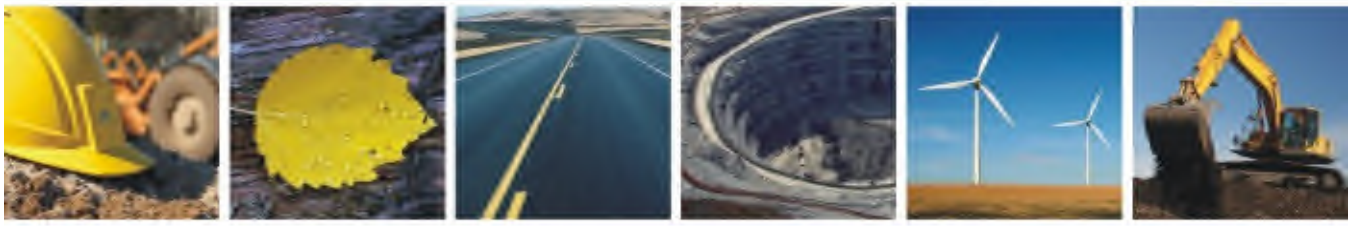
APPENDIX 6

ENNADAI LAKE
REMEDIATION PROJECT

ENVIRONMENTAL SCREENING REPORT (ESR)

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ENVIRONMENTAL SCREENING REPORT FOR THE FORMER ENNADAI LAKE WEATHER STATION UNDER THE NUNAVUT IMPACT REVIEW PROCESS ENNADAI LAKE, NUNAVUT



REPORT

MARCH 2013
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EXECUTIVE SUMMARY

Foreword

EBA Engineering Consultants Ltd., operating as EBA, A Tetra Tech Company (EBA) was hired by PWGSC to complete a Phase III Environmental Site Assessment (ESA), a Remedial Action Plan (RAP), and an Environmental Screening Report (ESR) for the Ennadai Lake remediation project. An Archaeological Impact Assessment (AIA) was also completed by Golder Associates. The former weather station at Ennadai Lake (the Site) is located in southwestern Nunavut, approximately 380 km west of Arviat. The facilities, the hazardous and non-hazardous waste, and the disturbance at the site are due to the construction and operation of a weather station between 1949 and 1979. Fieldwork that was necessary to complete all phases of this project was completed in August 2012.

This ESR has been completed to identify potential impacts of the RAP on the environment and propose actions to mitigate such impacts so that the Project can proceed through the licensing, contracting, and remediation phases. The instigation for the submission of this ESR is that the proposed RAP for the project is defined as a "project proposal" under the *Nunavut Land Claims Agreement* and therefore must be screened by the Nunavut Impact Review Board.

To complete remediation at the Site, the RAP proposes that unpainted wood be incinerated on site and all other non-hazardous waste be landfilled on site; organic liquids be used as heating fuel or incinerated on site; other non-hazardous liquids be treated on-site; and all other hazardous material would be removed off-site to an appropriate disposal facility. The recommended remediation option for metal contaminated soil is removal off site. Hydrocarbon contaminated soil will be treated on site in a landfarm facility.

Findings and Conclusions

Ennadai Lake is located in southwestern Nunavut – Kivalliq Region, approximately 370 km west of Hudson Bay, 120 km north of Manitoba and 50 km east of the Northwest Territories. The region lies in the Kazan River Upland Ecoregion of the Taiga Shield Ecozone. Peatlands and lakes of various sizes are common in the region and are often interconnected. Due to the temperatures and presence of permafrost, soils at the site would be classified as Cryosols. Undisturbed soils encountered during the field program consisted typically of a few centimetres of LFH horizon followed by a B horizon, usually loose sand texture with abundant cobbles and gravel. Occasionally A, Ah, or Om horizons were present below the LFH horizon.

Ennadai Lake lies across the treeline – the gradual transition from boreal forest to tundra. The south end of Ennadai Lake is characterized by open canopy stands of black spruce (*Picea mariana*), while the north end of Ennadai Lake is predominantly tundra vegetation and isolated black spruce colonies are only found in protected poorly drained terrain (Ecological Stratification Working Group 1995). The vegetation at the Site consists of a mosaic of ecosystem units dominated by low-lying shrubs such as scrub birch, blueberry, crowberry, bog cranberry, and willow. Saxifrage, moss campion, sedges and grasses were common.

A wide variety of wildlife species can be expected to use the habitats in the vicinity of the Project. Wildlife in the area ranges from shrew (*Sorex* spp.) to ptarmigan (*Lagopus* sp.) and grizzly bear (*Ursus arctos*). Species or signs (such as scat) that were observed during the 2012 Phase III ESA fieldwork included wolf, fox, caribou, ptarmigan and moose. Caribou were observed almost daily. Species potentially located in the project area require special attention due to their status of "special concern" as designated by Committee

on the Status of Endangered Wildlife in Canada (COSEWIC) and the Species At Risk Act (SARA), and/or listed as "sensitive" by the Government of Nunavut in the Report on Wildlife (Government of Nunavut 2007) include: grizzly bear, moose, grey wolf, wolverine, peregrine falcon, short eared owl, rusty blackbird, and horned grebe.

The Ennadai Lake site holds cultural significance to the people of the area. There is considerable past and recent history that make the site significant to the people of Arviat, Whale Cove and Rankin Inlet. Several heritage sites have been located at Ennadai Lake and during the AIA nine new heritage resources were located, including one gravesite. During the community meeting held in Arviat, other cultural features may be present on site that were not identified during the AIA. A commitment was made to the community to verify these sites prior to remediation. The site is used by regional residents for hunting and fishing as evidenced by food, materials, and a boat stored at the site.

Potential Valued Ecosystem Components (VECs) and Valued Socio-Economic Components (VSECs) were identified in a three stage process. Initially, a review of the regulatory responsibilities of government agencies was completed, and then VECs and VSECs identified in similar projects were reviewed. Once these VECs and VSECs were identified, they were confirmed during the community meeting. Identified VECs and VSECs included climate, air quality, terrain, soils, hydrology, wildlife, cultural features, and traditional land use. To determine the potential impacts to the various VECs or VSECs, the environmental baseline information and specific RAP activities were reviewed, and using professional judgement, project activities (site preparation and camp operation, remediation and closure) that would impact/interact with a specific VEC or VSEC were identified.

The most common potential impacts to VECs were contamination from spills during refuelling or servicing equipment used in project activities, from remediation activities themselves (such as incinerating waste), or direct physical disturbance to the VEC during project activities (such as sedimentation or camp/landfill/landfarm construction or borrow area development). Important impacts to wildlife range from direct mortality to sensory disturbances. The most important mitigation measures are those that will prevent or limit contamination, such as developing a spill contingency best management practice, or those that prevent or limit physical disturbances, such as using existing disturbances for access and construction areas. It is anticipated that there will be short-term positive impacts for the communities in business opportunities and employment.

Residual impacts are defined as impacts that remain after mitigation has been applied. Implementation of the mitigation strategies outlined for the remediation of the Ennadai Lake former weather station are predicted to result in no negative residual impacts with the exception of a residual aesthetic impact due to construction of the landfill. This impact is considered to be low and not significant.

Overall, the remediation will have a positive effect on the environment by removing contaminated soil and hazardous material from the Site. Cumulative environmental impacts occur when impacts, in particular residual negative impacts, from two or more concurrent project activities combine either additively or synergistically to further exacerbate the impact on a VEC or VSEC. Given that the project will have a positive impact on the environment, the remediation of the Site will not add to the cumulative environmental effects of other land use activities in the local area.

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1.0 INTRODUCTION

1.1 General Overview

Aboriginal Affairs and Northern Development Canada (AANDC) is the custodian of most federal lands in northern Canada and has responsibility, through the Contaminated Sites Program (CSP), of managing a number of contaminated properties that are no longer maintained by the original occupant. AANDC's portfolio of contaminated sites in Nunavut originated from private sector mining, oil and gas activities, and government military activity dating back over half a century, many years before the environmental impacts of such activities were adequately understood. The former weather station at Ennadai Lake (the Site) in southwestern Nunavut (Figure 1) and falls under the CSP and it is the responsibility of AANDC to ensure remediation of the site.

The AANDC Nunavut Regional Office is managing the remediation of the Site under the Federal Contaminated Sites Action Plan (FCSAP). Since 1999, the Treasury Board of Canada Secretariat (TBS) has approved a management framework of policies and best practices including the *Policy on Management of Real Property* (TBS 2006). Under this policy, AANDC is responsible for managing the contaminated sites within their jurisdiction. Public Works Government Services Canada (PWGSC) Northern Contaminated Sites Office is managing this project on behalf of AANDC.

EBA Engineering Consultants Ltd. (EBA) was hired by PWGSC to complete a Phase III Environmental Site Assessment (ESA) which included a Hazardous and Non-hazardous Materials Audit, an Archaeological Investigation and a Geotechnical Evaluation (EBA 2013a), a Remedial Action Plan (RAP, the "Project") (EBA 2013b) and an Environmental Screening Report (ESR) for the Project. Before completing the fieldwork, EBA reviewed existing site information, identified information gaps, and developed a detailed assessment plan. The necessary fieldwork was completed in August, 2012.

This ESR has been completed to identify potential impacts of the RAP on the environment and propose actions to mitigate such impacts so that the Project can proceed through the licensing, contracting, and remediation phases in future years.

1.2 Environmental Assessment (EA) Regulatory Process

This ESR is required because the proposed RAP is defined as a "project proposal" under Article 1 of the *Nunavut Land Claims Agreement* (NCLA) (Nunavut Tunngavik Inc. 1993) and the RAP is not "project proposal" exempt from screening as defined by Schedule 12-1 of the NCLA.

According to Section 12.3.1 of Article 12 of the NCLA, the Nunavut Planning Commission (NPC) will determine the conformity of the project proposal in relation to the land use plan. The NPC shall, subject to Sections 12.3.2, 12.3.3 and 12. 3.4, forward the proposal with its determination and recommendations to the Nunavut Impact Review Board (NIRB) for screening. The Site falls within the Keewatin Regional Land Use Plan (KRLUP) (NPC 2000).

To ensure that the NPC and NIRB has the required information to complete the review process, this ESR meets the terms of reference (TOR) (PWGSC 2012) provided in the Ennadai Lake RFP Solicitation EW699-130393/001/NCS and includes:

- Proponent information;
- Description of the existing environment (biophysical and socio-economic);
- Project proposal description including purpose, scope, timing, authorizations, and alternatives;
- Identification of potential environmental, socio-economic, and cumulative effects;
- Identification of mitigation measures, including contingency plans, and potential residual impacts;
- Steps to optimize benefits to the community and region and steps taken to compensate interests adversely affected by the project;
- Description of public participation (informing, consulting, participation);
- Monitoring program that may be required;
- Any interests in lands and waters that the proponent may seek to secure to implement the proposal;
- Non-technical project summary in English and Inuktitut and/or Inuinnaqtun, depending on the region summarizing the information outlined above (to be completed by INAC); and
- A map of the Project (local and regional scale) in electronic format.

1.3 Objectives

The specific objective of this ESR, as outlined in the TOR (PWGSC 2012), is to:

- Assess the environmental, social, economic, and cultural effects of the proposed remediation, including identification of potential impacts and development of mitigation measures where necessary.

Specific objectives that will assist in achieving the overall objective include:

- Identifying project components and development activities that may result in potential impacts to the environment and the effect of these on the receiving physical and/or socio-economic environments.
- Identifying existing conditions within the project area, including existing land uses, resources and other activities which have the potential, in combination with proposed remediation activities, to affect the physical and/or socio-economic environment.
- Assess the cumulative effects associated with this project and other past, present, or proposed projects in the area.
- Determine any follow-up requirements.

2.0 PROJECT DESCRIPTION

The ESR needs to include a description of Project activities. This information is provided so the reader can understand the scope of the Project and integrate the project description information with the baseline data that is provided. This forms the basis for determining the impacts and potential mitigation strategies.

The sections below provide a rationale for the Project, and a scope and description of activities that will be completed during the RAP.

2.1 Purpose of the Ennadai Lake Remediation Project

The objective of the Project is to reduce environmental liability to the Crown, maximize benefits to the local community and Inuit, and ensure good value to the people of Canada. More specifically, the RAP (EBA 2013b) will complete the following:

- Restore the site to an environmentally safe condition;
- Prevent environmental migration of contaminated soil into the surrounding ecosystem;
- Remove physical hazards for the protection of human health and safety; and
- Provide a cost-effective remediation solution.

Implementation of the RAP may create economic and social benefits for the Inuit community of Arviat and potentially for other communities in Nunavut. The Project would provide direct employment for community members who work on the Project, and spin-off employment and economic benefits for any northern persons or businesses that are directly or indirectly involved in the project.

2.2 Scope of Ennadai Lake Remediation Project

The Ennadai Lake site consists of a former weather station. Associated with this facility are: buildings, metal transmission towers, fuel drums, fuel tanks, buried and overhead pipelines to distribute fuel, concrete footings, and various equipment required to maintain the facility. An overview of site features and areas of potential environmental concern (APECs) are provided on Figure 2. More information on each of the APECs is provided in the Phase III ESA (EBA 2013a).

The implementation of the RAP will require mobilization, camp set up and operation, remediation activities, demobilization of the camp, and then transportation of materials off-site. These activities are discussed in further detail below and provided in the RAP (EBA 2013b).

Please note that the remediation description is limited to the recommended remediation options, and that not all remediation options considered in the RAP have been presented in this ESR. The initial start-up date for the RAP is expected in the summer of 2013, and the mobilization, remediation, and demobilization activities are expected to take one to three years to complete, depending on the remediation for the hydrocarbon-contaminated soil. A summary of construction equipment, access, camp set-up, remedial activities, and site closure is presented below.

2.2.1 Construction and Remediation Equipment

The RAP anticipates the following equipment needs for this project:

- Excavator(s) to remove contaminated soils for treatment and for use in trail and/or road improvements;
- Front end loader(s) to consolidate materials and for trail and or road improvements;

- Haul truck(s) to move materials to staging and treatment areas;
- Waste incinerator(s) (both for the camp waste and for incineration of certain materials currently located on-site);
- Aqueous liquid waste treatment system to treat aqueous liquids for on-site disposal;
- Dozer (s) to be used for landfill/landfarm construction and road improvements;
- Smooth drum compactor for landfill/landfarm construction;
- Water truck to haul water to camp if required or for dust suppression;
- Waste compactor;
- Drum crusher;
- Packer to ensure compaction is appropriate with natural terrain and for landfill/landfarm construction and operation;
- Ice runway;
- Generators;
- All-terrain vehicle (s) with trailers; and
- Other miscellaneous equipment determined necessary by the Contractor.

2.2.2 Mobilization and Site Access

The Site is considered to be remote, and was originally accessed by cat train and planes equipped with skis or floats. Hunters visit the Site from Arviat, NU during the winter via snowmobiles or by plane; there are no known documented summer trails between the Site and Arviat, NU. Summer access is via float plane. For the August 2012 field program, EBA used a deHavilland Canada DHC-6 Twin Otter on floats to transport equipment to the site, and a DHC-2 Beaver on floats to shuttle the EBA field team from a nearby lodge to Site. The float planes were docked on the beach at the site, but there is no functional dock on the beach. The location where the float plane docked is shown on Figure 3.

There is an unmaintained sand and gravel airstrip on the esker deposit located entirely on IOL, about 800 m northeast of the site (Figure 3). The airstrip is approximately 40 m wide, 375 m long and slopes gently (2%) to the east. Mr. Dean Carter and Mr. Brandon Kotulak, pilots with Arctic Sunwest Charters, visually assessed the airstrip. Both thought the airstrip would be suitable for Twin Otter or Beaver landings, provided the plane had proper tires and that a site reconnaissance (preferably by foot access from a float plane) was done prior to a landing attempt.

There are a number of trails on the esker and adjacent glaciofluvial deposits. These trails can be used by ATV and track-mounted equipment.

Mobilization and access activities will consist of the following:

- Mobilizing equipment to site during the winter via heavy lift airplane. Construction of an ice airstrip would be required;

- Potential upgrading of the Ennadai Lake airstrip to accommodate aircraft (if required);
- Construction of a docking area if float planes are used during the summer remedial activities; and
- Developing a borrow pit(s) to provide construction material for the airstrip upgrade (if required) and for trail upgrades.

After remedial activities are complete, previous and recently disturbed areas (including upgraded roads, borrow pit(s), remediated areas and the camp area) will be recontoured to promote natural revegetation. Demobilization will involve packing all materials remaining on-site into appropriate containers for airplane removal following completion of remedial activities.

2.2.3 Camp Development

To facilitate remediation, a camp will be set up sufficient distance away from the Site to ensure workers are not affected by hazards and contamination. A 20-person soft camp is anticipated for this project. This camp size is typical of other similar remote remediation projects. Two sites were identified as potential locations for construction camps (Figure 3). Camp 1 is located northwest of the airstrip, and west of a small lake. This site could be used if the airstrip was used to access the site. Camp 2 is located south of the western point of the esker near the shore of Ennadai Lake. This site could be used if the site was access primarily by boat or float plane. The camp will need to house workers and will need to meet the specifications laid out by PWGSC and Workers Safety and Compensation Committee. Facilities that will be required include the following:

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

2.2.4 Remedial Activities

The RAP proposes that all solid non-hazardous waste (with the exception of burnable wood), lead painted substrates following paint removal, asbestos waste, empty compressed gas cylinders, empty fire extinguishers, and creosote treated wood be landfilled on-site, as opposed to being transported off-site. Organic liquids will be used by the Contractor or local business operator or incinerated on-site. Other hazardous materials would be removed from site. Metal contaminated soil would be removed from site. Hydrocarbon impacted soil above AMSRP guidelines will be landfarmed on-site. A summary of proposed recommended options for the Site is provided in Table 1.

Table 1: Summary of Recommended Remedial Options

Waste Stream	Recommended Option	Comments
Wood Waste Non-Hazardous (unpainted)	Control burn on-site	Hazardous material must be separated and non-wood waste removed. Wood should be burned in controlled burn. Ashes to be taken off-site or landfilled if meet applicable guidelines
Aqueous Liquid Waste in Drums Non-Hazardous	Treat on-site	Treatment on-site is the most cost effective option. If the liquid waste cannot be treated to meet discharge criteria, then it will be packaged and shipped off-site.
Other Waste Non-Hazardous	Landfill on-site	Non-hazardous waste will need to be separated from hazardous waste and landfilled.
Asbestos Waste Hazardous	Landfill on-site	Asbestos waste will be handled by trained personnel and landfilled on-site.
Liquid Organic Wastes in Drums Hazardous	Use on-site for heating, use by local business operator, or incinerate on-site	Organic liquids will be re-used for heating fuel by the Contractor or removed off-site by local business operator, with the exception of drum content in poor condition that can be incinerated on-site. Those liquids not meeting the incineration criteria will be shipped off-site.
Pressurized Cylinders Hazardous	Evacuate and Landfill on-site	Depressurize, crush and landfill on-site. Known contents that cannot be safely depressurized will be shipped offsite in an approved container, following landfill and shipping company approval.
Fire Extinguishers Hazardous	Evacuate and Landfill on-site	Depressurize, crush and landfill on-site. Known contents that cannot be safely depressurized will be shipped offsite in an approved container, following landfill and shipping company approval.
Total Lead, Leachable Lead and PCB Paint on Equipment, Metal, Particulate Board, Wood and Metal Towers Hazardous	Combination of remove off-site and landfill on- site	Lead and PCB painted waste will be stripped and handled by trained personnel. The cleaned substrate will be moved to the on-site landfill. The softer painted substrates which cannot be stripped of paint will be removed to a Class 1 landfill off-site.
Total Lead and Leachable Lead Paint on Concrete Hazardous	Remove paint and concrete remains in place	Lead painted concrete will be stripped and handled by trained personnel, the remaining concrete will stay in place, and the stripped paint will be removed to a Class 1 landfill off-site.
Leachable Lead Paint on Drums Hazardous	Compact and remove off-site	Lead painted drums will be handled by trained personnel and crushed under proper containment. The crushed drums and any remaining paint chips will be removed to a Class 1 landfill off-site.

Table 1: Summary of Recommended Remedial Options

Waste Stream	Recommended Option	Comments
Total Lead and Leachable Lead Paint on Asbestos Panels and Ceiling Tile Hazardous	Remove off-site	Lead painted and asbestos panels and tiles will be handled by trained personnel and removed off-site to a Class 1 landfill.
Creosote Treated Wood: Hazardous	Landfill on-site	Creosote treated wood will be wrapped and landfilled on-site.
Other Solid Hazardous Waste	Compact and remove off-site	Miscellaneous solid hazardous waste (batteries, light ballasts, electrical parts, ODS, lead seals, etc.) and miscellaneous hazardous liquid waste (battery electrolyte, chemicals, oil/lubricants/fuels and paint and flammable drum content) will be removed off-site to a Class 1 landfill.
Metal-Contaminated Soils	Remove off-site	Remove off-site to an approved landfill; will require waste characterization.
Hydrocarbon-Contaminated Soils	Landfarm on-site	Will require regulatory approval; and review of timelines for completion of remediation
Physical Hazards	Remove all buildings; develop site-specific safety plans	Each hazard will need to be identified and properly mitigated prior to work commencing. Proper personal protective equipment to be worn at all times.

2.3 Details on the Remedial Activities

2.3.1 Schedule

The remediation contract is anticipated to be tendered in 2013 and contract award prior to the start of the 2013 summer season. The contract completion date is March 2016.

The 2013 summer work represents an important early start to complete abatement of hazardous materials on site and then allow building demolition and soil excavation in 2014 when heavy equipment is on-site. In addition, the hazardous materials work also represents a significant amount of on-site project time and is anticipated to require the full 2013 summer season to complete. An ice airstrip would be constructed in the winter of 2013/14 to transport heavy equipment to site and to remove hazardous materials off-site.

In the summer of 2014, soil treatment would begin and building demolition would be completed. The winter of 2014/15 would see construction of an ice airstrip for demobilization of all equipment except those needed for soil treatment; soil treatment would continue during the summer of 2015. The entire 2015 summer season would consist of fly-in and fly-out events to carry out the soil treatment work. Soil treatment will be completed at the end of the 2015 field season. The final demobilization from the site is set for winter 2016.

2.3.2 Non-Hazardous Waste

For **non-hazardous wood waste** at the site, the RAP recommends the following steps be taken:

- Remove all hazardous materials from the buildings on-site. Asbestos and lead abatement and handling should be conducted by trained professionals following safe work procedures.
- Remove all non-wood waste and move to the on-site landfill.
- Remove wood to an area, ideally where there is little vegetation.
- Conduct a controlled burn within an approved container, under careful supervision, and at a time of year when moisture conditions are higher and there is a low likelihood of causing a tundra fire. Fire suppression equipment should be at hand when the controlled burn takes place and air monitoring should be conducted. Conduct the burn according to the applicable guideline (GN 2012).

For **other solid non-hazardous waste** at the site, the RAP recommends the following:

- Conduct the separation of non-hazardous materials from buildings and removal from debris areas.
- Process and compact all waste.
- Haul materials to an on-site landfill, compact and cover.

2.3.3 Hazardous Waste

For **asbestos waste** at the site, the RAP recommends the following:

- Follow appropriate work procedures as outlined in Alberta Asbestos Abatement Manual (GA 2011) when the risk level has been identified, i.e., low risk, moderate risk or high risk.
- Asbestos must be wetted and double bagged in approved asbestos disposal bags and sealed with duct tape. The exterior of the bags must be cleaned with a damp cloth or HEPA vacuum prior to removing from work area.
- Haul materials to an on-site landfill and cover, according to the applicable guideline (GN 2011a).
- Conduct the required inspections and air monitoring during and post abatement. Ensure asbestos removal, prior to any demolition being carried out.

For **organic liquid waste** in drums, tanks and pipeline at the site, the RAP recommends the following:

- Re-use as heating fuel on site by Contractor or removal offsite by local business operator.
- Incineration on-site following approved procedures for all wastes that cannot be re-used by the Contractor or local business operator. Waste that does not meet incineration criteria will be removed off-site to a licensed disposal facility for hazardous waste.
- Complete air quality monitoring while this process is occurring, for predetermined parameters according to the applicable guideline (GN 2012).

For **total and leachable lead paint** on equipment, metal, particulate board, wood and metal towers at the site, the RAP recommends the following:

- Separate equipment, metal, particulate board, wood and metal towers from buildings and debris areas and place the materials in one area.
- Construct an enclosure over and around the harder painted waste, that will sufficiently collect the paint chips and prevent them from contaminating adjacent areas, following appropriate work procedures (GN 2011b, SSPC 2012).
- Remove paint by sandblasting or scrapping and collect the sand/paint for disposal off-site in a licensed disposal facility for hazardous waste.
- Dismantle, cut apart, crush and compact materials.
- Sample the surrounding soil to determine that the paint did not contaminate the soil.
- Compact, landfill and cover.
- Wrap the softer painted substrates intact with 6 mil polyethylene sheets and remove them, along with the lead paint chips generated from the abatement to an off-site facility to landfill (following TDG 1992, GC 2006).

For **total and leachable lead paint** on concrete at the site, the RAP recommends the following:

- Construct an enclosure over and around the materials that will sufficiently collect the paint chips and prevent them from contaminating adjacent areas, following appropriate work procedures (GN 2011b, SPC 2012).
- Remove paint by sandblasting or scrapping and collect the sand/paint for disposal off-site in a licensed disposal facility for hazardous waste.
- The remaining stripped concrete stays in its current location.

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

- Clean the inside and crush the drums.
- Remove to an off-site licensed disposal facility for hazardous waste (following TDG 1992, GC 2006).

For **total and leachable lead paint** on asbestos panels and ceiling tiles, the RAP recommends the following:

- Conduct removal of asbestos and lead waste materials from the building or substrate following safe work procedures as per applicable regulations. Asbestos and lead-painted waste is handled and removed by trained personnel and properly bagged.
- Haul to staging area for removal to an off-site landfill (following TDG 1992, GC 2006).

For **compressed gas cylinders and fire extinguishers** at the site, the RAP recommends the following:

- A specialist will vent the known or unknown contents on-site.
- Dispose of in the on-site landfill.

- Known contents that cannot be safely vented on-site (containing ODS) will be removed in an approved container as per TDG by air regulations to an off-site licensed disposal facility for hazardous waste (following TDG 1992, GC 2006).

For **creosote treated wood** at the site, the RAP recommends the following:

- Conduct the separation of creosote treated wood from buildings and removal from debris areas.
- Wrap the wood securely in 6 mil polyethylene sheets.
- Haul materials to an on-site landfill, compact and cover.

For **other solid and liquid hazardous waste** at the site, the RAP recommends the following:

- Collect solid and liquid hazardous waste and remove to an off-site licensed disposal facility for hazardous waste (following TDG 1992, GC 2006).

2.3.4 Metal Contaminated Soils

For remediation of metal-contaminated soils at the site, the RAP recommends the following:

- Excavate all metal contaminated soil and conduct confirmatory sampling of base and adjacent boundaries to ensure all contaminated soil has been removed.
- Remove to an off-site landfill.

2.3.5 Hydrocarbon-Contaminated Soils

For remediation of hydrocarbon-contaminated soils at the site, the RAP recommends the following:

- Excavate and treat on site all soil that is above the Abandoned Military Site Remediation Protocol (AMSRP) guidelines (2,500 mg/kg for soils < 0.5 m depth and 5,000 mg/kg for soils >0.5 m depth).
- Treatment of the soil (via landfarming, bioremediation and/or chemical treatment) will be within a lined treatment area).

2.4 Inventory of Contaminated Soil, Non-Hazardous Waste and Hazardous Waste

A summary of contaminated soil and materials that were inventoried at the Ennadai Lake, are provided in Tables 2 and 3 as follows.

Table 2: Summary of Contaminated Soil at the Ennadai Lake Site

Description	Contaminant of Concern	Volume of Contaminated Soil
Fuel tanks, fuel distribution line to buildings, pipeline, stored fuel and kerosene drums	PHC: F2 and F3	2,164 m^3
Burn pit	Metals: antimony and lead	0.5 m^3
	Total contaminated soil	**2,165 m^3**

Table 3: Material Inventory Summary at the Ennadai Lake Site

Type	Material	Volume
Non-Hazardous	Wood Waste	494 m^3
	Other Solid Waste	871 L
	Concrete on IOL	137 m^3
	Drums (20 L and 205 L)	762 drums
Hazardous	Asbestos Waste	196 m^3
	Liquid Organic Waste in Drums, Tanks and Pipeline	16,882 L
	Total Lead, Leachable Lead and PCB Paint on Equipment, Metal, Particulate Board, Wood and Metal Towers	143 m^3
	Total Lead and Leachable Lead Paint on Concrete	10 m^3
	Total Lead and Leachable Lead Paint on Drums	339 drums (20 L and 205 L)
	Total Lead and Leachable Lead Paint on Asbestos Panels and Ceiling Tile	18 m^3
	Compressed Gas Cylinders and Fire Extinguishers	0.6 m^3
	Creosote Treated Wood	3 m^3
	Other Hazardous Waste	19 m^3 of solid hazardous waste; 1475 L of liquid hazardous waste;

2.5 Geotechnical Considerations

2.5.1 Ennadai Lake Trail Network

There are a number of trails on the esker complex and adjacent glaciofluvial deposits at the Ennadai Lake site. The existing trails are poorly defined, mostly unvegetated, and composed of loose, well-drained sand, and some of the trails are on steep slopes. At the time of EBA's field program in August 2012, the trails were trafficable by ATVs. Haul roads will likely need to be constructed to access borrow sources, and the landfill and landfarm areas; and might also be needed to avoid using existing trails which are on steep and unsafe slopes. Any new roads or trails should consider waterbodies, springs, areas of cultural and historical significance, and steep slopes that are susceptible to erosion and potentially unsafe. Roads should also avoid organic terrain where permafrost and poorly-drained conditions were observed. In general, road development should be kept to a minimum to minimize site disturbances. Vegetation on the existing trails is minimal and has not recovered even after more than 30 years since site abandonment.

2.5.2 Airstrip

There is a sand and gravel airstrip on the esker about 800 m northeast of the site (Photos G6 to G10). The airstrip lies entirely on IOL, and is approximately 40 m (130 feet) wide, 375 m (1,230 feet) long and slopes gently (2%) to the east (Figure 3). The airstrip alignment extends to the west approximately 360 m. This area is about 30 to 40 m wide and slopes gently to the west, and consists of exposed sand with some gravel, occasional cobbles and boulders at the surface. Some areas have been colonized by grasses and there are

several debris items in the area as well. This area also lies on IOL and is not suitable for aircraft landings in its current condition. This is the site proposed for landfarm.

2.5.3 Borrow Pit Development

Borrow material will be required for upgrading the trail network, the landfill construction and for the landfarm for the treatment of hydrocarbon contaminated soil. Borrow may be needed if the airstrip is upgraded. The exact volume of borrow material required is not known at this time, but a number of borrow pit prospects for granular material were identified and were investigated during the 2012 field program. A total of seven borrow sources were identified at the Site (Figure 4) and range in available quantities from 6,500 m^3 to 27,900 m^3 (Table 4). Additional details are provided in the Phase III Environmental Assessment and RAP Reports (EBA 2013a, 2013 b).

Table 4: Volumes and Material Types Within Each Borrow Source

Borrow Source	Estimated Volume (m^3)	Material Description
Borrow 1	8,800	Gravelly sand with trace of fines; silt and sand
Borrow 2	12,000	Gravel and sand with trace of fines
Borrow 4	17,600	Gravelly sand with trace of fines; gravel and sand with trace of fines
Borrow 5	15,200	Sand; gravelly sand to silty sand
Borrow 6	9,000	Sand and gravel
Borrow 7	27,900	Gravelly sand with some fines
Borrow 8	6,500	Sand and gravel and some cobbles

2.5.4 Landfill

Non-hazardous landfills are above ground facilities constructed of a granular fill perimeter berm with a minimum 1.0 m thick granular fill cover. The landfill is not designed to freeze back the waste materials. Granular fill is mixed between subsequent layers of waste to fill voids and minimize settlement. The proposed location of the landfill is shown on Figure 4.

The solid waste to be contained within the non-hazardous landfill would consist of inert, non-leachable wastes including: asphalt shingles, rubber, concrete, insulation and particulate boards, plastic, windows, fibreglass insulation, styrofoam, textiles, porcelain, and empty crushed drums of varying sizes. All drums will have residue removed and crushed to minimize volume in the landfill. The conceptual steps to construct a non-hazardous landfill for the site are as follows:

- Survey landfill footprint and elevations.
- Excavate suitable landfill construction material and haul to site.
- Construct landfill perimeter berms to design elevations, while leaving an access corridor.
- Install up-gradient and down-gradient groundwater/leachate monitoring wells and conduct baseline soil and water sampling.

- Place waste in 0.5 m lifts separated by 0.15 m Type 2 intermediate cover and compact; place lifts to design height.
- Cover with a minimum 1 m of Type 1 granular fill.
- Place Select Type 1 granular fill on the top 0.5 m of the side-slopes.

Table 5 summarizes the landfill dimensions and the granular fill quantities.

Table 5: Landfill Dimensions and Fill Requirements

Footprint (inside toe of berms)	11.4 x11.4 m
Footprint (outside toe of berms)	Approximately 30.6 x 32.5 m
Height of berms	Ranging from 1 to 2.5 m
Type 1 – Well-graded Sand and Gravel (berms and cover)	~ 1,000 m^3
Select Type 1 – Coarse-Grained Material (side slopes)	~ 400 m^3
Type 2 – Sand (intermediate fill)	~ 65 m^3

2.5.5 Landfarm

Landfarms are above ground facilities constructed for remediating contaminated soils through aeration and biological processes. Contaminated soil is spread in a thin layer (approximately 0.3 m thick), and is then periodically tilled, together with other factors, to stimulate aerobic microbial activity. Landfarming is an effective and simple method for remediating PHC contaminated soil and is a practical option for many remote locations. Soils containing petroleum hydrocarbons (PHCs) in excess of AMSRP standards will be treated within an on-site landfarm facility at the Site. The soils to be contained in the landfarm at Ennadai Lake would include soil impacted with PHC fractions F1 to F3 as defined in the *Canada-Wide Standard (CWS) for Petroleum Hydrocarbons in Soil* (CCME 2008). The proposed location of the landfarm is shown on Figure 4.

The landfarm would need to slightly sloped so that there is drainage into one area, and designed so that leachate could be collected. The landfarm will also be a lined facility using a 60 mil HDPE geomembrane protected on either side with a non-woven geotextile. The landfarm dimensions are based on approximately 2,860 m^3 of PHC contaminated soil including a 30% bulking factor. Table 6 summarizes the landfarm dimensions and the granular fill quantities.

Table 6: Landfarm Dimensions and Granular Fill Requirements

Footprint (inside toe of berms)	9,600 m^2 (i.e., approximately 103 by 103 m or 66 by 162 m)
Footprint of berms	2,400 m^2
Height of berms	1 m
Type 1– Well-graded Sand and Gravel	~ 1,700 m^3
Type 2 – Bedding Sand	~ 2,900 m^3

3.0 PROJECT APPROVAL AND PERMIT REQUIREMENTS

The NLCA provides the regulatory context for completing this ESR for the proposed project for the NPC and the NIRB. However, both the federal and Nunavut governments have other necessary or potential legislative requirements related to this project. Table 7 provides a list of other Federal and Territorial agencies, associated legislation, and contact information for this proposed project.

Table 7: Regulatory Agencies, Legislative Requirements and Contact Information

Agency	Legislative Requirements	Contact Information
Federal Agencies		
AANDC	*Land Claims Settlement Act* Notes: Permits for land use and potential borrow sources may be required based on the Project as proposed.	Erika Solski Project Manager, Lands and Contaminated Sites Directorate Aboriginal Affairs and Northern Development Canada (AANDC)/ Nunavut Region P.O. Box 2200 Iqaluit, NU X0A 0H0 Phone: 867.975.4577 Fax: 867.975.4736 Email: Erika.Solski@aandc-aadnc.gc.ca
AANDC	*Land Use Permit* *Quarry Permit* Notes: road construction may be required for transport of soils to treatment area; borrow will be required for road construction, landfill and/or landfarm construction.	Land Administration Specialist, Land Administration Office Aboriginal Affairs and Northern Development Canada P.O. Box 2200 Iqaluit, NU X0A 0H0 Phone: 867.975.4283 landsmining@ainc-inac.gc.ca
PWGSC	*Federal Real Property Act* and *Regulations*	Michael Bernardin Environmental Specialist Public Works and Government Services Canada Real Property Services 10025 Jasper Avenue Edmonton, Alberta T5J 1S6 Telephone: 780.497.3853 Email: Michael.Bernardin@pwgsc-tpsgc.gc.ca
Fisheries and Oceans Canada (DFO)	*Fisheries Act* Notes: Authorizations or letter of advice may be required if project impacts fish habitat. Based on the current project, no authorization requirements are expected.	Stefan Romberg Fisheries Management Biologist Fisheries and Oceans Canada Iqaluit District Office PO Box 358 Iqaluit, Nunavut X0A 0H0 Telephone: 867.979.8002

Table 7: Regulatory Agencies, Legislative Requirements and Contact Information

Agency	Legislative Requirements	Contact Information
		Fax: 867.979.8039
Transport Canada (TC)	*Navigable Waters Protection Act* Notes: Authorization may be required if any structures are built within or on navigable waters. Based on the current project proposal, no authorization for navigable waters are expected. *Transportation of Dangerous Goods Act* *Transportation Act* *Note: construction of ice airstrip will be needed, Advisory Circular AC 301-003*	Regional Manager Prairie and Northern Region Transport Canada 9700 Jasper Avenue NW Edmonton, Alberta T5J 4E6 Telephone: 1.888.463.0521 E-mail: pnrweb@tc.gc.ca
Environment Canada (EC)	*Species at Risk Act* *Migratory Birds Act* and *Regulations* Notes: Authorizations not anticipated, but a list of species at risk and migratory birds, potential impacts to these species and mitigation strategies has been compiled as part of the ESR.	Siu-Ling Han Head Environment Canada Eastern Arctic Unit Qimugjuk Building, PO Box 1870 Iqaluit, Nunavut X0A 0H0 Telephone: 867.975.4633 Fax: 867.975.4645 Amy Sparks Contaminated Sites Officer Environment Canada Contaminated Sites 4999 - 98 Avenue Edmonton, Alberta T6B 2X3 Telephone: 780.951.8746
Territorial Agencies		
Designated Inuit Organization (DIO)	*Authorization/Exemption Permit for activities on Inuit Owned Lands (IOL)* Notes: Infrastructure and contaminated soil to be removed is on IOL	Kivalliq Inuit Association PO Box 340 164-1 Mivvik Avenue Rankin Inlet, NU X0C 0G0 Phone: (867) 645-5725 E-mail: reception@kivalliqinuit.ca
Nunavut Water Board	*Nunavut Waters Act* *Nunavut Surface Rights Tribunal Act* Notes: Authorizations for water use and deposit of waste into water. Based on the current project description, a water license will be required.	David Hohnstein Director, Technical Services PO Box 119 Gjoa Haven, Nunavut XOB 1JO Telephone: 780.443.4406 (based in Edmonton)

Table 7: Regulatory Agencies, Legislative Requirements and Contact Information

Agency	Legislative Requirements	Contact Information
Department of Environment (Government of Nunavut)	*Environmental Protection Act* *Wildlife Act* Notes: Based on the current project proposal, spill response plans and waste management guidelines must be followed and waste manifest documents will required for moving hazardous waste. Regulatory requirements related to land use and disturbing wildlife must also be met. Authorizations related to *Wildlife Act* requirement are not anticipated, but a list of wildlife species, potential impacts to these species, and mitigation strategies has been compiled.	Michael Mifflin Manager of Environmental Assessment and Land Use PO Box 1000, Stn. 1300 Iqaluit, Nunavut X0A 0H0 Telephone: 867.975.7732 Email: MMifflin@gov.nu.ca
Department of Culture, Language, Elders and Youth (Government of Nunavut)	*Nunavut Act (Nunavut Archaeological and Palaeontological Sites Regulations)* Notes: All archaeological sites identified in the Archaeological Impact Assessment for this project will be avoided. If any new sites are identified, the Department will be contacted.	Doug Stenton Director of Heritage Department of Culture, Language, Elders and Youth PO Box 1000, Stn. 800 Iqaluit, Nunavut X0A 0H0 Telephone: 867.975.5524 Email: DStenton1@gov.nu.ca
Department of Health and Social Services (Government of Nunavut)	*Public Health Act* and *Regulations* Notes: The criteria outlined in the Act and Regulations for any camps associated with the Project must meet requirement for sanitation, waste disposal, drinking water quality and medical facilities.	Geraldine Osborne Chief Medical Officer of Health PO Box 1000 Iqaluit, Nunavut X0A 0H0 Telephone: 867.975.5774 Email: GOsborne@gov.nu.ca
NIRB	*Review of the Environmental Screening Assessment*	Ryan Barry, Executive Director PO Box 1360 Cambridge Bay, Nu X0B 0C0 Phone 1-866-233-3033 Fax 1-867-983-2594 Email: rbarry@nirb.ca

EBA assumes that INAC and/or PWGSC will contact the agencies with regulations applicable to this project and secure the required permits, including completing *Part 1 Form Project Proposal Information Requirements* (NIRB 2010a) and *Screening Part 2 Form Project Specific Information Requirements* (NIRB 2010b) when submitting the ESR to the NPC.

4.0 SITE DESCRIPTION AND LOCATION

The sections below describe the ecological and social conditions of the project site. Included in this section is a description of the location, climate, geology, hydrogeology, hydrology, soils, vegetation, fish and wildlife, land use, cultural features, and aesthetic values.

4.1 Location

Ennadai Lake is located in southwestern Nunavut – Kivalliq Region, approximately 370 km west of Hudson Bay, 120 km north of Manitoba and 50 km east of the Northwest Territories. Ennadai Lake is 84 km long, between 5 and 23 km wide, and is drained to the north by the Kazan River. The region lies in the Kazan River Upland Ecoregion of the Taiga Shield Ecozone. Peatlands and lakes of various sizes are common in the region and are often interconnected.

The Site is located on the northeast end of Ennadai Lake, with the majority of the buildings being concentrated in an area approximately 180 m by 120 m. The site lies mostly on a small parcel of IOL with Ennadai Lake to the west, an esker ridge to the south, undulating/hummocky terrain to the east, and a bouldery till with organic veneer to the north. Terrain and landscape features are shown on (Figures 5 to 7).

The site ranges in elevation from 309 to 322 m, and has a moderate 1:15 slope to the west. There are large areas of exposed fine sand around the buildings, and approximately 30% of the site is covered in vegetation. The site shoreline of Ennadai Lake consists of a narrow sandy beach with clusters of boulders up to 1 m in diameter. The beach extends along the north side of the point. The esker ridge to the south rises up to 25 m above the surrounding terrain and has steep side slopes. Evidence of slumping was observed on the north side of the point that extends into Ennadai Lake. Closed depressions and kettle lakes are located on the south side of the esker ridge.

Ponded water was not observed at the site itself, but an active spring is located northeast of the site and a water-filled drainage channel lies just north of the site and flows west to Ennadai Lake. Springs were also observed along the beach at the site within a few metres of Ennadai Lake. Springs in subarctic environments are often associated with thick accumulations of ice over the winter (icings). Icings typically take longer to melt than snow.

4.2 Physiography

Ennadai Lake lies in the Churchill Province of the Canadian Shield, and the geology of the region is characterized by Archean age quartzfeldspathic gneiss, mafic metavolcanics, and granodiorite (Peterson 1992). The region was glaciated during the Wisconsin, and the centre of the Laurentide Ice Sheet lay approximately 100 km northeast of Ennadai Lake (Prest 1969). Common indicators of glaciation in the area include: eskers, kettle lakes, Rogen moraines, and till plains (Aylsworth 1989). Following retreat of the ice sheet about 7,900 years ago, the area was covered by a small glacial lake (Prest *et al*. 1968). Raised beach ridges on the eskers near Ennadai Lake are evidence of the glacial lake. Bedrock outcrops are common but are not a substantial component of the surficial geology.

Ennadai Lake lies at the southern extent of continuous permafrost, and ground temperatures are expected to be between -3 and -5 °C (Heginbottom *et al*. 1995). The active layer thickness is expected to vary considerably depending on soil and vegetation conditions. The top of permafrost may lie less than 0.5 m below the ground surface in wet organic soils, and more than 3 m in well-drained coarse material. Ice wedge polygons are common north of treeline in this area, and ground ice is expected to be associated with these features and with fine-grained sediment. Any glacial ice buried in eskers would have melted when the area was covered by the glacial lake, and is therefore not expected (Dredge *et al*. 1999).

The main feature of the area is a large glaciofluvial esker complex, which trends northeast to southwest. The esker complex has several closed depressions (kettles) with some of them containing ponded water (Figure 6). The esker deposit consists of variable amounts of vaguely horizontally bedded sand and sandy gravel. At the western end of the esker, the esker and surrounding till sediments have been reworked into beaches alongside the lakeshore dominated by sand. The southeast side of the esker is covered with rounded to sub-rounded boulders. The esker is surrounded by sandy till, containing boulders up to 2 m in size. The till is overlain in many places by organic veneers and blankets with poor drainage. The surficial geology mapping completed for the Site is presented on Figure 8.

4.3 Climate and Air Quality

Climate records are available for the Site for 1950 to 1979, and EC has maintained an automated weather station at the site since 1998 (EC 2012). The annual mean air temperature between 1950 and 1979 was -9.4, and ranged from -7.0 to -11.4 °C. Over the last 30 years the climate has warmed, and since 1998 the annual mean air temperature has ranged from -5.4 to -9.0 °C. The mean monthly air temperatures for January and July over the last 15 years have been -24 and 14 °C respectively. The total annual precipitation over the period of record is 280 mm on average, and has ranged from 160 to 450 mm. Snow cover typically extends from October to May.

No direct measurements or observations of air quality are available for the Project site. The Northwest Territories Cumulative Impact Monitoring Program and Audit Working Group (2005) reports that baseline air quality in the Northwest Territories is near pristine or always near background conditions, except near communities or industrial developments. A review of National Pollutant Release Inventory (NPRI) data for 2010 between Nunavut and the rest of Canada (Environment Canada 2013) confirms that remote areas in Nunavut have pristine air quality when compared to the rest of Canada (Table 8).

Table 8: Comparison of NPRI Data for Nunavut and Canada (2010 data)

Category	TPM	PM_{10}	$PM_{2.5}$	SO_X	NO_X	VOC	CO	NH_3
Total – Nunavut	8,570	2,662	729	135	14,211	364,715	7,929	7
Total – Canada	18,794,771	5,945,947	1,187,321	1,370,652	2,212,217	25,235,483	9,610,352	469.024
Note: Data includes open sources (such as agriculture and mine tailings) and natural sources (such as forest fires).								

4.4 Soils

Cryosols are the dominant soils in the Taiga Shield ecozone. Dystric Brunisols commonly occurring on sandy eskers are the dominant soils. Turbic Cryosolic soils are common in permanently frozen sites, with Organic Cryosols typical of wetlands. Patterned ground is widespread, and mineral soils exhibit discontinuous or distorted soil horizon development. Permafrost is almost continuous and has low to medium ice content (ESWG 1999). Soil names follow the Canadian System of Soil Classification (Soil Classification Working Group [SCWG] 1998).

Soils were sampled by test pitting during the field program for the Phase III ESA, primarily to delineate potential contamination and for geotechnical purposes. Soil horizon depths and soil texture of horizons

were logged and classified using the *Canadian System of Soil Classification* (SCWG 1998). Due to the temperatures and presence of permafrost, soils would be classified as Cryosols. Undisturbed soils encountered during the field program consisted typically of a few centimetres of LFH horizon followed by a B horizon, usually loose sand texture with abundant cobbles and gravel. Occasionally A, Ah, or Om horizons were present below the LFH horizon. The texture of the B and C horizons was coarse textured, primarily sand with varying degrees of coarse fragments. Some areas had a large gravel, cobble and boulder components.

More details on the soil and geotechnical survey can be located in the *Phase III Environmental Site Assessment, Hazardous and Non-Hazardous Materials Audit, and Geotechnical Evaluation, Ennadai Lake, Nunavut* (EBA 2013a).

4.5 Hydrology and Hydrogeology

Hydrology and hydrogeological data for the Project site is not available. In the region, the low relief and the relative immaturity of the drainage network have resulted in a drainage pattern with numerous lakes and many ephemeral streams within the uplands, boulder fields and bedrock outcrops. The drainage of these lakes and streams eventually flow into the Kazan River.

4.6 Vegetation

Ennadai Lake lies across the treeline – the gradual transition from boreal forest to tundra. The south end of Ennadai Lake is characterized by open canopy stands of black spruce (*Picea mariana*), while the north end of Ennadai Lake is predominantly tundra vegetation and isolated black spruce colonies are only found in protected poorly drained terrain (Ecological Stratification Working Group 1995).

The ecosystem units within the project site were classified using the system developed by EBA for the *Tibbitt to Contwoyto Winter Road Ecological Land Classification* (EBA 2001). This system includes ecosystem units for the boreal, the tundra, and the transition zones, with the tundra and transition zone classification being used for the Ennadai Lake site. This classification system closely parallels the systems described by Burt (1999) and Matthews, Epp, and Smith (2001).

The vegetation at the Site consists of a mosaic of ecosystem units (Figures 5 to 7, Photos 1 and 2). The ecosystem units at the Ennadai Lake site include Scrub Birch – Bluejoint Shrub Tundra (BC), Scrub Birch – Crowberry Tundra (BE), Scrub Birch - Labrador Tea Tundra (BL), Scrub Birch – Cloudberry Low Shrub Bog (BR), Willow – Nagoonberry Riparian Shrub (SR), Saxifrage – Moss Campion Tundra (SS) and a graminoid unit that was predominantly *Calamagrostis* and *Carex* species. Each of the ecosystem units is described briefly below. A list of vegetation species identified during the 2012 field program is provided in Appendix A.

BC – Scrub Birch – Bluejoint Shrub Tundra

This ecotype occurs where active seepage passes through bouldery morainal deposits. Soils are variable and moisture regimes are dependent on the time of year. Soil drainage was well to rapid. At Ennadai Lake it was common ecotype on the lower slopes of the esker complex.

Shrubs dominant the vegetation (Photo 3). Labrador tea (*Ledum palustre*), northern Labrador tea (*L. palustre* ssp. *decumbens*), scrub birch (*Betula nana*), crowberry (*Empetrum nigrum*), willow (*Salix* sp.) and bog blueberry (*Vaccinium uliginosum*) are common. Reed grass (*Calamagrostis* sp.) was common in the forb layer. Peatmoss (*Sphagnum* sp.) and haircap mosses (*Polytrichum* sp.) were found in the moss layer.

BE – Scrub Birch – Crowberry Tundra

The ecotype occurs on upland areas (eskers, crests and upper slope positions) with xeric to subxeric moisture regimes and very poor to poor nutrients. Surficial material consists of glaciofluvial and till deposits. Soil drainage is very rapid to rapid.

Vegetation species that define the BE ecotype are dwarf shrubs and low woody plants such as: northern Labrador tea, scrub birch, bog blueberry, crowberry, and alpine bearberry (*Arctostaphylos alpina* var. *rubra*) (Photo 4). The forb layer is not prominent. The moss layer generally consists of haircap mosses and swollen thread-moss (*Aulacomnium turgidum*). The lichen layer is prominent and defined by eyed foam (*Stereocaulon tomentosum*), lesser green reindeer (*Cladina mitis*), and paperdoll (*Flavocetraria* sp.). It was common to have bouldery variants for all the ecosystem units as shown in Photo 5.

BL – Scrub Birch – Labrador Tea Tundra

The ecotype occurs on upland areas (in all slope positions) with mesic to submesic moisture regimes and very poor to medium nutrients. Surficial material consists of glaciofluvial and till deposits. Soil drainage is well to moderately well.

Vegetation species that define the BL ecotype are dwarf shrubs and low woody plants such as: northern Labrador tea, scrub birch, bog blueberry, crowberry, bog cranberry (*Vaccinium vitis-idaea*), and alpine bearberry (Photos 6 and 7). The forb layer is not prominent. The moss layer generally consists of swollen thread-moss and hook mosses (*Dicranum* sp.). The lichen layer is prominent and defined by eyed foam, lesser green reindeer, and paperdoll.

BR – Scrub Birch – Cloudberry Low Shrub Bog

This was the only peatland that was identified at or near the Site. This is a common ecotype in the tundra and develops on poorly drained soils; the organic soils develop through an accumulation of Sphagnum mosses. Permafrost was found in all the BR units that were sampled.

Low shrubs and dwarf woody vegetation dominant the vegetation (Photo 8). Shrubs include bog rosemary (*Andromeda polifolia),* alpine bearberry, scrub birch, crowberry, bog cranberry, bog blueberry, northern Labrador tea, and small bog cranberry (*Oxycoccus oxycoccos*). Bluejoint, horsetail (*Equisetum* sp.), Labrador lousewort (*Pedicularis labradorica*) and cotton grass (*Eriophorum* sp.) were common in the herb layer. Common brown peat moss (*Sphagnum fuscum*) was the dominant moss.

SR – Willow – Nagoonberry Riparian Shrub

The ecotype occurs in riparian areas (in level slope positions) with hygric to subhydric moisture regimes and medium to rich nutrients. Surficial material consists of fluvial veneer. Soil drainage is imperfect.

Dense willow define the SR ecotype (Photo 9). Other deciduous shrubs may be present but are often scattered. The forb layer is moderately dominant, consisting of bluejoint (*Calamagrostis canadensis*), other

grasses, and sedges (*Carex* sp.). The moss layer is not dominant, but may consist glow moss (*Aulacomnium* sp.), stair-step moss (*Hylocomium splendens*), and sickle moss (*Drepanocladus* sp.), and poor fen peat moss (*Sphagnum angustifolium*). The lichen layer is absent.

SS – Saxifrage – Moss Campion Tundra

This unit is xeric to very xeric due to rapidly drained soils and exposure. It occurs on coarse grained glaciofluvial deposits and vegetation is patchy due to moisture deficit and very poor nutrient regime (Photo 10). Vegetation is dominated by dwarf woody shrubs, alpine bearberry, crowberry and bog cranberry. Moss campion (*Silene acaulis*), three toothed saxifrage (*Saxifrage tricuspidata*) and pussytoes (*Antennaria* sp.) are common forbs.

Graminoid

There were a number of small patches of predominately graminoid vegetation in low-lying areas. Soils tended to be poorly drained mineral soils, overlain with a well developed LFH layer. These units were typically very small (less than 1 ha). Dominant vegetation was reed grasses and sedges. A graminoid unit is shown on Photo 1.

Disturbed Areas

There were a number of disturbed areas around the site. These showed various degrees of revegetation, likely due to the coarse textured material, the limited precipitation and variable slopes. Considering that it has been over 30 years since this site has had regular human habitation, revegetation has occurred very slowly in a number of areas (Photos 11 and 12). It will be important to minimize disturbance to the existing vegetation.

4.7 Wildlife

Characteristic mammal species include barren-ground caribou, wolf, wolverine, weasel, Arctic and red fox, Arctic hare, and brown lemming. Additional mammal species, such as muskox, otter and mink, occur at the periphery of their ranges and may be expected to occur irregularly. Many mammal species occur year round. In particular, barren-ground caribou from the Beverly and Qamanirjuaq herds may occupy the area throughout the year, but may be expected in greatest numbers in the summer, fall and early winter. During the spring calving season, a few bulls, juveniles, and non-pregnant females may remain in the area rather than continuing their migration to the calving ground. Bird species in the region include willow ptarmigan, peregrine falcon, short-eared owl, sandhill crane and various waterfowl species. Ennadai Lake supports fish populations, including sport fish such as lake trout, lake whitefish, arctic grayling, burbot, and northern pike (Ecological Stratification Working Group 1999). Birds and mammals that were either observed in the area or have special conservation status are listed in Table 9.

Table 9: Wildlife Database Search Results

Common Name	Scientific Name	Nunavut Wild Species 2000	SARA Status[1]	SARA Schedule	COSEWIC Status[2]	Potential Habitat	Notes
Mammals							
Arctic ground squirrel	*Spermophilus parryii*	Secure	-	-	-	Yes	
Arctic fox	*Alopex lagopus*	Secure	-	-	-	Yes	Observed[3]
Arctic hare	*Lepus arcticus*	Secure	-	-	-	Yes	Observed
Brown lemming	*Lemmus trimucronatus*	Secure	-	-	-	No	
Ermine	*Mustela erminea*	Secure	-	-	-	Yes	
Red fox	*Vulpes vulpes*	Secure	-	-	-	Yes	Observed
Black bear	*Ursus americanus*	Secure	-	-	-	Yes	Observed
Grizzly bear	*Ursus arctos*	Sensitive	-	-	Special Concern	Yes	
Moose	*Alces alces*	Sensitive	-	-	-	Yes	Observed
Muskox	*Ovibus moschatus*	Secure	-	-	-	No	
Polar bear	*Ursus maritimus*	Sensitive	Special Concern	Schedule 1	Special Concern	No	
Grey wolf	*Canis lupus*	Sensitive	-	-	-	Yes	Observed
Wolverine	*Gulo gulo*	Sensitive	-	-	Special Concern	Yes	
Barren-ground caribou	*Rangifer tarandus groenlandicus*	Secure	Special Concern	Schedule 1	Special Concern	Yes	Observed, Status listings under SARA & COSEWIC specific to Union and Dolphin herd
Birds							
Ptarmigan	*Lagopus* sp	Secure	-	-	-	Yes	Observed
Eskimo curlew	*Numenius borealis*	-	Endangered	Schedule 1	Endangered	No	
Ivory gull	*Pagophila eburnea*	-	Endangered	Schedule 1	Endangered	No	
Red knot	*Calidris canutus islandica*	-	Special Concern	Schedule 1	Special Concern	No	
Red knot	*Calidris canutus rufa*	-	Endangered	Schedule 1	Endangered	No	
Ross's gull	*Rhodostethia rosea*	-	Threatened	Schedule 1	Threatened	No	

Table 9: Wildlife Database Search Results

Common Name	Scientific Name	Nunavut Wild Species 2000	SARA Status[1]	SARA Schedule	COSEWIC Status[2]	Potential Habitat	Notes
Rusty blackbird	*Euphagus carolinus*	-	Special Concern	Schedule 1	Special Concern	Yes	
Harlequin duck	*Histrionicus histrionicus*	-	Special Concern	Schedule 1	Special Concern	No	
Peregrine falcon	*Falco peregrinus anatum/tundrius*	-	Special Concern	Schedule 1	Special Concern	Yes	
Horned grebe	*Podiceps auritus*	-	-	-	Special Concern	Yes	
Short-eared owl	*Asio flammeus*	-	Special Concern	Schedule 1	Special Concern	Yes	Short-eared owl
Buff-breasted sandpiper	*Tryngites subruficollis*	-	-	-	Special Concern	No	Buff-breasted sandpiper

Notes:
[1] SARA - Species At Risk Act
[2] COSEWIC - Committee on the Status of Endangered Wildlife in Canada
[2] Observed – scat, tracks, dens or visual confirmation

Detailed descriptions on terrestrial and aquatic wildlife are provided below.

4.7.1 Terrestrial Species

A wide variety of wildlife species can be expected to use the habitats in the vicinity of the Project. Wildlife in the area ranges from shrew (*Sorex* spp.) to ptarmigan (*Lagopus* sp.) and grizzly bear (*Ursus arctos*). Many of the species in the project area are common with high population numbers, but there are species with special conservation status, as well. Species or signs (such as scat) that were observed during the 2012 Phase III ESA fieldwork included wolf (*Canis lupus*), fox (*Alopex lagopus*), caribou (*Rangifer tarandus*), ptarmigan (*Lagopus* sp.) and moose (*Alces alces*). Caribou were observed almost daily (Photo 7).

Mammals

Small mammals potentially found in the area of the proposed project include species such as snowshoe hare (*Lepus americanus*), arctic ground squirrel (*Spermophilusp parryii*), ermine (*Mustela erminea*), and other species adapted to arctic habitat conditions and related vegetation communities. Weasels are carnivorous species that depend on small mammals, such as artic ground squirrels, as a main staple of their diet. Arctic ground squirrels live in burrows where they hibernate for 7 months during the winter and feed on leaves, seeds, stems, flowers, grass roots, and fruit. The snowshoe hare feeds on vegetation growing in arctic environments and is an important prey species for carnivorous mammals (Canada Museum of Nature 2004), such as arctic fox.

A number of medium-sized mammals are likely to be found in the project area. Grey wolf, red fox, arctic fox, and wolverine (*Gulo gulo*) can be found in the project area. Wolverines have very specific habitat requirements, including the availability of a den that provides a safe habitat for females to give birth. Arctic

tundra areas provide some of the best denning opportunities for female wolverines (Environment Canada 2001). Wolverines are carnivores and scavengers, and their movements depend on those of wolves and caribou as a reliable source of carrion to feed on (Nunami Jacques Whitford Limited (NJWL) 2008). Wolves in the Arctic tend to vary their habitat and movements depending on caribou movements. Wolves tend to use the same denning areas to give birth and raise pups year after year, and this can sometimes mean travelling long distances between the den and caribou calving grounds, which are an important hunting ground and food source in the spring (NJWL 2008).

The arctic fox is well adapted to the severe climate because of its tendency towards generalist feeding behavior. The arctic fox will consume a wide variety of foods that allows it to thrive under harsh conditions. Similar to ermine in the Arctic, arctic fox depend heavily on small mammals as a prey source.

Other large mammals potentially found in the project study area include moose, caribou, grizzly bear, and barren-ground caribou. Moose and caribou are herbivorous ungulates that depend on a variety of habitat types through seasonal changes in the Arctic. Moose browse almost exclusively on woody species (primarily willow) in the winter, compared with a large proportion of aquatic plants in the spring and summer (Environment Canada 1997).

In the winter, a primary food source for caribou is ground lichens, but in the spring and summer, caribou focus on sedges, willow and other shrubs. Caribou are migratory and travel long distances between wintering and calving grounds. The Beverly and Qamanirjuaq Caribou Management Board (BQCMB) was created to help manage two caribou herds whose migratory routes straddle two territories, two provinces, and four different native cultures. The main purpose of the board is to safeguard the caribou herds in the interest of the aboriginal people who have traditionally relied upon caribou. The Beverly herd was estimated at 276,000 in 1994, and the Qamanirjuaq herd at 348,000 in 2008 (BQCMB 2013). The population of this herd is considered secure (COSEWIC 2012).

Grizzly bears are usually solitary animals although small groups may be seen feeding in the same area at particular times of the year. Males tend to roam farther than females. Bear denning occurs in late October and November; their body temperatures drop slightly and they fall into a deep slumber, but they can be awakened by noise or disturbances near the denning area. The breeding season for grizzlies is generally late spring to early summer with cubs being born in mid-winter. Grizzlies have a litter every third year, and the young stay with the mother for two or three years. In Nunavut, female grizzlies usually have their first litter at eight years of age; compared to grizzly populations located in more southern North America, this is quite late and makes barren ground grizzlies more sensitive to over-harvesting. The grizzly bear diet in Nunavut consists mainly of caribou, but is supplemented by vegetation material and small mammals in summer.

Birds

A wide variety of avian species can be expected to occur in the vicinity of the proposed project. Bird species from small, migratory passerines to various species of ptarmigan can be expected to use habitats within the project area. For example, passerines such as savannah sparrow (*Passerculus sandwichensis*), common redpoll (*Carduelis flammea*), American tree sparrow (*Passer montanus*) and white-crowned sparrow (*Zonotrichia leucophrys*) can be expected to occur within habitats of the project sites.

Similarly, a variety of waterfowl, shorebirds, and raptors can be expected to use habitats in the vicinity of the proposed project. Examples of waterfowl and shorebirds potentially found in the study area include semi-palmated plover (*Charadrius semipalmatus*), northern pintail (*Anas acuta*), green-winged teal (*Anas crecca*), and red-necked phalarope (*Phalaropus lobatus*). Raptors, such as peregrine falcon, rough-legged hawk (*Buteo lagopus*), and gyrfalcon (*Falco rusticolus*), can also be expected to use the habitats available in the study area. Bald eagles (*Haliaeetus leucocephalus*) were observed south of the Site but this would be the northern extent of their range.

Fish

No existing fisheries data was available for Ennadai Lake from previous reports. However, based on angling that was done at the lake during the site visit, it is known that Northern pike, lake trout, and Arctic grayling inhabit the lake. Based on this data, it can be assumed that Ennadai Lake supports other fish species found in similar habitats, including: arctic char (*Salvelinus alpinus*), round whitefish (*Prosopium cylindraceum*), broad whitefish (*C. nasus*), burbot (*Lota lota*), longnose sucker (*Catostomus catostomus*), ninespine stickleback (Pungitius pungitius) and slimy sculpin (*Cottus cognatus*) (Ellis 1956).

The anadromous forms of arctic char spend a considerable time of their lives at sea; non-migratory populations remain in lakes and rivers with cold and clear water (Svetovidov 1984). At sea, arctic char live along the coast (Kottelat & Freyhof 2007). As a nerito-pelagic species (Coad & Reist 2004), char populations prey on planktonic crustaceans, amphipods, mollusks, insects, fishes) but favour small pelagic daphnids as a food source (Hulley 1990).

Lake trout, found in shallow and deep waters of northern lakes and streams, is restricted to relatively deep lakes (Page & Burr 1991). Lake trout predate on plankton, sponges, fishes, insects, and small mammals (Morrow 1980). Lake trout are highly susceptible to pollution, especially from insecticides, and are a commercially valuable species widely pursued for both sport and food purposes (Morrow 1980).

Round whitefish can be expected to be found in shallow lakes (3-15 m depth) spawning over vegetation or gravels. They feed on benthic larval invertebrates, eggs of lake trout, and other small fish such as sculpins or sticklebacks (Joynt & Sullivan 2003).

Burbot feed on whitefish eggs and other species of fish. Burbot adults are more piscivorous as they mature and prefer to hide among boulders. They can be found in lakes and rivers always near the bottom (Joynt & Sullivan 2003).

Slimy sculpin feed on aquatic insects and small fishes, and they can be found in gravelly tributaries or along rocky bottoms of lakes.

Arctic grayling are inhabitants of well-oxygenated, open, clean, and cold waters of medium to large rivers and lakes. Grayling enter rocky creeks to spawn (Kottelat & Freyhoff 2007, Page & Burr 1991). Schooling in moderate numbers (Frimodt 1995), the young feed on zooplankton with a gradual shift to immature insects; adults feed mainly on surface insects but also take in fishes, fish eggs, lemmings, and planktonic crustaceans (Scott & Crossman 1973). Grayling are known to be extremely susceptible to various forms of pollution (Nelson & Paetz 1992).

Northern pike are primarily a freshwater fish occurring in clear, vegetated lakes, quiet pools, and backwaters of creeks and small to large rivers (Page & Burr 1991), but are known to enter brackish waters.

Typically non-migratory (Morrow 1980), this fish is usually solitary and highly territorial. Adults feed on fish, insects, and small birds and mammals; cannibalism is common, especially in arctic lakes, where it may be the only species present in a given waterbody (Coad et al. 2004). Pike are a valuable sport and food fish (Page & Burr 1991) that react poorly to habitat alterations (Kottelat & Freyhoff 2007).

Longnose sucker is found in clear, cold, deep water of lakes and tributary streams and occasionally found in brackish water in the Arctic (Page & Burr 1991). This species moves from lakes into inlet streams or from slow, deep pools into shallow, gravel-bottomed portions of streams to spawn (Morrow 1980). Feeding on benthic invertebrates, young suckers are preyed upon by other fishes and fish-eating birds, while adults in spawning streams are taken by mammals, osprey, and eagles (Page & Burr 1991).

Ninespine stickleback are found in multiple environments from shallow vegetated areas of lakes, ponds and pools of sluggish streams, to open water over sand. When abundant, it is preyed upon by other fishes (Scott & Crossman 1973), but is also preyed upon by birds (Morrow 1980).

4.7.2 Species of Concern

Species potentially located in the project area require special attention due to their status of "special concern" as designated by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Species At Risk Act (SARA), and/or listed as "sensitive" by the Government of Nunavut in the Report on Wildlife (Government of Nunavut 2007) include: grizzly bear, moose, grey wolf, wolverine, peregrine falcon, short eared owl (*Asio falmmeus*), rusty blackbird (*Euphagus carolinus*) and horned grebe (*Podiceps auritus*).

Of the large mammals found in the vicinity of the proposed project, the grizzly bear has been designated a status of "special concern" by COSEWIC (2012) and "sensitive" by the Government of Nunavut (2012); however, the grizzly bear population in Nunavut is considered to be growing (NJWL 2008). In Nunavut, the grizzly can be found throughout the Kivalliq region and in large portions of the Kitikmeot and Baffin regions, including all three sites. Grizzlies are omnivorous and an increase in the number of encounters between humans and grizzlies is resulting in more 'nuisance' bears being killed.

The moose has been designated a status of "sensitive" by the Government of Nunavut (2000). Moose primarily use swamps, tundra, wooded areas, lakes with nearby forests, and streams within the boreal forest for habitat. In the spring and summer months moose feed on grasses, salt-rich aquatic plants, and leaves. In the winter months moose browse on twigs. The main threat to moose is hunting by humans (Government of Nunavut, 2012).

The grey wolf has been designated a status of "sensitive" by the Government of Nunavut (2000). The grey wolf does not show preference of one habitat type. They can be found on the tundra, in forests, and on the plains. Their main source of prey in Nunavut is caribou, but will also prey upon hares, foxes, small rodents, fish, and birds. The main threat to grey wolf is hunting by humans (Government of Nunavut, 2012).

The wolverine has been designated a status of "sensitive" by the Government of Nunavut (2000) and a status of "special concern" by COSEWIC. Wolverines prefer tundra habitat between the tree line and the coastline. They can also be found in rocky outcrops and open plains. The diet of wolverine ranges from large game to eggs and roots (Government of Nunavut, 2012).

The peregrine falcon has been designated a status of "special concern" by SARA and COSEWIC. Peregrine falcons primarily use open habitat that is suitable for hunting, including tundra, wetlands, sea coasts, and mountain meadows. They require nesting sites on cliffs adjacent to their hunting territories. Their diets are composed almost entirely on birds. Threats to the peregrine falcon include deterioration of habitat, pesticides, and the current small population size (SARA 2012).

The short-eared owl has been designated a status of "special concern" under Schedule 1 of SARA and a status of "special concern" by COSEWIC. The short-eared owl primarily uses marshlands and open grasslands as habitat, but is susceptible to disturbance due to its ground nesting habit (NJWL 2008). The distribution of short-eared owls depends greatly on the abundance of small mammal prey species (AMEC 2008).

The rusty blackbird has been designated a status of "special concern" by SARA and COSEWIC. Rusty blackbirds primarily reside in the boreal forest, along edges near wetlands and pastures. The diet of the rusty blackbird mainly comprises invertebrates, but also includes small fish, salamanders, seeds, and small fruits. The main threat to the rusty blackbird is the destruction of wintering grounds in the Mississippi Valley floodplains (SARA 2012).

The horned grebe has been designated a status of "special concern" by COSEWIC. Horned grebes primarily use small ponds for nesting, but occasionally use bays of lakes. They require emergent vegetation for nesting material and protection of their young. Threats to the horned grebe are unknown (SARA 2012).

5.0 LAND USE HISTORY, CULTURAL FEATURES, AND SPECIAL PLACES

Reviews of the Archaeological Impact Assessment (AIA) (Golder 2012) and of the Phase III ESA (EBA 2012) were completed and used in developing a land use history of the area and for identifying any cultural features and/or special places in the project area.

5.1 Historical Occupation and Land Use

Golder (2012) completed an Archaeological Impact Assessment (AIA) of the site in 2012. The information in this section is summarized from the Golder AIA report unless otherwise indicated. References to the information in this section can be found in the Golder report.

Occupation of the Barrenlands of Nunavut began shortly after the recession of the glaciers approximately 9000 before present (BP). The Tyrrell Sea occupied lands boarding the current extent of the Hudson Bay until approximately 5000 BP. The earliest recognized archaeological tradition in the region is Northern Plano (8000 to 6500 BP), which is similar inform to artefacts found in Agate Basin in the plains of North America. The concentration of Northern Plano materials on Grant Lake further suggest the Dubawnt and Thelon Rivers were major caribou migration corridors exploited by Northern Plano peoples. Approximately 6,500 years ago, Northern Plano evolved into Shield Archaic (6500 to 3500 BP). This cultural development coincided with a warming period that resulted in the expansion of the boreal forest as far north as Dubawnt Lake.

The Shield Archaic Tradition was followed by the Pre-Dorset Tradition which lasted from approximately 3450 to 2650 BP. Pre-Dorset is part of the Arctic Small Tool Tradition (ASTt), well known in the high arctic. The migration of these early Pre-Inuit groups corresponded with a cooling trend that adversely affected maritime hunting. As a result, these arctic-adapted people were forced further south in their quest for food. They were able to exploit migrating caribou herds on the Barrenlands as a result of the southward retreating forest edge.

The Taltheilei Tradition is the latest precontact archaeological culture identified in the study area, and dates from approximately 2600 to 1200 BP. People representing this tradition moved into the region from the west after the preceding cooling period ended and are generally regarded as ancestral Dene. During the 18th Century, Dene groups were decimated by European diseases and abandoned the Barrenlands in favour of the forests to the south to engage in the fur trade. As a result of this abandonment, the historic Caribou Inuit moved into the region approximately 200 years ago, either from the central arctic or the east coast of Hudson's Bay. Their descendants have occupied much of the interior of Nunavut ever since, including the Kazan, Dubawnt, and lower Thelon drainage basins. The site is located in the traditional territory of the Caribou Inuit, specially the Ahiarmuit, however the Denesuline also claim the area (Canadian Geographic Enterprises 2005).

The first historical accounts of the area are from Thomas Button (1612-1613); however regular contact with people was not established until James Knight established Fort Prince of Wales at Churchill Manitoba. Early European exploration of the area of the Barrenlands now known as Nunavut began with the establishment of fur trade posts on the western shore of Hudson's Bay in 1670.

5.2 Recent History

Construction of the Royal Canadian (RC) Signals Station by the Department of National Defence (DND) began in July 1949. Equipment was brought to the Site from Churchill, MB by air and cat train. Construction was completed in October 1949. It was operated by the DND until the site was handed over to the Department of Transport on September 18, 1954 (Martin 2012). Between 1949 and 1954 the weather station personnel often provided medical assistance and food to the Kazan River Group of Eskimos and personnel at the station were credited with saving the band from influenza and apparently starvation numerous times (Martin 2012). In an effort to avoid the looming starvation and perceived dependency of the Eskimos on the station, the Eskimos were deported from Ennadai Lake several times between 1950 and 1958 (Laugrand 2009).

Other operations in the area included mining exploration camps and prospecting. Transport Canada (TC) operated the site until April 1, 1979, when it was handed over to the Atmospheric Environment Service of Environment Canada (EC). In 1980 EC established a reserve, number 1849, at the Site and the surplus buildings were put up for sale. The buildings were eventually sold to 59549 Manitoba Ltd., and EC requested a reduction in reserve for an unmanned weather station. In January 1984, Indian and Northern Affairs Canada (INAC) notified 59549 Manitoba Ltd. that they would have to lease the land below the buildings because the government could not sell or transfer the reserve to the public. A lease was granted to Tundra Adventures Ltd. (formerly 59549 Manitoba Ltd.) for 10 years effective May 1, 1984. The lease included the main camp at the Site and adjacent airstrip. At this time, the lands were reportedly removed from the original EC reserve number 1849 (WESA 2010). In June 1992, INAC notified Tundra Adventures

Ltd. that the leases would be transferred to Nunavut Tunngavik Incorporated (NTI) and the leases would be administered by the Designated Inuit Organization (DIO). In August 1994, Keewatin Inuit Association (KIA) informed INAC of a fuel spill at the Site. INAC in turn notified EC and Tundra Adventures Ltd. that these lands were not Crown land but are now transferred to NTI (WESA 2010).

The Site is part of the Nunavut Settlement Area and is surrounded by partially designated Inuit Owned Land (IOL). Land claims surrounding the Site are part of the Arviat IOL. Parcel AR-41 is east of the Site, AR-39 is north and south of the Site, and AR-40 is west of the Site across Ennadai Lake (AANDC 2012). During the 2012 EBA field program survey markers were observed at the Site indicating a portion of the site is designated IOL. These markers were surveyed by on-site personnel so accurate IOL boundaries could be determined. The portion of the site containing the former weather station buildings, as well as a portion of land surrounding and including the airstrip is designated IOL as shown in Figure 3. The remainder of the site is Crown land. No known active or inactive mineral claims were found for the Site (AANDC 2012).

The Site is currently unoccupied with no ongoing land use since previous manned weather station activities ceased in the 1970s; a newer automated weather station is present at the site (Figures 2 and 7). EC personnel likely visit the site occasionally to collect data and maintain equipment.

The Site is also used as a cache by local hunters, as a new boat and motor were observed during the Phase III ESA. New containers of fuel, clothing, and food were found inside the buildings. Graffiti was observed on several buildings during the site visit. There is potential for tourists to visit the site as the nearby lodge offers wildlife viewing tours.

5.3 Cultural Features and Special Places

The Ennadai Lake site holds cultural significance to the people of the area. There is considerable past and recent history that make the site significant to the people of Arviat, Whale Cove and Rankin Inlet. Several heritage sites have been located at Ennadai Lake and during the AIA new heritage resources were located, including one gravesite. Details of these resources can be found in the Golder AIA (Golder 2012).

During the community meeting held in Arviat in December 2012, other cultural features may be present on site that were not identified during the AIA (Figure 9). A commitment was made to the community to verify these sites prior to remediation.

The Kazan River is classified as a Heritage River. The river flows through the heart of the barrenlands, with its origin at the northern end of Ennadai Lake.

5.4 Aesthetic Values

Natural landscapes, encompassing the land, water, and sky, changing from season to season, especially those undisturbed by human activities, are highly valued by most members of society. Natural landscapes disturbed by anthropogenic activities are often much less valued by societies. The natural landscapes at the Site have been disturbed by anthropogenic activities. Disturbances include damaged terrain, such as the trail networks, waste (hazardous and non-hazardous), such as structures, tanks, and drums, and soil contamination.

6.0 SOCIO-ECONOMIC CONDITIONS

6.1 General Information

The Hamlet of Arviat (formerly called Eskimo Point) is the closest Nunavut community to the project site and is located on the Hudson Bay. The population of Arviat is 2,851 (Hamlet of Arviat 2012), and it is the third largest community in Nunavut, behind Iqaluit and Rankin Inlet. The population is predominately Inuit. Based on a 2006 study (Terriplan 2008), over 98% of the people in Arviat listed an aboriginal language as their first language.

The only access to Arviat is by air, boat or snowmobile. There is consideration of a highway from Manitoba (Thompson, Lynn Lake) to Rankin that would pass through Arviat, though the logistically and economic challenges make this remote possibility in the near future. Like other Arctic coast communities there is an annual sealift to bring in community supplies. Churchill Manitoba is the closest community to the south, and is often accessed by boat, snowmobile, and air for supplies.

The Hamlet of Arviat is governed by the Mayor, Deputy Mayor, and 7 councillors. Together the council makes decisions and plans on behalf of the residents of Arviat. Hamlet council also represents Arviat on a territorial and national level. The council is responsible for public works, economic development, community policing, municipal liaison services, and recreation and community wellness.

Arviat is well known around the Arctic for its artistic qualities. It is a thriving community with many talented musicians: Susan Aglukark; Simon "Johnny Cash of the North" Sigyariaq; the band Uniaqtuq, with Arsene, Pelagie and Mary Angalik; the Arviat Band, with John and Billy Kuksuk, Paul Kattau and others; the Irksuk band, played by Paul Irksuk and sons. All have had CDs recorded commercially.

6.2 Employment

According to Terriplan (2008), the economy of Arviat is a typical northern mixed economy with government transfer payments, traditional activities, and wages from employment inside and outside the community supporting the economy. The employment rate in Arviat was listed at 43%. The wage economy is dominated by employment with the government, or by government-related agencies such as education, healthcare, and municipal services. Sales and services occupations and the trades/ transport/contrating are listed as the top two workforce occupations.

The population distribution has two age groups that make up the majority of citizens: 5-14,and 25 – 54. In 2006, over 25% of the population was under the age of 20. The majority of the people (71%) do not have a high school diploma, certificate or degree; 4% have a trades certificate or apprenticeship; and 9% have a college or equivalent certificate or diploma. Opportunity for training or employment is of importance when planning these types of projects.

6.3 Community Services

The Hamlet of Arviat has a wide variety of community services and organizations. The community has two schools and a college that provide education to residents. The hamlet also has a community health centre, elder's centre, youth centre, recreation centre, and wellness centre. Local services include electrical power generation; an airport; numerous retail stores; hotel/inns; general contracting, construction and expediting

services; tourism, arts, hunting and fishing businesses; churches; a RCMP detachment; water and sewage collection; and a volunteer fire department (Hamlet of Arviat 2012).

6.4 Traditional Land Uses

Hunting and fishing are still the primary source of meat in the community, while other staples are brought into the community. A 2008 socio-economic study puts the total annual net value of the caribou harvest at more than $12 million for the region (BQCMB 2013). While meat harvest is essential to the residents, additional values are derived from the use of skins for clothing and bedding, and bones and antlers for handicrafts. Apart from purely economic factors, the use of caribou is important to the culture and traditional lifestyle of aboriginal people.

During the community meeting, a number of residents indicated that they, or a family member, had hunted or fished at Ennadai Lake and that they had use the old weather station as a base for the duration of their stay.

7.0 PROJECT/ENVIRONMENT INTERACTIONS

This ESR has been prepared in a manner that is consistent with NIRB requirements as outlined in Article 12 of the NCLA and the *Guide 3: Guide to Filing Project Proposals and the Screening Process* (NIRB 2007a). In order to determine project and environment interactions, it is necessary to identify relevant ecosystem components (biological and anthropogenic), determine potential impacts to those components based on the scope of work, and the possible mitigation strategies available to reduce or eliminate those impacts. The sections below outline the process to identify and determine the interactions.

7.1 Identification of Valued Environmental and Socio-economic Components

The NIRB (NIRB 2007b) defines valued ecosystem components (VECs) as "those aspects of the environment considered to be of vital importance to a particular region or community, including:

- Resources that are either legally, politically, publicly or professionally recognized as important, such as parks, land selections, and historical sites;
- Resources that have ecological importance; and
- Resources that have social importance.

Valued Socio-Economic Components (VSECs) are defined by the NIRB (NIRB 2007b) as "those aspects of the socio-economic environment considered to be of vital importance to a particular region or community, including components relating to the local economy, health, demographics, traditional way of life, cultural well-being, social life, archaeological resources, existing services and infrastructure, and community and local government organizations."

Potential VECs and VSECs were identified in a three-stage process. Initially, a review of the regulatory responsibilities of applicable Nunavut and other government agencies was completed, including the NIRB. Also, VECs and VSECs identified in other projects in Nunavut such as the *Environmental Screening of the Proposed Investigation and Remediation of PIN-B Clifton Point DEW Line Site* (AMEC 2008), and the

Environmental Screening Assessment of the Proposed Remediation of the Hope Lake Sites under the Nunavut Impact Review Process (EBA 2011) were reviewed.

Once these VECs and VSECs are identified, they are confirmed during the field work and public consultation process and in discussions with local government. Finally, based on the activities in the proposed RAP, professional judgement of environmental practitioners and remediation specialists identified any potential gaps in the VECs and VSECs previously identified. As a result of this process, a comprehensive list and selection rationale was developed and is outlined below in Table 10.

Table 10: List of VECS and VSECs and Selection Rationale

VEC or VSEC	VEC/VSEC Selection Process			
	Regulatory Requirement	Identified in other ESRs	Public/Inuit Input	Professional Judgment
Climate and Air Quality	✓	✓		✓
Terrain and Geology		✓		
Soils	✓	✓		✓
Hydrology	✓	✓	✓	✓
Hydrogeology	✓	✓	✓	
Vegetation	✓	✓	✓	✓
Wildlife (Terrestrial Species)	✓	✓	✓	✓
Wildlife (Aquatic Species)	✓	✓	✓	✓
Cultural Features and Special Places	✓	✓	✓	✓
Job Opportunities	✓	✓	✓	✓
Current Employers	✓		✓	✓
Traditional Land Use	✓	✓	✓	✓
Community Services	✓			
Aesthetics	✓	✓		

7.2 Identification of Project Impacts and Mitigation

To determine the potential impacts to the various VECs or VSECs, the baseline information along with specific project activities outlined in the RAP were reviewed, and using professional judgement, project activities that would impact/interact with a specific VEC or VSEC were identified. As recommended by the NIRB (2010b) in *Screening Part 2 Form Project Specific Information Requirements (PSIR)* this process was completed using a matrix of project activities versus VECs and VSECs. This matrix and the results of the process are included in Table 11.

Table 11: Identification of Project Impacts on VECs and VSECs

VEC or VSEC	Project Activities												
	Site Preparation and Camp Operations			Remediation								Closure	
	Mobilization, Transportation of Personnel and Equipment	Trail and Camp Construction; Development of Borrow area(s)	Camp Setup and Operation – Waste Treatment Systems and Maintenance	Structure Demolition and Debris Removal	On-Site Burning of Non-Hazardous Wood Waste	On-Site Incineration of Liquid Organic Waste	On-Site Preparation/ Handling of Hazardous Solid Waste	On-site Treatment of Aqueous Liquid Waste	On-Site Construction of Non-Hazardous Landfill[1]	Construction and Operation of Landfarm[2]	Off-Site Transportation of Hazardous Waste to Disposal Facility[3]	Site Recontouring and Natural Revegetation	Demobilization and Transportation of Personnel and Equipment
Climate and Air Quality	√	√	√	√	√	√	√	√	√	√		√	√
Terrain and Geology		√							√	√		√	
Soils		√	√	√		√	√	√	√	√		√	
Hydrology		√		√		√		√	√	√		√	
Vegetation		√	√	√				√	√	√		√	
Wildlife (Terrestrial Species)		√	√	√			√	√	√	√	√	√	
Wildlife (Aquatic Species)				√									
Cultural Features and Special Places		√		√					√	√		√	
Job Opportunities	√	√	√	√	√	√	√	√	√	√	√	√	√
Current Employers	√	√	√	√	√	√	√	√	√	√	√	√	√
Traditional Land Use		√	√	√	√	√	√	√	√	√		√	
Community Impacts		√	√						√	√		√	
Aesthetics		√	√						√	√		√	

Notes:

[1] – The landfill will be for non-leachable, inert waste such as plastics, metal, glass, fibreglass. Asbestos will be double bagged and landfilled with other inert material.

[2] – The landfarm will be used to treat petroleum hydrocarbon contaminated soil. Landfarm is expected to be operation from 2014 to end of season 2016.

[3] – Materials to be shipped: materials with total and leachable lead paint, PCB paint; mercury, miscellaneous hazardous liquids and solids.

In NIRB (2007b) *Guide 2 Guide to Terminology and Defintions* significance is defined as "…a consideration of the context of the project and the intensity of adverse effects, by giving particular regard to the following:

- The environmental sensitivity of the geographic area likely to be affected by the project;
- The historical, cultural and archaeological significance of the geographic area likely to be affected by the project;
- The extent of the effects of the project, including the geographical area that will be affected, the size of the affected human populations, and the size of the affected wildlife populations and related habitat;
- The extent of the effects of the project on other regional human populations and wildlife populations, including the extent of the effects on Inuit harvesting activities;
- The magnitude and complexity of adverse effects;
- The probability of adverse effects occurring;
- The frequency and duration of adverse effects;
- The reversibility or irreversibility of adverse effects; and
- The potential for cumulative adverse effects given past, present and future relevant events.

Environmental effects are defined as "any positive or negative change in the biophysical and/or socio-economic environment caused by, or directly related to, a former, ongoing or proposed activity (NIRB 2007b). There are three types of effects:

- Direct effects - refer to changes in the environmental components that result from direct cause-effect consequences of interactions between the project activities and the environment.
- Indirect effects - result from cause-effect consequences of interactions between the environment and direct impacts. For example, the effect of pollution may not only be seen directly in the loss of local vegetation, but indirectly as a degradation of the health, culture and social structure of the local people."
- Cumulative Effects - refer to the accumulation of changes to the environment caused by human activities (e.g. past, existing and proposed activities, including activities associated with the project under assessment). These changes occur over space and time and can be brought about by environmental effects that are additive or interactive. For example hunting, oil spills, and loss of habitat, commercial fishing pressure on prey species, can affect marine mammals in the Arctic.

Socio-economic effects are defined as "…any of a variety of social and economic effects, including impacts upon the local economy, health, demographics, traditional way of life, cultural well-being, social life, archaeological resources, existing services and infrastructure, and local and regional government organizations" (NIRB 2007b).

Once an impact to a particular VEC or VSEC was identified, the impact was rated using the system outlined in Table 12. This system is based on Smardon et al. (1976) and Leopold et al. (1971). This system was used by AMEC (2008) and EBA (2011) for similar screening reports and has been advocated by the Canadian

Environmental Assessment Agency (CEAA 2010). This rating system has been modified so that the definitions provided by NIRB have been considered and to make it suitable for this project.

Table 12: Impact Rating Criteria

Attribute	Options	Definition
Direction	Positive	Beneficial impact to population or resource
	Neutral	No change to population or resource
	Negative	Adverse impact to population or resource
Scope	Local	Impact restricted to area within 1 km of the Project site
	Regional	Impact extends up to several kilometers from the Project site
	Territorial	Impact extends throughout Nunavut
Duration	Short-Term	Impacts are significant for less than a year before population or resource returns to its previous state; or for a species, less than one generation
	Medium-Term	Impacts are significant for 1 to 10 years; or for a species, for one generation
	Long-Term	Impacts are significant for greater than 10 years; or for a species, significant for more than one generation
Frequency	Once	Occurs only once
	Intermittent	Occurs occasionally at irregular intervals
	Continuous	Occurs on a regular basis and regular intervals
Magnitude	Negligible	No measurable change from background in the population or resource; or in the case of air, soil or water quality, if the parameter remains less than the standard, guideline or objective
	Low	Impact causes <1% change in the population or resource (where possible the population or resource base is defined in quantitative terms)
	Moderate	Impact causes 1 to 10% change in the population or resource
	High	Impact causes >10% in population in resource
Probability	Low	The impact is unlikely to occur
	Medium	The impact is fairly likely to occur
	High	There is a high probability of the impact occurring
Significance	Insignificant	Minimal or no measurable change from background conditions that may last over a long-term period (less than 10 years or for one generation)
	Significant	Measurable change from background conditions that may last over a long-term period (greater than 10 years or for more than one generation)
	Unknown	Insufficient data available to make a professional judgment, more study required.

Different project activities have similar impacts and impact ratings and consequently similar mitigation strategies; therefore, in the following sections, project activities with analogous impacts, impact ratings, and mitigation have been grouped together for each of VECs and VSECs. The following tables provide an assessment of project interactions, potential impacts and ratings, and mitigation strategies. A brief summary for each VEC is also included. A discussion, rather than a table format, is provided for VSECs and project interactions later in the report. Only residual impacts, those impacts that cannot be mitigated and that are also considered significant, are discussed later in the ESR.

7.3 Project Impacts and Mitigation

7.3.1 Climate and Air Quality Impacts and Mitigation

Table 13: Assessment of Impacts on Climate

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Greenhouse gas emissions from this project are insignificant so mitigation is not required (Note that the majority of organic waste is anticipated to be used on site as heating fuel)
Mobilization and transportation of personnel and equipment Trail and camp construction; development of borrow area(s) Camp equipment setup and operation – waste treatment systems and maintenance	Greenhouse gas emissions from equipment operation and camp waste incineration		
Remediation			
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site incineration of liquid organic waste On-site handling of hazardous solid waste Landfill construction Landfarm construction and operation Off-site transportation of hazardous waste	Greenhouse gas emissions from wood waste, from incineration equipment and incinerating liquid organic waste, and from equipment operation		
Closure			
Site recontouring and natural revegetation of disturbances Demobilization and transportation of personnel and equipment off-site	Greenhouse gas emissions from equipment operation		
Summary: Adverse impacts to air quality with respect to climate are associated with all phases, including mobilization, remediation and demobilization. As a result of this project, emissions of greenhouse gases, nitrogen oxides (NO_x), sulphur dioxide (SO_2) particulate matter, and carbon monoxide (CO) due to combustion of fuel and gasoline; incineration of liquid hazardous waste and burning of non-hazardous wood waste will increase for the duration of the activity but each activity is short lived. Emissions from construction equipment will be short term and intermittent and will not have a significant residual effect on the climate within the local study area, regionally, or nationally.			

Table 14: Assessment of Impacts on Air Quality

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control Best Management Practices (BMP), such as using water for controlling dust and limiting remediation activities during high wind periods Exhaust emissions for project are insignificant so mitigation is not required
Trail and camp construction; development of borrow area(s)	Dust from development of borrow pit(s), upgrading trails, and camp construction Exhaust emissions from equipment operation		
Remediation		Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: Low (hazardous emissions) High (particulate matter) Significance: Insignificant	Proper segregation of wood from other material so only wood is burned Proper training of burning operators to ensure high temperatures to limit particulate emissions
On-site burning of non-hazardous wood waste	Potentially hazardous air emissions if hazardous material is burned with wood Potentially increased emissions of particulate matter		
On-site incineration of liquid organic waste	Potentially hazardous air emission s from moving and incinerating hazardous material (e.g., dioxins and furans); Potentially increased emissions of particulate matter Exhaust emissions from equipment operation	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: Low Significance: Insignificant	Incineration equipment only operated by trained contractor and equipment is properly maintained to ensure the liquid organic waste is completely incinerated and particulate emissions are controlled Exhaust emissions for project are insignificant so mitigation is not required (Note that the majority of organic waste is anticipated to be used on site as heating fuel)
Structure demolition and debris removal On-site compaction of hazardous solid waste Construction of landfill Construction and operation of landfarm Off-site transportation of hazardous waste	Potential emissions of hazardous waste particles and dust while completing remediation activities and the potential construction and operation of landfarm Exhaust emissions will result from equipment operation	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: Medium Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods Careful segregation and transportation of hazardous waste Exhaust emissions for project are insignificant so mitigation is not required
Closure		Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods Exhaust emissions for project are insignificant so mitigation is not required
Site recontouring and natural revegetation of disturbances Demobilization of camp and construction equipment	Potential dust emissions while recontouring disturbed areas Exhaust emissions from equipment operation		
Summary: Adverse potential impacts to air quality are associated with all phases, including mobilization, remediation and demobilization. To complete the proposed remediation, heavy equipment, liquid waste treatment, and incineration equipment will be used and wood waste will be burned. As a result emissions will increase due to combustion of aviation fuel, diesel fuel and gasoline, incineration of liquid organic waste and burning of wood waste. Emissions from vehicles and construction equipment however will be short term and intermittent and will not have a significant residual effect on air quality within the local study area, regionally or nationally. Dust generation is expected to also be low in volume and infrequent. A number of measures will be implemented to mitigate the potential adverse effects associated with project activities. These will include, though not be limited to: dust suppression/control measures, implementation of good practice measures and avoidance of work during extreme wind events. There is potential for emissions of dioxins and furans through the incineration of liquid organic wastes and the inadvertent burning of hazardous wastes, but these will be managed by ensuring proper on-site diversion and segregation of waste, thus only appropriate waste streams are burned and / or incinerated. Additionally, the amount of soil exposed and disturbed will be limited to the areas requiring remediation and the movement of soils will be minimized whenever possible. Exposed soil piles will be covered, except for the landfarm. A BMP for Dust Control will be developed and implemented and will contain these and other measures. Following implementation of mitigation measures, adverse impacts associated with project activities to air quality will be local, short term and insignificant. Additionally, these impacts are not expected to contribute to any adverse cumulative effects.			

7.3.2 Terrain and Geological Impacts and Mitigation

Table 15: Assessment of Impacts on Terrain and Geology

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-Term Frequency: Once Magnitude: Low Probability: High Significance: Insignificant	
Trail and camp construction; development of borrow area(s)	Site preparation and construction activities could disturb the terrain and potentially damage permafrost		Use existing trails and previously disturbed areas to the fullest extent possible Limit creation of new disturbed areas Disturbed areas will be recontoured to match pre-disturbance conditions to the fullest extent possible
Remediation			
Construction and operation of landfarm	Disruption of surficial geology may provide a potential pathway for impact into the bedrock Permafrost may be damaged		The landfarm must be constructed with a proper liner (which must not be breached) and leachate collection system Proper operation of the landfarm to ensure impact is contained within the landfarm Limit exposure time of the permafrost, if encountered
Structure demolition and debris removal On-site burning of non-hazardous wood waste Construction of landfill	Remediation activities could disturb the terrain and potentially damage permafrost		Minimize disturbance to the terrain Incinerate in non-permafrost areas Recontour disturbed area quickly to match pre-disturbance conditions
Closure		Direction: Negative Scope: Local Duration: Short-term Frequency: Once Magnitude: Low Probability: Moderate Significance: Insignificant	
Site recontouring and natural revegetation of disturbances	Activities could disturb the terrain and potentially damage permafrost		Land surface will be recontoured to match pre-disturbance conditions to the fullest extent possible Surface area and time of permafrost exposure will be minimized
Summary: Adverse potential impacts to geology are associated with the construction of a landfill and the landfarm and the potential for impact of the underlying geology. However, if proper construction and maintenance techniques are followed no impacts are expected and their construction is not expected to contribute to any adverse cumulative effects. It is expected that the Project will have long-term beneficial effects on the geology at the sites due to the removal or treatment of hazardous waste and treatment contaminated soil as these sources of impact will have been removed. No residual or cumulative impacts to geologic resources are expected.			

7.3.3 Soil Impacts and Mitigation

Table 16: Assessment of Impacts on Soil

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel will be stored in easily accessible and bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage areas (including drums) will be inspected daily Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Mobilization and transportation of personnel and equipment to sites Trail and camp construction; development of borrow area(s) Camp equipment setup and operation – waste treatment systems and maintenance	Potential impact of soil from spills when refuelling and servicing equipment		
Trail and camp construction; development of borrow area(s)	Degradation (erosion, compaction, admixing) of soil during site preparation activities	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Low Probability: Moderate Significance: Insignificant	A Soil Management BMP will be developed and implemented Use existing roads, pathways and previously disturbed areas to the fullest extent possible Topsoil (if present) and subsoil will be handled and stored separately Soil will not be disturbed or handled during wet and / or windy conditions
Remediation		Direction: Negative (beneficial once non-hazardous and hazardous materials and contaminated soil have been treated or removed from the site) Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel and hazardous material will be stored in easily accessible and bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Hazardous waste and fuel storage areas (including drums) will be inspected daily All workers will be trained in proper handling of non-hazardous and hazardous materials and contaminated soil Hazardous materials and contaminated soil will be exposed for as short time as possible
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site incineration of liquid organic waste On-site compaction of hazardous solid waste On-site treatment of aqueous liquid waste Construction of landfill Construction and operation of landfarm	Potential impact of soil from spills when refuelling and servicing equipment Potential soil impact while removing, transporting, burning or incinerating remediation materials		
Structure demolition and debris removal Contaminated soil removal Landfill construction Landfarm construction and operation	Degradation (erosion, compaction, admixing) of soil during remediation activities such as removing waste, contaminated soil or landfill/landfarm construction	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Low Probability: Moderate Significance: Insignificant	A Soil Management BMP will be developed and implemented Use existing roads, pathways and previously disturbed areas to the fullest extent possible Topsoil (if present) and subsoil will be handled and stored separately Soil will not be disturbed or handled during wet and / or windy conditions
Closure		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel will be stored in easily accessible and bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage areas (including drums) will be inspected daily
Site recontouring and natural revegetation of disturbances Demobilization and transportation of personnel and equipment off-site	Potential impact of soil from spills when refuelling and servicing equipment		

Table 16: Assessment of Impacts on Soil

Project Activity	Potential Impact	Impact Rating	Mitigation
Site recontouring and natural revegetation of disturbances	Degradation of soil (erosion, compaction, admixing) during recontouring	Direction: Negative Scope: Local Duration: Short-term Frequency: Once Magnitude: Low Probability: Moderate Significance: Insignificant	A Soil Management BMP will be developed and implemented Topsoil (if present) and subsoil will be handled and stored separately Soil will not be disturbed or handled during wet and / or windy conditions
Summary: Adverse potential impacts to soils are associated with all phases of the Project, including mobilization, remediation and demobilization, especially in the event of extreme precipitation. Adverse effects may include degradation of soil through compaction and/or admixing of topsoil and subsoil. Potential soil impact can occur from improper storage, transportation and use of fuel and hazardous waste. Adverse effects associated with extreme precipitation events include erosion, slumping or sliding of surficial materials (especially during landfill/landfarm construction and operation. A number of measures will be implemented to mitigate the potential adverse effects associated with project activities. These will include, though not be limited to, locating access routes and storage areas on previously disturbed areas, limiting the area and time that permafrost is exposed, re-contouring and grading to ensure that landforms match pre-disturbance conditions as much as possible. Coarse granular material will also be used on the outside of the landfill berms to reduce the potential for erosion. Other measures include avoiding working with equipment during extreme precipitation events, and if required separating topsoil and subsoil during construction activities. A soil handling protocol will be developed prior to construction activities. To mitigate the impacts of potential soil impact, fuel and hazardous material will be stored in an easily accessible bermed area; hazardous waste and fuel storage areas (including drums) will be inspected daily. Fuel and hazardous material containers will be stored in a manner that allows easy removal in case of a leak or spill. A Spill Contingency BMP will be developed and implemented, and along with spill containment equipment, be available to all workers on-site. Overall, the removal of abandoned site infrastructure and debris, removal or treatment of hazardous and non-hazardous waste, and removal or treatment of contaminated soil will be beneficial to soil resources as sources of impact will be removed. Following implementation of mitigation measures, adverse effects associated with project activities to landforms and soils will be local, short term and insignificant. Additionally, these impacts are not expected to contribute to any adverse cumulative effects.			

7.3.4 Hydrology and Hydrogeology Impacts and Mitigation

Table 17: Assessment of Impacts on Hydrology and Hydrogeology

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations			
Mobilization and transportation of personnel and equipment to sites Trail and camp construction; development of borrow area(s) Camp equipment setup and operation – waste treatment systems and maintenance	Potential impact of surface water and groundwater from spills when refuelling and servicing equipment (on land and ice airstrip)	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies Fuel will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage areas (including drums) will be inspected daily Fuel storage and refueling of equipment will occur at least 100 m from any waterbodies Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Trail and camp construction; development of borrow area(s)	Sedimentation or damage to riparian areas can occur during site preparation activities	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	Development and implementation of a Sediment Control BMP. Placement of temporary (during remediation) and permanent (e.g., coarse materials on landfill berms) erosion control measures (i.e., berms, silt fences) Limit disturbance of any new areas Disturbed areas near adjacent to water bodies will be stabilized Environmental monitoring will occur during construction activities to ensure erosion control measures are implemented and adequate
Camp equipment setup and operation – waste treatment systems and maintenance	The operation of the work camp will include disposal of camp sewage, grey water, garbage and other non-hazardous wastes which could impact water quality	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Camp sewage and grey water will be diverted to sumps that are located a minimum of 100 m from a watercourse or a waterbody Sumps will be closed off at the end of remediation activities All other camp waste will be disposed of off-site on completion of the remediation activities
Remediation			
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site incineration of liquid organic waste On-site handling of hazardous solid waste On-site treatment of aqueous liquid waste Landfill construction Landfarm construction and operation Off-site transportation of hazardous waste	Potential impact of surface water and groundwater from spills when refuelling and servicing equipment Potential surface water and groundwater impact while removing, transporting, burning or incinerating waste materials, and landfill/ landfarm construction	Direction: Negative (beneficial once non-hazardous and hazardous materials and contaminated soil have been treated or removed from site) Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage, hazardous material storage and refueling of equipment will occur at least 100 m from any waterbodies Hazardous waste and fuel storage areas (including drums) will be inspected daily Hazardous materials and contaminated soil will be exposed for as short time as possible All workers will be trained in proper handling of non-hazardous and hazardous materials and contaminated soil Landfill is for non-hazardous, non-leachable, inert waste materials Landfarm will be constructed to ensure leachate will not impact the surrounding environment Installation of monitoring wells for the duration of the landfarm, and for long term monitoring of the landfill

Table 17: Assessment of Impacts on Hydrology and Hydrogeology

Project Activity	Potential Impact	Impact Rating	Mitigation
Structure demolition and debris removal Removal of contaminated soil Construction of landfill Construction and operation of landfarm	Sedimentation or damage to riparian areas can occur during remediation activities that disturb the land surface through erosion and sedimentation	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Moderate Significance: Insignificant	Development and implementation of a Sediment Control BMP. Placement of temporary (during remediation, landfill and landfarm construction) erosion control measures (i.e., berms, silt fences) Limit disturbance of any new areas Disturbed areas near adjacent to water bodies will be stabilized Remedial excavations and landfill/landfarm design should provide for proper drainage and soil stability Environmental monitoring will occur during remediation activities to ensure erosion control measures are implemented and adequate
Closure		Direction: Negative (beneficial once non-hazardous and hazardous materials and contaminated soil have been treated or removed from the sites) Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies Fuel will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage areas (including drums) will be inspected daily Fuel storage and refueling of equipment will occur at least 100 m from any waterbodies Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Demobilization and transportation of personnel and equipment off-site Site recontouring and natural revegetation of disturbances	Potential impact of surface water and groundwater from spills when refuelling and servicing equipment		
Site recontouring and natural revegetation of disturbances	Sedimentation or damage to riparian areas can occur during site recontouring through erosion and sedimentation	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Moderate Significance: Insignificant	Development and implementation of a Sediment Control BMP. Disturbed areas near adjacent to water bodies will be stabilized Recontouring site to match natural terrain after infrastructure, hazardous and non-hazardous waste, and contaminated soil removal
Summary: Adverse potential impacts to aquatic resources and water quality are possible during all phases of the Project due to potential spills and sedimentation events (especially during extreme rainfall events). Silt generated by the use and movement of heavy equipment and remediation equipment across the site, the excavation of contaminated soil, the construction of the landfill and landfarm, the operation of the landfarm, along with fugitive dust emissions may have an effect on surface water quality and could impact local aquatic environments. Surface and groundwater impacts could occur from improperly storing and transporting fuel and hazardous waste; refuelling equipment; improper incinerating and / or burning of hazardous and non-hazardous waste; and from potential landfarm leachate. A number of environmental protection measures will be incorporated to reduce the likelihood of surface and groundwater impacts such as developing and implementing a Spill Contingency BMP which will include measures such as having containment equipment available, storing fuel and hazardous material and refuelling of equipment at least 100 m from any waterbodies and proper treatment of waste water. Construction design of the landfarm must ensure that leaching to surrounding surface water or groundwater will not occur. The landfill will only accept non-hazardous, inert, non-leachable waste. Erosion and sediment release can occur at any time but especially at the beginning of construction (therefore sedimentation control barriers should be placed as soon as possible), and during precipitation events or during snowmelt. The highest potential for sedimentation occurs during clearing, grading and during activities in or near wetlands and watercourses. Specific mitigation measures for the protection of the topsoil resource and water quality from sedimentation will be in the Sedimentation Control BMP and will include limiting the disturbance of any new areas and placing temporary sedimentation control barriers. Overall the remediation activities are expected to have positive impact on the hydrology and hydrogeology with removal of hazardous and non-hazardous materials, and contaminated soil. Following implementation of mitigation measures, adverse effects associated with project activities to the hydrology and hydrogeology of the project areas will be local, short-term and insignificant. These impacts are not expected to contribute to any adverse cumulative effects.			

7.3.5 Vegetation Impacts and Mitigation

Table 18: Assessment of Impacts on Vegetation

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods
Trail and camp construction; development of borrow area(s)	Dust from development of borrow area(s), upgrading trails, and camp construction could impact vegetation		
Mobilization and transportation of personnel and equipment to sites Trail and camp construction; development of borrow area(s) Camp equipment setup and operation – waste treatment systems and maintenance	Potential impact to vegetation from spills when refuelling and servicing equipment	Direction: Negative Scope: Local Duration: Medium-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Fuel will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage areas (including drums) will be inspected daily Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Trail and camp construction; development of borrow area(s)	Loss or alteration of vegetative cover can occur when completing site preparation and camp construction	Direction: Negative Scope: Local Duration: Long-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Use existing roads, pathways and previously disturbed areas to the fullest extent possible Ensure natural drainages are recreated to limit water ponding and foster revegetation Use equipment with low pressure tires Storage of non-contaminated surface soil for use in revegetation
Remediation		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods
Structure demolition and debris removal Removal of contaminated soil Construction of landfill Construction and operation of landfarm	Dust from remediation activities could impact vegetation		
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site incineration of liquid organic waste On-site handling of hazardous solid waste On-site treatment of aqueous liquid waste Removal of contaminated soil Landfill construction Landfarm construction and operation Off-site transportation of hazardous waste	Potential impact to vegetation from spills when refuelling and servicing equipment Potential vegetation impact from wastes while moving, transporting, burning or incinerating waste materials	Direction: Negative (beneficial once non-hazardous, but especially hazardous materials and contaminated soil have been treated or removed from the sites) Scope: Local Duration: Medium-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Hazardous waste and fuel storage areas (including drums) will be inspected daily All workers will be trained in proper handling of non-hazardous and hazardous materials and contaminated soil Hazardous materials and contaminated soil will be exposed for as short time as possible Landfarm will be constructed to ensure leachate will not impact the surrounding environment

Table 18: Assessment of Impacts on Vegetation

Project Activity	Potential Impact	Impact Rating	Mitigation
Structure demolition and debris removal Removal of contaminated soil Construction of landfill Construction and operation of landfarm	Physical disturbance, loss or alteration of vegetative cover can occur when completing remediation activities	Direction: Negative Scope: Local Duration: Long-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Use existing roads, pathways and previously disturbed areas to the fullest extent possible Ensure natural drainages are recreated to limit water ponding and foster revegetation Limit creation of new disturbed areas while completing remediation Use equipment with low pressure tires
Closure		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods
Site recontouring and natural revegetation of disturbances	Dust from recontouring could impact vegetation		
Site recontouring and natural revegetation of disturbances Demobilization and transportation of personnel and equipment off-site	Potential impact to vegetation from spills when refuelling and servicing equipment	Direction: Negative Scope: Local Duration: Medium-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Fuel will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage areas (including drums) will be inspected daily Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Site recontouring and natural revegetation of disturbances	Loss or alteration of vegetative cover can occur when completing recontouring activities	Direction: Negative Scope: Local Duration: Long-term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Use existing roads, pathways and previously disturbed areas to the fullest extent possible Ensure natural drainages are recreated to limit water ponding and foster revegetation Land surface will be recontoured in to match pre-disturbance conditions to the fullest extent possible but with the minimal equipment use to foster natural revegetation Utilize stockpiled surface soil for revegetation Use equipment with low pressure tires
Summary: Adverse potential impacts to vegetation are associated with all phases of the Project. The movement of heavy equipment, transportation equipment and remediation equipment across the site, upgrading trails, camp construction, borrow pit development, construction and operation of the landfill/landfarm, removing waste and debris, and recontouring will result in fugitive dust emissions. Dust suppression and control measures will be implemented, thus dust is not expected to have a significant effect on adjacent vegetation. Remediation will significantly remove contaminants in local soils and remove the long-term potential for vegetation damage. Longer term impacts on vegetation are expected from disturbance during infrastructure and debris removal; hazardous and non-hazardous waste removal, storage and transport; and potential landfarm construction (including stockpiles); upgrading trails and the airstrip; potential borrow pit development; and camp construction. To minimize the potential for direct loss and / or alteration of vegetation, remediation activities will be limited to the footprint of previously disturbed areas as much as possible. Extreme windy conditions may exacerbate fugitive dust, extreme rainfall may exacerbate erosion, and accidental hydrocarbon spills have the potential to adversely affect vegetation. With appropriate mitigation, such as proper fuel storage, erosion control and dust control measures the probability of significant adverse effects is anticipated to be low. Residual effects on vegetation may result from some site preparation and remedial activities until natural revegetation occurs. These impacts are not expected to contribute to any adverse cumulative effects.			

7.3.6 Wildlife Impacts and Mitigation

Table 19: Assessment of Impacts on Terrestrial Wildlife

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations			
Mobilization and transportation of personnel and equipment to sites Trail and camp construction; development of borrow area(s) Camp equipment setup and operation – waste treatment systems and maintenance	Direct mortality, sensory impairment, disruption of movement patterns and indirect mortality produced by wildlife/human interactions potentially caused during transportation of materials and site preparation, such as upgrading trails, ice airstrip construction and camp operations	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Implement Wildlife BMP that includes noise abatement measures Conduct pre-disturbance nest surveys; avoid active nesting structures when present; if habituated by a bird species of special concern remove structure when nesting complete Inspect all structures and debris for wildlife use prior to remediation Suspend activities during the caribou calving season (May-July) if caribou cows are present Suspend activities if large numbers (>100) caribou are migrating through or within 5 km of the site Aircraft flights will maintain a minimum altitude of 610 m above ground level except for takeoff and landing (AMEC, 2008) Containers for domestic waste will be located in enclosed bear-proof structures Garbage will be removed or incinerated from sites daily Bear safety awareness training will be provided as well as information on other wildlife encounters All personnel will be familiar with current 'Safety in Bear/Polar Bear Country' literature produced by Nunavut Department of Environment Bear deterrents will be kept at all sites The use of electric fencing will be considered for the camp
Mobilization and transportation of personnel and equipment to sites Trail and camp construction; development of borrow area(s) Camp equipment setup and operation – waste treatment systems and maintenance	Potential impact to wildlife habitat from spills when refuelling and servicing camp, construction, and transportation equipment	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage areas (including drums) will be inspected daily Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Remediation			
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site incineration of liquid organic waste On-site compaction of hazardous solid waste On-site treatment of aqueous liquid waste Construction of landfill Construction and operation of landfarm Off-site transportation of hazardous waste	Direct mortality, sensory impairment, disruption of movement patterns and indirect mortality produced by wildlife/human interactions potentially caused by remediation activities like removing debris and demolishing infrastructure using heavy equipment	Direction: Negative (beneficial once non-hazardous and hazardous materials and contaminated soil have been treated or removed) Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Implement Wildlife BMP that includes noise abatement measures Conduct pre-disturbance nest surveys; avoid active nesting structures if habituated by a bird species of special concern, remove structure when nesting completed Inspect all structures and debris for wildlife use prior to remediation Suspend activities during the caribou calving season (May-July) if caribou cows are present Suspend activities if large numbers (>100) caribou are migrating through or within 5 km of the site Restrict wildlife access to disturbed areas Aircraft flights will maintain a minimum altitude of 610 m above ground level except for takeoff and landing (AMEC, 2008) Bear safety awareness training will be provided as well as information on other wildlife encounters All personnel will be familiar with current 'Safety in Bear/Polar Bear Country' literature produced by Nunavut Department of Environment Bear deterrents will be kept at all sites

Table 19: Assessment of Impacts on Terrestrial Wildlife

Project Activity	Potential Impact	Impact Rating	Mitigation
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site incineration of liquid organic waste On-site compaction of hazardous solid waste On-site treatment of aqueous liquid waste Construction of landfill Landfarm construction and operation Off-site transportation of hazardous waste	Potential impact of wildlife from spills when refuelling and servicing remediation equipment	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel and hazardous material will be stored in and easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Hazardous waste and fuel storage areas (including drums) will be inspected daily All workers will be trained in proper handling of non-hazardous and hazardous materials and contaminated soil Hazardous materials and contaminated soil will be exposed for as short time as possible
Closure			
Site recontouring and natural revegetation of disturbances Demobilization and transportation of personnel and equipment off-site	Direct mortality, sensory impairment, disruption of movement patterns and indirect mortality produced by wildlife/human interactions potentially caused during transportation of materials by aircraft and construction equipment	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Implement Wildlife BMP that includes noise abatement measures Suspend activities if large numbers (>100) caribou are migrating through or within 5 km of the site Aircraft flights will maintain a minimum altitude of 610 m above ground level except for takeoff and landing (AMEC, 2008) Bear safety awareness training will be provided as will information on other wildlife encounters All personnel will be familiar with current 'Safety in Bear/Polar Bear Country' literature produced by Nunavut Department of Environment Bear deterrents will be kept at all sites
Site recontouring and natural revegetation of disturbances Demobilization and transportation of personnel and equipment off-site	Potential impact of wildlife habitat from spills from when refuelling and servicing construction and transportation equipment	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage areas (including drums) will be inspected daily Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)

Summary:

Potential adverse impacts to terrestrial wildlife are associated with all phases of the Project. Adverse effects may include sensory disturbance, disruption of wildlife movement, direct and indirect wildlife mortality as a result of project activities and wildlife/human interactions. Noise from transportation equipment, heavy equipment and remediation equipment and human activity will likely result in the temporary avoidance of the area by most wildlife, and may result in changes in local movement patterns of wildlife. The impacts from noise are considered to be of negligible-low magnitude based on the potential species present and number of individuals. Maintaining equipment in good working condition, turning equipment off when not in use, and use of mufflers will reduce the effects of noise on wildlife.

Nest sites and / or burrows maybe disturbed during the demolishment of infrastructure and the removal of non-hazardous waste, hazardous waste (including containers) and debris. Infrastructure should be checked for all wildlife species but especially species of concern. In the event that remediation activities cannot be completed without disturbing/destroying nests or burrows associated with migratory birds or species of special concern a wildlife officer from the Government of Nunavut should be contacted for additional guidance and/or to obtain a permit authorizing the removal of nests or disruption of habitat. Small mammals with ground colonies should also be avoided, where possible.

The potential for wildlife and human interactions during the Project is possible, especially at the camp location; however, it is expected that such encounters will be infrequent and insignificant. Longer term contact is possible with the landfarm. Bear, wolverine, foxes, wolves, and ravens may also be attracted to the site. Proper containment and disposal of wastes/garbage, such as removal or incineration at the end of every day, and training of workers in wildlife interactions and bear safety will reduce the probability of adverse wildlife encounters.

Leaks or spills of stored hazardous waste or fuel are possible and could impact wildlife. Previous measures outlined for preventing or dealing with spills and leaks will be implemented. The development and implementation of a Wildlife Management BMP will assist in minimizing project impacts on wildlife and could include measures such as aircraft maintaining minimum altitudes and providing bear proof structures for containers for domestic waste. Overall, the removal of abandoned site infrastructure and remediation of contaminated soils will improve habitat quality and thus, have long-term benefits for wildlife. Following implementation of mitigation measures, adverse effects associated with project activities to wildlife will be local, short-term, and insignificant. These impacts are not expected to contribute to any adverse cumulative effects.

Table 20: Assessment of Impacts on Aquatic Wildlife

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage will occur at least 100 m from any waterbodies Fuel storage areas (including drums) will be inspected daily Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Mobilization and transportation of personnel and equipment to sites	Potential impact to aquatic resources from spills when refuelling and servicing ice airstrip and airplanes		
Remediation		Direction: Negative (beneficial once non-hazardous and hazardous materials and contaminated soil have been treated or removed) Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage, hazardous material storage and refueling of equipment will occur at least 100 m from any waterbodies (with the exception on the ice airstrip) Hazardous waste and fuel storage areas (including drums) will be inspected daily All workers will be trained in proper handling of non-hazardous and hazardous materials and contaminated soil Landfill is for non-hazardous, non-leachable, inert waste materials Landfarm will be constructed to ensure leachate will not impact the surrounding environment Installation of monitoring wells for the duration of the landfarm, and for long term monitoring of the landfill to monitor groundwater
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site incineration of liquid organic waste On-site compaction of hazardous solid waste On-site treatment of aqueous liquid waste Removal of contaminated soils Construction of landfill Construction and operation of landfarm Off-site transportation of hazardous waste	Potential impact of aquatic resources from spills when refuelling and servicing remediation equipment Spills associated with handling and loading of hazardous materials while on ice airstrip		
Closure		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	Development and implementation of a Sediment Control BMP Disturbed areas near adjacent to water bodies will be stabilized Recontouring site to match natural terrain after infrastructure, hazardous and non-hazardous waste, and contaminated soil removal
Demobilization and transportation of personnel and equipment off-site	Potential impact of aquatic resources from spills from when refuelling and servicing construction and transportation equipment		
Summary: The greatest risk to aquatic resources is the accidental release shipped hazardous materials and/or a spill of fuel during refuelling, which could directly impact aquatic wildlife or aquatic wildlife habitat. A Spill Contingency BMP will include measures for dealing with a spill on water. The Spill Contingency BMP will minimize the potential of an accidental release of contaminants into the aquatic environment. Generally, the impact on aquatic resources is expected to be neutral with no adverse cumulative effects.			

7.4 Cultural Features and Special Places Impacts and Mitigation

During the AIA completed for Ennadai Lake, nine previously unrecorded archaeological sites and three land use sites were identified (Golder 2012). Four of these were isolated find sites that are likely not in-situ due to the degree of land disturbance. The fifth site consists of four stone features, hunting blind, a possible cache and grave. The grave may be from the indigenous historical period. The sixth site are stone markers associated with a tent outline. The seventh site is likely an indigenous historic camp site. The eight site is two wooden stakes partially buried in the ground. The ninth site consists of two small stones situated on top of a large erratic.

The three land use sites represent evidence of human, typically by not exclusively Inuit use of the land within the past 50 years. All three may have been used as snow trail markers. Should development impact these sites, the community should be consulted regarding the significance of the markers.

Current mobilization, remediation, and demobilization activities planned for the project areas will not impact any cultural features or special places identified in the AIA. To protect the cultural features at Ennadai Lake, locations will be identified and their boundaries, with a buffer, will be visibly marked while remediation activities are taking place to ensure they are not affected. Location and boundary markers will be removed once remediation activities are completed.

Prior to remediation, community members that have a history at Ennadai Lake will be taken to site to field confirm additional culturally significant locations identified during the community meeting (Figure 9). If any new cultural features are discovered, especially in areas slated for remediation, their location and boundary, including a buffer, will be marked and the area avoided. The discovery will be reported to the Archaeology Division of the Department of Culture, Language Elders and Youth of the Government of Nunavut. If a cultural feature or features need to be impacted to complete the remediation, no disturbance of the feature will occur until advice from the Archaeology Division is received. This may require hiring an outside consultant to complete additional assessment work and make recommendations for the treatment of the cultural feature or features. Impacts to the current cultural features/special places or any discovery of any cultural features/special places can be mitigated, and no adverse cumulative effects are expected.

7.5 Socio-Economic Impacts and Mitigation

7.5.1 Traditional Land Use

Ennadai Lake and the surrounding area are used by Inuit for hunting and fishing. The buildings on site are used by local hunters; this is the only current land use at the Site.

The mobilization, remediation, and demobilization activities will only affect traditional land use in the project area during the project work. A schedule of activities is not currently known but will be provided to the Hunters and Trappers Organization (HTO) and the Kivalliq Inuit Association (KIA). The landfarm will require regular operation and maintenance; the operation and maintenance schedule will be provided to both organizations. Impacts to the traditional land uses in the project area can be mitigated and positive residual impacts are expected. Positive residual impacts are expected with the removal of non-hazardous and hazardous waste and clean-up of contaminated soil at the sites, which will improve wildlife habitat and therefore potentially increase traditional land use activities.

Community members that utilize the site expressed concern that the buildings would be removed. It was recommended that they communicate with the HTO and that the HTO contact AANDC regarding construction of a new cabin for HTO use.

7.5.2 Job Opportunities and Current Employers

The Project will result in positive socio-economic benefits to the community of Arviat. The NCLA (Nunavut Tunngavik Inc. 1993) serves as a guide for the mitigation of socio-economic impacts, for example, it provides for the creation of procurement policies by federal and territorial governments for Inuit-owned firms. An Aboriginal Opportunities Considerations (AOC) section will be included in the contract for the work. The AOC will guarantee minimum levels of Inuit employment and Inuit sub-contracting. Project procurement proposals will be evaluated based on criteria such as socio-economic benefit, technical content and cost. Individuals and businesses will be able to benefit through employment and procurement opportunities and related economic benefits. Employment opportunities could provide positive economic benefit through skills acquisition and work experience. Some of the possible employment opportunities could include:

- Camp staff;
- Equipment operators;
- Mechanics;
- Surveyors;
- Trades;
- Labourers;
- Wildlife monitors;
- Interpreters;
- Health and safety officer; and
- Sampling scientist.

During the community meeting, a number of individuals indicated that they had hazardous material handling training, which will be needed for the remedial activities at Ennadai Lake. No negative impacts to job opportunities and current employers are expected, and therefore, no residual impacts are expected.

7.5.3 Community Impacts

It is expected that much of the labour force for this work would come from Arviat or other local communities. This positive impact would be of short duration. Specific experience gained during the completion of the work would have positive residual impacts on the community. While many of the staff required to complete the remedial activities at Ennadai Lake may be from Arviat, a number of individuals from outside the community will likely be needed for the duration of the remedial activities. This influx of people is expected to be small and is not expected to impact the community as most staff will be staying at the camp that will be set up at Site.

7.6 Aesthetic Impacts

The remediation activities will be beneficial to the aesthetics of areas as buildings will be demolished and all debris will be removed. A short-term aesthetic impact will be the construction of the landfarm, but once soil in the landfarm meets regulatory criteria this area will be recontoured. The landfill will have a long-term aesthetic impact, however, it will be integrated into the existing landscape as much as possible. Residual impacts to aesthetic impacts are considered low.

7.7 Residual Impacts

Residual impacts are defined as impacts that remain after mitigation has been applied (CEAA 1999). The remediation of the Ennadai Lake site is not expected to result in any negative residual impacts, and the remediation of the sites will have a positive effect on the environment.

8.0 CUMULATIVE ENVIRONMENTAL IMPACTS

Cumulative environmental impacts occur when impacts, in particular residual impacts, from two or more concurrent project activities combine either additively or synergistically to further exacerbate the impact on a VEC or VSEC. CEAA (1999) defines cumulative impacts as "…changes to the environment that are caused by an action in combination with other past, present, and future human actions." While the NIRB (2007b) defines cumulative impacts as "…the accumulation of changes to the environment caused by human activities (e.g., past, existing and proposed activities, including activities associated with the Project under assessment). These changes occur over space and time and can be brought about by environmental effects that are additive or interactive. For example, hunting, oil spills, loss of habitat, and commercial fishing pressure on prey species, can affect marine mammals in the Arctic".

A cumulative effects assessment includes activities that have already taken place, or are likely to take place, in the foreseeable future. The foreseeable future usually describes projects that are under regulatory review or are proposed for regulatory review (CEAA 1999). CEAA defines the reasonably foreseeable as "The [project] may proceed, but there is some uncertainty about this conclusion."

The amount of development in this part of the Kivalliq region of Nunavut is minimal. There is another remediation site at Otter & Montgomery Lakes, however remediation has not started at this site.

The remediation program at the Ennadai Lake site will initially disturb the existing terrain and environmental conditions of the study area. However, given the limited environmental footprint of the site and the removal, treatment, containment and/or disposal of contaminated soil and hazardous and non-hazardous waste, it is expected that the overall impact of the remediation project will be positive. In the long term, the remediation project will facilitates the return of soil, water, and vegetation and wildlife habitat to natural conditions.

Given that the Project will have a positive impact on the environment and only has low residual impacts to aesthetic values, the remediation of the three sites will not add to the cumulative environmental effects of other land use activities in the local area.

9.0 MONITORING PROGRAM

Project monitoring has two objectives:

- Monitor implementation of the Project to confirm compliance with the remediation objectives and accuracy of impact predictions; and
- Monitor the long-term success of the Project; measuring environmental conditions against triggers and thresholds that would initiate adaptive management and contingency plans.

The NIRB (2007b) defines monitoring as the systematic observation or tracking of an activity to determine whether it is proceeding or functioning as expected. Through monitoring, the accuracy of environmental impact predictions is assessed. Two different monitoring activities that will be incorporated into this Project are identified below:

- Effects monitoring is the process of measuring and interpreting changes to environmental and socio-economic parameters to identify relevant project effects, and may involve assessing the accuracy of impact predictions contained in the Project impact statements.
- Compliance monitoring is the process of determining whether and to what extent the activity is carried out according to regulatory requirements, including terms and conditions contained in NIRB project certificates.

Based on the NIRB definition and the monitoring objectives, compliance monitoring will be completed for the duration of the remedial activities. This will include such actions as adherence to safety standards, sampling protocols, and reporting schedules. A monitoring plan will be completed prior to the work being conducted that will outline requirements of compliance monitoring based on regulatory and industry standards. Both the landfarm and the landfill will require groundwater monitoring; the landfarm while it is operational, and the landfill monitoring is expected to last for 25 years.

10.0 KNOWLEDGE DEFICIENCIES

Information on the environmental conditions at the site was collected during previous field studies. While this information is adequate for the scope of this work, there are some knowledge deficiencies with respect to remediation work in the arctic that are not specific to this project.

The International Panel on Climate Change (IPCC) reports that average global temperatures could increase by up to 6°C by the end of the century (IPCC 2007), and this increase could result in an increased frequency of extreme weather events including increased precipitation. Much uncertainty remains regarding climate change predictions and how these changes will affect Arctic regions. However, likely alterations include changes in the range and depth of permafrost occurrences, all of which have a bearing on impact predictions related to soil stability, erosion control, and drainage. The landfill is not expected to influence permafrost, nor is it expected that minor change in permafrost conditions would impact the long-term stability of the landfill. However, it is not known how significant changes in permafrost would impact landfill stability.

The BQCMB (2013) indicates that the migration patterns of the Beverly-Qamanirjuaq caribou herd are inconsistent and unpredictable. While on completing the fieldwork on the Phase III ESA, we saw numerous

caribou move through the site. It is unknown if or when caribou will be present when remediation is ongoing or how they may affect the project work.

11.0 PUBLIC INPUT AND CONCERNS

To collect public input and to receive public concerns regarding the Project, a community meeting was held in Arviat on December 11, 2012, to discuss the draft RAP. Approximately 60 members of the local community attended the meeting. RAP information was also provided to members of the Kugluktuk Hunters and Trappers Organization and the Kivalliq Inuit Association. The primary concerns of the community were impacts of the Project on culturally sensitive lands, traditional land use and employment opportunities directly working on the Project, or for other employers in Arviat.

12.0 CONCLUSION

The mitigation strategies outlined for the remediation of the Ennadai Lake site are predicted to result in no negative residual impacts (with the exception of aesthetic value), and overall, the remediation of the Site will have a positive effect on the environment by removing contaminated soil and hazardous material from the Site. Cumulative environmental impacts occur when impacts, in particular residual impacts, from two or more concurrent project activities combine either additively or synergistically to further exacerbate the impact on a VEC or VSEC. Given that the project will have a positive impact on the environment and has little to no residual impacts, the remediation of the site will not add to the cumulative environmental effects of other land use activities in the local area.

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14.0 CLOSURE

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

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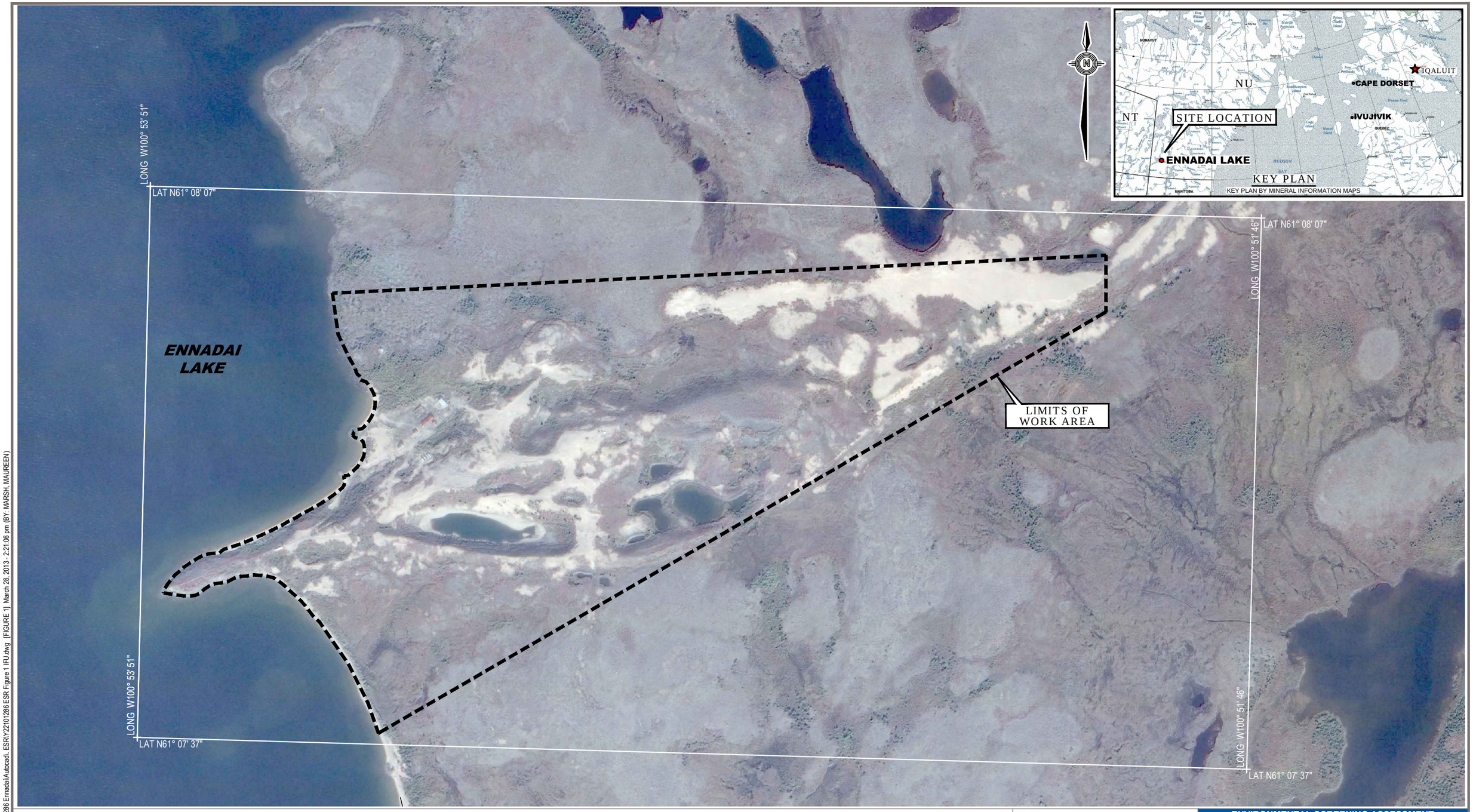
THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
PERMIT NUMBER
P 018
EBA ENGINEERING CONSULTANTS LTD.
April 3, 2013.

FIGURES



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ISSUED FOR USE

0 200 m

Approximate Scale 1: 6 000

CLIENT

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

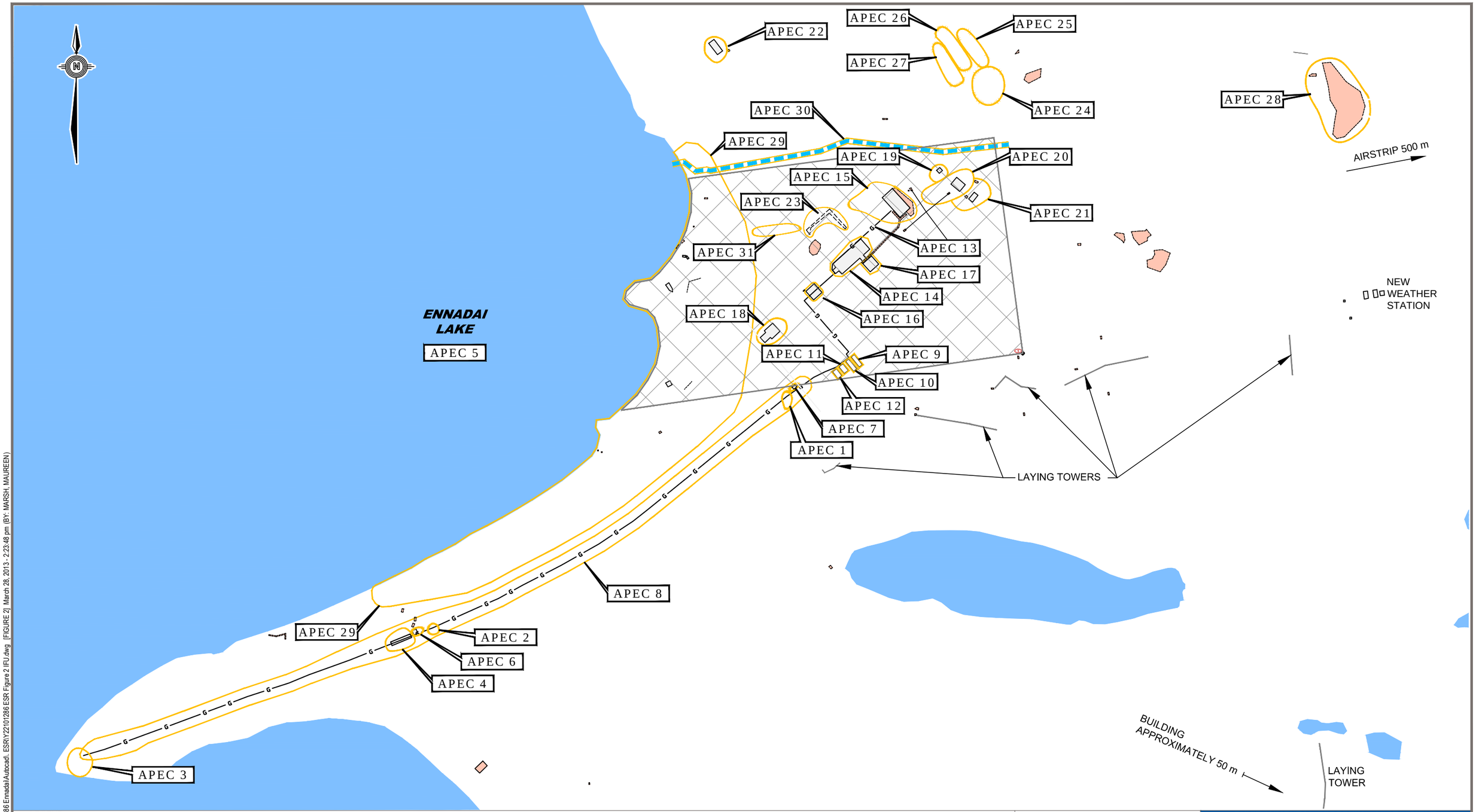
A TETRA TECH COMPANY

ENVIRONMENTAL SCREENING ASSESSMENT
FORMER WEATHER STATION
ENNADAI LAKE, NU

OVERALL SITE PLAN

PROJECT NO.	DWN	CKD	REV
Y22101286	MM	KO	0
OFFICE: EDM	DATE: March 2013		

Figure 1



LEGEND:

- INUIT OWNED LAND
- APEC - AREA OF POTENTIAL ENVIRONMENTAL CONCERN
- APPROXIMATE LOCATION OF DRAINAGE CHANNEL
- BUILDINGS
- DEBRIS
- WATER

ISSUED FOR USE

0 100 m

Scale: 1: 2 000

CLIENT

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ENVIRONMENTAL SCREENING ASSESSMENT
FORMER WEATHER STATION
ENNADAI LAKE, NU

OVERVIEW OF SITE FEATURES

eba A TETRA TECH COMPANY

PROJECT NO.	DWN	CKD	REV
Y22101286	MM	KO	0

OFFICE	DATE
EDM	March 2013

Figure 2

Q:\Edmonton\Drafting\PROJECTS\Y22\Y22101286 Ennadai\Autocad\ ESR\Y22101286 ESR Figure 2 IFU.dwg [FIGURE 2] March 28, 2013 - 2:23:48 pm (BY: MARSH, MAUREEN)

LONG W100° 53' 51"

LAT N61° 08' 07"

LONG W100° 51' 46"

LAT N61° 08' 07"

POTENTIAL CAMP 1 C1

AIRSTRIP

ENNADAI LAKE

FLOAT PLANE ACCESS USED AUGUST 2012

ENVIRONMENT CANADA WEATHER STATION (BOUNDARIES ARE APPROXIMATE)

C2 POTENTIAL CAMP 2

LONG W100° 53' 51"

LAT N61° 07' 37"

LONG W100° 51' 46"

LAT N61° 07' 37"

LEGEND:

- INUIT OWNED LAND
- ORGANIC TERRAIN - AVOID DISTURBANCE
- C1 - POTENTIAL CONSTRUCTION CAMP LOCATION
- ★ - SPRING
- ATV TRAIL
- POTENTIAL NEW ROAD ROUTE
- FLOAT PLANE ACCESS
- ENVIRONMENTAL RESTRICTED AREA
- DRAINAGE CHANNEL

ISSUED FOR USE

0 200 m

Approximate Scale 1: 6 000

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ENVIRONMENTAL SCREENING ASSESSMENT
FORMER WEATHER STATION
ENNADAI LAKE, NU

SITE PLAN SHOWING
SITE ACCESS

A TETRA TECH COMPANY

PROJECT NO.	DWN	CKD	REV
Y22101286	MM	KO	0

OFFICE: EDM

DATE: March 2013

Figure 3

Q:\Edmonton\Drafting\PROJECTS\Y2211\Y22101286 Ennadai\Autocad\ ESRI\Y22101286 ESR Figure 3 IFU.dwg [FIGURE 3] March 28, 2013 - 2:27:27 pm (BY: MARSH, MAUREEN)

LONG W100° 53' 51"

LAT N61° 08' 07"

LAT N61° 08' 07"

LONG W100° 51' 46"

LONG W100° 53' 51"

LAT N61° 07' 37"

LONG W100° 51' 46"

LAT N61° 07' 37"

ENNADAI LAKE

B8

B4

LANDFILL

LANDFARM

09

B1

08

07

06

01

02

03

04

05

B6

B5

ENVIRONMENT CANADA WEATHER STATION (BOUNDARIES ARE APPROXIMATE)

10

11

12

13

14

15

16

17

18

21

20

B2

19

B7

LEGEND:

- INUIT OWNED LAND
- ELC SAMPLE LOCATION
- DRAINAGE CHANNEL
- BORROW SOURCE
- SPRING
- ENVIRONMENTAL RESTRICTED AREA
- PROPOPSED LOCATION FOR LANDFILL AND LANDFARM

ISSUED FOR USE

0 200 m

Approximate Scale 1: 6 000

CLIENT

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

ENVIRONMENTAL SCREENING ASSESSMENT FORMER WEATHER STATION ENNADAI LAKE, NU

SITE PLAN SHOWING LANDFILL, LANDFARM, BORROW AREAS AND ELC SAMPLE LOCATIONS

PROJECT NO.	DWN	CKD	REV
Y22101286	MM	KO	0

OFFICE	DATE
EDM	March 2013

Figure 4

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Q:\Edmonton\Drafting\PROJECTS\Y2221\Y22101286 Ennadai\Autocad\ ESRI\Y22101286 ESR Figure 4 IFU.dwg [FIGURE 4] March 28, 2013 - 2:28:55 pm (BY: MARSH, MAUREEN)

ECOSYSTEM UNITS:

SS	- Saxifrage - Moss Campion	BC	- Scrub birch - Bluejoint Shrub
BE	- Scrub birch - Crowberry	SL	- Spruce - Lichen
BL	- Scrub birch - Labrador Tea	SA	- Spruce - Alder
BR	- Scrub birch - Cloudberry Low Shrub Bog	SR	- Nagoonberry Riparian Shrub
		b	- bouldery

ISSUED FOR USE

0 100 m

Scale: 1: 2 000

CLIENT

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A TETRA TECH COMPANY

ENVIRONMENTAL SCREENING ASSESSMENT
FORMER WEATHER STATION
ENNADAI LAKE, NU

ECOSYSTEM UNITS SURROUNDING SITE

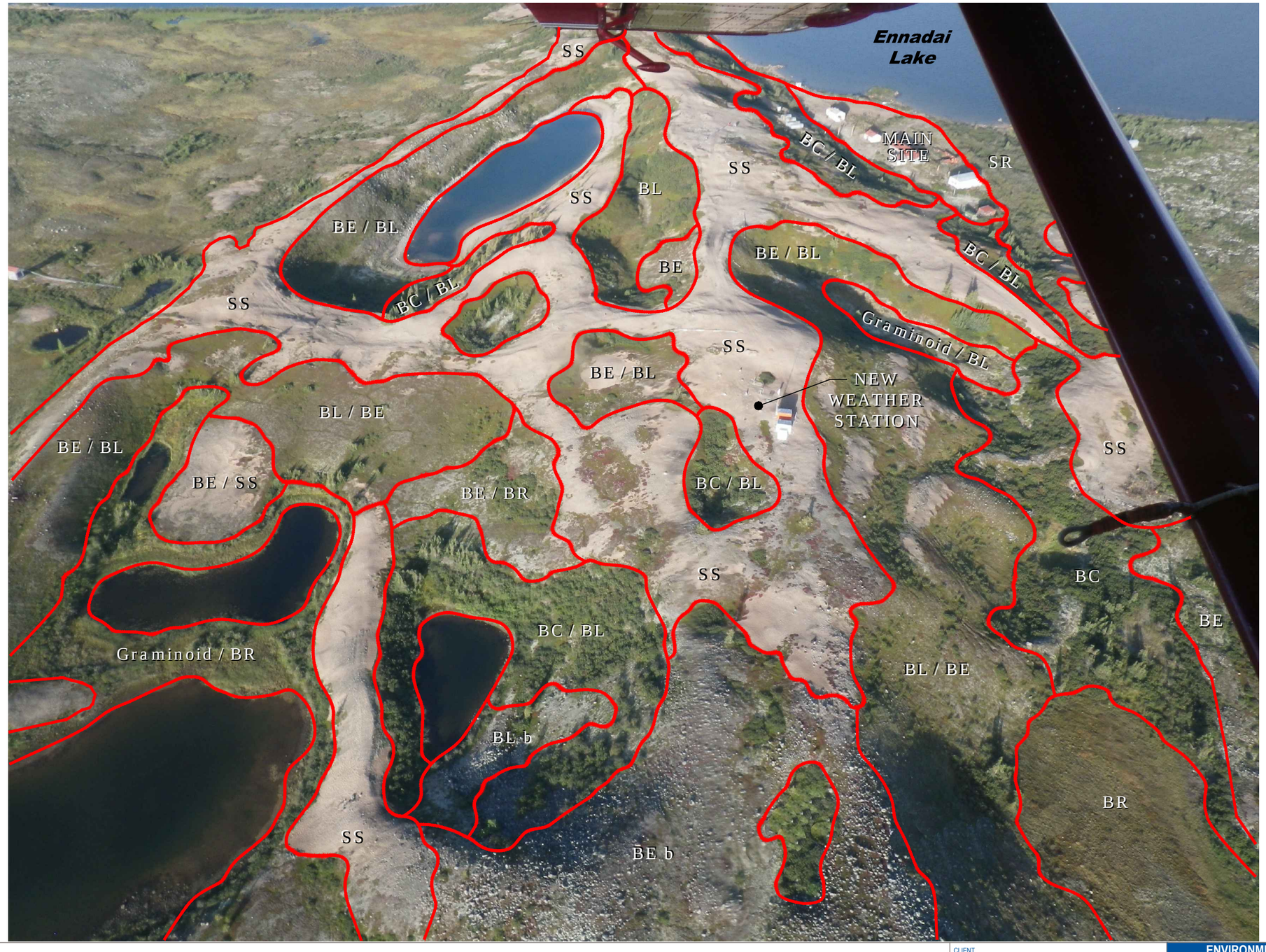
PROJECT NO.	DWN	CKD	REV
Y22101286	MM	KO	0

OFFICE: EDM

DATE: March 2013

Figure 5

Q:\Edmonton\Drafting\PROJECTS\Y2211\Y22101286 Ennadai\Autocad\ ESR\Y22101286 ESR Figure 5, 6, 7 IFU.dwg [FIGURE 5] March 28, 2013 - 2:32:31 pm (BY: MARSH, MAUREEN)



ECOSYSTEM UNITS:

SS	- Saxifrage - Moss Campion	BC	- Scrub birch - Bluejoint Shrub
BE	- Scrub birch - Crowberry	SL	- Spruce - Lichen
BL	- Scrub birch - Labrador Tea	SA	- Spruce - Alder
BR	- Scrub birch - Cloudberry Low Shrub Bog	SR	- Nagoonberry Riparian Shrub
		b	- bouldery

ISSUED FOR USE

0 100 m

Scale: 1: 2 000

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

ENVIRONMENTAL SCREENING ASSESSMENT
FORMER WEATHER STATION
ENNADAI LAKE, NU

ECOSYSTEM UNITS SOUTHEAST OF SITE

A TETRA TECH COMPANY

PROJECT NO.	DWN	CKD	REV
Y22101286	MM	KO	0
OFFICE: EDM	DATE: March 2013		

Figure 6

ECOSYSTEM UNITS:

SS - Saxifrage - Moss Campion

BE - Scrub birch - Crowberry

BL - Scrub birch - Labrador Tea

BR - Scrub birch - Cloudberry Low Shrub Bog

BC - Scrub birch - Bluejoint Shrub

SL - Spruce - Lichen

SA - Spruce - Alder

SR - Nagoonberry Riparian Shrub

b - bouldery

ISSUED FOR USE

0 100 m

Scale: 1: 2 000

CLIENT

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

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ENVIRONMENTAL SCREENING ASSESSMENT FORMER WEATHER STATION ENNADAI LAKE, NU

ECOSYSTEM UNITS EAST AT AIRSTRIP

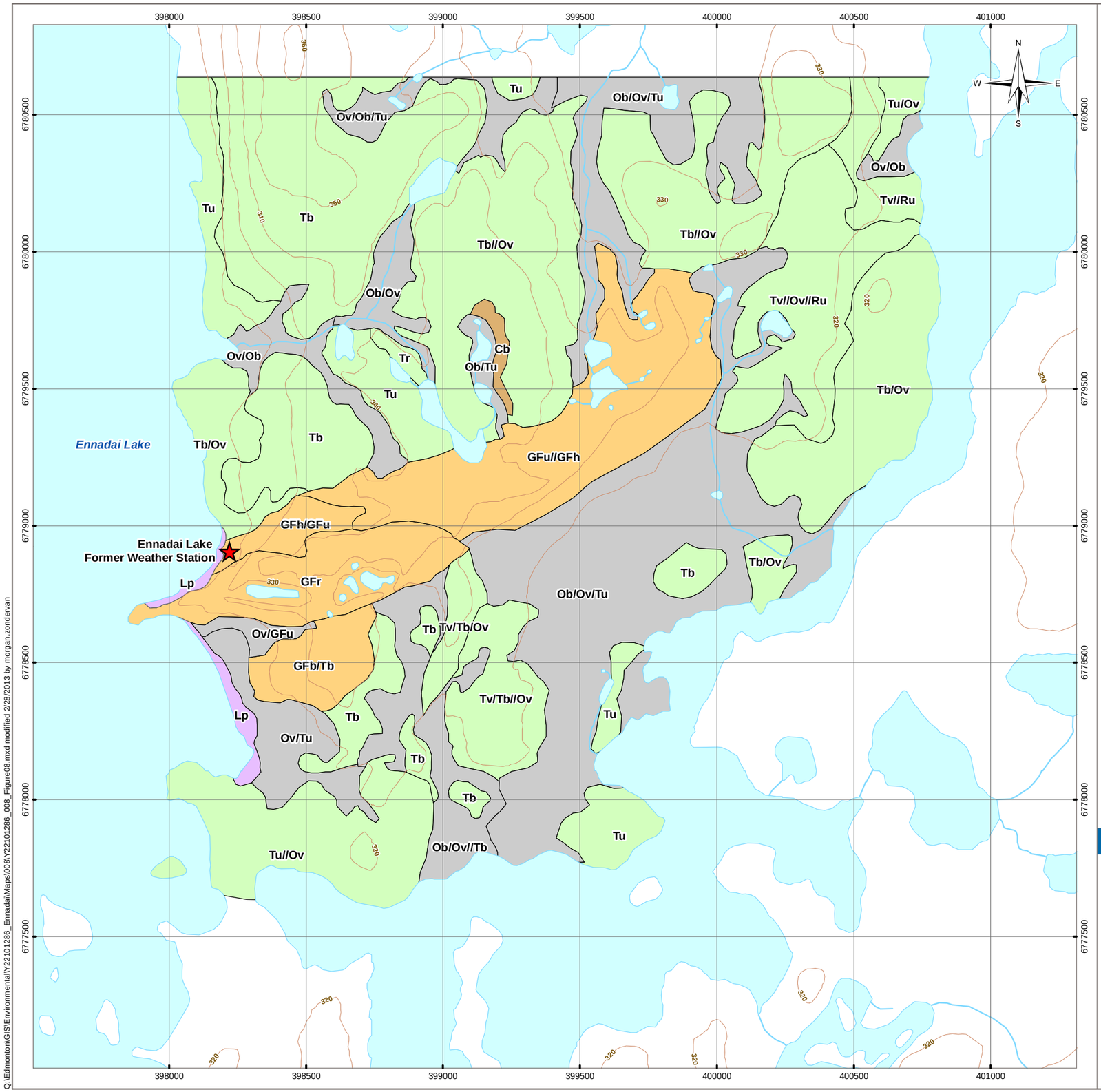
PROJECT NO.	DWN	CKD	REV
Y22101286	MM	KO	0

OFFICE: EDM

DATE: March 2013

Figure 7

Q:\Edmonton\Drafting\PROJECTS\Y22\Y22101286 Ennadai\Autocad_ESRI\Y22101286 ESR Figure 5, 6, 7 IFU.dwg [FIGURE 7] March 28, 2013 - 2:31:08 pm (BY: MARSH, MAUREEN)



SURFICIAL MATERIAL

O **Organic Deposit:** woody, fibrous peat, present in wetlands(bogs, fens and marshes) and organic mud; underlain by poorly drained sediment or bedrock.

C **Colluvial Deposit:** poorly sorted, commonly poorly compacted material, deposited by gravity-induced mass movement and permafrost thaw.

GF **Glaciofluvial Deposit:** well to poorly sorted sediment deposited by glacial meltwater rivers that flowed within glaciers (eskers). Commonly consists of sand and pebble to boulder gravel that is subangular to rounded.

T **Till:** very poorly sorted sediment (diamicton) deposited directly by ice by lodgment, melt out, or post-melt out gravity flow; generally matrix-supported and compact. Generally found as blankets and veneers over bedrock, but may also form undulating terrain.

L **Lacustrine Deposit:** Sandy littoral bars and beach deposits formed by currents and wave action.

SURFICIAL EXPRESSION

v **Veneer:** deposit less than 1 m thick; minor irregularities of the underlying unit (generally bedrock) are masked but the topographic form is obvious

b **Blanket:** deposit greater than 1 m thick; minor irregularities of the underlying unit (generally bedrock) are masked but the topographic form is still evident.

p **Plain:** flat or relatively level landscape element; bedrock topography is masked.

h **Hummocky:** random assemblage of mounds and depressions with no trend or parallelism; bedrock topography is masked.

u **Undulating:** low relief, rolling terrain with no trend or parallelism; bedrock topography is masked.

r **Ridge:** narrow, elongated and commonly steep-sided feature that rises above surrounding landscape; bedrock topography is masked (unless a bedrock ridge). Includes string bogs (Or).

DELIMITERS

/ First component more common than second (e.g. Tv/Ov means till veneer covers 60-75% of polygon area, and organic veneer covers the rest).

// First component much more common than second (e.g. Tbv//Rr means a combination of till blanket and till veneer cover 80-95% of polygon area, with ridged bedrock covering the rest).

- First component approximately equal in proportion to the second.

TERRAIN CODE

Tv/Tb//GFb

First unit — Second unit — Third unit

Upper case letter = Surficial Material
Lower case letter = Surficial Expression

LEGEND

- Contour (10 m)
- Stream
- Waterbody

NOTES

Base data sources: CanVec, Government of Canada, Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information (2007)

STATUS
ISSUED FOR USE

ENVIRONMENTAL SCREENING ASSESSMENT OF THE FORMER WEATHER STATION ENNADAI LAKE, NU

Surficial Geology

PROJECTION	DATUM	CLIENT
UTM Zone 14	NAD83	Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

Scale: 1:15,000
200 100 0 200 400
Metres

FILE NO. Y22101286_008_Figure08.mxd

PROJECT NO.	DWN	CKD	APVD	REV
Y22101286	MEZ	SL	SMC	0

OFFICE EBA-VANC
DATE February 2013

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Figure 8

Q:\Edmonton\GIS\Environmental\Y22101286_EnnadaiMaps\008\Y22101286_008_Figure08.mxd modified 2/28/2013 by morgan.zondervan

LEGEND:

- INUIT OWNED LAND
- AREAS OF INTEREST AS IDENTIFIED BY ARVIAT COMMUNITY MEMBERS

NOTE:

EXACT LOCATIONS TO BE VERIFIED BY LOCAL COMMUNITY MEMBERS PRIOR TO START OF CONSTRUCTION

ISSUED FOR USE

0 100 m

Scale: 1: 2 000

CLIENT

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

ENVIRONMENTAL SCREENING ASSESSMENT FORMER WEATHER STATION ENNADAI LAKE, NU

AREAS OF CULTURAL SIGNIFICANCE AS IDENTIFIED BY ARVIAT COMMUNITY MEMBERS

PROJECT NO.	DWN	CKD	REV
Y22101286	MM	KO	0
OFFICE	DATE		
EDM	March 2013		

Figure 9

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PHOTOGRAPHS

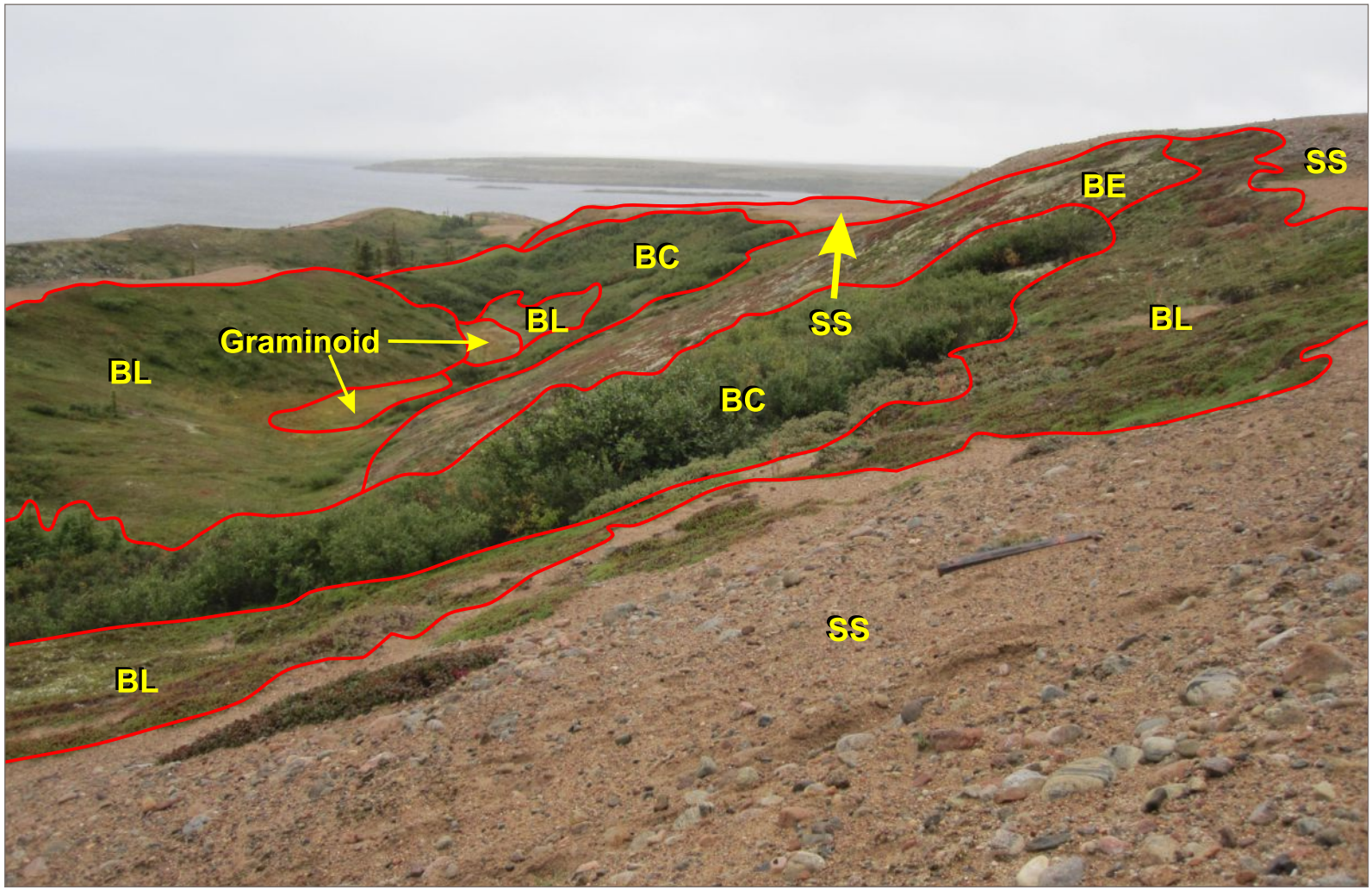

Photo 1: General landscape photo showing several ecosystem units in relation to topography

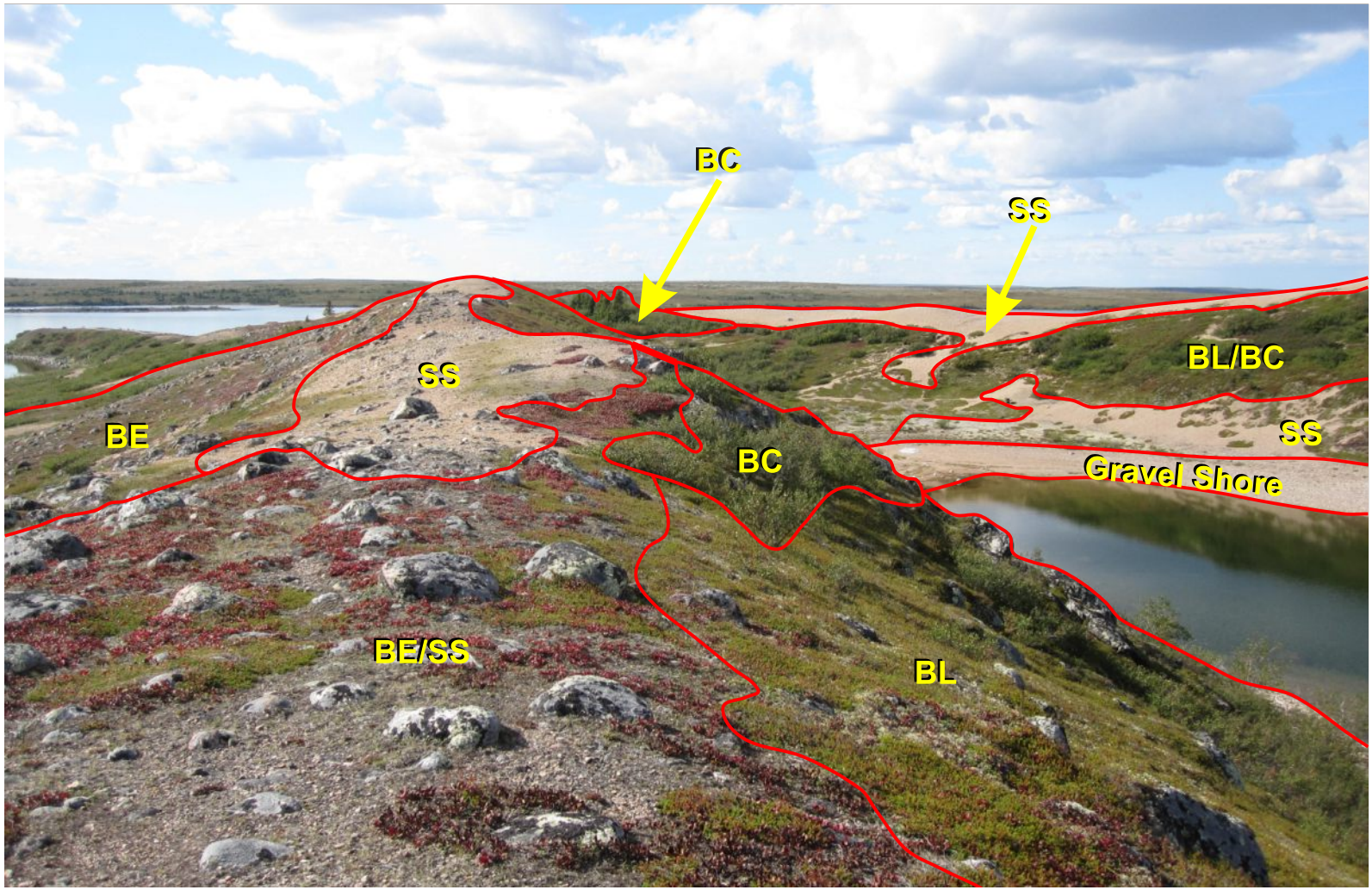

Photo 2: General landscape photo showing several ecosystem units in relation to topography

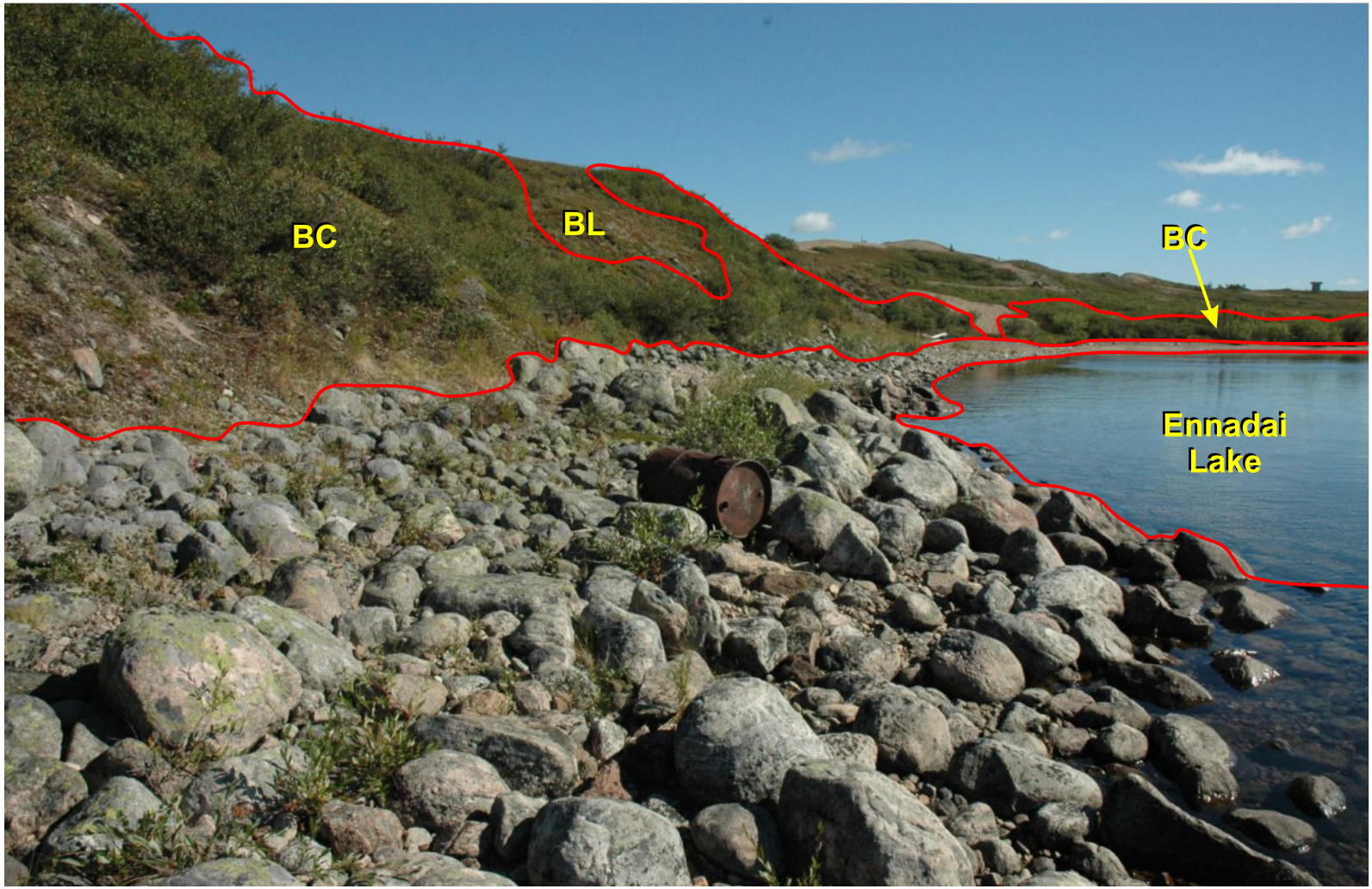

Photo 3: Close up of BC ecosystem unit

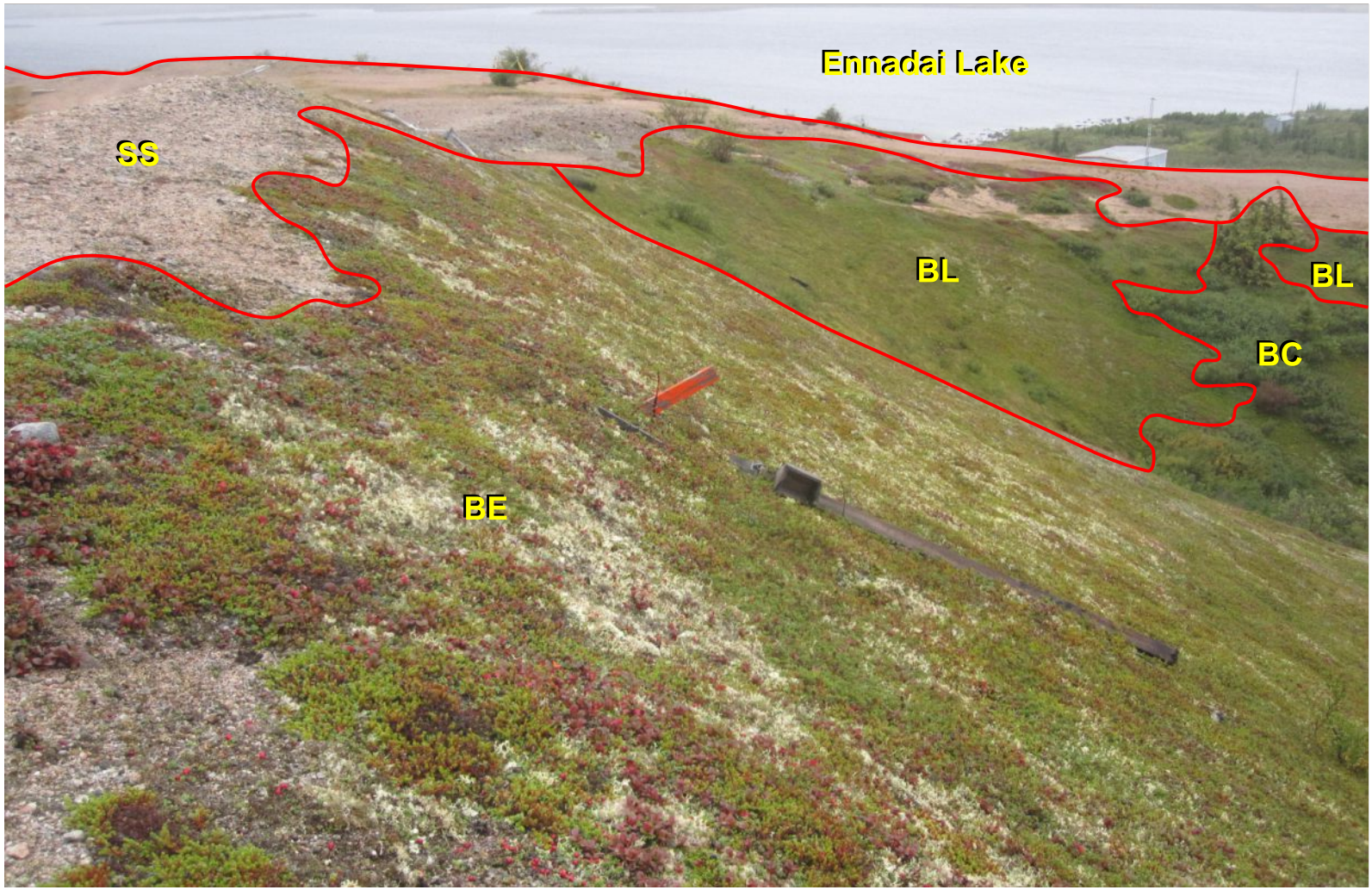

Photo 4: Close up of BE ecosystem unit

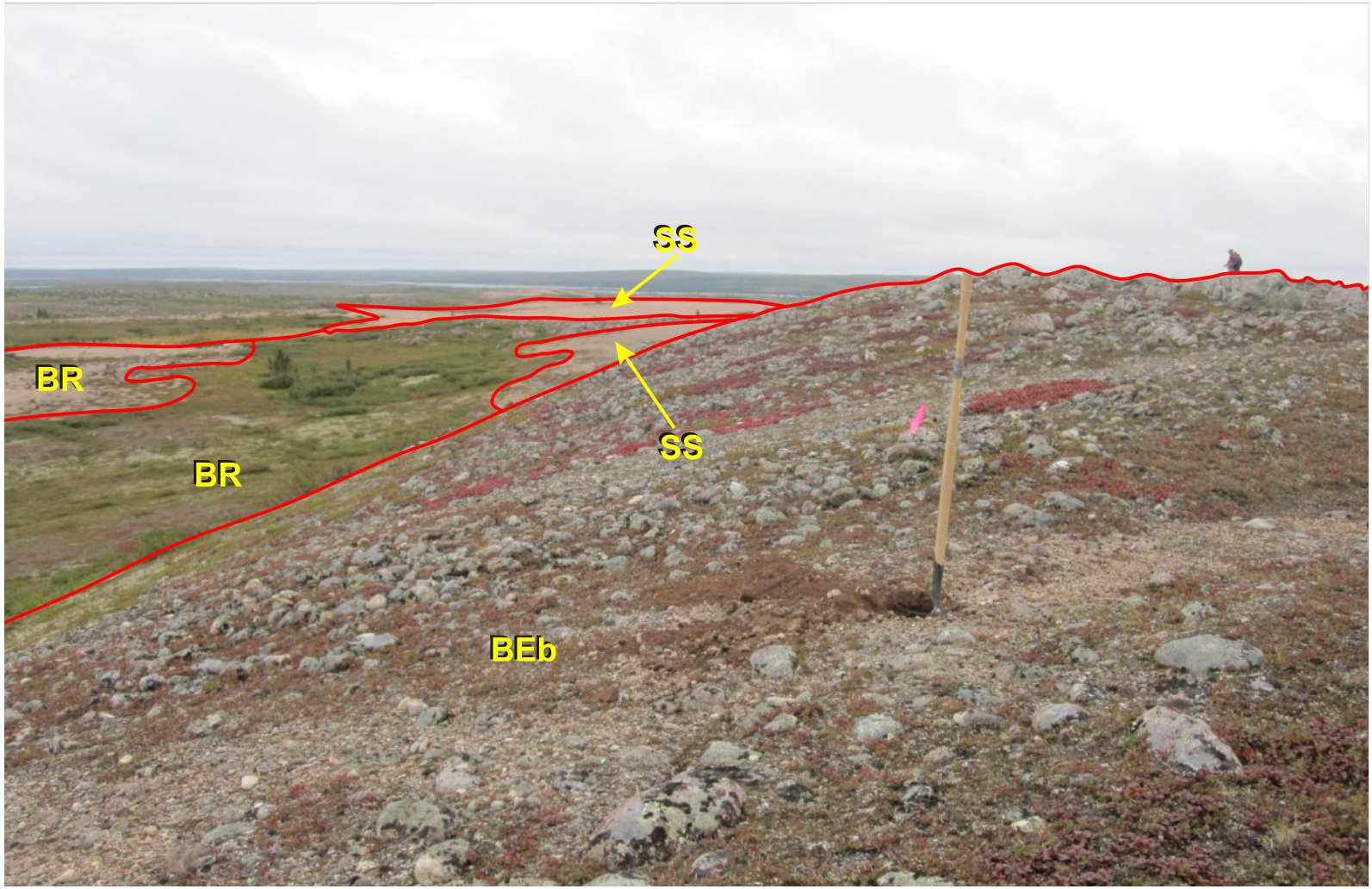

Photo 5: Close up of BEb ecosystem unit

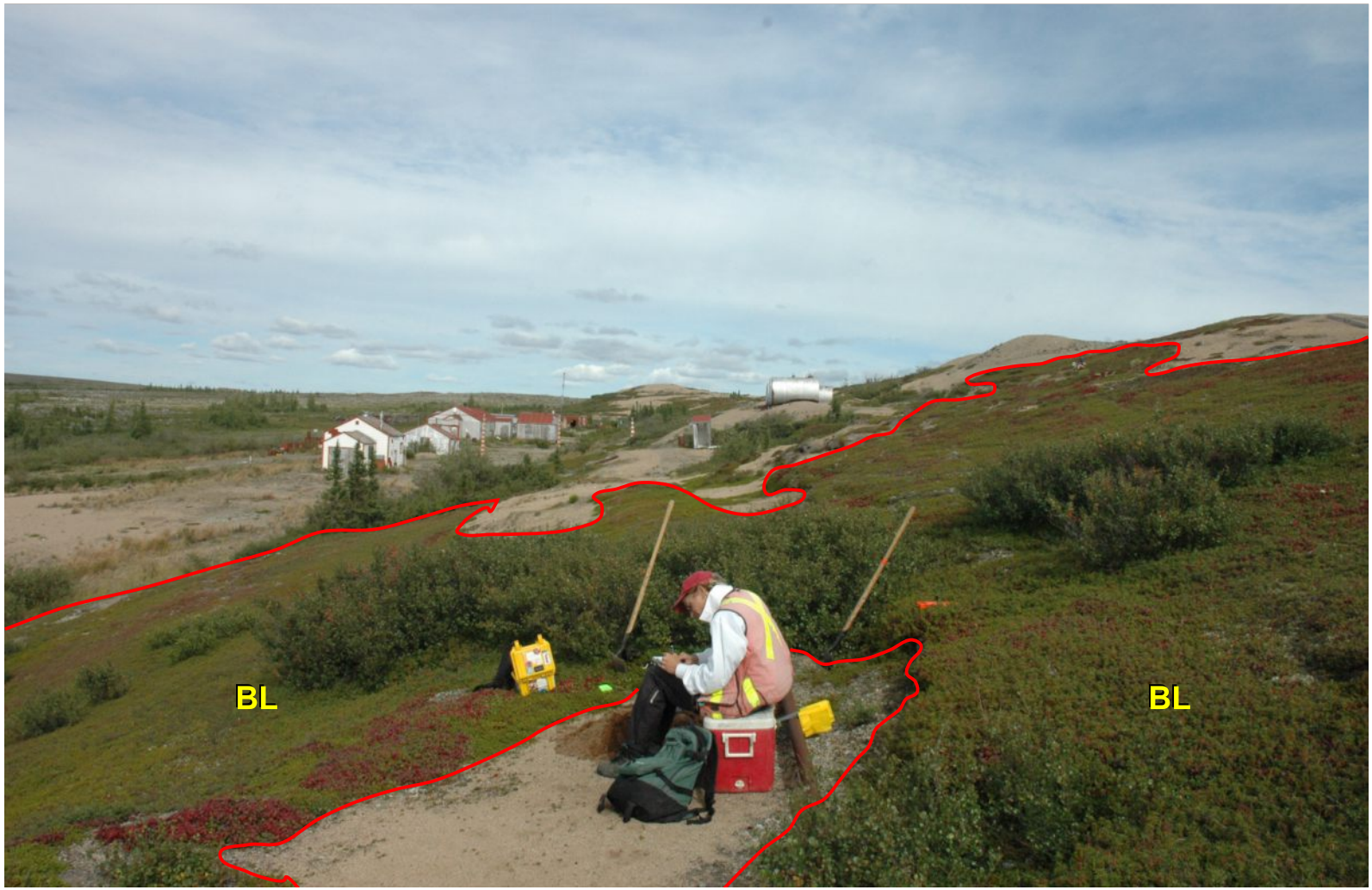

Photo 6: Close up of BL ecosystem unit

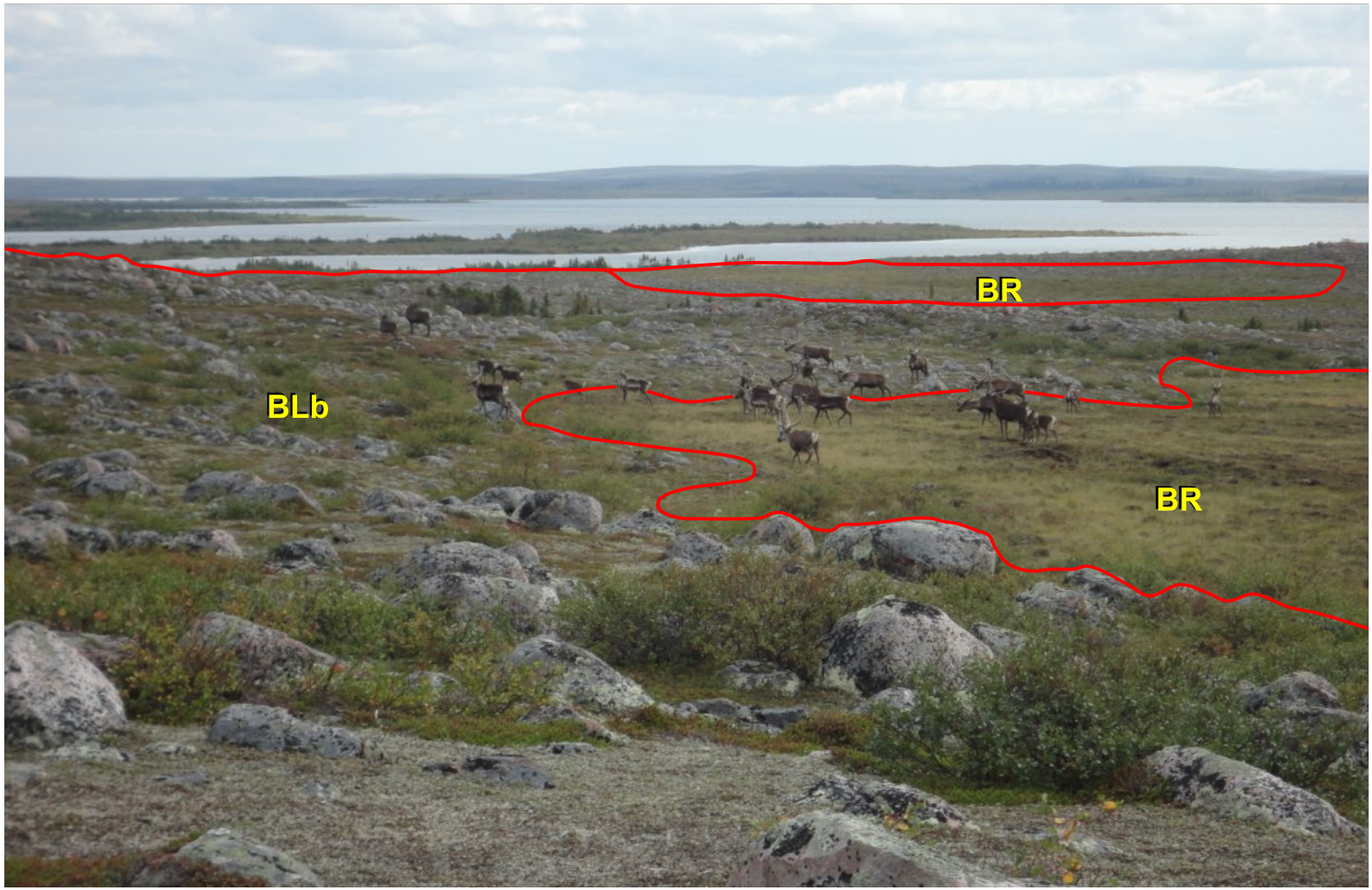

Photo 7: Close up of BLb ecosystem unit

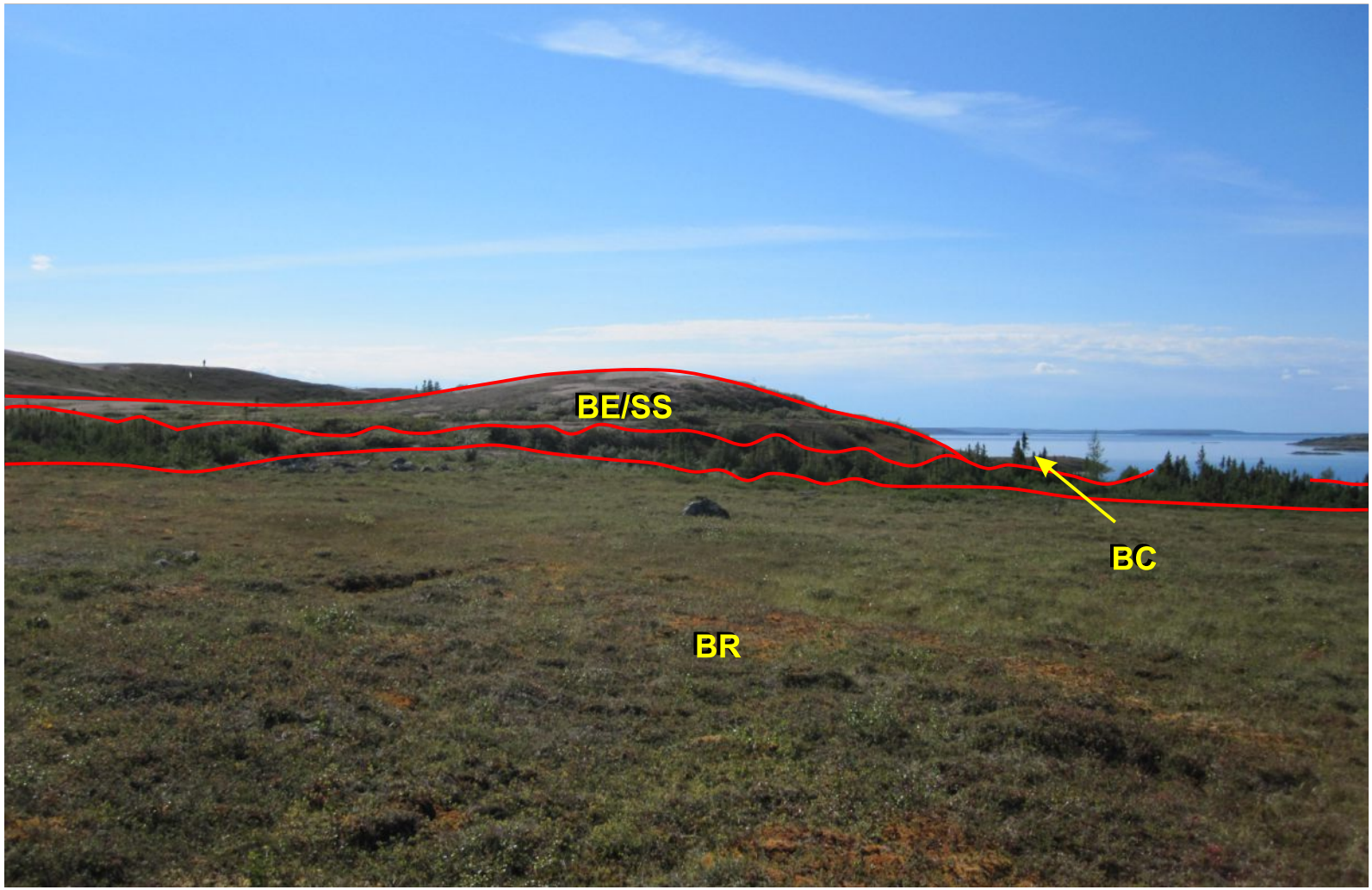

Photo 8: Close up of BR ecosystem unit

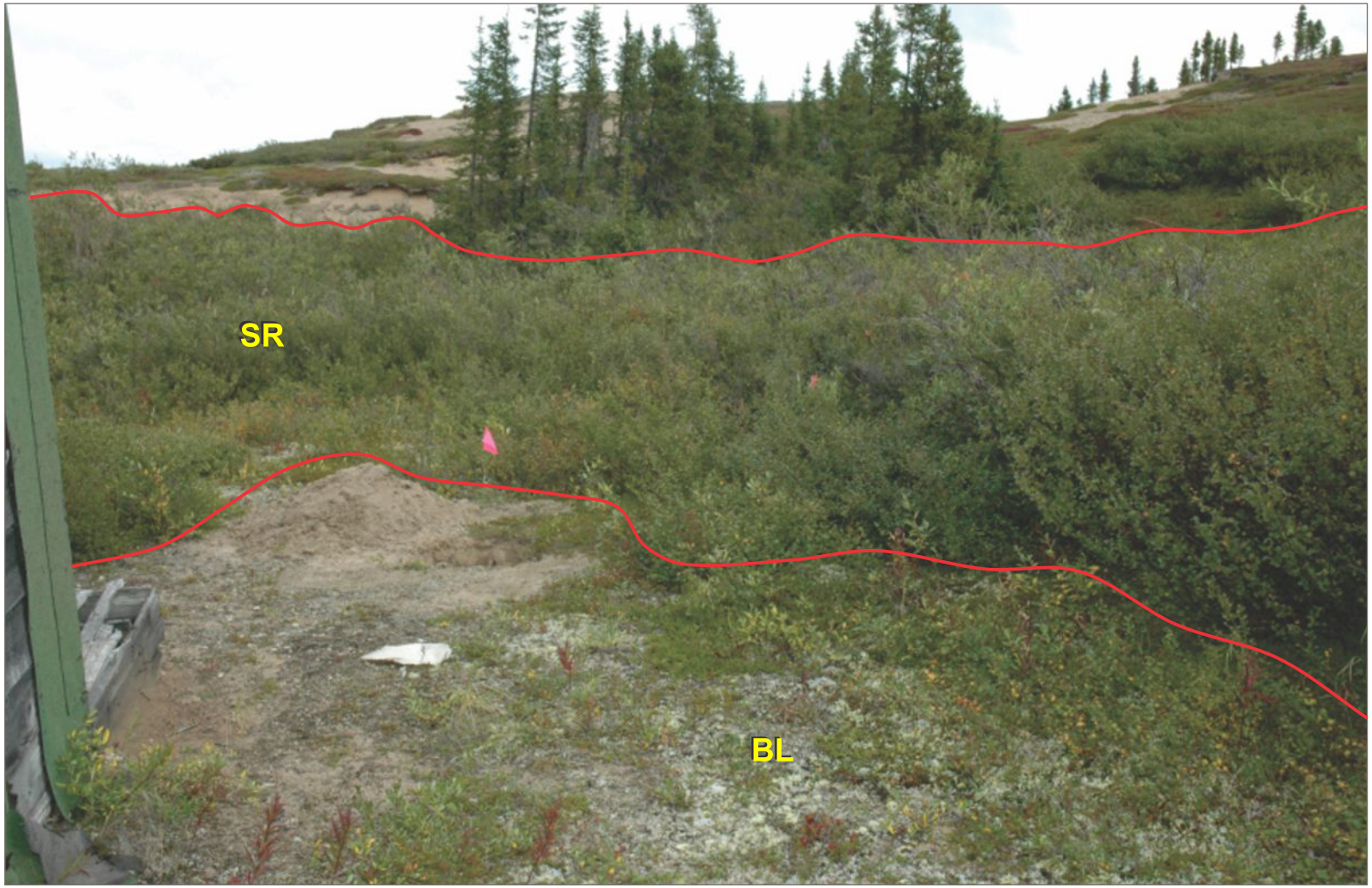

Photo 9: Close up of SR ecosystem unit

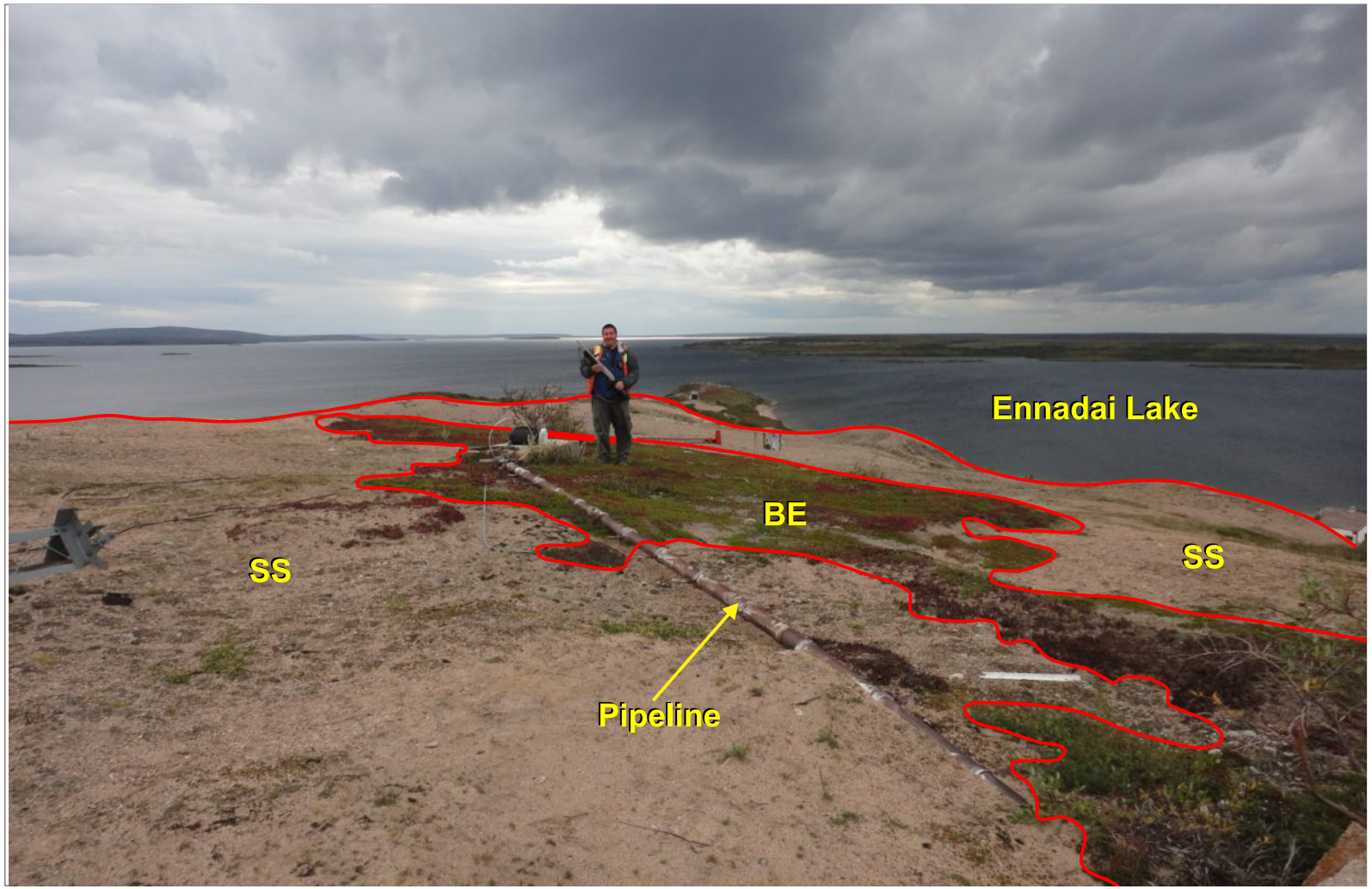

Photo 10: Close up of SS ecosystem unit

Photo 11: Disturbed site with very little revegetation

Photo 12: Disturbed site with a moderate amount of revegetation

APPENDIX A
LIST OF VEGETATION SPECIES

BC - Scrub Birch - Bluejoint Shrub Tundra

Layer	Latin Name	Common Name	P	MC	ELC011	ELC013
Shrub	*Betula nana*	scrub birch	100.0%	1.0	1.0	1.0
	Empetrum nigrum	crowberry	100.0%	1.0	1.0	1.0
	Ledum groenlandicum	Labrador tea	50.0%	0.5		1.0
	Ledum palustre ssp. *decumbens*	northern Labrador tea	50.0%	0.5		1.0
	Oxycoccus oxycoccos	bog cranberry	50.0%	0.5		1.0
	Picea mariana	black spruce	50.0%	0.5		1.0
	Salix Sp.	willow	50.0%	0.5	1.0	
	Vaccinium uliginosum	bog blueberry	50.0%	0.5		1.0
Forbs	*Calamagrostis canadensis*	bluejoint	50.0%	0.5	1.0	
	Pinguicula sp.	butterwort	50.0%	0.5		1.0
	Rubus chamaemorus	cloudberry	50.0%	0.5		1.0
Moss and Lichen	*Cladina mitis*	lesser green reindeer	50.0%	0.5	1.0	
	Peltigera neopolydactyla	greater frog pelt	50.0%	0.5	1.0	
	Polytrichum sp.	haircap moss	50.0%	0.5		1.0
	Polytrichum strictum	bog haircap moss	50.0%	0.5	1.0	
	Sphagnum angustifolium	poor-fen peat-moss	50.0%	0.5		1.0
	Stereocaulon tomentosum	eyed foam	50.0%	0.5	1.0	

Notes:
P - Percent of plots in ecosite containing this species
MC - Mean cover

BE - Scrub Birch - Crowberry Tundra

Layer	Latin Name	Common Name	P	MC	ELC003	ELC004	ELC010
Shrubs	*Arctostaphylos alpina* var. *rubra*	alpine bearberry	66.7%	0.7	1.0	1.0	
	Betula nana	scrub birch	33.3%	0.3			1.0
	Empetrum nigrum	crowberry	100.0%	1.0	1.0	1.0	1.0
	Ledum groenlandicum	Labrador tea	33.3%	0.3			1.0
	Salix Sp.	willow	33.3%	0.3			1.0
	Vaccinium uliginosum	bog blueberry	33.3%	0.3		1.0	
	Vaccinium vitis-idaea	bog cranberry	66.7%	0.7	1.0	1.0	
Forbs	*Calamagrostis canadensis*	bluejoint	33.3%	0.3			1.0
	Epilobium angustifolium	fireweed	33.3%	0.3			1.0
	Lycopodium annotinum	stiff club-moss	33.3%	0.3			1.0
Moss and Lichen	*Cladina mitis*	lesser green reindeer	33.3%	0.3			1.0
	Stereocaulon tomentosum	eyed foam	33.3%	0.3			1.0

Notes:
P - Percent of plots in ecosite containing this species
MC - Mean cover

BL - Scrub Birch - Labrador Tea Tundra

Layer	Latin Name	Common Name	P	MC	ELC002	ELC008
Shrubs	*Arctostaphylos alpina* var. *rubra*	alpine bearberry	50.0%	0.5	1.0	
	Betula nana	scrub birch	50.0%	0.5		1.0
	Betula pumila	low birch	50.0%	0.5	1.0	
	Empetrum nigrum	crowberry	100.0%	1.0	1.0	1.0
	Ledum palustre ssp. *decumbens*	northern Labrador tea	100.0%	1.0	1.0	1.0
	Salix Sp.	willow	100.0%	1.0	1.0	1.0
	Salix arctica	arctic willow	50.0%	0.5	1.0	
	Vaccinium uliginosum	bog blueberry	100.0%	1.0	1.0	1.0
	Vaccinium vitis-idaea	bog cranberry	100.0%	1.0	1.0	1.0
Forbs	*Calamagrostis canadensis*	bluejoint	100.0%	1.0	1.0	1.0
	Eleocharis sp.	spike-rush	50.0%	0.5		1.0
	Epilobium angustifolium	fireweed	100.0%	1.0	1.0	1.0
	Festuca sp.	fescue	100.0%	1.0	1.0	1.0
	Triantha glutinosa	sticky false asphodel	50.0%	0.5	1.0	
Moss and Lichen	*Cetraria* sp.	icelandmoss lichens	50.0%	0.5	1.0	
	Cladina rangiferina	grey reindeer	50.0%	1.0	1.0	
	Polytrichum juniperinum	juniper haircap moss	50.0%	1.0	1.0	
	Stereocaulon tomentosum	eyed foam	100.0%	1.0	1.0	1.0

Notes:
P - Percent of plots in ecosite containing this species
MC - Mean cover

BR - Scrub Birch - Cloudberry Low Shrub Bog

Layer	Latin Name	Common Name	P	MC	ELC009
Shrubs	*Andromeda polifolia*	bog-rosemary	100.0%	1.0	1.0
	Arctostaphylos alpina var. *rubra*	alpine bearberry	100.0%	1.0	1.0
	Betula nana	scrub birch	100.0%	1.0	1.0
	Empetrum nigrum	crowberry	100.0%	1.0	1.0
	Ledum palustre ssp. *decumbens*	northern Labrador tea	100.0%	1.0	1.0
	Oxycoccus oxycoccos	bog cranberry	100.0%	1.0	1.0
	Vaccinium uliginosum	bog blueberry	100.0%	1.0	1.0
	Vaccinium vitis-idaea	bog cranberry	100.0%	1.0	1.0
Forbs	*Calamagrostis canadensis*	bluejoint	100.0%	1.0	1.0
	Equisetum sylvaticum	wood horsetail	100.0%	1.0	1.0
	Eriophorum sp.	cotton-grass	100.0%	1.0	1.0
	Pedicularis labradorica	Labrador lousewort	100.0%	1.0	1.0
Moss and Lichen	*Cetraria* sp.	icelandmoss lichens	100.0%	1.0	1.0
	Cladina rangiferina	grey reindeer	100.0%	1.0	1.0
	Sphagnum fuscum	common brown peat-moss	100.0%	1.0	1.0

Notes:
P - Percent of plots in ecosite containing this species
MC - Mean cover

Graminoid

Layer	Latin Name	Common Name	P	MC	ELC005
Forbs	*Calamagrostis canadensis*	bluejoint	100.0%	1.0	1.0
	Carex sp.	sedge	100.0%	1.0	1.0

Notes:
P - Percent of plots in ecosite containing this species
MC - Mean cover

SR - Willow - Nagoonberry Riparian Shrub

Layer	Latin Name	Common Name	P	MC	ELC001
Shrub	*Alnus viridis*	green alder	100.0%	1.0	1.0
	Betula nana	scrub birch	100.0%	1.0	1.0
	Ledum palustre ssp. *decumbens*	northern Labrador tea	100.0%	1.0	1.0
	Salix Sp.	willow	100.0%	1.0	1.0
	Vaccinium uliginosum	bog blueberry	100.0%	1.0	1.0
	Vaccinium vitis-idaea	bog cranberry	100.0%	1.0	1.0
Forb	*Calamagrostis canadensis*	bluejoint	100.0%	1.0	1.0
	Carex sp.	sedge	100.0%	1.0	1.0
	Epilobium angustifolium	fireweed	100.0%	1.0	1.0
	Epilobium glaberrimum	smooth willowherb	100.0%	1.0	1.0
	Equisetum arvense	common horsetail	100.0%	1.0	1.0
	Equisetum sylvaticum	wood horsetail	100.0%	1.0	1.0
	Pyrola sp.	wintergreen	100.0%	1.0	1.0
	Rubus arcticus	nagoonberry	100.0%	1.0	1.0
Moss and Lichen	*Drepanocladus* sp.	hook-moss	100.0%	1.0	1.0
	Peltigera canina	dog pelt	100.0%	1.0	1.0
	Polytrichum strictum	bog haircap moss	100.0%	1.0	1.0
	Tomentypnum nitens	golden fuzzy fen moss	100.0%	1.0	1.0

Notes:

P - Percent of plots in ecosite containing this species

MC - Mean cover