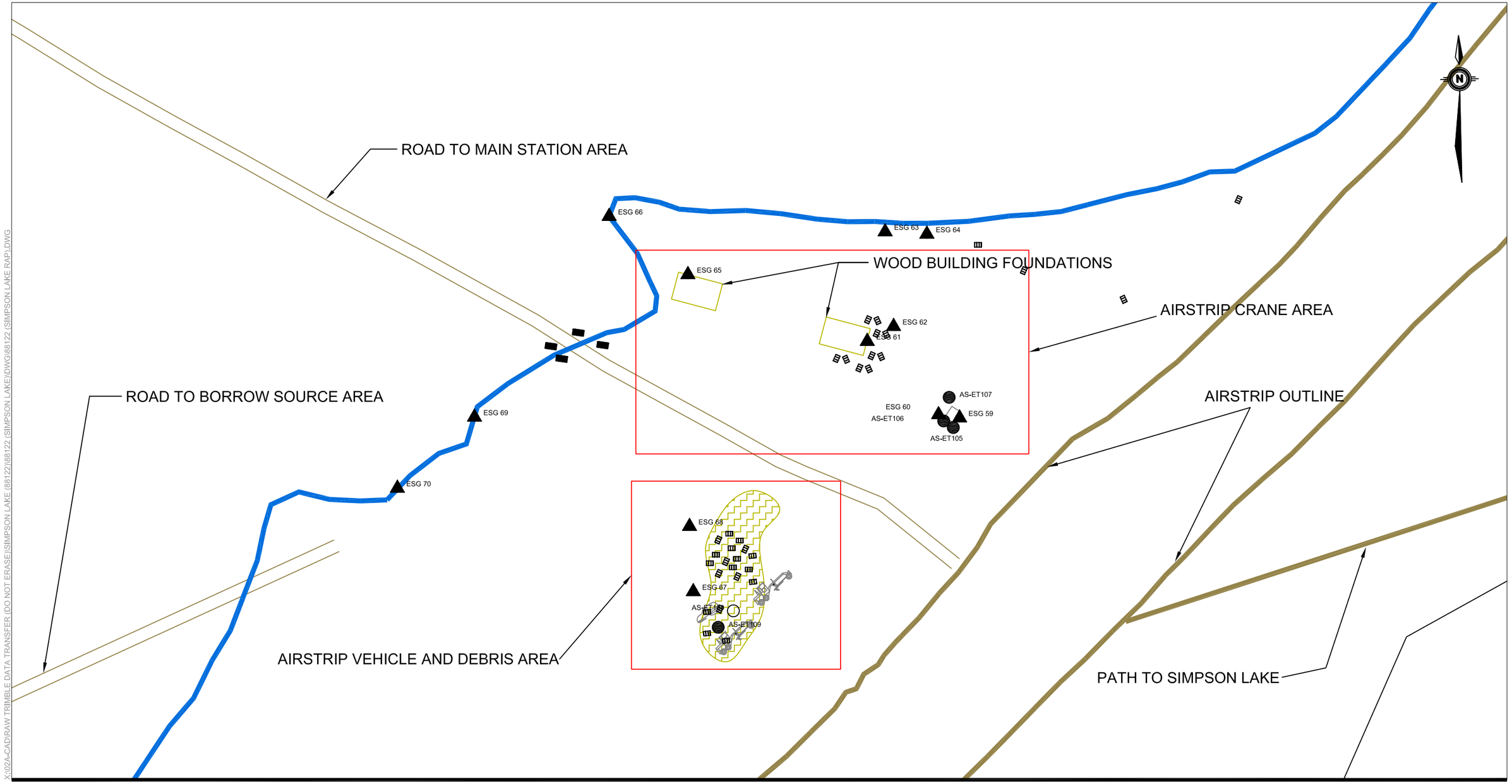
- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC

CAM–D DEW LINE REMEDIATION ACTION PLAN

VEHICLE AND MAIN BARREL DUMP AREA

Figure 5.11



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Date: MARCH 17, 2006
SCALE:

0 25 50

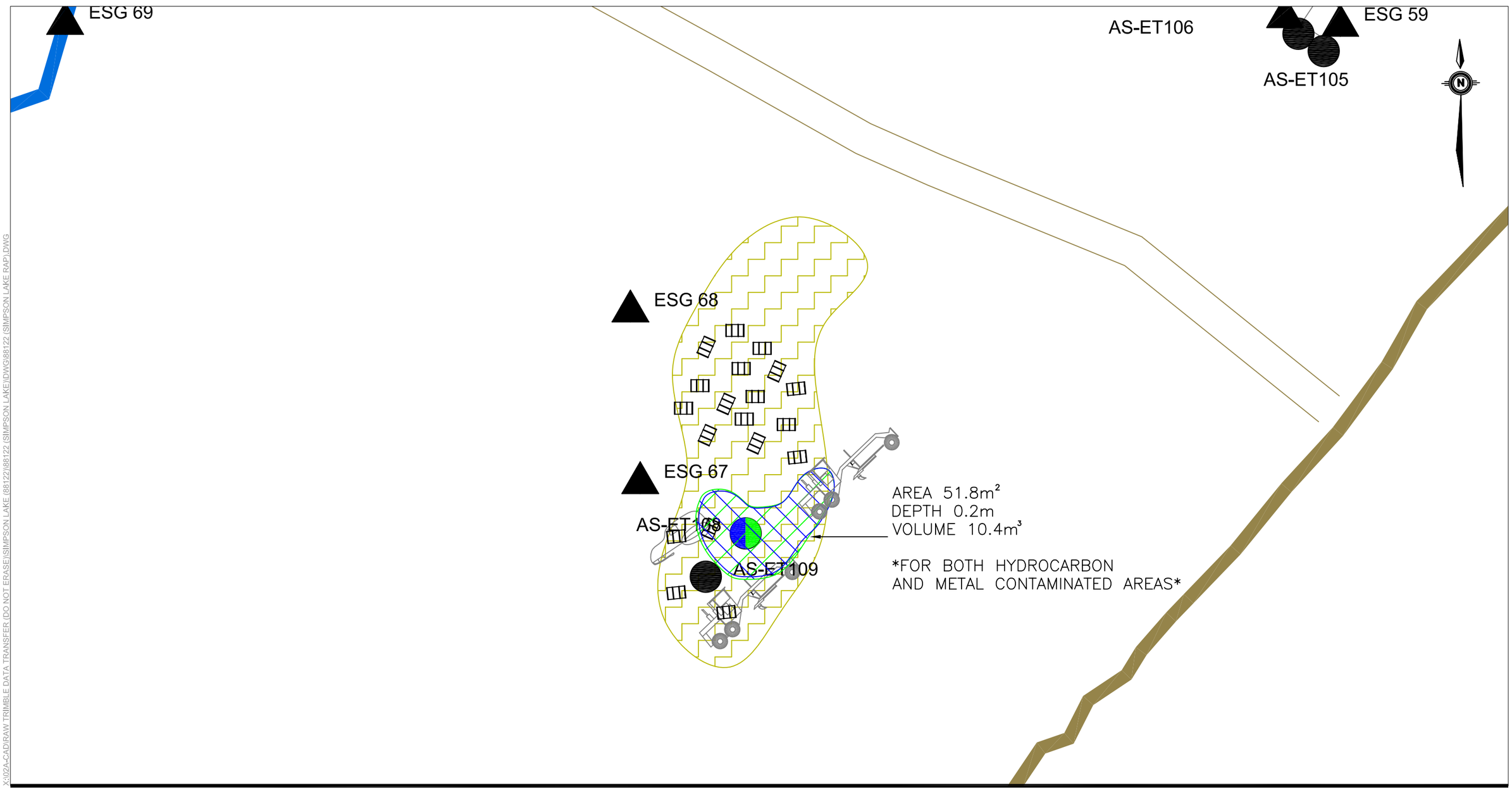
1:750

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
AIRSTRIP AREA
Figure 6.0



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Date: MARCH 17, 2006
SCALE:

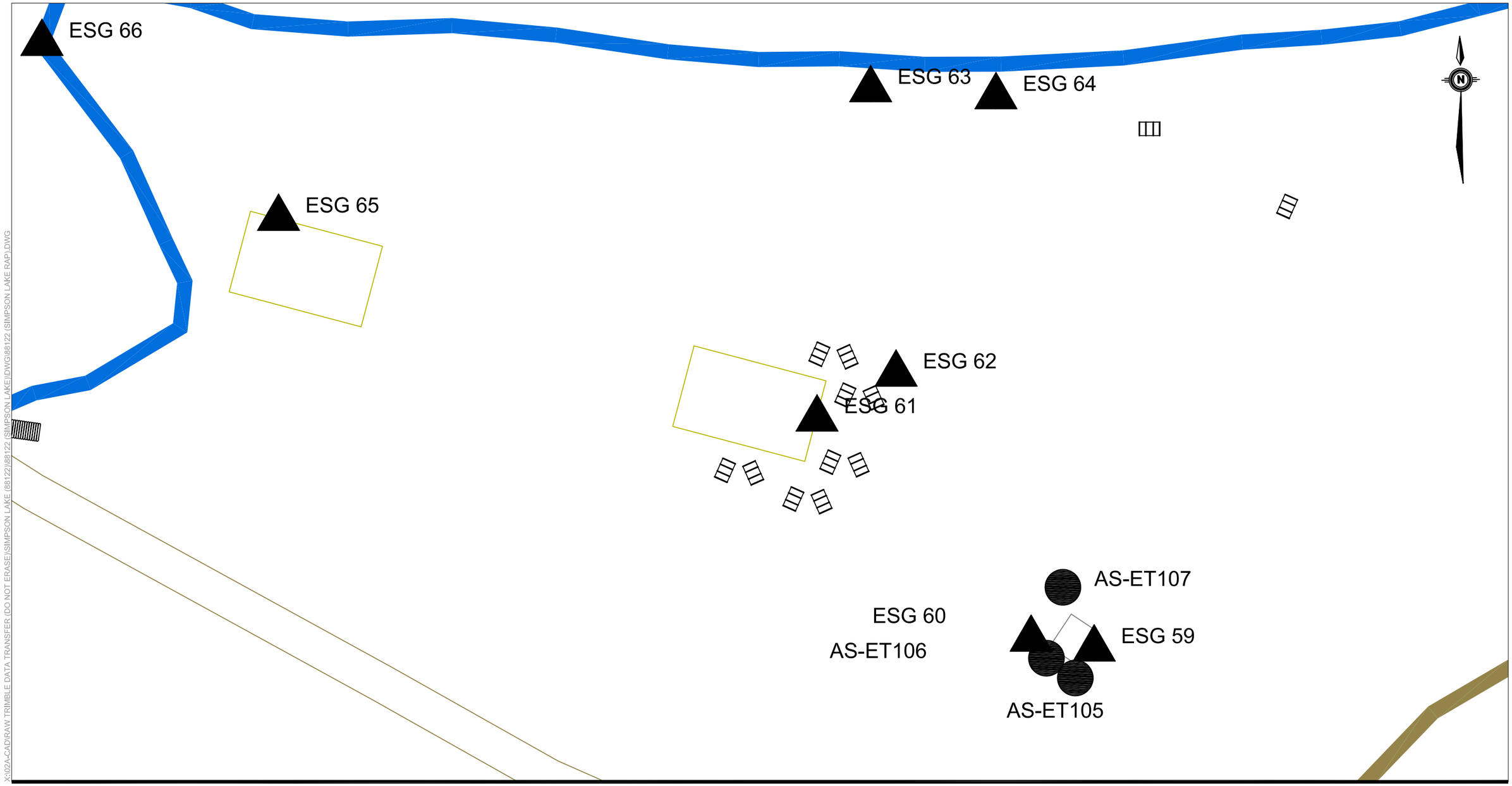
0 5 10
1:250

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
AIRSTRIP VEHICLE AND DEBRIS AREA (0–20 cm)
Figure 6.1



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Date: MARCH 17, 2006
SCALE:

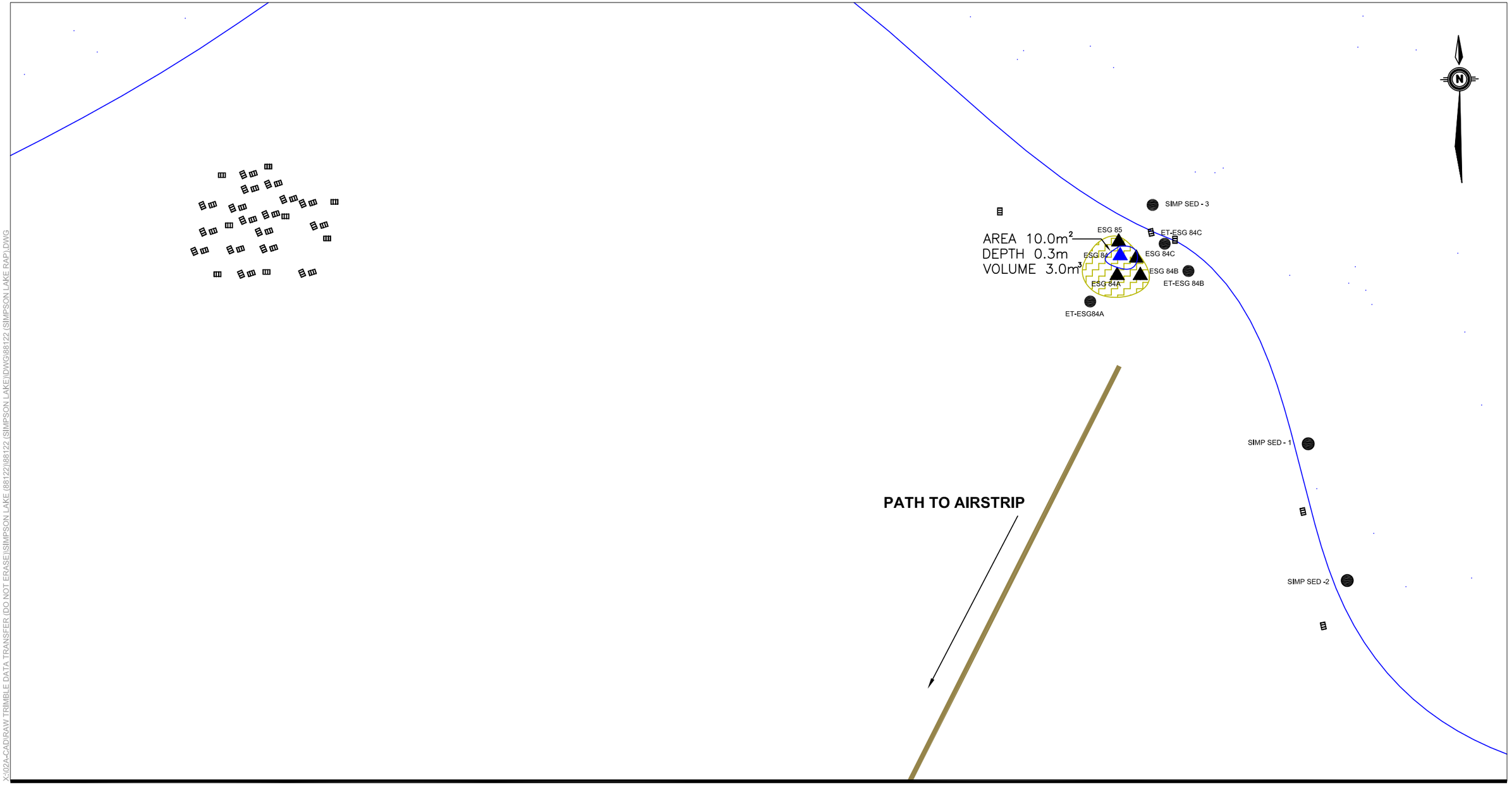
0 5 10
1:250

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
CRANE AREA
Figure 6.2



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Date: MARCH 17, 2006
SCALE:

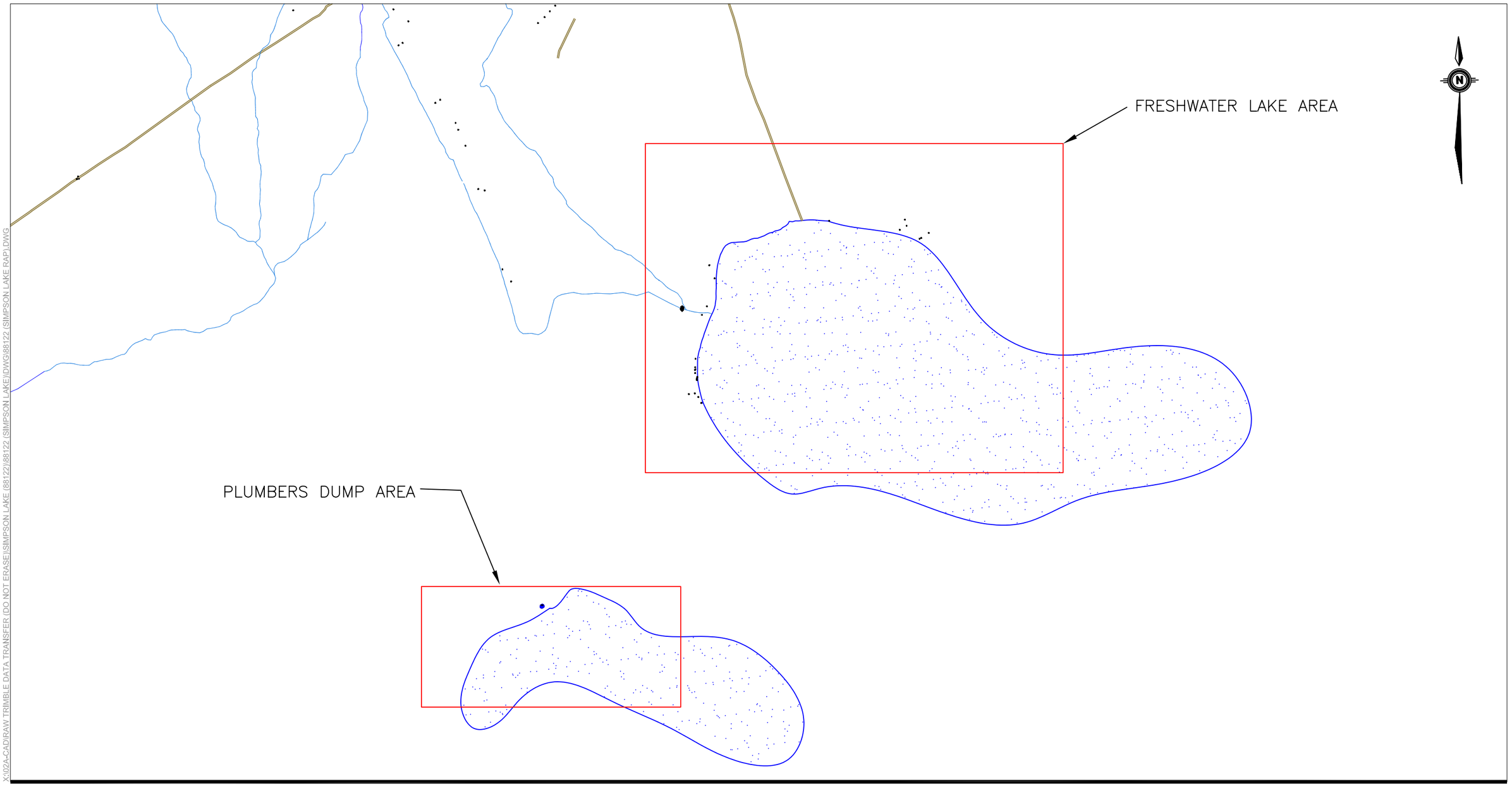
0 20 40 60 80 100m
Scale 1:750

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
SIMPSON LAKE AREA
Figure 7.0



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Date: MARCH 17, 2006
SCALE:

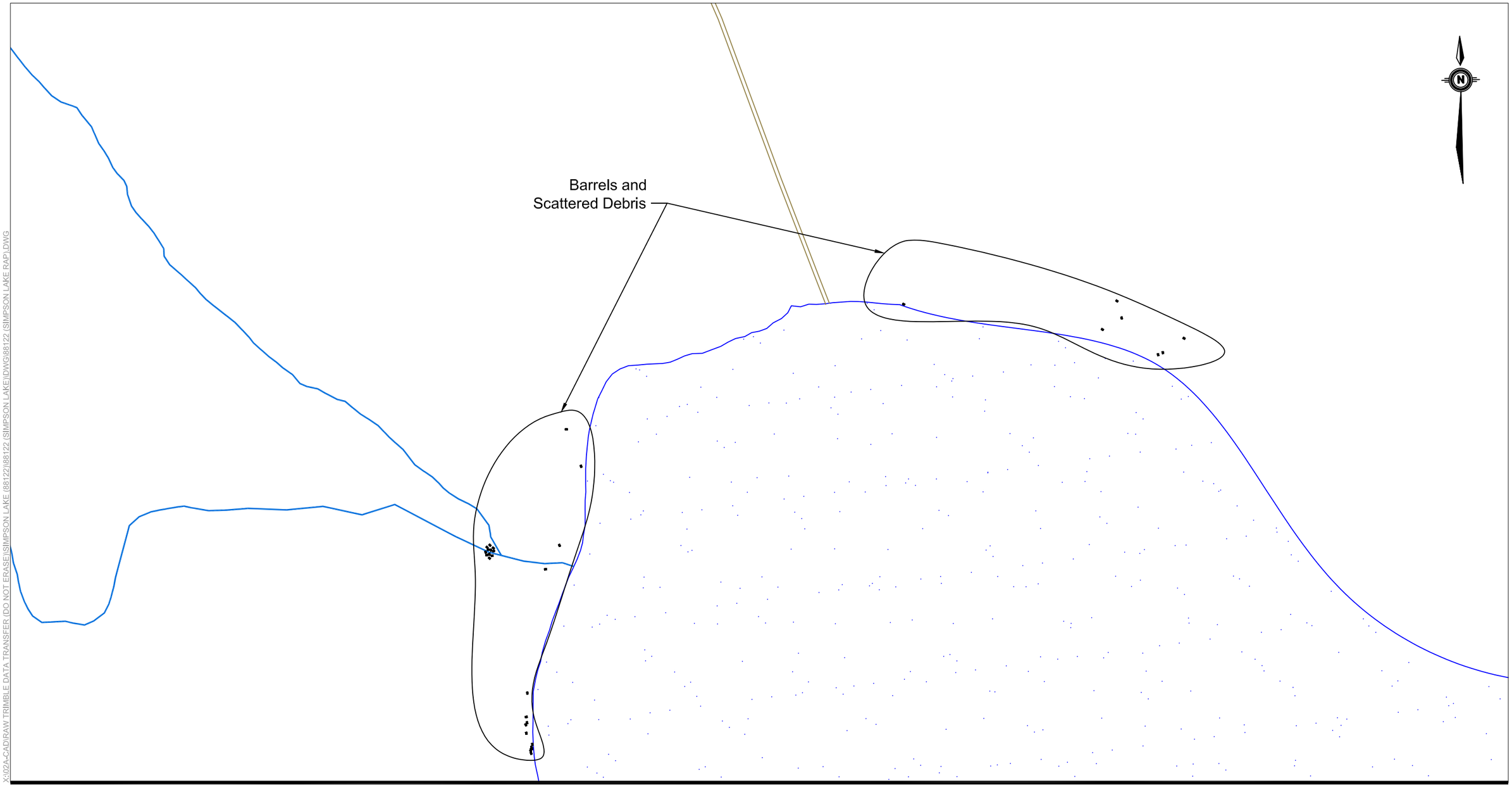
0 200 400 600 800 1000m
Scale 1:7500

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
FRESHWATER LAKE AND PLUMBERS DUMP AREA
Figure 8.0



Date: MARCH 17, 2006
SCALE:

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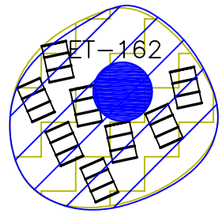
1:2500

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
FRESHWATER LAKE AREA
Figure 8.1



AREA 41.9m²
DEPTH 0.3m
VOLUME 12.6m³

Date: MARCH 17, 2006
SCALE:

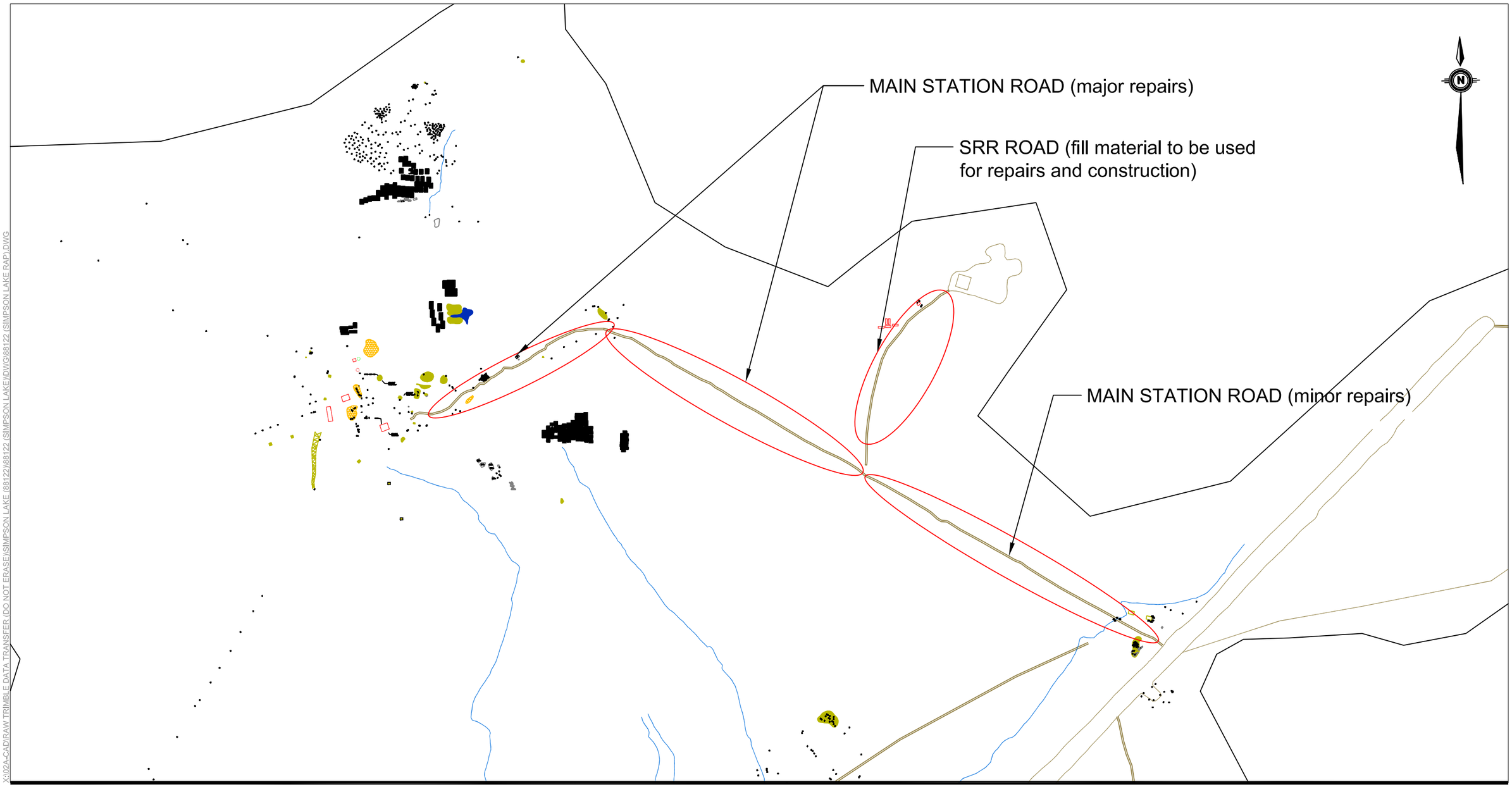
0 5 10
1:250

EarthTech
A Tyco International Ltd. Company

Legend (Note: ESG Samples were not analyzed for PHC or PAH)

- SOIL SAMPLE
- ESG SAMPLE
- PLANT SAMPLE
- BARREL
- CULVERT
- COMPRESSED GAS CYLINDER
- PCBs EXCEEDANCE
- METALs EXCEEDANCE
- PHCs EXCEEDANCE
- PAHs EXCEEDANCE
- MISCELLANEOUS DEBRIS
- BURRIED DEBRIS
- PCBs CONTAMINATION PLUME
- METALs CONTAMINATION PLUME
- PHCs CONTAMINATION PLUME
- PAHs CONTAMINATION PLUME
- WATERCOURSE

PWGSC
CAM-D DEW LINE REMEDIATION ACTION PLAN
PLUMBERS DUMP AREA
Figure 8.2



X:\02A-CAD\RAW TRIMBLE DATA TRANSFER (DO NOT ERASE)\SIMPSON LAKE (88122)\88122 (SIMPSON LAKE)\DWG\88122 (SIMPSON LAKE RAP).DWG

Date: MARCH 17, 2006
SCALE:

EarthTech
A Tyco International Ltd. Company

PWGSC

CAM–D DEW LINE REMEDIATION ACTION PLAN

REMEDIATION ACTION PLAN MAIN STATION AREA ROAD UPGRADES

Figure 9.0

TURN AROUND

NEW TEMPORARY ROAD

LANDFILL AREA

LAND FARM AREA

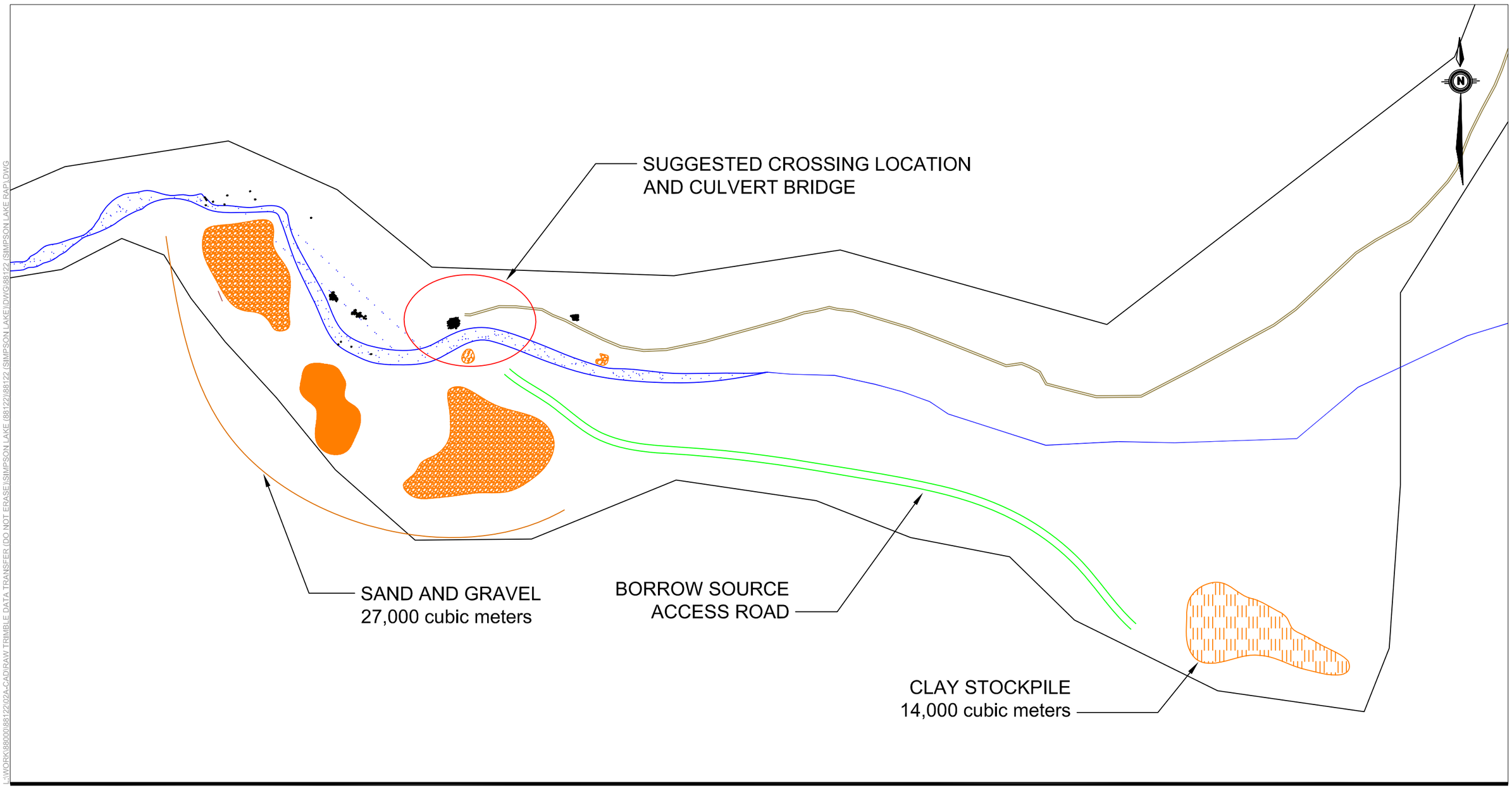
WASTE HANDLING FACILITY

X:\02A-CADRAW TRIMBLE DATA TRANSFER (DO NOT ERASE)\SIMPSON LAKE (88122)\88122 (SIMPSON LAKE)\DWG\88122 (SIMPSON LAKE RAP).DWG

Date: MARCH 17, 2006
SCALE:

EarthTech
A Tyco International Ltd. Company

PWGSC
CAM–D DEW LINE REMEDIATION ACTION PLAN
REMEDIATION ACTION PLAN MAIN STATION AREA
Figure 10.0



Date: APRIL 13, 2006
SCALE:

EarthTech
A Tyco International Ltd. Company

PWGSC

CAM–D DEW LINE REMEDIATION ACTION PLAN

REMEDIATION ACTION PLAN BORROW SOURCE AREA

Figure 11.0

APPENDIX B

Indian and Northern Affairs Canada
Abandoned Military Site Remediation Protocol

Jacques Whitford AXYS

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

Abandoned Military Site Remediation Protocol

March 2005

Indian And Northern Affairs Canada

Abandoned Military Site Remediation Protocol

March 2005

TABLE OF CONTENTS

LIST OF APPENDICES

(at end of text)

CHAPTER 1

1.0 INTRODUCTION

The Department of Indian and Northern Affairs Canada (INAC) is responsible for contaminated military sites, including intermediate and auxiliary Distant Early Warning (DEW) Line sites, in the Canadian Arctic (Fletcher 1989; INAC 2002). Environmental issues of concern at these sites have been identified that need to be addressed. This site remediation Protocol provides the guiding principles for the remediation of the contaminated sites under the control of INAC. The main DEW Line sites are the responsibility of the Department of National Defence (DND). Most of the INAC sites differ from the related DND sites in that they were in operation for a very limited period of time and were significantly smaller than the DND sites. Six of the INAC sites, Hat Island (CAM-B), Simpson Lake (CAM-D), Rowley Island (FOX-1), Bray Island (FOX-A), Nadluarjuk Lake (FOX-B) and Resolution Island (BAF-5), have currently operational North Warning System (NWS) sites co-located with the original DEW Line Site reserve.

INAC has undertaken the remediation of a number of sites across the Canadian Arctic namely Iqaluit Upper Base, Resolution Island, Horton River (BAR-E), and Pearce Point (PIN-A). The approach adopted for the remediation of these sites has generally been consistent with the DLCU Protocol (ESG 1991, 1993) with some site-specific modifications. Although no formal protocol was established or followed, remediation levels achieved at these sites were established for the protection of the environment. Due to the federal governments commitment to future funding of contaminated site clean up, INAC recognizes the need for a consistent protocol for abandoned military site cleanup (INAC 2002).

There are a number of factors that must be considered when determining the most suitable approach to site remediation. This protocol is based on an approach which addresses all legal requirements, INAC's Draft Contaminated Sites Policy (including risk management requirements) and standard environmental management practices (INAC 2002). This Protocol also takes into consideration financially prudent methodologies that address all the site environmental issues while striking a balance with remedial cost.

CHAPTER 2

2.0 CLEANUP OBJECTIVES

The following cleanup objectives, which are consistent with the CSMWG objectives to "integrate sustainable development and pollution prevention principles while meeting environmental regulations and protecting public health" (CSM, 2000, TB 1998, 2000, 2002), have been identified:

- To restore sites to an environmentally safe condition;
- To prevent migration of contaminants into the Arctic ecosystem;
- To remove physical hazards for the protection of human health and safety; and
- To implement a cost effective remediation solution.

These objectives are consistent with those applied by DND in the remediation of DEW Line sites under DND control (ESG 1991, 1993). The following considerations need to be taken into account when developing and implementing a remediation plan for the INAC sites:

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

CHAPTER 3

3.0 BACKGROUND

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

CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT APPROACH

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

- *Method 1*: Follow CCME Environmental Quality Guidelines (CCME 1997, 1999), as amended from time to time, and, where applicable, the *Canada-wide Standard for Petroleum Hydrocarbons in Soil* (CCME 2001). To the extent that such guidelines do not exist for a particular type of contamination, or are technically or economically inappropriate for a particular situation, departments and agencies may follow equivalent guidelines or standards (e.g. provincial);
- *Method 2*: Follow modified CCME Environmental Quality Guidelines where site conditions, land use, receptors, or exposure pathways differ only slightly from the protocols used in the development of the Guidelines; and
- *Method 3*: Develop site-specific remediation objectives based on a site-specific risk assessment, as outlined by the CCME, or equivalent, where site conditions are unique or particularly sensitive.

DEPARTMENT OF NATIONAL DEFENCE (DND) DEW LINE CLEAN UP PROTOCOL

The DLCU Protocol was developed by DND, with other government agency and stakeholder involvement, as a functional strategy for the effective remediation of the DND DEW Line sites (ESG 1991, 1993, 2003). The Protocol was developed at a time when no remediation standards and criteria specific to the Canadian Arctic existed. The

DEW Line Cleanup Criteria (DLCU Criteria) was validated through the collection of soil and vegetation samples from all of the DEW Line sites to monitor contaminant uptake using a contaminant source and pathway targeted approach. A broad suite of chemicals was investigated and the contaminants of concern at DEW Line sites were identified as those contaminants that were consistently elevated relative to the site background levels and the available Canadian federal or provincial guidelines (CCME 1991). The importance of the sites acting as point sources for contaminants in the Canadian Arctic was demonstrated through radial studies conducted at a number of DEW Line sites (ESG 1995). Contaminant concentrations were demonstrated to decrease with the increase in distance from the site but with constant contaminant patterns.

In 1996 DND initiated remediation of the first DEW Line sites using the DLCU Protocol and since then has applied this Protocol to all DND sites. A number of developments and modifications have been made to the approach to address issues that have arisen during the DND site remediations, such as the addition of petroleum hydrocarbons (PHC), elevated metal background concentrations in excess of the DLCU Criteria etc. These have been necessary due to the changing regulatory framework and to address site-specific conditions (e.g. CCME 2001, ESG 2005).

The development of the DLCU Protocol, the DND application of the Protocol and the Protocol itself has been reviewed by INAC to determine the applicability of the DLCU Protocol to the INAC abandoned military sites (WESA 2004). The Protocol has been determined to be generally applicable and indicates that this approach can be adopted to address specific remediation technical issues, is applicable at the smaller sites, and is appropriate for the INAC military sites. The DLCU Protocol has therefore been retained with minor modifications for application to the INAC sites. The supporting technical protocols have been developed to ensure the INAC Protocol remains relevant to the unique characteristics of INAC's sites.

The DEW Line Protocol has been retained with modifications appropriate to the scale of the site remediation requirements. These criteria remain relevant in accordance with the federal real property approach. The Criteria are adopted under the *CCME Method 1* where equivalent guidelines or standards are permissible for technical or economical reasons (CCME 1997). Where contaminants (not including hydrocarbons) are not addressed by the adopted DEW Line Cleanup Criteria, the CCME risk assessment approach (Method 3) will be applied. Hydrocarbon related contaminants will be addressed according to the CCME Canada Wide Standards (CWS) (CCME 2001).

CLEANUP CRITERIA FOR ADDITIONAL CONTAMINANTS OF CONCERN

The DEW Line Cleanup (DLCU) Protocol that includes criteria for a specific limited set of contaminants will be adopted for the INAC sites. An alternative mechanism is required to establish the cleanup criteria for contaminants of concern, identified below, that are not included in the DLCU Criteria.

PETROLEUM HYDROCARBON CONTAMINANTS

Consistent with the *CCME Method 1,* hydrocarbon contamination will be addressed through the application of the CCME CWS for Petroleum Hydrocarbons (PHC) Tier 2 (CCME 2001). Where it can clearly be demonstrated that Tier 2 levels are inappropriate due to the absence of specific pathways or receptors, a Tier 3 risk assessment approach may be adopted (CCME 1996).

Where free product is encountered the free phase liquid will be addressed prior to the application of the CCME CWS PHC or risk assessment methods for establishing remediation requirements.

ADDITIONAL NON-HYDROCARBON CONTAMINANTS

The level of environmental protection afforded the Arctic through the remediation of these contaminated sites needs to be consistent with the increased sensitivity of the receptors that are present, or frequent the sites. Environmental cleanup criteria developed for application at other more southerly latitudes are not necessarily sufficient to protect the sensitive Arctic ecosystem (INAC 2000). In order to demonstrate that the cleanup criteria adopted for the INAC military sites are sufficiently protective, an Ecological and Human Health Risk Assessment was conducted at two sites, Sarcpa Lake (CAM-F) and Ekalugad Fiord (FOX-C) (JW 2005). The impacts of the contaminants with a wide range of parameters on selected representative receptors were assessed and the related risk to the ecological or human health determined. The results of the risk assessment applying the DLCU Protocol showed that the level of risk posed by residual contaminants following remediation to these standards is well below the acceptable risk levels for both ecological and human receptors. The ecological risks at the DLCU levels are negligible. The human health risks are also negligible except in the case of PCBs where the risk is small; however below the Health Canada human health effects levels (HC 2002).

The Ecological and Human Health Risk Assessment will be used to establish appropriate remediation criteria for parameters that are not included in the DLCU Protocol.

In a limited number of cases the INAC military sites served as centres for other non-military activities. In these cases it is possible that contaminants have been introduced and are present that have not been identified as common to all sites and therefore are not included in the DLCU Protocol. At sites where this is known or suspected to be the case, the ecological and human health data will be collected and the corresponding risk assessment completed to determine the appropriate remedial standard for any additional elements detected during the investigation phase. The contaminants, not addressed by the DLCU Criteria or the CCME PHC CWS, will be addressed through *CCME Method 3 site-specific risk assessment* (CCME 1996). A site-specific risk assessment is required due to the unique and sensitive nature of the Arctic environment.

SENSITIVE RECEPTORS

Where contaminants are present in close proximity to sensitive receptors special attention, that may require a risk assessment, should be given to the remediation approach and residual contaminant levels post-cleanup to ensure effective protection of the sensitive receptors.

ECONOMIC CONSIDERATIONS - COST BENEFIT ANALYSIS

Prior to implementing any remedial plan the costs of implementing all potentially suitable remedial solutions for each component of the site need to be evaluated and the total costs of the alternative solutions established to determine the most cost effective solution. The total costs should include consideration of the logistical and resource requirements. In addition to these costs, the long-term monitoring and maintenance of the sites should be considered and the future liability of residual site contamination and facilities be addressed.

The costs associated with implementing approved remedial solutions during site remediation arise from a number of assorted expenses. These include, but are not limited to, resources (i.e. materials, suitable equipment, human resources with the necessary technical skill sets, on-site maintenance and support services) and logistics (transportation and communication).

Typically the complexities of the post-cleanup monitoring and maintenance efforts conducted under remote Arctic conditions are associated with the logistical aspects of the operation and the remoteness of the sites from technical resources and support services. The cost of implementing an acceptable technical remedial solution is often overshadowed by the costs of mobilizing the necessary resources including material, equipment and human resources with the required skill sets for demanding work under difficult conditions.

Following implementation of a technically feasible remedial solution, increased costs may be incurred to ensure effective monitoring of the sites. Problems identified during the monitoring program may result in a requirement to perform additional remedial action with additional costs.

RISK MANAGEMENT CONSIDERATIONS - RISK ASSESSMENT

The risks to the Department during the monitoring and maintenance of the site need to be identified (eg. National Classification System (NCS) and Northern Environmental Risk Assessment Strategy (NERAS)). The costs incurred during the implementation of the cleanup need to be commensurate with the environmental benefit and the residual risk to the Department (TB 2000). The risks associated with the site may be more readily reduced during the remediation phase than during the post-cleanup monitoring phase.

The risks to the project should be evaluated through standard risk assessment tools applied to Departmental projects.

CHAPTER 4

4.0 INAC MILITARY SITE PROTOCOL - TECHNICAL ASPECTS

The elements of this remediation protocol have been developed through the review of previous work at related sites (eg. PWGSC 2001, 2001b, 2001c, 2002, 2002b, 2002c, 2002d, 2002e, 2002f, 2003, IEG 2001, EWG 1998 & 1999, UMA 1994) and taking into consideration information of particular relevance to the unique character of the INAC sites. Typical environmental issues and their associated remedial action procedures addressed by the Protocol are outlined below.

LANDFILLS

LANDFILL CLOSURE

Landfills on INAC abandoned military sites can be classified into one of three broad categories. Actions associated with each category of landfill have been identified. Where a landfill exists on INAC abandoned military sites, the condition of the landfill will be evaluated to determine the most appropriate action;

- If the landfill is located in an unstable, high erosion location, it will be relocated to a properly engineered landfill. During the relocation process, any identified hazardous materials will be segregated for off-site disposal (Class A landfill);
- If the landfill is located in a suitable, stable location, but there is evidence of contaminated leachate, a suitably engineered containment system will be constructed. If this course of action is cost prohibitive, the landfill may be relocated to an engineered landfill or the waste may be disposed of off-site (Class B Landfill); and
- If the landfill is located in a suitable, stable location, with no evidence of contaminated leachate, it will be left in place. If required, additional granular fill will be placed to ensure erosion protection and proper drainage (Class C Landfill).

LANDFILL DEVELOPMENT

New engineered landfills may be required to address specific contaminants. These landfills will be used for the disposal of non-hazardous materials and non-regulated contaminated soils only. The landfills will be capped with a minimum of 0.6m of granular fill material or other thickness as determined by site conditions, which will be graded to

promote surface run-off and minimize erosion. The cover thickness will promote redevelopment of the permafrost layer to stabilize the non-regulated contaminated soil landfill contents.

Consideration for the location of any new landfill will include the proximity to drainage courses, material to be placed within the landfill, borrow source locations and the overall topography of the site.

Monitoring of the new landfills will be required to ensure that they are operating as intended. Monitoring activities may include visual inspection to ensure that water is not ponding on the landfill cover, that the cover is not eroding and that the permafrost is developing within the landfill consistent with the design.

PHYSICAL DEBRIS

Visible site debris will be collected and segregated into hazardous and non-hazardous waste streams for disposal;

- Non hazardous waste: The volume of the non-hazardous materials will be minimized through crushing, shredding, or incineration, prior to their placement in an on-site engineered landfill. If there is no existing landfill on-site, and no suitable location for a new engineered landfill, the non-hazardous materials will be disposed of off-site; and
- Hazardous waste: These materials will be disposed of off-site, in accordance with the current regulations governing the handling and disposal of hazardous materials.

CONTAMINATED SOILS

Contaminated soils will be considered in three primary categories; soils that are regulated, soils that are classified as hazardous and soils that are classified as contaminated but not hazardous waste. Contaminated soils that are regulated will be remediated and/or disposed of in compliance with the applicable regulations. Contaminated soils that are not regulated or hazardous will be remediated to meet the DLCU Criteria (see Appendix B). Where the historical land use has been for another industry in addition to the military operations, additional parameters will be assessed and remediated to levels established through Site Specific Risk Assessments. Hydrocarbon contaminated soil remediation levels will be established through the

application of the CCME Canada Wide Standards - Petroleum Hydrocarbons in Soil (CCME 2001).

Three primary contaminated soil types have been identified; metal contaminated soil, hydrocarbon contaminated soil and PCB contaminated soil. Where multiple contaminants are present in the soils, the most conservative remedial option that addresses both contaminant types will be applied.

METALS CONTAMINATED SOILS

All soils with metal concentrations exceeding the DLCU Criteria or criteria derived through Risk Assessment processes will be either disposed of off-site or encapsulated on-site.

PETROLEUM HYDROCARBON CONTAMINATED SOILS

Hydrocarbon contaminated soil remediation levels will be established through the application of the CCME Canada Wide Standards - Petroleum Hydrocarbons in Soil. Tier 2 levels will be routinely applied with Tier 3 levels applied to sites where conditions are significantly different than the norm. Where hydrocarbon contamination is determined to exceed these protective levels, in-situ or ex-situ remediation options will be considered. Where on-site remediation is not cost effective, hydrocarbon contaminated soils may be transported off site for disposal. If they do not pose a significant environmental risk, they may be capped in place or left in place to remediate through natural attenuation.

Where free product is encountered the free phase liquid will be addressed prior to the application of the CCME CWS PHC or risk assessment methods for establishing remediation requirements.

PCB CONTAMINATED SOILS

All soils with PCB concentrations exceeding the DLCU Criteria will be either disposed of off-site or encapsulated on-site. If the PCB contaminated soils are considered to be a PCB Waste under the Canadian Environmental Protection Act (CEPA 1999), soil handling and disposal will be governed by the PCB regulations.

HAZARDOUS MATERIALS

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

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

BARRELS

Barrels identified at the site will be handled according to the DLCU Barrel Protocol (see Appendix D) as outlined below:

- Empty Barrels: Empty barrels will be crushed and disposed in an on-site engineered landfill;
- Filled or Partially Filled Barrels: Barrel contents will be inspected and tested if necessary and disposed of appropriately (off-site or incinerated). The empty barrel will be rinsed, crushed and disposed on-site in an engineered landfill. The spent rinse liquid will be treated with absorbent material and disposed as hazardous material, as required; and
- Buried Empty Barrels: Areas containing buried empty barrels will be inspected to determine if any of the barrels contain material and characterized through a geophysical survey. If the barrels are found to be empty the area will be stabilized through compaction to crush any corroded barrels. A cover of borrow material will be placed over the area and compacted.

BUILDINGS AND INFRASTRUCTURE

The existing buildings and infrastructure at a site will be demolished to their foundations. All hazardous materials will be segregated prior to or during demolition. Non-hazardous demolition materials and asbestos will be collected and disposed in an on-site engineered landfill. Hazardous demolition materials will be disposed off-site.

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

BORROW SOURCES

Granular borrow material will be required for the development of new landfills and general site grading purposes. Available existing sources of borrow material will be exhausted before exploiting new areas. Abandoned gravel pads and road infrastructure will be used as granular source material wherever possible. At the completion of the remedial activities, all borrow areas will be recontoured to restore natural drainage and to match the surrounding topography, in accordance with all applicable licenses.

SITE GRADING

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

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

CONTRACTOR SUPPORT ACTIVITIES

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

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

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

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

CHAPTER 5

5.0 POST CONSTRUCTION LANDFILL MONITORING

Monitoring of the historical landfills and new landfills will be required to ensure that they are operating as intended. Monitoring activities may include visual inspection to ensure that water is not ponding on the landfill cover, that the cover is not eroding and that the permafrost is developing within the landfill consistent with the design.

The landfill monitoring will follow a pre-established monitoring program and will occur at regular intervals following closure of the site. Once it has been demonstrated that the landfill is stable physically and chemically then the frequency of monitoring will be reduced. Physical stability of the landfill will be established as a minimum through visual inspection and may include instrumentation for thermal monitoring. Chemical stability of the landfill will be established through the collection of suitable samples from around the landfill site consistent with the monitoring program and site specific monitoring plan.

CHAPTER 6

6.0 CLOSURE

The approach presented here and to be adopted during the INAC abandoned military site remediation program is consistent with federal and departmental policies. It takes advantage of the historical research and development previously completed and respects the approach adopted and experience gained in the past to remediate similar contaminated sites. It accounts for site-specific conditions and allows flexibility to address unforeseen issues at individual sites through risk assessment and risk management methods consistent with federal guidelines.

The supporting technical guidance documents will provide sufficient information and detail to ensure the consistent application of this approach which will provide a consistent level of environmental protection and quality assurance for all of the sites remediated during the program.

The financial analyses and control coupled with the risk evaluation and management approach will ensure that the funds expended on the remediation effort are most beneficial to the local and greater Canadian community stakeholders over the lifetime of the project and the ensuing years.

APPENDIX A:

List of References

REFERENCES

Andzans 1984: *Andzans and Associates,* DEW Line Data File, Department of Indian and Northern Affairs*, 1984*.

CCME 1991: Canadian Council of Ministers of the Environment (CCME) 1991. *Interim Canadian Environmental Quality Criteria for Contaminated Sites.*

CCME 1992: *Canadian Council of Ministers of the Environment,* National Classification System for Contaminated Sites, *1992*.

CCME 1996: *Canadian Council of Ministers of the Environment,* A Framework for Ecological Risk Assessment*, 1996*.

CCME 1996: *Canadian Council of Ministers of the Environment*. A protocol for derivation of environmental and human health soil quality guidelines, 1996.

CCME 1996: *Canadian Council of Ministers of the Environment*, Guidance manual for developing site-specific soil quality remediation objectives for the contaminated sites in Canada, 1996.

(CCME 1997): *Canadian Council of Ministers of the Environment,* Guidance Document on the Management of Contaminated Sites in Canada, *1997*.

CCME 1999: *Canadian Council of Ministers of the Environment,* Canadian Environmental Quality Guidelines, *1999*.

CCME 1999: Canadian *Council of Ministers of the Environment,* Canadian Environmental Quality Guidelines Update, *2001*.

CCME 2001 *Canadian Council of Ministers of the Environment,* Canada Wide Standards for Petroleum Hydrocarbons in Soil, 2001.

CCME 2002: *Canadian Council of Ministers of the Environment,* Guidelines for Canadian Drinking Water Quality *, 2002*.

CEPA 1999: *Canadian Environmental Protection Act. 1999*.

CSM 2000: *Contaminated Sites Management Working Group,* Federal Approach to Contaminated Sites, 2000.

EWG 1998: *Environmental Working Group (EWG)*, DEW Line Cleanup, Nunavut, Environmental Working Group Report, Prepared for Nunavut Tunngavik Incorporated and the Department of National Defence, March 1998.

EWG 1999: *Environmental Working Group (EWG),* Evaluation of Hydrocarbon Contamination at DEW Line Sites in Nunavut – Addendum*,* Prepared for Nunavut Tunngavik Incorporated and the Department of National Defence, May 1999.

ESG 1991: *Environmental Sciences Group*, North Warning System Environmental Study, *1991*.

ESG 1993: *Environmental Sciences Group for the Director General Environment Department of National Defence,* Environmental Impact of the DEW Line on the Canadian Arctic*, 1993*.

ESG 1995: *Environmental Sciences Group*, Evidence of Short-Range Transport of Polychlorinated Bihenyls in the Canadian Arctic using Congener Signatures of PCBs in Soils, Science in the Total Environment, 160/161: 251-263, 1995.

ESG 2003: *Environmental Sciences Group*, The Development of an Environmental Cleanup Strategy for the DEW line, in press, 2003.

ESG 2005: *Environmental Sciences Group*, Development of Site-Specific Environmental Criteria From Background Data, in press, 2005.

FCS 2000: Federal Contaminated Sites and Solid Waste Landfills Inventory Policy, July 2000.

Fletcher, 1989: *Fletcher R. J.,* Military Radar Defence Lines of North America: An Historical Geography, Polar Record 26, (156), 265-276*, 1990*.

HC 2002: *Health Canada*, Food Program, Food Safety and PCBs Found in Fish, 2001.

IEG 2001: *Inuvialuit Environmental Group for INAC*, Design of the Cleanup of Atkinson Point: BAR-D, 2001.

INAC, 1997:*Arctic Environmental Strategy – Northern Contaminants Program*, Canadian Arctic Contaminants Assessment Report, Vol 25 1997.

INAC 2002: *Department of Indian and Northern Affairs*, Contaminated Sites Program Management Framework Version 1, October 2002.

INAC 2003: Indian and Northern Affairs - Northern Contaminants Program, Canadian Arctic Contaminants Assessment Report, 2003.

JW 2005: *Jaques Whitford* Ecological and Human Health Risk Assessment – a. Ekalugad Fiord (FOX-C) and b. Sarcpa Lake (CAM-F), in preparation, 2005.

PWGSC 2001: Public *Works and Government Services Canada for INAC*, Former Mid-Canada Line Radar Station, Bear Island, Nunavut, Preliminary Design and Outline Specifications, March 2001.

PWGSC 2001b: Public *Works and Government Services Canada for INAC*, Former US Coast Guard Loran Station Cape Christian, Nunavut, Preliminary Design and Outline Specifications, November 2001.

PWGSC 2001c: *Public Works and Government Services Canada for INAC*, Former US Coast Guard Weather Station, Padloping Island, Nunavut, Preliminary Design and Outline Specifications, November 2001.

PWGSC 2002: Public *Works and Government Services Canada for INAC*, Remediation Action Plan, Former Mid-Canada Line Radar Station, Bear Island, Nunavut, March 2002.

PWGSC 2002b: *Public Works and Government Services Canada for INAC*, Remediation Action Plan, Former US Coast Guard Loran Station Cape Christian, Nunavut, March 2002.

PWGSC 2002c: *Public Works and Government Services Canada for INAC*, Remediation Action Plan, Former US Coast Guard Weather Station, Padloping Island, Nunavut, March 2002.

PWGSC 2002d: Public *Works and Government Services Canada for INAC*, Remediation Action Plan, Former Navigational Aid and Weather Station, Radio Island, Nunavut, March 2002.

PWGSC 2002e: *Public Works and Government Services Canada for INAC,* Former Navigational Aid and Weather Station, Radio Island, Nunavut, Preliminary Design and Outline Specifications, November 2002.

PWGSC 2003: *Public Works and Government Services Canada for INAC*, Environmental Review of DIAND Contaminated Sites in the Territory of Nunavut, September 2003.

TB 1998: *Treasury Board* Real Property Environmental Policy, June 1998.

TB 2000: *Treasury Board* Federal Contaminated Sites and Solid Waste Landfills Inventory Policy, July 2000.

TB 2000b: *Treasury Board* Draft Guidelines on Liabilities and Contingent Liabilities Related to Federal Contaminated Sites, November 2000.

TB 2002: *Treasury Board* Federal Contaminated Sites Management Policy, June 2002.

TC 2002: *Transport Canada*, Transportation of Dangerous Goods Regulations: Clear Language. Transportation of Dangerous goods Act 1992.

UMA 1994: *UMA Engineering*, Concept Design for 21 DND DEW Line Sites, 1994.

WESA 2004: *Remediation of Northern Military Sites* - Standards and Approaches Workshop September 2004.

APPENDIX B:

DEW Line Cleanup Soil Criteria

GENERAL PROTOCOL FOR DEW LINE CLEANUP

A. STAINED SOIL

1. Remediation will be applied to all areas where inorganic elements and/or PCBs are at concentrations in excess of the Quebec B[1] or CCME R/P[2] criteria, whichever is lower.
2. This combination of the Quebec B and CCME R/P criteria form the DEW Line Cleanup Criteria (DCC). The DCC (Table 1) were determined, on the basis of site specific investigations, to be protective of the Arctic ecosystem.
3. Remediation responses differ depending on the tier of DCC, I or II that is applied. Thus:
   - All soils containing substances in excess of the DCC Tier II (numerically equal to CCME R/P) criteria will be containerized[3]; and
   - Excavated soils containing PCBs at concentrations between 1 and 5 ppm, and/or lead at concentrations between 200 and 500 ppm may be landfilled. The lower of the concentrations for these elements form the DCC Tier I criteria.
4. Some site specific exceptions may be applied; for example, the bird sanctuary at Cape Parry may be treated more rigorously.
5. Follow up (confirmation) testing will be to the DCC II (CCME R/P) criteria.

B. SEWAGE OUTFALLS

1. Use of active outfalls to be discontinued and secure sewage lagoons to be established where practical.
2. Abandoned outfalls to be considered as stained areas.

1. This refers to the Quebec Soil Contamination Guidelines (as of 1991).
2. Refers to the Interim Canadian Environmental Quality Criteria for Contaminated Sites (as of 1991) produced for the Canadian Council of Ministers of the Environment (CCME).
3. Containerized" refers to removal of the soil in a manner which precludes contact with the Arctic ecosystem.

C. SEWAGE LAGOONS

1. Existing lagoons which are not highly contaminated can continue in use provided measures are applied for leachate control.

2. Existing lagoons which are highly contaminated are to have their use discontinued, evaporation allowed to take place, and the dried residue removed and disposed in accordance with the protocol for stained soils.

D. LANDFILLS

Fall into one of three categories:

1. Located in an unstable, high erosion area; must be removed;
   Contents to be treated as per the procedures adopted for stained soils and physical debris.
2. Suitable location and no evidence of contaminated leachate;
   Can remain as is.
3. Suitable location, but source of contaminated leachate;
   Action must be taken to contain leachate. Options for the containment/stabilization of landfills can include the addition of clean fill; other suitable measures can be employed.

E. PHYSICAL DEBRIS

Visible physical debris is to be sorted into hazardous and non-hazardous components.

1. Hazardous material is to be containerized and stored in a secured location.
2. Non-hazardous material is to be buried in a suitable landfill location.

Debris from the demolition of facilities no longer required should be dealt with in the same manner as visible physical debris. Incineration of this material is not recommended; if burning is employed, the ash should be treated as hazardous waste.

It should be noted that this last requirement does not preclude the incineration of some non-hazardous materials, although it is advisable to ensure that the ash from all burning be buried in a suitable landfill. Structures that contain paints, metal etc

which could form a hazardous ash after combustion, should be broken down and buried; if this is not practical due to lack of a suitable landfill location and/or fill, then incineration may be considered as long as the ash is treated as hazardous waste.

TABLE 1: DEW LINE CLEANUP CRITERIA (DCC)[a]

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

a. These criteria were adopted specifically for the cleanup of Arctic DEW Line Sites from the 1991 versions of the Quebec Soil Contamination Indicators and the Canadian Council of Ministers of the Environment Interim Canadian Environmental Criteria for Contaminated Sites.

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

c. Soils containing lead and/or PCBs at concentrations in excess of DCC I, but less than DCC II, may be landfilled,

d. Soils containing one or more substrates in excess of DCC II must be containerized - i.e. removed in a manner which precludes contact with the Arctic ecosystem.

Table B-1: DEW Line Cleanup Summary

Cleanup requirement	DLCU Protocol
Building demolition and physical debris removal	– After demolitions sort debris into hazardous/nonhazardous waste. – Bury nonhazardous waste in unlined-engineered landfill and cover with clean fill. – Ship hazardous material South.
Barrels	– Crush or shred, analyze contents, then incinerate or ship to southern facility
Landfills - three types: 1. In unstable locations or leaching high levels of contaminants. 2. Contaminants leaching at low levels, and situated in a stable location which is not subject to erosion. 3. No contaminants leaching from the toe of dump.	After removal of any visible debris from the surface of the dump: 1. Excavate and sort into hazardous/nonhazardous debris. 2. Design engineering solution to stabilize in place by the use of liners and fill. 3. Cover with clean fill and recontour to direct surface waters away from the landfill.
Contaminated soil: 1. PCB level > 50 ppm (CEPA) 2. > DCC Tier II but < CEPA 3. > DCC Tier I but < DCC Tier II	1. Shipment to Southern licensed facility. 2. Isolate from the Arctic ecosystem (Northern Disposal Facility or ship South). 3. Burial in nonhazardous landfill.

APPENDIX C:

CCME CWS PHC Tier 1 and Tier 2 Criteria

HYDROCARBON CONTAMINATED SOIL
CANADA –WIDE STANDARDS FOR PETROLEUM HYDROCARBONS

A. INTRODUCTION

The Canadian Council of Ministers of the Environment (CCME) have developed the Canada Wide Standards (CWS) for petroleum hydrocarbons (PHC) in soil (CCME, 2001) in an attempt to provide a consistent evaluation and analytical approach to dealing with hydrocarbon contamination throughout Canada.

The PHC CWS is a three-tiered risk-based remedial standard for contaminated soil and subsoil occurring in four land use categories. Tier 1 sets generic numerical levels; Tier 2 allows for adjustments to Tier 1 levels based on site-specific information; whereas Tier 3 involves a site-specific risk assessment consistent with the CCME approach to the development of remedial objectives.

The PHC CWS four generic land uses are agriculture, residential/parkland, commercial and industrial. The exposure scenario associated with each of these land use categories forms the basis of the PHC CWS. Jurisdictions may also elect to define generic land uses involving the presence or absence of any relevant receptors and pathways, if appropriate in the context of geographic location, local land use and development trends.

B. CCME CWS PHC APPLICATION TO INAC SITES

LAND USE

Residential/Parkland has been applied to the INAC sites and is defined as the land use where the primary activity is residential or recreational activity. The parkland land use is defined as a buffer between the areas of residency and occupation, but this does not include wild lands such as national or provincial parks or undeveloped areas, other than campgrounds.

PATHWAYS AND RECEPTORS

The key receptors and exposure pathways considered for residential/parkland land use are as follows:

EXPOSURE PATHWAY	RECEPTOR
soil contact	invertebrates, plants, human (child)
soil ingestion	wildlife*, human (child)
groundwater / surface water	aquatic life, human (child)
vapour inhalation	child indoor

*wildlife dermal contact and ingestion is applicable when free product is present at surface, but there are insufficient data to develop guidelines that address this exposure pathway. Also, there are insufficient data to evaluate PHC exposure through the food chain. The few data available indicate that plant uptake of PHCs and subsequent exposure at higher trophic levels is not a concern.

HUMAN HEALTH EXPOSURE SCENARIOS

The critical receptor assumed at the residential/parkland land use category is a toddler. Exposed to PHC impacted soil and groundwater by ingestion, inhalation and dermal contact is assumed to be for 24 hours/day, 7 days/week, and 52 weeks/year. In addition, other receptor characteristics include soil ingestion rates (0.08 g/day), water ingestion rate (0.6 L/day), and inhalation rate (9.3 m^3/day). Route specific absorption rates are assumed to be 100% for ingestion and inhalation, and 20% for dermal contact. Additionally, to account for non-point source pollution, a soil allocation factor (SAF) of 0.5 is assumed for F1 and F2. SAFs of 0.6 and 0.8 are assumed for F3 and F4 respectively.

ECOLOGICAL EXPOSURE SCENARIOS

The ability for soil to support plant and soil invertebrate communities is deemed to be important for both short-term and long-term ecological sustainability. CWS does not consider mammalian and avian wild life as critical receptors as most PHCs are readily metabolized by vertebrates, modified into a more readily excretable form, and thus do not tend to accumulate in tissues. In addition, PHCs are not readily absorbed into and accumulated into plant tissues. The net result of consumption of either plants and/or other animals (as opposed to direct soil ingestion) does not tend to constitute a major component of exposure for PHCs in wild life and livestock populations. Therefore, direct

soil contact with soil invertebrates and plants is the only direct ecological exposure pathway considered applicable by CWS. The indirect contact of aquatic life with the PHCs is also considered by CWS.

TOXICOLOGICAL BASIS

The PHC CWS adopted the US Total Petroleum Hydrocarbons Working Group (TPHCWG) system and uses the oral reference doses (RfDs) and inhalation reference concentrations (RfCs) for each of the 14 aliphatic or aromatic sub-fractions identified in this system. Toxicological information for each TPHCWG sub-fraction is combined with the information on the expected mass of each sub-fraction to produce a toxicological benchmark for each of the four PHC CWS sub-fractions. The toxicological basis for ecological receptors is based on the toxicological data for vascular plants and soil invertebrates. Endpoints examined included chronic and sub-chronic responses (*e.g.,* root elongation, shoot growth, reproduction) as well as acute and lethal responses (*e.g.,* invertebrate survival and seed germination) in both field and artificial soils. The studies were based on the use of either whole products or vacuum distillates of fresh as opposed to weathered Whole Federated Crude Oil, using coarse textured soils.

ANALYTICAL METHOD

A significant development introduced through the CWS is the adoption of a benchmark method for the determination of PHC in soil. The adoption of a standard analytical method addresses major sources of variability and uncertainty related to the extraction, purification, quantification, and reporting of hydrocarbon contaminant levels in soils. Different analytical methods are prescribed for the four Fractions recognized by the PHC CWS. F1 PHC is isolated through purge and trap procedures followed by gas chromatography with a flame ionization detector (GC-FID). F2 - F4 PHC up to C50 are extracted by a Soxhlet procedure, “cleaned up” on silica gel and determined by GC-FID. C50+ PHC, if present, is determined either gravimetrically or through extended chromatography. Specific chromatograph calibration standards are required.

PHC CWS is implemented in three tiers: (1) the application of generic Tier 1 levels that are protective of the human health and the environment, (2) site-specific adjustments to Tier 1 levels to calculate Tier 2 levels that accommodate unique site characteristics, and (3) Tier 3 levels that are developed from site-specific ecological or human health risk assessment, when assumptions in the Tier 1 values are not appropriate for a site. The level of protection is the same for all three tiers.

Residential/parkland land use category was adopted as a conservative basis for the development of DEW Line Cleanup (DLCU) Criteria for inorganic elements and PCBs listed as the primary contaminants of concern. Residential/Parkland Tier 1 levels (mg/kg soil) for PHCs for coarse-grained surface soils are presented in Table 1 given below. Typical soil conditions at INAC military sites are located within 1.5 m from the ground surface and with grain size greater than 0.75 µm. These are defined as coarse-grained surface soils within the CWS system.

TABLE 1: CCME RESIDENTIAL/PARKLAND TIER 1 LEVELS (mg/kg SOIL) FOR PHCS FOR COARSE-GRAINED SURFACE SOILS

EXPOSURE PATHWAYS	F1 (C_6-C_{10})	F2 (>C_{10}-C_{16})	F3 (>C_{16}-C_{34})	F4 (>C_{34})
Soil ingestion	15,000	8,000	18,000	25,000
Vapour inhalation (slab-on-grade)	30	150	NA[3]	NA[3]
Protection of GW for aquatic life[1]	230	150	NA[3]	NA[3]
Eco soil contact[2]	130	450	400	2800

[1] Assumes surface water body at 10 m from HC source area.
[2] Tier 1 values based mainly on laboratory bioassay response to fractions derived from fresh Federated Crude Oil.
[3] NA – not applicable.

If Tier 1 levels, as outlined above, are implemented, the governing pathways are protection of aquatic life at the beach POLs, and ecological soil contact at other PHC impacted areas such as module train, garage, and hangars. Most of these source areas (*i.e.,* pads) contain sparse vegetation. Furthermore, invertebrates are not present at least at the sites in the central and eastern Arctic (Nunavut). The presence of PHCs in the soil may have some adverse impact on the microbial processes. Because of the sparse vegetation, the microbial processes in soil are relatively less important than aquatic ecosystem in the Arctic. Therefore, the ecological soil contact pathway can be qualitatively eliminated for soils well removed from the aquatic ecosystem. Exposure to indoor inhalation is not applicable as the garages and hangars are demolished during the cleanup. The remaining applicable pathways are soil ingestion and protection of aquatic life. Therefore, the most likely cleanup levels applicable are as follows (see Table 2).

The resulting soil remediation criteria for fuel oils in areas removed from life supporting water bodies is 8,000 ppm and the soil remediation criterion in areas in close proximity to life supporting water bodies within 10 m of the hydrocarbon contaminant source is 150 ppm.

TABLE 2: CCME RESIDENTIAL/PARKLAND TIER 1 LEVELS (MG/KG SOIL) APPLICABLE PATHWAYS

EXPOSURE PATHWAYS	F1 (C_6-C_{10})	F2 (>C_{10}-C_{16})	F3 (>C_{16}-C_{34})	F4 (>C_{34})
Soil ingestion (garages, hangars, etc.)	15,000	8,000	18,000	25,000
Protection of GW for aquatic life[1] (beach POLs)	230	150	NA[2]	NA[2]

[1] Assumes surface water body at 10 m from HC source area.
[2] NA – not applicable.

In cases where pertinent site conditions are similar relative to each other, it may be possible and cost effective to develop site-specific objectives based on one site. Provided the site similarities can be demonstrated to be sufficiently similar that the risk assessment assumptions and inputs for each site are equivalent the results may be generally applicable to all of the similar sites. Reviewing site assumptions and dependencies will require verification of the similarity of the sites. Where significant differences are identified the impacts of the differences on the risk assessment output will need to be assessed.

C. CONCLUSIONS AND RECOMMENDATIONS

The CCME guidelines for contaminated sites provide generic standards or the mechanism for modifying the standards and developing site-specific risk based standards.

The development of site-specific criteria through the application of a CCME Method 2 (modified generic guidelines) or Method 3 (risk assessment derived site-specific objectives) approach is provided for application. The approach used to modify the soil quality guidelines should adhere to the soil protocols and minimum data requirements established in the soil protocol (CCME 1996a). Risk assessment derived soil objectives applicable for a particular site may be transferable to the other similar sites.

The application of the CWS PHC at the Tier 2 level is considered to be more appropriate for the derivation of contaminant criteria. The standards achieved through the application of the CWS are of the order of 150 ppm for ecologically sensitive areas and 8000 ppm for areas removed from ecologically sensitive areas. However, the application of the CWS has some practical application limitations. The analytical requirements are rigorous and demanding especially for implementation in remote locations where on-site analytical capabilities are limited and significant time is required to transport samples to an analytical laboratory.

The soils at the sites are typically contaminated with petroleum hydrocarbons, PCBs, and inorganic elements specifically lead, copper and zinc. Soils impacted by petroleum hydrocarbons should be delineated to two different criteria as follows:

1. Petroleum hydrocarbon impacted soils close to fisheries sensitive environment should be delineated to 150 ppm; and
2. Petroleum impacted soils in other areas of the site should be delineated to 5,000 ppm.

Typical areas include POL facilities at the beach and the station areas. Stains of heavy end hydrocarbons (lube oil) are common around module trains and garages. The type of hydrocarbons present include diesel, gasoline, waste lube oils. The diesel and gasoline contamination typically extends to the permafrost boundary. Permafrost is typically encountered at 0.3 – 2.5 m below surface.

It is necessary to collect source, pathway and receptor information for all the petroleum hydrocarbon areas to ensure sufficient information is available to perform the appropriate level of risk assessment. Risk assessment derived soil objectives applicable for a particular site may be transferable to the other similar sites.

In many instances the volume of contaminated soil present at a site may be sufficiently small that removal of the contaminant through excavation and disposal or remediation is the most cost effective approach. It is therefore appropriate to address contaminated areas site-specifically and area specifically.

The completion of the Risk Assessment for a typical model site as well as the CCME Tier 2 comparison will provide a clear understanding of the primary influencing factors in the level of risk posed by contaminated soil at INAC contaminated sites. With this level of understanding flexibility in the implementation of the requirements and therefore the approach is available. The interaction of source, pathway and receptor in determining the risk posed by the contamination allows for various points of intervention to mitigate the risk. Where options are available field decisions may be required to ensure the most appropriate site-specific solution is applied.

REFERENCES

Canadian Council of Ministers of the Environment (CCME) 1991. *Interim Canadian Environmental Quality Criteria for Contaminated Sites.*

Canadian Council of Ministers of the Environment (CCME). 1992. *National Classification System for Contaminated Sites*.

Canadian Council of Ministers of the Environment (CCME) 1996a. *A protocol for derivation of environmental and human health soil quality guidelines.*

Canadian Council of Ministers of the Environment (CCME) 1996b. *Guidance manual for developing site-specific soil quality remediation objectives for the contaminated sites in Canada.*

Canadian Council of Ministers of the Environment (CCME). 2001. *Canada Wide Standards for Petroleum Hydrocarbons in Soil*.

Environmental Working Group (EWG). *DEW Line Cleanup, Nunavut, Environmental Working Group Report*. Prepared for Nunavut Tunngavik Incorporated and the Department of National Defence, March 1998.

Environmental Working Group (EWG). *Evaluation of Hydrocarbon Contamination at DEW Line Sites in Nunavut - Addendum to the Environmental Working Group Report (1998)*. Prepared for Nunavut Tunngavik Incorporated and the Department of National Defence, May 1999.

APPENDIX D:

DEW Line Cleanup Barrel Contents Criteria

DEW LINE CLEANUP BARREL PROTOCOL

A. INTRODUCTION

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

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

During the delineation phase of the site investigation, an inventory of the number and locations of barrels at the site is to be compiled. This inventory should include buried or partially buried barrels that will be taken out of the landfills during excavation. Barrels are only sampled during the cleanup phase and as such, the handling, transportation and opening of barrels is the responsibility of the site contractor.

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

TABLE 1: DLCU BARREL PROTOCOL CRITERIA AND DISPOSAL SUMMARY

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

B. INSPECTION

1. All barrels are to be inspected to address the following items which shall be recorded and used as a guide prior to opening barrels.
2. Symbols, words, or other marks on the barrel that identify its contents, and/or that its contents are hazardous: e.g. radioactive, explosive, corrosive, toxic, flammable.
3. Symbols, words, or other marks on the barrel that indicate that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume containers.
4. Signs of deterioration or damage such as corrosion, rust, or leaks at seams, rims, and V grooves, or signs that the barrel is under pressure such as bulging and swelling.
5. Spillage or discoloration on the top and sides of the barrel.

C. SAMPLING

1. Barrels shall not be transported until it has been determined that they are not under pressure, do not leak, and are sufficiently sound for transport.
2. Barrels to be sampled should be set in an upright position, provided that this does not cause them to leak and that it is physically possible.
3. Barrels should only be opened according to accepted procedures and under qualified supervision, preferably using remotely operated, non-sparking equipment.
4. Once open, barrels will be sampled by personnel wearing proper personal protective equipment as described below (G.1). Samples of the contents of all barrels shall be extracted using a drum thief and placed into a pre-labelled glass vial. The depth of liquid and the size of each barrel are to be recorded.
5. In instances where there are a large number of barrels with obviously similar contents, these can be grouped together and 30 to 40% of the barrels in the group sampled. Barrels containing less than 50 mm of liquid may be combined with compatible material prior to sampling; samples inferred to contain only water on a visual examination shall be tested prior to this consolidation. Barrel contents, which consist of black oil, shall not be consolidated.
6. All barrels shall be clearly numbered using spray paint or other suitable marker. The number on this label should be the only sample coding provided to the laboratory.

7. The barrel locations and barrel sample descriptions should be recorded.
8. Samples should be kept at ambient temperatures and shipped by guaranteed freight to laboratories where they should be kept cold pending analysis.

D. TESTING

1. Liquid samples shall be inspected and classified as either containing water or organic materials. Samples thought to contain water shall be analyzed to confirm that they are indeed water, and contain less than 2% glycols or alcohols.
2. The contents of barrels containing organic materials, including aqueous samples which contain more than 2% glycols or alcohols, shall be tested for PCBs, total chlorine, cadmium, chromium and lead, in addition to identification of the major components e.g. fuel oil, lubricating oil.
3. Contents of barrels which contain two or more phases shall have all phases analyzed; the organic phases as described above and the aqueous phase to ascertain whether it contains less than 2% organic substances. In addition, the aqueous phase shall be tested for any components found in the organic phases above the criteria described below.

E. DISPOSAL OF BARREL CONTENTS

1. Barrels containing only rust and sediment shall be treated as empty barrels.
2. Barrel contents comprising water only (less than 2% glycols or alcohols) shall be transferred to an open vessel such as a utility tub or half-barrel and any organic material removed by agitation with a pillow or segment of oil absorbent material. The water may then be discarded on to the ground that is a minimum of 30 meters distance from natural drainage courses. Used oil absorbent material shall be treated as described in below (E.5.).
3. Barrel contents which are composed of water with glycols and/or alcohols or organic phases, and which contain less than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium, and 100 ppm lead, may be disposed of by incineration. Alternatively these contents may be disposed of off-site at a licensed disposal facility. The solid residual material resulting from incineration shall be subjected to a leachate extraction test. Material found to not be leachable shall be disposed of as DCC Tier II

contaminated soil. Leachable material shall be treated as hazardous waste and disposed of off-site at a licensed disposal facility.

4. Barrel contents, which contain greater than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium or 100 ppm lead shall be disposed of off-site at a licensed disposal facility. Contents may be combined with compatible materials for shipping purposes. Flash points may be required to be determined if they cannot be inferred from the product identification.
5. Used oil absorbent material should be treated as hazardous waste and disposed of off-site at a licensed disposal facility. If it is shown to be uncontaminated with PCBs (< 2 ppm), chlorine (< 1000 ppm), cadmium (< 2 ppm), chromium (< 10 ppm) and lead (< 100 ppm), it may be incinerated on-site.

F. DISPOSAL OF BARRELS

1. Empty barrels may be crushed or shredded and landfilled on-site as non-hazardous waste after they have been cleaned in an appropriate manner. The barrels shall be crushed in such a manner so as to reduce their volume by a minimum of 75%. Shredded barrels may be disposed of off-site as recycled metals.

G. PERSONNEL PROTECTIVE EQUIPMENT

1. Safety equipment required includes a respirator with organic vapour cartridges, safety glasses, a hard hat, rubber safety boots, double gloves (chemically resistant on the outside, and latex on the inside) and disposable Syranex-coated coveralls.
2. A decontamination procedure should be established at the barrel sampling area(s) to prevent tracking potentially contaminated liquids outside of the sampling area(s).
3. It is advisable to have one person outside of the sampling area to observe the sampler(s) in case of unexpected hazards, and also to record the samplers' observations.

APPENDIX C

Community Meeting Notes

PROJECT NAME:	Cam-D Public Consultation		
LOCATION:		PAGE:	1 of 3
DATE OF MEETINGS:	April 26-29, 2006	DATE:	January 17, 2007
		PROJECT NO.:	94464-10 (93181)
		CONTRACT NO.:	

PRESENT:	Joseph (Interpreter)	-
	Lou Spagnuolo – INAC	-
	Brad Thompson – PWGSC	-
	Greg Wright – Earth Tech	-

PURPOSE: CAM-D Community Meetings

DISTRIBUTION TO ALL ABOVE AND:

WRITTEN BY: Greg Wright

ITEM	DESCRIPTION	ACTION BY
	April 26, 2006 – Taloyoak Community Meeting	
1.	Joseph (Interpreter) • In 1963 moved to Taloyoak (from community N). • Patrick Lyall passed away approximately 2-3 month (5 charters for funeral – government, organizations *a lot of people – he was well known). • Lots of exploration activity in the area. Mining company presenting next week.	
2.	Questions • Lady in Red Parka – been through the area on way to Kugaaruk knows the DEW line on hill. Q: If there is a landfill would it leak into water and rivers? A: Monitoring wells to assess and annual monitoring events to confirm. Q: Where are the contaminants going? A: Shipped south for disposal. • Man in green parka Q: Who to contact for hiring/laborers? A: Unsure of contractor, but approximately 30-40 workers required from Taloyoak, Gjoa Haven & Kugaaruk. C: Due to high cost of unemployment happy to have jobs and happy to know contaminants are being removed. • Man in grey vest Q: Do you need PCB contractors? Q: Have you checked with contractors for PCB cleanup? A: Evaluate contractors bidding. C: Helped on site last year – PCB were priority. We know how to build an atomic bomb – why use PCBs? Since they (USA) ruined land, should give us money.	

ITEM	DESCRIPTION	ACTION BY
	• Lady in black/pink floral parka Q: How are the contaminants being removed? (Hazardous materials, soils). A: Evaluating best route, but will be shipped offsite in specialized containers. • Lou "anyone know the best route?" • Man in grey parka Q: Was the site built in 1957? A: Yes. Q: Early 1960s went to DEW line site to get a building (3 buildings) (warehouse and another buildings) – doesn't think it was that one disassembled for communities. Might be same area as sited last year. • Man in grey parka C: Remembers site with barrels around the site. Q: What's happening with the buildings onsite? A: Demolished and sorted and disposed. Q: How long to clean-up site? A: One Summer (plus additional monitoring). C: Due to high unemployment, happy to see job opportunities. Would like to see those that haven't had opportunity to have jobs. Lou will train workers. Blue and red jacket C: Thankful for sharing information and for the job opportunities. Q: Has a study been done to check risk for humans and animals? A: Yes, but still cleaning up site landfill – wise choice for leak proof design (use a liner). C: Even though very little training, community needs employment. R: Training will be provided and crucial for project. C: Due to high unemployment – wants jobs kept to local communities. Dark blue jacket Q: Contamination dangerous to humans and wildlife? A: Based on investigation – low risk. Q: Is there a risk for cancer or illness? A: PCB can be carcinogenic, but so little on this site continuous exposure (ingestion, dermal) would be necessary. April 27, 2007 • Alex (worked at CAM 3 and married there) believes all heavy equipment was brought to CAM-D via Hercules plane.	

ITEM	DESCRIPTION	ACTION BY
	April 28, 2006 – Gjoa Haven Community Meeting • Simon (Interpreter) – Simpson Lake called "Kook". • Charlie • No attendees April 28, 2006 – Kugaaruk Community Meeting • Chris – February/March/April (early) – better time of year for community meetings. Head out onto land in the spring. Lake and rivers are biggest concerns. • Ranger Hoodie – Travel through the area every year. April 29, 2006 – CAM-D Meeting With Lou & Brad • Hydrocarbon soils: Option 1: Landfarm PHC soils need to discuss with regulators about what level of clean up F1, F2, F3 and F4 or just F1 and F2? Option 2: Landfill. • Comments for RAP by May 15th: - Earth Tech to wait for all comments and notes from meeting with regulators to make edits (in June). - End of June RAP finalized • Barrel sampling – representative number. • Assessment of questionable areas (vehicle pile, barrel cache, close out PHC if necessary). • Buried Hazardous Materials: Confirm with Natalie (by May 15th) probably dig up, sort and dispose accordingly.* **These minutes are in the writer's best interpretation of discussions held during the meeting. Please inform the writer of any noteworthy omissions or errors.** _____ Greg Wright	