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Qulliq Energy Corporation

PHASE I ENVIRONMENTAL SITE ASSESSMENT

Proposed Power Plant Location in Zone 13W
Cambridge Bay, Nunavut – Option 02

FEBRUARY 2021

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FINAL REPORT

Englobe

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Summary

Site and Adjacent Land Conditions

Location(s)	Zone 13W, Site located 3 km west of the Hamlet of Cambridge Bay and east of Cambridge Bay Airport
Type of facility	Vacant
Current on-site facilities	Golf Course
Former on-site facilities	None
Site Zoning	Restricted Industrial
Adjacent land use	North: Vacant South: Tank Farm East: Vacant West: Road, Vacant Land/Airport
Current Site owner	Crown Land
Previous owners/caveats of Potential Environmental Concern (PEC)	None
PECs identified during aerial photo review	None

Site Reconnaissance Findings

Spills/stains	None
Aboveground storage tanks	No evidence
Underground storage tanks	No evidence
Vegetation	Grasses, sedge, lichens

Environmental Receptors

Residences/subsurface features	None
Groundwater use	None
Local water supply	None
Surface water bodies	None within 500 m radius of the Site
Sensitive habitats or areas	None

Areas of Potential Environmental Concern

On site	None
Adjacent properties	Airport is approximately 1 km west of the Site and there is an active Tank Farm situated roughly 500 m south of the Site

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Property and Confidentiality

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1 Introduction

Englobe Corp. (Englobe) was retained by Qulliq Energy Corporation (QEC) to perform a Phase I Environmental Site Assessment (ESA) of the proposed power plant location situated along the tank farm road, 1 km directly east of Cambridge Bay Airport and approximately 2 km southwest of Cambridge Bay Hamlet (Option 02) in Zone 13W in Cambridge Bay, Nunavut (the Site). A Site location map is presented on Figure 1 and a Site plan is presented on Figure 2.

1.1 Objectives

The objectives of the Phase I ESA are to:

- Determine if the current and past usage of the Site and/or adjacent properties could have had an environmental impact at the Site.
- Identify areas of potential environmental concern (APECs) and potential contaminants of concern (PCOCs) at the Site.
- Identify potential sensitive receptors that could be affected by environmental impacts.

The Phase I ESA is based on a visual inspection of the Site and neighboring areas, interviews concerning historical uses and practices of the area, and the consultation of records of hazardous spills, hamlet records, satellite imagery and aerial photographs.

2 Phase I Environmental Site Assessment

2.1 Site Description and Background

Cambridge Bay is a hamlet and the largest settlement located on Victoria Island in the Kitikmeot Region of Nunavut. For Land Use Planning purposes, the community of Cambridge Bay is not yet covered by an approved land use plan (Nunavut Planning Commission, 2020). The Site is a vacant lot approximately 0.95 ha located 500 m northeast of the tank farm, on the east side of tank farm road (Road R36), approximately 1 km directly east of Cambridge Bay Airport and approximately 2 km southwest of Cambridge Bay Hamlet, Nunavut.

The Site is trapezoid in shape and lies within part of the Many Pebbles Golf Course. Figure 1 provides the location of the Site and shows details of the surrounding land use. There are some sparsely distributed vegetations throughout the Site area, and the nearest surface water bodies are unnamed ponds that are located approximately 450 m west of the Site, and another approximately 600 m northeast of the Site. In addition, approximately 600 m south of the Site is Cambridge Bay that opens into Coronation and Queen Maud Gulfs through Dease Strait.

The Site is zoned as Restricted Industrial Land, Zone 13W, under Schedule 1 and Schedule 2 in the Cambridge Bay Community Plan under the Cambridge Bay Community By-Law No. 288 of the Municipality of Cambridge Bay in Nunavut Territory (Municipality of Cambridge Bay, 2016).

The land use surrounding the Site is as follows:

- North: Ovayok Road and Many Pebbles Golf Course.

- South: Dumpsite and Tank Farm roughly 500 m southeast of the Site.
- East: Many Pebbles Golf Course.
- West: Cambridge Bay Airport property, covers more than 1 km west of the Site.

Currently, the Site is unoccupied and vacant but lies within the designated 450 m waste disposal setback. Based on the information gathered from available documents, the property has always been vacant, with no history of residential, industrial, or commercial buildings, nor have there been any known activities in the past in which a potential contamination might have occurred.

For the purposes of this study, the area investigated as part of this Phase I ESA is the Site, and adjacent properties, as required by the CSA standard. Areas within a 250 m radius of the Site were assessed as part of the database search (herein referred to as the Phase I Study Area, as shown on Figure 2.

2.2 Geology, Topography and Hydrogeology

The surficial geology within the Site consists of undifferentiated colluvial deposits and sediments characterized by the presence of extensive reworked glacial and glaciofluvial deposits consisting primarily of clast-rich, sand with clay and silt, having abundant fragments of weathered carbonate bedrock with sandstone mix. These sediments overlie the Precambrian regional bedrock that consists of mainly flat-lying, carbonates (limestone or dolostone) with smaller proportions of sandstone, siltstone, and shale (Franz, 2010).

Based on available topographic maps the Atlas of Canada's Toporama website from Natural Resources Canada, the overall topography of the Site is relatively flat, gently sloping east towards the unknown pond in the northeast and the Cambridge Bay in the southeast. The inferred groundwater flow direction in the vicinity of the Site is likely eastward towards Cambridge Bay, based on the topography of the Site (NRC, 2020).

A site-specific topographical map is presented in Appendix A.

2.3 Methodology

The Phase I ESA was completed in accordance with Government of Nunavut Environmental Guideline for the Management of Contaminated Sites (2014) and Canadian Standard's Association CAN/CSA Z768-01 (R2016).

The four principal components of this Phase I ESA include a review of available public and private information regarding the Site, a Site visit, interviews, and the evaluation and reporting of information.

2.3.1 Review of Available Public and Private Information

This activity involves the review of available information on site history, including ownership and use, aerial photos, publicly available environmental reports, water well records, along with a review for the presence of upstream oil and gas activities. Englobe also obtained an EcoLog Environmental Risk Information Services Ltd. (ERIS) report for the Site and surrounding properties within a 250 m radius of the centre of the Site.

This research helps to determine if past activities may have impacted the Site, as well as if activities carried out on adjacent properties may have contributed to potential impacts at the Site.

2.3.2 Site Visit

The Site visit takes place after the records review. The Site visit helps to determine if potential impacts exist on the Site, and if there are any discrepancies from the records reviewed. A thorough examination of the Site is conducted to determine any site impacts, hazards, and risks.

2.3.3 Interviews

Interviews are conducted, to gather information that may not have been formally documented, and to corroborate or augment information gathered in the records review and site visit.

2.3.4 Evaluation and Reporting

All of the information gathered from the Phase I ESA is evaluated and reported to assist in the potential subsequent ESAs at the Site.

3 Records Review

The following sources of information were consulted and reviewed to determine potential environmental impacts from past activities on the Site or on adjacent sites. Table 1 below is a summary of records reviewed.

Table 1: Summary of Records Reviewed

Record	Consultation Location
Land use and ownership titles	Legal Registries Division (Land Titles Office), Government of Nunavut
Historical City Directories	The Municipality of Cambridge Bay, Government of Nunavut
Aerial photographs	National Air Photo Library, Google Earth
Hazardous Materials and Spill Database	Online, Government of Northwest Territories
Publicly available environmental reports	Government of Nunavut, Treasury Board of Canada, Natural Resources Canada
Various government and private source records	EcoLog ERIS, Government of Nunavut Department of Environment, Government of Northwest Territories Department of Environment and Natural Resources: Spills Database, and The Municipality of Cambridge Bay
Records from Regulatory Agencies	Nunavut Planning Commission, Municipality of Cambridge Bay

3.1 Land Use and Ownership Titles

As of December 2020, the Site occupies Lot 1005 Quad 77 D/02 Plan 3120, which is part of the Cambridge Bay Airport property land based on the Cambridge Bay Community Plan Map of 2015.

The Kitikmeot Land Administrator, Sophia Ohokanoak, has stated that though the plot is described by the Legal Registries Division (Land Titles Office), Department of Justice, GN as Lot 1005 Plan 3120, it is actually Lot 1017 Plan 4573. The Kitikmeot Land Administrator is currently registering a new survey plan for the area and upon approval, the lot number will

change from Lot 1017 Plan 4573 to Lot 3 Block 67 Plan 4781. The official date of transfer cannot be confirmed at the time of writing this report.

3.2 Chain of Title

According to the Legal Registries Division (Land Titles Office) at the GN Department of Justice, there are no historical land titles and no land titles have been raised on these lots. Therefore, a chain of title could not be obtained for the Site. See Appendix B for communications regarding land titles.

Upon review of the aerial photographs, it does not appear that development on the Site has changed significantly between 1969 and 2020, and a majority of the properties within the area appear to remain vacant with the exception of the present-day Tank Farm and service station, located southeast of the Site (see Section 3.7). Therefore, the absence of the land title and chain of title is not anticipated to impact the conclusions of this report.

3.3 Historical City Directories

A City Directory search provides the names of occupants or businesses that were operating at a certain municipal address at a point in time. However, the City Directory does not exist for this property and thus, there are no details as to the activities that take place at the property. A request for information regarding the occupancy of properties within the Phase I Study Area was requested. Brief historical information about the Site was gathered from an interview with the Hamlet of Cambridge Bay Development Officer who confirmed the non-existence of activities on the Site over time.

Correspondences with the Government of Nunavut's Environmental Liabilities Project Manager, Lauren Perrin indicates that there had not been any Environmental Site Assessments or repositories for the Site.

3.4 Fire Insurance Plans

The Catalogue of Canadian Fire Insurance Plans 1875-1975 (Catalogue) was not requested given the historical background of the Site.

3.5 Site Operating Records

Since the proposed Site for the construction of the new QEC Power Plant was previously undeveloped, there are no Site Operating Records for the Site.

3.6 Previous Environmental Reports

The Government of Nunavut Department of the Environment provided a Contaminated Sites Inventory for the Kitikmeot Region of Nunavut prepared by Nunami Jacques Whitford Ltd. (NJWL) in 2009. This report presented 18 contaminated sites within Cambridge Bay, including Cambridge Bay Airport and the Tank Farm which lies roughly 600 m west and 500 m southeast of the proposed Site, respectively. The report, prepared by NJWL, is based on field visits that were conducted in 2007 (NJWL, 2009). NJWL, in their conclusions, classified the Cambridge Bay Airport and the Tank Farm sites as Class 1 Site - High-Risk Potential. The

classification was based on CCME National Classification System for Contaminated Sites (2008) Scoring using three factors including the degree of hazard, contaminant quantity and the physical state of contaminants. NJWL recommendations included the removal of impacted surface soils and the development of a monitoring program for all noted impacted sites (NJWL, 2009). The review, however, yielded no evidence of contaminant impacts from the aforementioned nearby contaminated sites, and no evidence of historic, active or suspected contaminants within a 250 m radius of the proposed Site.

The Phase II/III Environmental Site Assessment Draft Field Report, Cambridge Bay Airport, Cambridge Bay, Nunavut; prepared for Public Works & Government Services Canada on behalf of Transport Canada by Franz Environmental Inc. (Franz) in March 2010 was also reviewed. The ESA identified three (3) Areas of Environmental Concern (AECs) within the airport property, which lies roughly 600 m west of the proposed Site. Franz recommended excavation and treatment of contaminated soils and groundwater, additional site investigation, as well as post-remediation monitoring to assess attenuation of contaminants following soil remediation activities. The review, however, yielded no evidence of historic, active or suspected contaminants on the proposed Site.

Refer to Appendix C for details of all previous environmental reports.

3.7 Aerial Photographs and Satellite Imagery

Aerial photographs of the Site were obtained from the National Air Photo Library (NAPL) of Natural Resources Canada through ERIS for 1969 to 1993. Satellite imagery obtained from Google Earth® for 2006, 2011, 2017, 2020 and Google Map® for 2020 were used to develop a history of land use for the Site and adjacent properties. Tables 2 and 3 summarize the results of the aerial photograph review. The aerial photographs are presented in Appendix D.

Table 2: Aerial Photographs and Main Observations of the Site and its Neighbouring Area

Image	Id Number / Date	Year	Observations
Aerial Photographs	20302100250	1969	No buildings or infrastructure present on the Site. Piles of objects present in the southeast portion of the Site.
	20302100250	1975	
	A26792-171	1985	
	A31573-117	1990	
	A27750-182	1991	
	A27936-022	1993	
Google Earth®	July 31, 2006	2006	No buildings or infrastructure present on the Site. Two visible boulders present in the southeast portion of the Site.
	July 2, 2010	2010	
	July 8, 2011	2011	
	June 21, 2017	2017	
	July 26, 2019	2019	
	July 31, 2020	2020	

Table 3: Description of Surrounding Area based on Aerial and Satellite Image Record

Year	Site Review	North of Site	West of Site	South of Site	East of Site
1969	Piles of objects present	Vacant land that extends to a road	Road towards tank farm (SE) and vacant land is visible	Road towards tank farm (SE) is visible	Vacant land
1975	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent
1985	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent
1990	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	Aboveground storage tanks are visible	No significant changes are apparent
1991	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent
1993	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent
2006	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent
2010	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	Some unidentified items are present in the Tank Farm location	No significant changes are apparent
2011	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	Some unidentified structures are present in the Tank Farm location	No significant changes are apparent
2017	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	Tank Farm is present	No significant changes are apparent
2020	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent	No significant changes are apparent

Based on the review of aerial and satellite images, there is no history of residential, industrial, or commercial buildings. The Site appears to have been historically vacant and undeveloped.

3.8 Records from Regulatory Agencies

The publicly available information from the following regulatory agencies was reviewed for environmental information pertaining to the Site during the assessment. When it was deemed to be relevant, the regulatory agencies were contacted for environmental information pertaining to the Site. Copies of the correspondence are included in Appendix E. Relevant information from these inquiries is presented below:

- The Hamlet of Cambridge Bay
- The Department of Environment, Government of Nunavut

- Community and Government Services (CGS)
- Nunavut Impact Review Board
- Hazardous Materials Spills Database

3.8.1 Hamlet Records

The Hamlet of Cambridge Bay was contacted to request any relevant information about the history of the Site and surrounding lots. Interviews and email communications were conducted with the Development Officer and with the Kitikmeot Regional Land Use Planner, however, they were unable to provide specific information about the Site or adjacent properties. These communications are presented in Appendix E. If any information is forthcoming which may differ from the findings discerned herein, Englobe will provide an amendment.

The lot number and plan were obtained from the Community Planning and Lands Management System, operated by the Government of Nunavut Community & Government Services Planning & Lands Division. The Cambridge Bay Community Land Use and Planning Map obtained from the Community and Government Services indicates the property is located within the Restricted Industrial zone.

3.8.2 Department of Environment, Government of Nunavut

The Department of Environment (DOE) of the Government of Nunavut was contacted to request any relevant information about the history of the Site and surrounding lots as pertains to any potential environmental contamination. The DOE provided a Contaminated Sites Inventory for the Kitikmeot Region of Nunavut prepared by NJWL (2009). A review of this report did not show any evidence of historic, active or suspected contaminants within a 250 m radius of the proposed Site. A summary of the findings of this report is provided in Section 3.6. Refer to Appendix C for the detailed summary report. Email correspondences with the Department of Environment are included in Appendix E.

3.8.3 Nunavut Impact Review Board Public Registry

The Nunavut Impact Review Board Public Registry was reviewed. No projects within a 250 m radius of the Site were found within the registry.

3.8.4 Hazardous Materials Spills Database

The Government of Northwest Territories Department of Environment and Natural Resources maintains an active Spills Database that provides records of reported spills within Nunavut, Yukon, and the Northwest Territories. Information recorded includes the spill ID, occurrence date, location, a general location description, information regarding the product spilled, volume of product spilled, spill cause, and the lead agency. Englobe consulted the Hazardous Materials Spills Database (HMSD) in December 2020.

Nineteen (19) spill reports were found for the Hamlet of Cambridge Bay (refer to entire list included in Appendix F). Each spill report was verified to determine the exact location. Table 4 summarizes the one (1) spill that is known to have occurred within 250 m of the Site and Table 5 presents a summary of the unplottable spills.

Table 4: Summary of Spill which occurred in Proximity to the Site

Spill ID.	Date	Location Description	Approximate Distance to Site	Contaminant	Volume (L)	Spill Cause	Lead Agency
Spill-2017196	June 5, 2017	Cambridge Bay, NWS LRR CAM-M, 69 06 16N 105 05 59W	216 m southeast of Site	Heating Fuel	1295	Pipe Leak	GN

The spill occurred approximately 216 m southeast of the proposed project Site on June 5, 2017. The spill event was caused by a pipe leakage close to the Tank Farm, releasing approximately 1295 L (litres) of heating fuel. According to the Hamlet's Development Officer, the spill was cleaned up by the Canadian Armed Forces, safety cones that were placed around the spill site were visible during Englobe's site visit on November 25, 2020.

Of the 19 records retrieved from the HMSD for the community of Cambridge Bay, three were unplottable records. Unplottable reports are records that could not be mapped due to various reasons, including limited geographic information but were considered in this report as reference due to the geographic location name. A review of the unplottable records determined that none had sufficient information to determine the location of the subject record or were not pertinent. The unplottable spills are summarized in Table 5, note that the spill location could not be confirmed.

Table 5: Summary of Unplottable Spills which occurred in Proximity to the Site

Spill ID	Date	Location Description	Approximate Distance to Site	Contaminant	Volume (L)	Spill Cause	Lead Agency
Spill-2018270	July 11, 2018	Military	Unplottable	Heating Fuel	1	Breakage	CIRNAC
Spill-2009500	November 6, 2009	Cambridge Bay Airport Off Apron	Unplottable	Heating Fuel	40	Pipe Leaks	GN
Spill-1996176	September 4, 1996	1 Mile Offshore of Cambridge Bay Airport	Unplottable	Mixed load: water/oil	6 Liters	Unknown	-

Notes:
IRNAC – Crown-Indigenous Relations and Northern Affairs Canada
ECCC – Environment and Climate Change Canada
GN – Government of Nunavut

3.9 Various Government and Private Source Records

EcoLog ERIS is a database and information Service Company that specializes in providing environmental and historical information compiled from government and private source records. A request was forwarded to ERIS to conduct a search of the databases listed in Table 6.

Table 6: EcoLog ERIS Databases Reviewed

Federal	Territorial	Other
National PCB Inventory	Crown Land Fuel Storage Tanks	Retail Fuel Storage Tanks
Federal Convictions	Mineral Occurrences	Dry Cleaning Facilities
Federal Contaminated Sites	Hazardous Materials Spills Database	Scott's Manufacturing Directory
National Pollutant Release Inventory		ERIS Historical Searches
National Environmental Emergencies System		Canadian Mine Locations
National Analysis of Trends in Emergencies System		Canadian Pulp and Paper
National Defence and Canadian Forces Spills		Automobile Wrecking and Supplies
National Energy Board Pipeline Incidents		Oil and Gas Wells
National Energy Board Wells		Compressed Natural Gas Stations
National Defence and Canadian Forces Waste Disposal Sites		Greenhouse Gas Emissions from Large Facilities -
Federal Identification Registry for Storage Tank Systems (FIRSTS)		
Indian and Northern Affairs Fuel Tanks		

Notes:
PCB – Polychlorinated biphenyl

Relevant information from the database searches is presented below and is summarized according to the database reviewed. The ERIS results are presented in Appendix G.

3.10 Federal Contaminated Land

The Federal Contaminated Sites Inventory (FCSI) identifies all known federally operated contaminated sites, including sites under the custodianship of departments, agencies, consolidated crown corporations, and sites for which the Government of Canada has accepted financial responsibility. The database search and review indicated no current or historical contaminated sites within 250 m radius of the Site.

3.11 Upstream Oil and Gas Facilities

There are no upstream oil and gas facilities on or near the Site.

4 Results

4.1 Site Visit Results

A site reconnaissance visit was conducted by a representative of Englobe on November 25, 2020. The site visit included a walkthrough of the Site and a cursory assessment of adjacent properties. During the site reconnaissance, the weather was cold, windy, overcast and the temperature was between -8 and -12°C. Photographs were taken during the site reconnaissance and the photograph locations are illustrated in Appendix H.

4.2 Topography

The topography of the Site and surrounding land is generally flat terrain covered with grass and gravel fill, sloping east towards an unknown pond in the northeast and Cambridge Bay in the southeast. Please refer to Appendix A for a detailed topographical survey of the Site.

4.3 Current Use of the Site

Currently, the Site is primarily unoccupied and undeveloped. According to information provided by the Hamlet's Development Officer, the Site has always been undeveloped while it belonged to the Airport until it was handed over to the Hamlet and currently, is partly used as a golf course.

4.4 Adjacent and Surrounding Properties

A visual inspection of the adjacent properties and properties within 250 metres of the Site was undertaken to determine the occupants, document the activities and sources of potential contamination.

As observed in the aerial photos, the Site is bound on the west by the tank farm road that runs northwest to southeast followed by a 1 km stretch of vacant undeveloped land that leads to the Cambridge Bay Airport runway. The north and east adjoining land areas are also vacant and undeveloped, however information from Englobe's interactions with the Hamlet's Development Officer during the Site visit reveals that part of the Site to the east has been used as a golf course. The tank farm road cuts through the south vacant lands and runs southeast to the tank farm and dumpsite located approximately 500 m southeast of the Site.

4.5 Utilities

There are no utility lines that run through or are located on the Site, however, the closest observed pipeline goes from the storage tank from the southeast direction towards the northeast. A power line that runs along the tank farm road (west of Site) to the tank farm was also observed.

4.6 Drains, Pits and Sumps

There are no drains, pits or sumps on the Site.

4.7 Interviews

Englobe's representative interviewed the Hamlet's Development Officer during the November 25, 2020 Site visit. Notes from the Site visit are provided in Appendix I, while email communications are presented in Appendix E.

The Hamlet's Development Officer provided basic information regarding this Site. According to the officer, the property previously belonged to the Cambridge Bay Airport, but ownership was later transferred to the Hamlet. He also informed Englobe personnel that part of the Site to the east has recently been used as a golf course.

Further communications by email with the Hamlet of Cambridge Bay's Development Officer, Kevin Taylor and Kitikmeot Regional Land Use Planner, Corey Dimitruk did not provide any more detailed information on the Site plot or surrounding areas.

Email and phone communications with the Kitikmeot Land Administrator, Sophia Ohokanoak confirms that the lot previously belonged to the Airport and that her office does not have any records of contaminations or spills on the lot. She also stated that although the plot is described by the Legal Registries Division (Land Titles Office), Department of Justice, GN as Lot 1005 Plan 3120, it is actually Lot 1017 Plan 4573. She is currently working on registering a new survey plan for the area and upon approval, the lot number will change from Lot 1017 Plan 4573 to Lot 3 Block 67 Plan 4781.

4.8 Gas Well

During the Site visit, no well was observed; there is no active gas well or history of gas wells located on Site or on the surrounding sites.

4.9 Air Emissions

No strong, pungent or noxious odours were noted during the Site visit. There is no environmental concern associated with air emissions at the Site.

4.10 Water and Wastewater Discharges

The Site drainage follows the gently topographic slope eastward towards an unknown pond, as a catchment in the northeast and the Cambridge Bay in the southeast.

4.11 Waste Management, Handling and Landfill

At the time of the Site visit, there were no hazardous wastes and no additional wastes generated on the Site. The municipal of Cambridge Bay Hamlet collects waste on a weekly basis and waste is directed to the designated waste dump northeast of the hamlet (i.e. approximately 3.5 km northeast of the Site).

4.12 Material and Chemical Storage, Handling and Management

No material or chemical storage was observed on the Site at the time of inspection.

4.13 Spills and Releases

No evidence of spills or releases were observed on the Site and there is no record of spills on the proposed Site. One spill was reported close to the Tank Farm, approximately 216 m southeast of the proposed project Site, as indicated by the results of the HMSD search conducted by Englobe in September 2020. The spill occurred on June 5, 2017 and was caused by a pipe leak close to the Tank Farm, releasing approximately 1295 L (litres) of heating fuel.

4.14 Designated Substances

4.14.1 Asbestos-containing Materials

Regulation 25 of the 2018 Government of Nunavut Building Code Act R-009-2018 stipulates: "No building permit shall be issued, and no variance or alternative solution approved, where any of the materials, systems or equipment to be used includes asbestos in any form". Asbestos was used as a construction material for residential and commercial buildings from 1920 to 1986.

Englobe personnel observed during the Site visit that there are no buildings on Site to contain ACMs, and there is no construction debris present on site that could contain ACMs.

4.14.2 PCB-containing Materials and Equipment

The use of PCB dielectric fluids in electrical equipment such as transformers, fluorescent light ballasts and capacitors was a common industry practice up to approximately 1980. The Federal Chlorobiphenyls Regulation, SOR/91-152, prohibits the use of PCBs in this electrical equipment installed after July 1, 1980.

There are no buildings on Site to contain PCBs, and there is no construction debris present on Site that could contain PCB-containing materials and equipment.

4.14.3 Lead-based Paint

Although Lead-based Paints (LBP) were banned from use on exterior or interior surfaces of buildings, furniture or household products in the early 1970s, various commercial paints are still known to contain lead in concentrations greater than 0.5% by weight (e.g., road paint).

There are no buildings on Site to contain LBP, and there was no construction debris present on site that could contain LBP.

4.14.4 Mercury

Englobe did not observe any potential mercury-containing devices or equipment on Site during the reconnaissance.

4.14.5 Urea Formaldehyde Foam Insulation

Urea Formaldehyde Foam Insulation (UFFI) was commonly used as insulation in buildings between 1975 and 1978. The use of UFFI was banned across Canada on December 17, 1980.

There are no buildings on Site to contain UFFI, and there was no construction debris present on Site that could contain UFFI.

4.14.6 Ozone-depleting Substances

In 1987, Canada signed the Montreal Protocol on Substances that Deplete the Ozone Layer which involved the phase out of Ozone-depleting Substances (ODS). Currently, it has been agreed upon that developed countries must phase-out the production and consumption of hydrochlorofluorocarbons, which were used as transitional chemicals to replace more harmful ODS, by 75% in 2010, 90% in 2015, and completely by 2020. Therefore, these transitional ODS may still be in use and are typically found in refrigerants on heating, ventilation and air conditioning systems, refrigerators, coolers, and freezers.

No potential ODS sources were observed on the Site; therefore, ODS is not considered an environmental concern.

4.14.7 Radioactive Materials

Englobe did not observe any potential radioactive materials present on Site. A naturally-occurring radioactive materials survey was not completed as part of this Phase I ESA.

4.14.8 Radon Gas

Radon gas is a product of the natural decay series that begins with uranium. Radon is produced directly from barium, which can be commonly found in geologic materials that contain black shale and/or granite. In confined spaces (e.g., basements) it can be concentrated and become a health hazard.

Given that only low levels of radon are found in Nunavut soils and that Englobe did not observe any confined spaces on Site, Radon gas is not expected to be an area of environmental concern for the Site.

4.14.9 Potential for Mould

Englobe did not observe any evidence of mould during the Site reconnaissance.

4.15 Aboveground Storage Tanks

No evidence of Aboveground storage tanks (ASTs) was observed at the Site.

4.16 Underground Storage Tanks

No evidence of Underground Storage Tanks (USTs) was observed at the Site.

4.17 Phase I ESA Results

The results obtained from the Phase I ESA revealed the following Areas of Potential Environmental Concern (APEC):

- APEC 1: The documented spill site, approximately 216 m southeast of the Site and in close proximity to the tank farm; and,

- APEC 2: The off-Site presence of a gasoline and diesel service station and heating oil distribution center to the southeast of the Site.

However, due to their distance from the Site, these APECs are not considered to be problematic, as the likelihood of related on-Site environmental impacts is very low.

5 Summary and Conclusions

Englobe carried out a Phase I ESA for the proposed power plant location (Option 02) in Zone 13W in Cambridge Bay, Nunavut. The objectives of the Phase I ESA were to determine if the current and past usage of the Site and/or adjacent properties could have had an impact on soil and groundwater quality at the Site, and to identify APECs and PCOCs that could have resulted from past on-site activities and/or activities on neighbouring properties.

The following points summarize the findings of the Phase I ESA:

- The Site is vacant and is currently used as a golf course;
- The Site is bordered by a road and a vacant land to the west; and vacant land towards the west, north and south; and industrial district towards the southeast;
- The results from the site reconnaissance visit did not identify APECs for the Site;
- Records from the regulatory agencies due not reveal APECs that are considered problematic.

6 Recommendations

Based on the available information, no additional assessment is recommended for the Site.

7 References

LITERATURE CITED

CANADIAN STANDARDS ASSOCIATION (CSA). 2001. Z768-01 (R2006) – Phase I Environmental Site Assessment. Current as of 2006. Toronto, ON. ISBN: 1-55-324-599-7.

ECOLOG ERIS (ECOLOG ENVIRONMENTAL RISK INFORMATION SERVICES LTD.). 2020. EcoLog Environmental Risk Information Services Ltd.

FRANZ ENVIRONMENTAL INC. 2010. Phase II/III Environmental Site Assessment Draft Field Report, Cambridge Bay Airport, Cambridge Bay, Nunavut prepared for Public Works & Government Services Canada on behalf of Transport Canada. Vancouver, Canada.

GEOLOGICAL SURVEY OF CANADA. 2016. Surficial Geology Cambridge Bay, Nunavut, NTS 77-D and part of NTS 77-A. Available at https://doi.org/10.4095/297438.

MUNICIPALITY OF CAMBRIDGE BAY IN NUNAVUT TERRITORY. 2016. Cambridge Bay Community Plan, Cambridge Bay Community By-Law No. 288. Available at: http://www.cambridgebay.ca/sites/default/files Accessed November 2020.

NATURAL RESOURCES CANADA. 2014. Lands Survey System - CLSS Map Browser Available at: https://clss.nrcan-rncan.gc.ca/map-carte-eng.php. Accessed November 2020.

NATURAL RESOURCES CANADA, 2010. Cambridge Bay, Nunavut; Centre for Topographic Information. Canadian Topographic Maps 77-D/2, (ed. 02 ver. 00). Available at: https://geoscan.nrcan.gc.ca. Accessed November 2020.

NUNAMI JACQUES WHITFORD LIMITED. 2009. Contaminated Sites Inventory – Kitkmeot Region. Final Report.

THE HAMLET OF CAMBRIDGE BAY. 2015. Cambridge Bay Community Plan 2015 - 2035, Scale 1 : 300, 000. Available at https://cgs-pals.ca/.

SMITH, I. R. AND FORBES, D. L., 2014. Reconnaissance Assessment of Landscape Hazards and Potential Impacts of Future Climate Change in Cambridge Bay, Western Nunavut. Available at https://geoscan.nrcan.gc.ca. Accessed November 2020.

PERSONAL COMMUNICATIONS

GOVERNMENT OF NUNAVUT, DEPARTMENT OF JUSTICE, CORPORATE REGISTRIES, LEGAL REGISTRIES DIVISION (LAND AND TITLES OFFICE). Email communication on land titles and use on the study site and adjacent sites. email: corporate.registries@gov.nu.ca. Phone: (867) 975-6590.

GOVERNMENT OF NUNAVUT, KITIKMEOT REGIONAL LAND USE PLANNER. Corey Dimitruk. Email communications on the retrieval of any past environmental concerns on the study site. Email: cdimitru@gov.nu.ca. Phone: (867) 983-4012. November 2020.

GOVERNMENT OF NUNAVUT, KITIKMEOT REGIONAL LAND ADMINISTRATOR. Sophia Ohokanoak. Email and phone communications on the retrieval of information regarding present occupation and of any past environmental concerns on the study site and sites within the study area. Email: sohokanoak@gov.nu.ca. Phone: (867) 983-4020. December 2020.

HAMLET OF CAMBRIDGE BAY DEVELOPMENT OFFICER. KEVIN TAYLOR. Email communications on the retrieval of information regarding present occupation of the study site and sites within the study area. Email: ktaylor@cambridgebay.ca. Phone: (867) 983-4653. November 2020.

PUBLIC REGISTRIES

NUNAVUT IMPACT REVIEW BOARD: https://www.nirb.ca/

NUNAVUT PLANNING COMMISSION: https://lupit.nunavut.ca/portal/registry.php?public=notices

HAZARDOUS MATERIALS AND SPILL DATABASE: https://www.enr.gov.nt.ca/en/spills

FEDERAL CONTAMINATED SITES INVENTORY: https://www.tbs-sct.gc.ca/fcsi-rscf/home-accueil-eng.aspx

COMMUNITY PLANNING AND LANDS MANAGEMENT SYSTEM. Government of Nunavut Community & Government Services Planning & Lands Division https://cgs-pals.ca/

DEPARTMENT OF COMMUNITY AND GOVERNMENT SERVICES (https://www.gov.nu.ca/community-and-government-services). Community maps, zoning bylaw information and AutoCad files were downloaded from this site.

INTERVIEWS

NOVEMBER 6, 2020. CAMBRIDGE BAY DEVELOPMENT OFFICER. INTERVIEW CONDUCTED BY SHARATH SUKRUTHA, OF ENGLOBE CORP.

IMAGERY

ERIS HISTORICAL AERIALS (ECOLOG ENVIRONMENTAL RISK INFORMATION SERVICES LTD.). 2020. Stock aerial photographs 1958 and 1967.

NATIONAL AERIAL PHOTO LIBRARY. 1969. 20302100250

NATIONAL AERIAL PHOTO LIBRARY. 1975. 20302100250

NATIONAL AERIAL PHOTO LIBRARY. 1985. A26792_171

NATIONAL AERIAL PHOTO LIBRARY. 1990. A31573_116

NATIONAL AERIAL PHOTO LIBRARY. 1990. A31573_117

NATIONAL AERIAL PHOTO LIBRARY. 1991. A27750_182

NATIONAL AERIAL PHOTO LIBRARY. 1993. A27936_022

GOOGLE EARTH PRO V7.3.3.7786. (31/07/2006). CAMBRIDGE BAY, NUNAVUT. 69° 6'25.74"N, 105° 6'4.65"W, EYE ALT 844 FEET. (NOVEMBER 2020).

GOOGLE EARTH PRO V7.3.3.7786. (02/07/2010). CAMBRIDGE BAY, NUNAVUT. 69° 6'25.74"N, 105° 6'4.65"W, EYE ALT 844 FEET. (NOVEMBER 2020).

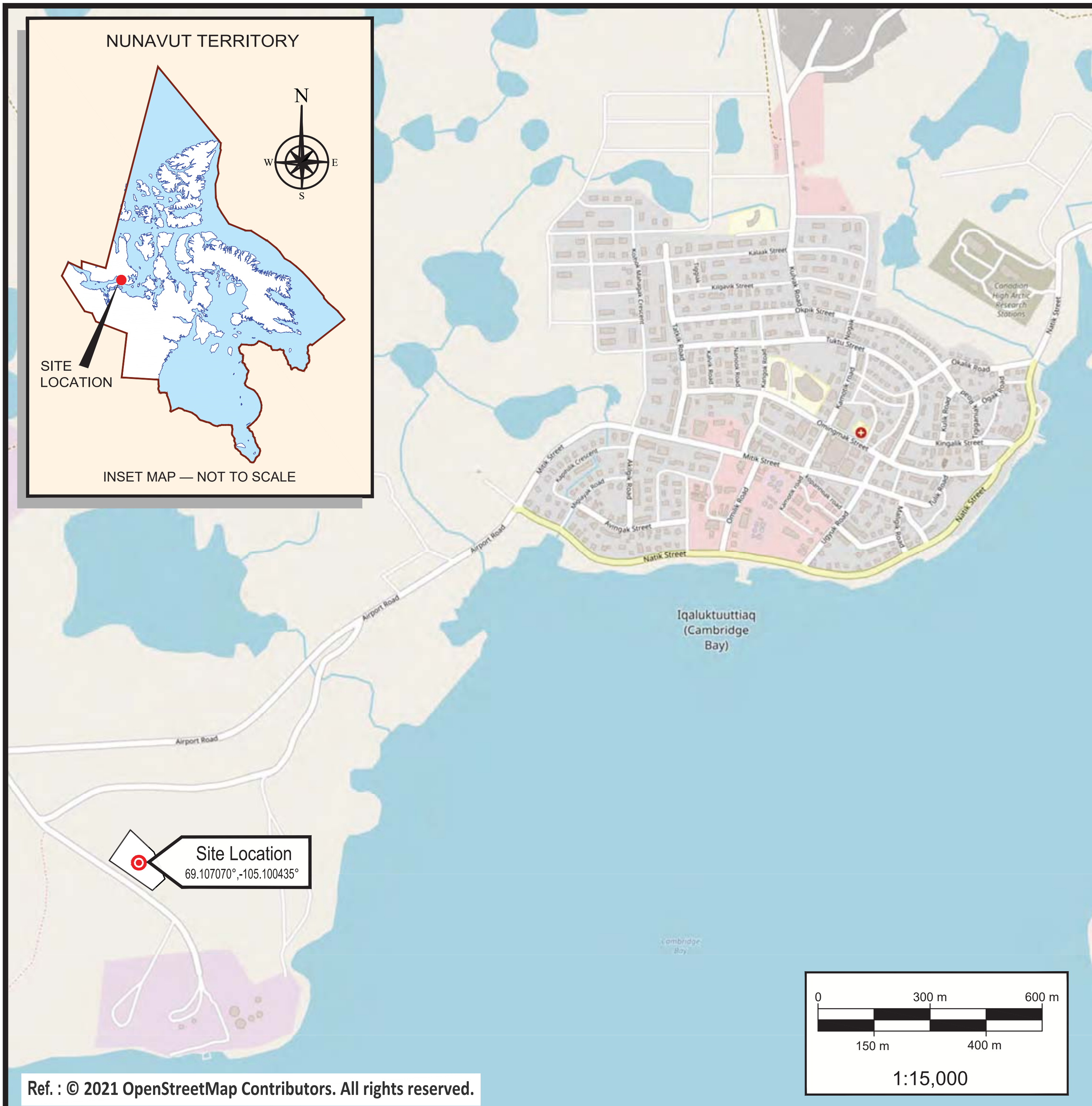
GOOGLE EARTH PRO V7.3.3.7786. (08/07/2011). CAMBRIDGE BAY, NUNAVUT. 69° 6'25.74"N, 105° 6'4.65"W, EYE ALT 844 FEET. (NOVEMBER 2020).

GOOGLE EARTH PRO V7.3.3.7786. (21/06/2017). CAMBRIDGE BAY, NUNAVUT. 69° 6'25.74"N, 105° 6'4.65"W, EYE ALT 844 FEET. (NOVEMBER 2020).

GOOGLE EARTH PRO V7.3.3.7786. (26/07/2019). CAMBRIDGE BAY, NUNAVUT. 69° 6'25.74"N, 105° 6'4.65"W, EYE ALT 844 FEET. (NOVEMBER 2020).

GOOGLE EARTH PRO V7.3.3.7786. (31/07/2020). CAMBRIDGE BAY, NUNAVUT. 69° 6'25.74"N, 105° 6'4.65"W, EYE ALT 844 FEET. (NOVEMBER 2020).

FIGURES



A	FINAL	2021-02-12	D.W.	E.E.	P.G.
No.	Version	Date	By	Check.	Appr.

Qulliq Energy Corporation
Société d'énergie Qulliq
Qulliq Alruyaktuqtunik Ikumatjutiit

Englobe
16114, 114 Avenue NW
Edmonton, Alberta
T5M 2Z5
780-481-1416

PHASE I ENVIRONMENTAL SITE ASSESSMENT
PROPOSED POWER PLANT LOCATION
Cambridge Bay, Nunavut

SITE LOCATION – OPTION 02

Discipline : Environment		Prepared by : E. ELIJAH	Checked by : E. ELIJAH
Scale : 1:15,000		Drawn by : D. WILSON	Approved by : P. GINGRAS
Date : February 2021		Figure no. : FIGURE 1	
Layout : LS-OPTION 02	Paper size : LETTER (8.5" x 11")	Registration no. : ---	

Resp.	Project	Otp	Project/ Disc	Phase/ Type	Electronic ref./ Drawing no.	Rev.
140	P0023273.000-0100-0000	---	---	---	P0023273.000-0100-0000-LS-PHI-CAM.dwg	---

G:\141\CAD\Projects\P0023273.000-0100-0000\P0023273.000-0100-0000-LS-PHI-CAM.dwg

Ref. : © 2020 Microsoft / Earthstar Geographics / TomTom. All rights reserved.

N
W E
S

LEGEND

Proposed Site (12,076 m^2)

A — Geodetic Coordinate (Typical; see table)

Point	Northing	Easting	Elevation (masl)
A	7666385.41	495973.18	18.80
B	7666325.95	496036.37	19.09
C	7666254.06	496065.90	18.78
D	7666223.14	496032.31	18.83
E	7666310.63	495913.62	19.48

Datum is NAD83(CSRS) / UTM zone 13N

No.	Version	Date	By	Check.	Appr.
B	FINAL	2021-02-12	D.W.	K.B.	P.G.
A	PRELIMINARY	2021-01-13	D.W.	K.B.	P.G.

Qulliq Energy Corporation
Société d'énergie Qulliq
Qulliq Airuvaktuqtunik Ikumatjutiit

Englobe Corp.
16114, 114 Avenue NW
Edmonton, Alberta
T5M 2Z5
780-481-1416

0 60 120 m
30 90
1:3,000

PHASE I ENVIRONMENTAL SITE ASSESSMENT
PROPOSED POWER PLANT LOCATION
Cambridge Bay, Nunavut

Aerial Photograph showing
Proposed Site Coordinates – Option 02

Discipline :	Environment
Scale :	1:3,000
Date :	February 2021
Layout :	Paper size
OPTION 02	ANSI full bleed B (11.00 x 17.00 Inches)

Prepared by :	K. BUDD
Checked by :	K. BUDD
Drawn by :	D. WILSON
Approved by :	P. GINGRAS
Figure no. :	FIGURE 2
Registration no. :	—

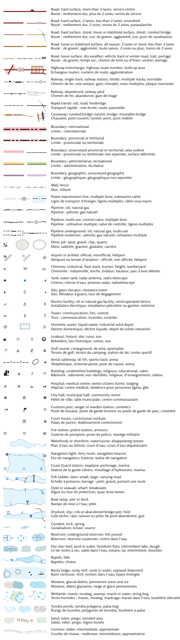
Resp.	Project	Otp	Project/ Disc	Phase/ Type	Electronic ref./ Drawing no.	Rev.
140	P0023273.000-0100-0000	---	---	---	P0023273.000-0100-0000-PL-PHI-CAM.dwg	--

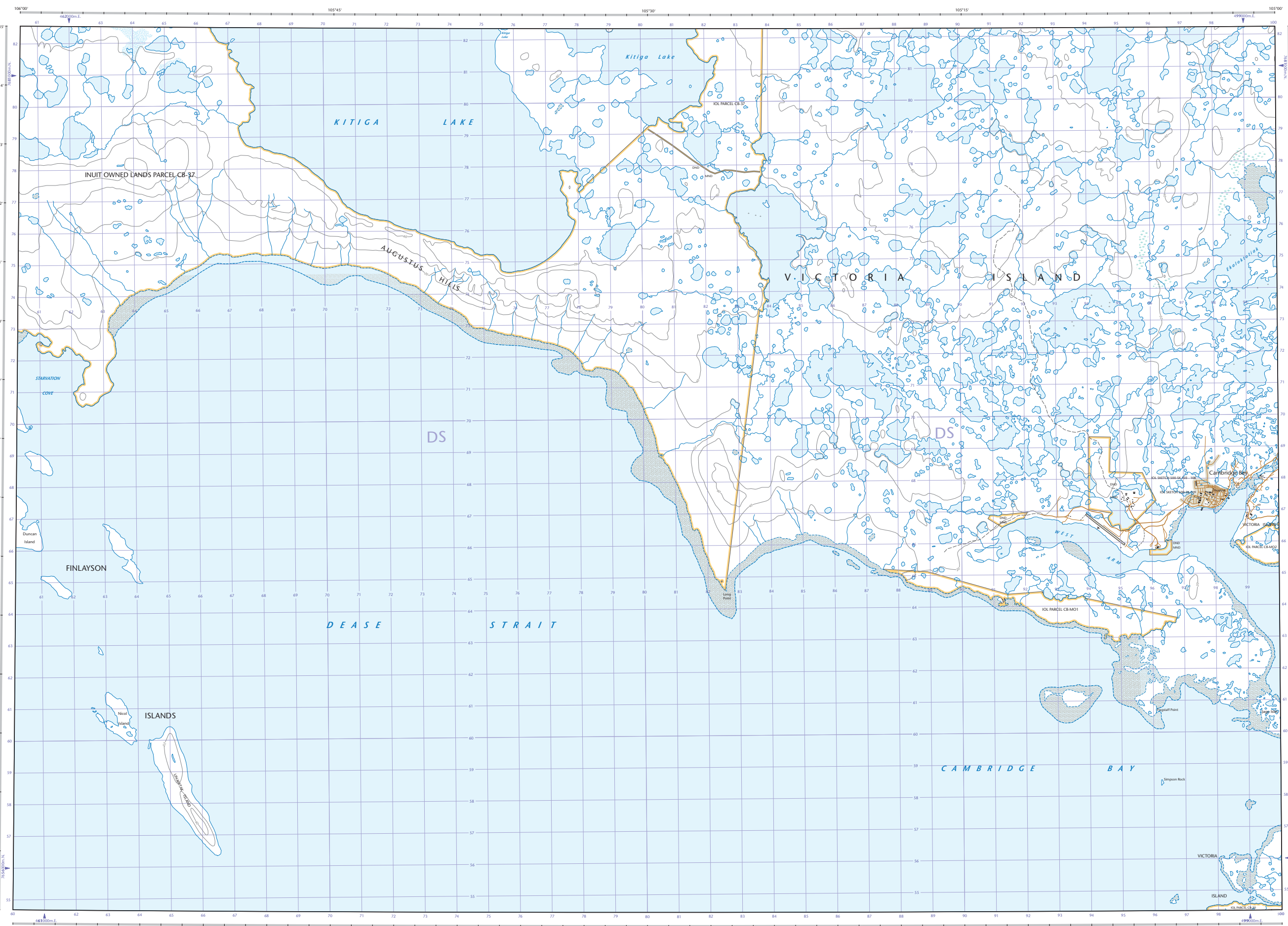
G:\1141\CAD\Projects\P0023273.000-0100-0000\P0023273.000-0100-0000-PL-PHI-CAM.dwg

Appendix A Topographic Survey

77-D/2

Canada





77-D/2 SCALE ÉCHELLE 1:50 000 EDITION ÉDITION 02

CAMBRIDGE BAY

Nunavut

69°30'			
	77-D/6	77-D/7	77-D/8
69°15'	77-D/3	77-D/2	77-D/1
69°00'	77-A/14	77-A/15	77-A/16
68°45'	107°00'	106°00'	105°00' / 104°00'

Canadian Topographic Maps / Cartes topographiques du Canada

Natural Resources Canada / Ressources naturelles Canada

ISBN 978-0-660-65098-2

Produced on July 27, 2010, by the Centre for Topographic Information, Natural Resources Canada.

Établie le 27 juillet 2010, par le Centre d'information topographique, Ressources naturelles Canada.

The paper copy of this map meets the print quality standards of Natural Resources Canada when it bears a Certified Map Printer holographic label.

La copie papier de cette carte respecte les normes de qualité d'impression de Ressources naturelles Canada quand elle porte l'étiquette holographique de l'imprimeur de cartes accrédité.

Map content validity dates
- Road network, 1996 - 2006
- Hydrographic network, 1999
- Vegetation, Absent
- Buildings, 1956
- Boundaries, 2005 - 2010
- Toponymy, 2004 - 2006

Detailed metadata can be found at: http://GeoGratis.gc.ca

For corrections, additions or comments concerning the content of this map, please contact Natural Resources Canada at: *topo.maps@NRCan.gc.ca*
Visit our Web site: *http://maps.NRCan.gc.ca*

This map is not to be used for air or marine navigation.

Dates de validité du contenu de la carte
- Réseau routier, 1996 - 2006
- Réseau hydrographique, 1999
- Végétation, Absent
- Bâtiments, 1956
- Limites, 2005 - 2010
- Toponymie, 2004 - 2006

Consultez les métadonnées détaillées sur : http://GeoGratis.gc.ca

Pour toutes corrections, additions ou commentaires concernant le contenu de cette carte, veuillez contacter Ressources naturelles Canada par courrier électronique à : *cartes.topo@RNCan.gc.ca*
Visitez notre site Web : *http://cartes.RNCan.gc.ca*

Cette carte ne doit pas être utilisée pour la navigation aérienne ou maritime.

CAMBRIDGE BAY

Nunavut

Scale **1:50 000** Échelle

1 centimetre on the map represents 500 metres on the ground
Contour Interval: 20 metres
Elevations in metres above Mean Sea Level

1 centimètre sur la carte représente 500 mètres au sol
Équidistance des courbes : 20 mètres
Altitudes en mètres au-dessus du niveau moyen de la mer

Use diagram only to obtain numeric values
Approximate Mean Declination 2010 for centre of map
Annual change decreasing 40.7'

N'utiliser le diagramme que pour obtenir les valeurs numériques
Déclinaison moyenne approximative au centre de la carte en 2010
Variation annuelle décroissante 40.7'

For magnetic declination information, visit: *http://gsc.NRCan.gc.ca/geomag*
Pour information sur la déclinaison magnétique, visitez : *http://cgc.RNCan.gc.ca/geomag*

The magnetic compass may be erratic in this region
La boussole sera peut-être instable dans cette région

0°28' (8 mils)
9°29' (165 mils)
Grid North • Nord du quadrillage
True North • Nord géographique
Magnetic North • Nord magnétique

100 000 metre Square Identification
Identification du carré de 100 000 mètres

DS

Transverse Mercator Projection
Projection transverse de Mercator
North American Datum 1983
Système de référence nord-américain 1983

1000 metre Universal Transverse Mercator Grid
Zone 13
Quadrillage universel transverse de Mercator de 1000 mètres

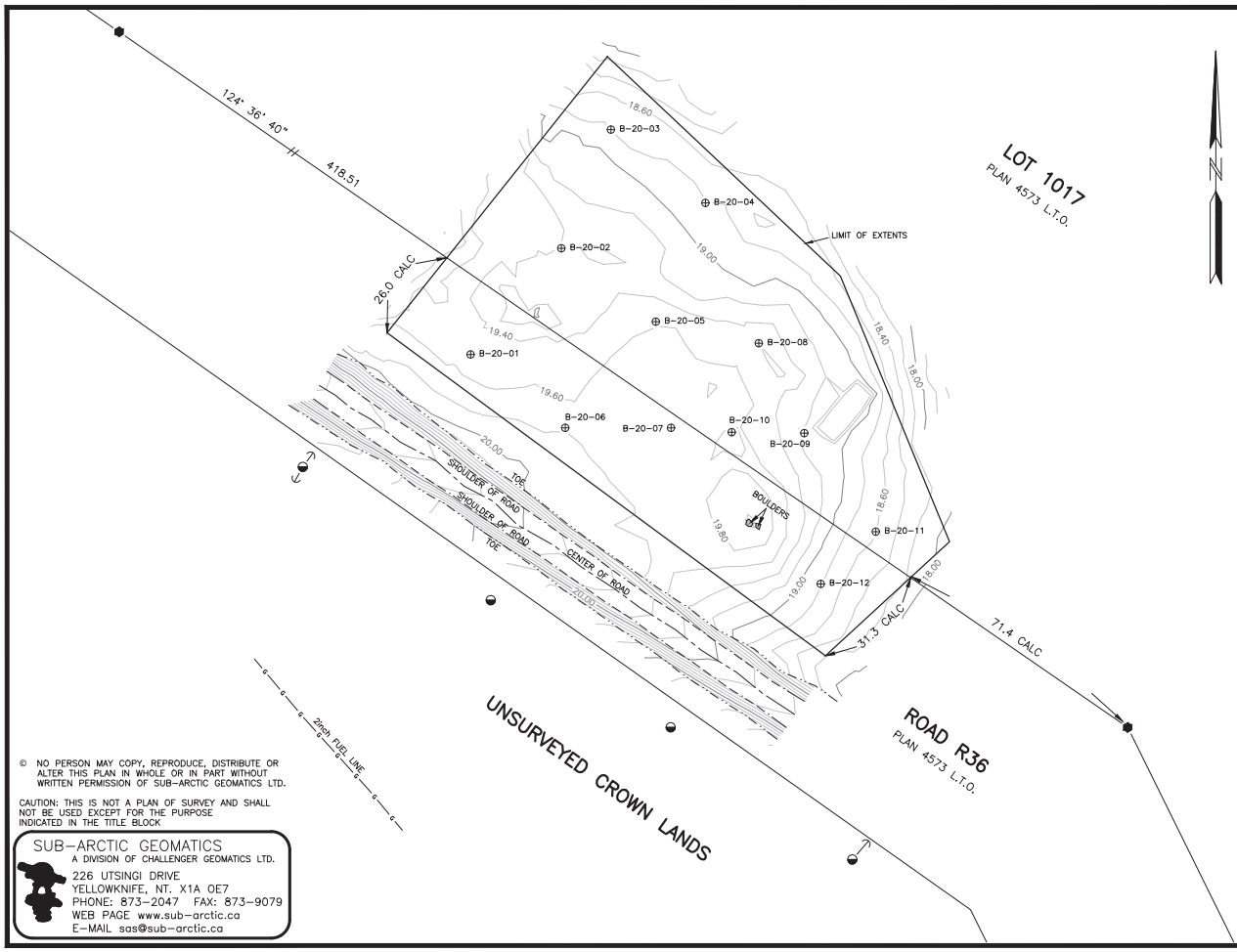
Grid Zone Designation
13W
Désignation de la zone du quadrillage

A tutorial on how to estimate position from the UTM grid can be found at: *http://maps.NRCan.gc.ca/topo101*
Consultez le tutoriel sur la manière d'évaluer la position à partir de la grille UTM sur : *http://cartes.RNCan.gc.ca/topo101*

77-D/2
SCALE ÉCHELLE 1:50 000
EDITION ÉDITION 02 VERSION VERSION 00
SERIES SÉRIE A713

Printed map / Carte imprimée
Cat. no. / No de cat.
M116-2/077D02
ISSN 1915-884X
ISBN 978-0-660-65098-2

Digital map / Carte numérique
Cat. no. / No de cat.
M116-2/077D02-PDF
ISSN 1915-8858
ISBN 978-1-100-50981-5



CAUTION: THIS IS NOT A PLAN OF SURVEY AND SHALL NOT BE USED EXCEPT FOR THE PURPOSE INDICATED IN THE TITLE BLOCK

SUB-ARCTIC GEOMATICS
A DIVISION OF CHALLENGER GEOMATICS LTD.
226 UTSINGI DRIVE
YELLOWKNIFE, NT. X1A 0E7
PHONE: 873-2047 FAX: 873-9079
WEB PAGE www.sub-arctic.ca
E-MAIL sas@sub-arctic.ca

NOTES:

DATE OF SURVEY: SEPTEMBER 24 AND 25, 2020

CONTOUR INTERVAL IS 0.20 METRES

ALL ELEVATIONS ARE EXPRESSED IN METRES OR DECIMALS THEREOF.

LOT STRUCTURE COPIED FROM N.T.S. ZONE MAPPING.

ELEVATIONS BASED ON CSRS-PPP OBSERVATIONS

UTM ZONE 13 NAD83
CGVD2013 DATUM

PROJECT# 501-7523

LEGEND:

BOREHOLE ..... ⊕
POWER POLE ..... ◒
GUY WIRE ..... ↗

NO.	REVISION\ISSUE	DATE:

DRAWN BY: J.N.
CHECKED BY: B.P.

ENGLOBE CORP.

TOPOGRAPHIC SURVEY
CAMBRIDGE BAY - NU
POTENTIAL POWER PLANT LOCATION

PROJECT NO.: 80590
FILE NO.:
80590-TOPO-0C26-REV1

DATE: OCTOBER 26, 2020

SCALE: 1:1000

Appendix B Historical Land Titles

Amanda Bruneski

From: Kevin Taylor <ktaylor@cambridgebay.ca>
Sent: December 3, 2020 4:25 PM
To: Katheryne Budd
Cc: Ekikere Elijah
Subject: RE: Land title request

Plan number #3120
QUAD 77D/2
NWS site
DnD Reserve (Department of National Defence)

Kevin Taylor
Development Officer
Hamlet of Cambridge Bay
Ph: 867-983-4653
Fx : 867-983-2193
ktaylor@cambridgebay.ca

From: Katheryne Budd [mailto:Katheryne.Budd@englobecorp.com]
Sent: December-03-20 4:10 PM
To: Kevin Taylor
Cc: Ekikere Elijah
Subject: Land title request

Hello,

I am presently working on a Ph I environmental site assessment and would like to Obtain a copy of the land title for lot 1005 (airport land) however the corporate registries department has request I supply them with the plan number associate with the lot.

Can you advise me of what Plan # references the lot 1005?

Best,

Katheryne

Katheryne Budd, B.A. Geog.

Project Manager
Environmental engineering, Northern & Western Canada
1200, S-Martin Blvd West, Suite 400, Laval (quebec) H7S 2E4
514.281.5151 ext. 122704 Cell. 514.260.8208
englobecorp.com

Amanda Bruneski

From: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Sent: December 10, 2020 7:25 AM
To: Corporate Registries
Cc: Ekikere Elijah
Subject: RE: request to get land titles for Phase I ESAs

Hello,

Thank you for verifying.

Best regards,

Katheryne

From: Corporate Registries <Corporate.Registries@gov.nu.ca>
Sent: Thursday, December 10, 2020 9:24 AM
To: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

Good morning,

No titles have been raised on LOT 1005 QUAD 77 D/02 PLAN 3120 either.

Kind regards,

Legal Registries Division (Land Titles Office)
Department of Justice
Government of Nunavut
P.O. Box 1000, Stn. 570, Iqaluit, NU, X0A 0H0
(p): (867)-975-6590
(f) : (867)-975-6594

Website: http://nunavutlegalregistries.ca

From: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Sent: December 9, 2020 4:10 PM
To: Corporate Registries <Corporate.Registries@gov.nu.ca>
Subject: RE: request to get land titles for Phase I ESAs

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi,

The email below mentions lot 1006, does a title exist for lot 1005?

Best,

katheryne

From: Corporate Registries <Corporate.Registries@gov.nu.ca>
Sent: Wednesday, December 9, 2020 3:27 PM
To: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

ATTENTION: Assurez-vous que le contenu soit de confiance avant d'ouvrir une pièce jointe ou un hyperlien.
CAUTION: Do not click on links or open attachments you do not trust.

Good afternoon,

No titles have been raised on LOT 1006 QUAD 77 D/02 PLAN 3120.

Kind regards,

Legal Registries Division (Land Titles Office)
Department of Justice
Government of Nunavut
P.O. Box 1000, Stn. 570, Iqaluit, NU, X0A 0H0
(p): (867)-975-6590
(f) : (867)-975-6594

Website: http://nunavutlegalregistries.ca

From: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Sent: December 4, 2020 5:07 PM
To: Corporate Registries <Corporate.Registries@gov.nu.ca>
Subject: RE: request to get land titles for Phase I ESAs

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello,
I have obtained the Cambridge bay lot number,

Cambridge bay lot 1005 : Plan number #3120
QUAD 77D/2
NWS site
DnD Reserve (Department of National Defence)

Would you accept the cc authorisation form via email for the purchase of the title?

Best,

Katheryne

From: Corporate Registries <Corporate.Registries@gov.nu.ca>
Sent: Thursday, December 3, 2020 5:18 PM
To: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

Good afternoon,

As per your request, please note the attached. Please note we can not provide a title search for "Cambridge bay : lot 1005 (airport Land)**"** as we required a Plan number.

The credit card has been charged $ 8.00.

Receipt#: M84008597-001-001-731-0
Auth#: 080093

The above information now serves as an official receipt. Physical copies of receipts will no longer be provided.

If you have any questions or require anything further, do not hesitate to contact our office.

Kind regards,

Legal Registries Division (Land Titles Office)
Department of Justice
Government of Nunavut
P.O. Box 1000, Stn. 570, Iqaluit, NU, X0A 0H0
(p): (867)-975-6590
(f) : (867)-975-6594

Website: http://nunavutlegalregistries.ca

From: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Sent: December 3, 2020 5:05 PM
To: Corporate Registries <Corporate.Registries@gov.nu.ca>
Subject: RE: request to get land titles for Phase I ESAs

Here is the form, Thank you

From: Corporate Registries <Corporate.Registries@gov.nu.ca>
Sent: Thursday, December 3, 2020 4:52 PM

To: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

Yes you can, the fee is $8.00 as we require a Plan number to search the last one.

Legal Registries Division (Land Titles Office)
Department of Justice
Government of Nunavut
P.O. Box 1000, Stn. 570, Iqaluit, NU, X0A 0H0
(p): (867)-975-6590
(f) : (867)-975-6594

Website: http://nunavutlegalregistries.ca

From: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Sent: December 3, 2020 4:35 PM
To: Corporate Registries <Corporate.Registries@gov.nu.ca>
Subject: RE: request to get land titles for Phase I ESAs

Hello, can I email the form back to you as I do not have a fax machine?

Can you confirm that the charge will be 3 x $4 = 12$ + txt?

From: Corporate Registries <Corporate.Registries@gov.nu.ca>
Sent: Thursday, December 3, 2020 4:30 PM
To: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Cc: Ekikere Elijah <eelijah@dstgroup.com>; Kiran Chandra Prakash <Kiran.ChandraPrakash@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

Good afternoon,

We have a attempted to charge the credit card provided but received a declined message. Can you please provide another card for payment, and respond to this email.

Kind regards,

Legal Registries Division (Land Titles Office)
Department of Justice
Government of Nunavut
P.O. Box 1000, Stn. 570, Iqaluit, NU, X0A 0H0
(p): (867)-975-6590
(f) : (867)-975-6594

Website: http://nunavutlegalregistries.ca

From: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Sent: December 2, 2020 2:22 PM
To: Corporate Registries <Corporate.Registries@gov.nu.ca>
Cc: Ekikere Elijah <eelijah@dstgroup.com>; Kiran Chandra Prakash <Kiran.ChandraPrakash@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

Hello,

I would like to confirm that I would like to proceed with the order of titles for the following two properties :

Kugaaruk : Lot 231 plan 4517
Kugaaruk : Lot 222 plan 4517
Cambridge bay : lot 1005 (airport Land)

We will be sending a cc authorisation form over shortly,

Many thanks,

katheryne

From: Corporate Registries <Corporate.Registries@gov.nu.ca>
Sent: Wednesday, December 2, 2020 1:08 PM
To: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

Good afternoon,

Yes we can confirm this is a fee simple title.

Would you like a copy of the title?

We did not receive your payment information, sometimes our fax machine doesn't always work.

If you have any questions or require anything further, do not hesitate to contact our office.

Kind regards,

Legal Registries Division (Corporate Registries)
Department of Justice
Government of Nunavut
P.O. Box 1000, Stn. 570, Iqaluit, NU, X0A 0H0

(p): (867)-975-6590
(f) : (867)-975-6594

Website: http://nunavutlegalregistries.ca
WP

From: Katheryne Budd <Katheryne.Budd@englobecorp.com>
Sent: November 22, 2020 2:24 PM
To: Corporate Registries <Corporate.Registries@gov.nu.ca>
Cc: Kiran Chandra Prakash <Kiran.ChandraPrakash@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

Hello,

In the context of Phase I ESAs, I am looking to get land title information on the following property :

Kugaaruk : Lot 231 plan 4517, can you confirm that this is a *fee simple title*?

Please see the credit card authorisation form for the processing fee, which will be faxed tomorrow (Englobe- Kugaaruk Lot 231 plan 4517 land title)

From: Corporate Registries <Corporate.Registries@gov.nu.ca>
Sent: Thursday, September 17, 2020 9:13 AM
To: Alix Rive <Alix.Rive@englobecorp.com>
Cc: Katheryne Budd <Katheryne.Budd@englobecorp.com>; Kiran Chandra Prakash <Kiran.ChandraPrakash@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

Good morning Alix,

Thank you for your email.

Please note, each one of the parcels listed below have a Fee Simple title. Having said this, to proceed there is a $4.00 fee for a copy of each title so I have included a pre authorization form which can be faxed to our office.

Please confirm how you would like to proceed.

If you have any questions or require anything further, do not hesitate to contact our office.

Kind regards,

Legal Registries Division (Land Titles Office)
Department of Justice
Government of Nunavut

P.O. Box 1000, Stn. 570, Iqaluit, NU, X0A 0H0
(p): (867)-975-6590
(f) : (867)-975-6594

Website: http://nunavutlegalregistries.ca

CC

From: Alix Rive <Alix.Rive@englobecorp.com>
Sent: September 15, 2020 3:33 PM
To: Corporate Registries <Corporate.Registries@gov.nu.ca>
Cc: Katheryne Budd <Katheryne.Budd@englobecorp.com>; Kiran Chandra Prakash <Kiran.ChandraPrakash@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello,
Here is the lot and plan information for the Kugaaruk sites option 1 and option 2.
Option #1 Lot 209/210 plan 4517
Option #2 Lot 220/221 plan 4517

Could I get the legal titles please (past and present) ?
Thanks,
Alix

ALIX RIVE, Biol., M.Sc
Project Manager
Environmental engineering, Northern Canada

Englobe
16114 – 114 Avenue NW
Edmonton (Alberta) T5M 2Z5 Canada
T 780.481.1416, ext. 104; **C 780-782-5637**
F 780.481.9008
alix.rive@englobecorp.com
www.englobecorp.com

Follow us :

From: Corporate Registries <Corporate.Registries@gov.nu.ca>
Sent: Wednesday, September 9, 2020 11:40 AM
To: Alix Rive <Alix.Rive@englobecorp.com>
Subject: RE: request to get land titles for Phase I ESAs

ATTENTION: Assurez-vous que le contenu soit de confiance avant d'ouvrir une pièce jointe ou un hyperlien.
CAUTION: Do not click on links or open attachments you do not trust.

Hi,

Unfortunately we cannot use the coordinates and satellite image to retrieve the legal descriptions.

Kind regards,

Legal Registries Division (Land Titles Office)
Department of Justice
Government of Nunavut
P.O. Box 1000, Stn. 570, Iqaluit, NU, X0A 0H0
(p): (867)-975-6590
(f) : (867)-975-6594

Website: http://nunavutlegalregistries.ca

From: Alix Rive <Alix.Rive@englobecorp.com>
Sent: September 9, 2020 1:30 PM
To: Corporate Registries <Corporate.Registries@gov.nu.ca>
Cc: LandTitleSearches <landtitlesearches@gov.nu.ca>
Subject: RE: request to get land titles for Phase I ESAs

Hello,
All I have is
Zone 17W Heavy Industrial and Nuna.
I don't have any site plans.

Are you able with the coordinates and satellite image to retrieve past and present land titles?

Thank you!

ALIX RIVE, Biol., M.Sc
Project Manager
Environmental engineering, Northern Canada

Englobe
16114 – 114 Avenue NW
Edmonton (Alberta) T5M 2Z5 Canada
T 780.481.1416, ext. 104; **C 780-782-5637**
F 780.481.9008
alix.rive@englobecorp.com
www.englobecorp.com

Follow us :

From: Corporate Registries <Corporate.Registries@gov.nu.ca>
Sent: Wednesday, September 9, 2020 9:53 AM
To: Alix Rive <Alix.Rive@englobecorp.com>
Cc: LandTitleSearches <landtitlesearches@gov.nu.ca>
Subject: RE: request to get land titles for Phase I ESAs

Good afternoon,

In order for our office to perform a title search, we require the legal description (Lot, Block (if any) and Plan number). Are you able to provide the legal descriptions?

Legal Registries Division (Land Titles Office)
Department of Justice
Government of Nunavut
P.O. Box 1000, Stn. 570, Iqaluit, NU, X0A 0H0
(p): (867)-975-6590
(f) : (867)-975-6594

Website: http://nunavutlegalregistries.ca

From: Alix Rive <Alix.Rive@englobecorp.com>
Sent: September 8, 2020 5:42 PM
To: LandTitleSearches <landtitlesearches@gov.nu.ca>
Subject: request to get land titles for Phase I ESAs

Hello,
In the context of Phase I ESAs, I am looking to get land title information on the following sites (their aerial photographs are attached with their UTM coordinates):

1) Cambridge Bay (1 site)
2) Gjoa Haven (1 site)
3) Igloolik (1 site)
4) Kugaaruk (1 site)
5) Chesterfield Bay (two sites)

Please confirm whether this is the right department to be sending this request, thank you very much for your help.

Have a good day,
Alix

ALIX RIVE, Biol., M.Sc
Project Manager
Environmental engineering, Northern Canada

Englobe
16114 – 114 Avenue NW
Edmonton (Alberta) T5M 2Z5 Canada
T 780.481.1416, ext. 104; **C 780-782-5637**
F 780.481.9008
alix.rive@englobecorp.com
www.englobecorp.com

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Appendix C Previous Environmental Reports

Contaminated Sites Inventory

KITIKMEOT REGION, NUNAVUT

FINAL REPORT

Prepared for:
Government of Nunavut
Department of Environment
Iqaluit, Nunavut

Prepared by:
Nunami Jacques Whitford Limited
Yellowknife, Northwest Territories

December 2009

JOB NO. 1027936

Executive Summary

Nunami Jacques Whitford Limited (NJWL) was retained by the Department of Environment (DoE) of the Government of Nunavut (GN) to conduct an inventory of contaminated sites within communities in the Kitikmeot Region of Nunavut.

DoE provided NJWL a list of potential contaminated sites for investigation located within the communities of Cambridge Bay, Gjoa Haven, Kugaaruk, Kugluktuk and Taloyoak. The sites were selected by DoE in order to try to identify actual or potential contaminants present, prioritize sites in terms of environmental risk and identify parties responsible for contamination confirmed on sites investigated.

During visits to each community, NJWL conducted interviews with DoE Conservation Officers and/or the Senior Administrative Officer to identify any additional sites requiring investigation.

Sixty-five sites were investigated between August 22 to September 19, 2007. Site investigations involved observation and documentation of site conditions and collection of soil and water samples. Background samples were collected in each community. Assessment of hydrocarbon impacts in soil was the primary focus of this investigation; however, other chemicals of concern [metals, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs)] were also assessed. Site summaries for each site are included in **Appendix A**.

Each site was scored using the National Contaminated Sites (NCS) scoring process. The results are as follows:

- 36 Class 1 Sites, having a high risk potential
- 26 Class 2 Sites, having a medium risk potential
- 1 Class 3 site, having a medium-low risk potential
- 3 Class I sites, requiring further investigation before they can be properly classified

The statements made in this Executive Summary text are subject to the limitations included in Section 6.0, and are to be read in conjunction with the remainder of this report.

Table of Contents

List of Tables

1 Introduction

Nunami Jacques Whitford Limited (NJWL) was retained by the Government of Nunavut (GN) to complete a Contaminated Sites Inventory in five (5) communities in the Kitikmeot Region of Nunavut, including:

- Taloyoak
- Kugaaruk
- Gjoa Haven
- Kugluktuk
- Cambridge Bay

The project was completed in accordance with NJWL's Proposal No. 1025718 titled *Proposal for Contaminated Sites Identification, Five Communities in the Kitikmeot Region, Nunavut*, dated June 21, 2007.

This report is presented in five sections. Section 1 of the report provides an overview of the work conducted, including the purpose and scope of work. The applicable regulatory framework is presented in Section 2. The methodology, summary of results and conclusions are present in Section 3. A summary of the NCS scoring and the analytical results of the background samples are present in Section 4. Section 5 consists of a discussion of technical issues and general recommendations. Summary information about each site investigated including site location, description, analytical results, NCS scoring and a site plan are provided in **Appendix A**. A table summarizing key information for all of the sites are presented in **Appendix B**. Analytical results of background sample analyses are presented in **Appendix C**. Laboratory certificates of analyses are included in **Appendix D**.

1.1 Objectives

The primary objectives of this project were to evaluate potential environmental risks associated with each site included in this inventory and to document site specific information so that the GN could:

1. Identify actual/potential environmental liabilities
2. Prioritize these sites according to risk
3. Determine responsible parties for identified environmental impacts

1.2 Scope of Work

The following scope of work was implemented to achieve the objectives listed above:

1. Background information for each site, where available, was reviewed to identify potential environmental concerns.
2. A visit was completed to each site to document site conditions, interview people knowledgeable of the sites and collect representative soil and water samples for laboratory analyses of potential chemicals of concern.
3. Data analysis and reporting.

Specifically, NJWL gathered the following information for each site as best as practicable:

1. Site name(s)
2. Location
3. GPS Coordinates (Latitude/Longitude)
4. Size (area)

5. Site description
6. Site history
7. Current and former land use(s)
8. Current and former property owners/occupants
9. Actual/potential contaminants of concern (CoCs)
10. Responsible parties
11. Sources of information reviewed
12. Photographic records
13. Site layout (Preparation of Site Plans)
14. Analytical Results Compilation and Interpretation

2 Regulatory Framework

All sites investigated under this project are located within municipal boundaries; therefore, the GN has regulatory authority for the assessment and management of contaminants. The GN's Environmental Guideline for Site Remediation (2002) focuses on petroleum hydrocarbons (PHCs) whilst the GN's Environmental Guideline for Industrial Waste Discharges (2002) addresses the discharge of effluents generated from industrial activities.

In addition to these criteria, the GN has adopted the Canadian Council of the Minister of the Environment (CCME) Environmental Quality Guidelines (soil and water) and Canada-Wide Standards (CWS) for PHCs in Soil. Soil and water sample analytical results were compared to GN criteria, or where GN criteria did not exist, relevant CCME criteria as outlined below. Analytical results for soil samples were compared with commercial land use criteria where surrounding land use was primarily commercial; residential land use criteria were applied where surrounding land use was predominantly residential. Where sensitive environmental receptors were located in proximity to the Site, the most protective regulatory criteria (residential criteria) were applied.

2.1 GN Environmental Guideline for Site Remediation

Issued under the authority of the territorial *Environmental Protection Act* (EPA) the GN Environmental Guideline for Site Remediation contains remediation guidelines for soil. Remediation criteria are presented for benzene, toluene, ethyl benzene and xylenes (collectively known as BTEX); total petroleum hydrocarbons (TPH); and, polychlorinated biphenyls (PCBs) for agricultural, residential/parkland, commercial and industrial land uses.

2.2 GN Environmental Guideline for Industrial Waste Discharges

Issued under the authority of the territorial *Environmental Protection Act* (EPA) the Environmental Guideline for Industrial Waste Discharges contains guidelines for the discharge of effluent into municipal systems. The Schedule II standards apply to non-point source discharges, such as surface runoff, from industrial sources to storm sewers, ditches and other areas for containment, routing and disposal.

2.3 CCME CWS for PHCs in Soil

The CCME CWS for PHCs in Soil (2001) are typically used as a preliminary means of evaluating PHCs in soil at federal sites. CWS have also been adopted by some provincial and territorial agencies, including Nunavut.

CWS criteria are dependent on the nature of the hydrocarbon type. That is, the CWS group PHCs into four practical fractions (F1, F2, F3 and F4) with different criteria for each. CWS guidelines have been developed based on land use, soil type and soil depth. Different generic levels exist for "Agricultural", "Residential", "Commercial" and "Industrial" sites and are based on coarse-grained soil versus fine-grained soil. The standards also change with depth of soil as related to exposure. Allowable concentrations for surface soil [less than 1.5 metres below grade (mbg)] are different from those for subsurface soil (that which is deeper than 1.5 mbg).

In addition to land use and soil characteristics, additional generic criteria have been developed according to exposure pathways. If potential exposure pathways can be identified at a site, different generic levels exist for exposure pathways including soil ingestion, dermal contact, vapour inhalation, protection of

groundwater for aquatic life, protection of groundwater for livestock watering, nutrient cycling, eco-soil contact, eco-soil ingestion, produce and offsite migration.

The following factors were used to select remediation criteria for each site:

- the “Eco Soil Contact” pathway is determined to be the applicable exposure pathway in most situations
- in cases where the project team was able to access the interior of buildings or assess that Site buildings were built on engineered foundations, the “Inhalation of Indoor Air” pathway was determined to be the applicable exposure pathway
- surface soil criteria are applicable as all soil samples were collected from less than 1.5 metres below grade
- soil types are either fine grained or coarse grained depending on site specific conditions
- commercial or residential criteria as determined by surrounding land use

2.4 CCME Canadian Soil Quality Guidelines

The CCME Canadian Soil Quality Guidelines (SQGs) for the Protection of Environmental and Human Health (last updated 2007) are risk-based and are typically used to evaluate soil. The soil quality guidelines have been developed based on land use; different guidelines exist for “Agricultural”, “Residential/Parkland”, “Commercial”, and “Industrial” sites. Based on the same land use considerations presented above, analytical results are compared to either commercial or residential land use criteria.

2.5 CCME Canadian Water Quality Guidelines

The CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (updated 2006) are risk-based, and are typically used as a preliminary means of evaluating surface water. The water quality guidelines are also used as a preliminary means of evaluating groundwater (or melt water) where sample locations are near a perennial surface water body and have been developed for both freshwater and marine receptors.

Analytical results from water samples are compared with the criteria for the protection of Freshwater Aquatic Life (FAL) when the sample is from a water source which does not drain directly to the marine environment. Where water samples have been collected from a source which drains directly to the marine environment, the criteria for the protection of Marine Aquatic Life (MAL) are applied.

2.6 CCME National Classification System for Contaminated Sites

The CCME National Classification System for Contaminated Sites (1992) was developed as a method for evaluating contaminated sites according to their current or potential adverse impact on the environment and as a means for the comparable assessment of contaminated sites across Canada. The NCS is meant to be used as a tool for the classification and prioritization of contaminated sites for action rather than a general or quantitative risk assessment. The NCS evaluates the hazard potential of a site by scoring characteristics grouped under three categories:

- contaminant characteristics – the quantity and nature of the wastes stored on-site
- exposure pathways – the route a contaminant may follow to a receptor
- receptors – resources that may be exposed to contamination

Completed NCS Scoring forms for each site can be found with the Site Summaries in **Appendix A**.

2.7 Sites Inventory

The original list of 53 sites to be included in this inventory was identified by the GN during the proposal stage. It is understood that this list was generated from various sources including records of previous environmental work, spill records and local/regional knowledge. An additional 16 sites were added to the inventory during field activities based on the results of interviews and other information. Table 2-1 on the following page presents the list of the sites assessed in each community. Three of the original sites identified by the GN could not be found by the field team during the community visits: these sites are identified on Table 2-2.

Table 2-1 Kitikmeot Region – Sites Visited

Site Number	Site Name[1]		Site Number	Site Name[1]
Cambridge Bay			**Kugluktuk *continued***	
MLCB001	Solid Waste Disposal		MLKG004	Tank Farm
MLCB002	Sewage Disposal Facility		MLKG012	Arctic Coast[2]
MLCB006	Metals Dump		MLKG009	Used Oil Storage[4]
MLCB010	Loran Tower		MLKG007	Metals Dump
MLCB007	Doctor's Residence 500SK294		MLKG006	Old Landfill
MLCB014	Airport		MLKG001	Solid Waste Disposal
MLCB017	Former DPW Site[2]		MLKG003	Quarry
MLCB018	Float Base[2]		MLKG002	Sewage Disposal Facility
MLCB009	Old Dump Near Town Water Supply		**Gjoa Haven**	
MLCB013	Industrial Park Area		MLGH015	Hamlet Garages[2]
MLCB004	Tank Farm		MLGH003	Quarry
MLCB005	Power Plant		MLGH002	Sewage Disposal Facility
MLCB016	Old Fred Ross Site[2]		MLGH007	Old Dumpsite Across the Bay
MLCB008	Cambridge Bay Renewable Resources Office Blk.2, Lot 15, Plan 2649		MLGH009	Old Dumpsite NE of Community near Airport

Table 2-1 Kitikmeot Region – Sites Visited (cont'd)

Site Number	Site Name[1]		Site Number	Site Name[1]
Cambridge Bay			**Gjoa Haven**	
MLCB003	Quarry		MLGH001	Solid Waste Disposal
MLCB012	Old Barrel Dump on Road to DND Station		MLGH008	Old Dumpsite at South End of Community
MLCB015	Drum Incineration Site[2]		MLGH011	Old Power Plant[2]
Taloyoak			MLGH013	Cap Garage by Airport[2]
MLTA014	Hamlet Garage[2]		MLGH006	Old Tank Farm
MLTA005	Power Plant		MLGH010	Airport
MLTA010	Boneyard		MLGH004	Tank Farm
MLTA013	Crusher Area[2]		MLGH005	Power Plant
MLTA007	Hamlet Area		MLGH012	Water Lake[2]
MLTA012	Area SW of Former Tank Farm[2]		MLGH014	Cap Garage by Hamlet Garages[2]
MLTA003	Quarry		**Kugaaruk**	
MLTA001	Solid Waste Disposal[3]		MLKU007	Metals Dump and Used Oil Storage
MLTA002	Sewage Disposal Facility		MLKU003	Quarry
MLTA006	NPC Bioremediation Site		MLKU001	Solid Waste Disposal
MLTA011	Airport		MLKU004	Tank Farm
MLTA009	Old Dumpsite		MLKU002	Sewage Disposal Facility
MLTA004	Tank Farm		MLKU010	Kudlik Construction Site[2]
Kugluktuk			MLKU009	Hamlet Garage[2]
MLKG011	Shoreline Buried Drums[2]		MLKU008	Airport
MLKG005	Power Plant		MLKU005	Power Plant
MLKG010	Airport		MLKU006	Old Tank Farm

NOTES:

[1] The Site names listed are as they were provided by the GN to NJWL.

[2] Sites not included in the original scope of work, but were added to the inventory by the field team during community site visits.

3 Solid Waste Disposal Facility and the Used Oil Storage Site (MLTA008) located in Taloyoak, NU were combined into one as the Sites were in close vicinity of each other. The Used Oil Storage Site description has been incorporated into the Solid Waste Disposal Facility Site Summary (MLTA001) provided in **Appendix A**.

4 Used Oil Storage and Battery Storage Sites located in Kugluktuk, NU were combined into one as the Sites were in close vicinity of each other. The Battery Storage Site description has therefore been incorporated into the Used Oil Storage Site Summary (MLGK009) provided in **Appendix A**.

Table 2-2 Kitikmeot Region – Sites Not Found

Site Number	Site Name	Community
MLCB011	Old RCMP Site	Cambridge Bay

3 Methodology

Activities completed during preparation of the Contaminated Sites Inventory are summarized in this section.

3.1 Information Review

Prior to the site visit available information about each of the original sites was reviewed. Information included Hazardous Materials Spills Database reports, previous environmental reports and any additional information provided by the GN. The intent of the information review was to try and identify potential areas of environmental concern for investigation during the community visits.

3.2 Site Investigations

The GN Contaminated Sites Inventory was completed from August 22 to September 19, 2007 by Patricia Coyne of NJWL. Mr. Jamessee Moulton of DoE accompanied the NJWL field assessor during the site visits.

3.2.1 Health and Safety

A project specific Health and Safety Plan was prepared and submitted to DoE for review prior to conducting the site visits. A copy of the Health and Safety Plan was maintained on-site for the duration of each site visit. Prior to conducting field work at each site, a “Last Minute Risk Assessment” health and safety meeting was completed with NJWL and DoE personnel. Personnel on-site were made aware of the Health and Safety Plan, the location of emergency contact numbers, and site specific hazards. NJWL field personnel complied with applicable internal NJWL Safe Work Practices for the field tasks completed. No health and safety incidents or near misses occurred during the site assessment.

3.2.2 Work Plan / Field Methodologies

The field component consisted of two main activities, the community interviews and the site visits to each of the sites identified.

The community interviews typically included interviews with the local DoE Conservation Officers and/or the Senior Administrative Officer (SAO) for the municipality. During the interview, the list of contaminated sites outlined by DoE was reviewed and other potential areas of environmental concern were identified. In some locations, interviews were also held with knowledgeable community members to gather additional information. This information gathered from interviews was reviewed and where applicable, site inventories were updated.

The site investigations included visual observation and documentation of site conditions, collection of samples, photo documentation and preparation of a site plan. The NJWL field team toured the site and took extensive notes to highlight areas of concern such as surface staining or areas of contaminant storage. A site diagram was sketched out as part of the field notes. These notes were used to develop the site descriptions and the drawings found in the site summaries in **Appendix A**. The NJWL field team also took digital photographs of buildings and other features of interest on-site. The photographs taken by the field team are all contained on the DVD accompanying this report.

3.2.2.1 Sample Collection

NJWL field staff examined the site and selected potential sample locations. Surface soil samples were gathered at locations likely to be impacted such as areas of surface staining or areas immediately down gradient of contaminants of concern. Soil samples were collected by hand excavation of shallow test pits using shovels. Groundwater and surface water samples were also obtained from several sites where contamination of groundwater and surface water was a concern.

Sample locations are marked on the site diagrams located in **Appendix A**.

Field Screening

Field screening of soil samples for the presence of combustible soil vapours (CSV) was conducted using a portable GasTechtor 1238ME (GasTechtor) calibrated to a hexane standard with methane elimination. Soil samples subjected to vapour screening were collected in resealable plastic bags. Each bag was approximately half filled with soil to provide adequate headspace for the accumulation of released vapours. Cohesive samples were broken by hand to increase surface area and permit vapour release. Prior to conducting vapour screening, plastic bags were left to stand upright, undisturbed and allowed to reach ambient room temperature.

The concentration of accumulated hydrocarbon and organic vapours in the headspace was then measured by inserting the probe of the GasTech into the headspace of the bag. The CSV concentrations were measured in parts per million (ppm) or percent of the Lower Explosive Limit (% LEL) relative to hexane. The measurements were recorded on a field log for comparison with subsequent samples.

The sites visited during the inventory consisted of sites with aged fuels. Because of the degradation of CSV over time, the effectiveness of CSV screening was limited. Most soil samples obtained were submitted for analysis of PHCs, including volatile hydrocarbons. As a result, NJWL field personnel determined that the CSV screening was not effective and it was subsequently discontinued.

Laboratory Analysis

Select soil and water samples were submitted to Maxxam Analytics in Edmonton, Alberta for laboratory analysis of chemicals of concern (CoCs). Maxxam Analytics is accredited by the Standards Council of Canada and their methodologies conform to Standard CAN-P-4E/ISO/IEC 17025:2005. Maxxam is also CAEAL accredited for the surface water analysis completed as part of this site assessment. The analytical tests to be performed on a particular sample were determined by several factors;

- CoCs identified during the proposal stage
- Field observations
- Visual and olfactory evidence of impacts
- Relative sample locations to suspected contaminant source(s)

The Laboratory Certificates of Analyses contained in **Appendix D** include a complete schedule of the samples submitted for analysis. The results of sample analysis can be found in the tables in **Appendix A**.

Laboratory Quality Assurance / Quality Control

The following section discusses information regarding QA/QC sampling procedures completed during site assessment. A QA/QC review was performed to assess the reliability of the data for the purposes of the project. The review consisted of evaluating holding times and general laboratory comments. Blind field duplicate samples and laboratory duplicate samples were not analyzed during this project.

Sample Handling

All samples were collected following standard NJWL sampling procedures. Samples were uniquely labelled and control was maintained through the use of chain of custody forms. Collected samples were placed in laboratory supplied sterile containers and were stored/shipped in dedicated coolers and kept cool with ice and by the cool ambient temperatures during field activities. When necessary, samples were stored in a refrigerator at the NJWL office in Yellowknife prior to shipping.

Laboratory Comments

In addition to reporting the analytical results provided by the laboratory, NJWL completed a review of general comments provided in the laboratory certificates of analysis. Comments in the laboratory certificates discuss and provide rationale/implications of QA/QC issues such as poor sample duplicate agreement, elevated detection limits, and interference from other parameters that may be present but were not analyzed. There were no laboratory comments included with the certificates of analysis indicative of quality issues related to the collection, handling or shipping of samples from this project.

3.2.2.2 Background Sampling

As part of the work plan, the project team collected two background surface soil samples in each of the communities. The samples were submitted to the laboratory for analysis of PHCs and metal concentrations. The analytical results are summarized in the tables located in **Appendix C**.

3.2.3 Data Analysis and Reporting

Upon completion of field investigations and receipt of laboratory certificates, NJWL commenced the analysis of data and report preparation. Field observations, analytical results and NCS scoring were summarized into individual Site Summaries for each site investigated. Each Site Summary also provides conclusions and recommendations about each site. Site Summaries are grouped by community in **Appendix A**. Summary results are presented in Section 4 of this overview report section.

4 Results

4.1 Sites

Table 4-1 presents the results of the NCS scoring for each site and recommended follow-up action. Detailed results, conclusions and recommendations for each site are included in the Site Summaries in **Appendix B**.

Table 4-1 Summary of NCS Scoring for all Sites

Site Number	Site Name	NCS Score	Recommended Additional Work
CLASS 1 SITES – High Risk Potential			
MLCB006	Cambridge Bay Metals Dump	77 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA007	Taloyoak Hamlet area	77 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH008	Gjoa Haven Old Dumpsite at South End of Community	76 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG011	Kugluktuk Shoreline Buried Drums	76 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA005	Taloyoak Power Plant	76 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG005	Kugluktuk Power Plant	75 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKU001	Kugaaruk Solid Waste Disposal	75 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH011	Gjoa Haven Old Power Plant	75 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH007	Gjoa Haven Old Dumpsite Across the Bay	75 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG012	Kugluktuk Arctic Coast	74 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG009	Kugluktuk Used Oil Storage	74 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKU005	Kugaaruk Power Plant	74 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant

Table 4-2 Summary of NCS Scoring for all Sites (cont'd)

Site Number	Site Name	NCS Score	Recommended Additional Work
CLASS 1 SITES – High Risk Potential			
MLKU009	Kugaaruk Hamlet Garage	74 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA001	Taloyoak Solid Waste Disposal	74 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB016	Cambridge Bay Old Fred Ross Site	74 +/- 1	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG006	Kugluktuk Old Landfill	73 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKU010	Kugaaruk Kudlik Construction Site	73 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKU008	Kugaaruk Airport	73 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB005	Cambridge Bay Power Plant	73 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA014	Taloyoak Hamlet Garage	73 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB017	Cambridge Bay Former DPW Site	73 +/- 1	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB018	Cambridge Bay Float Base	73 +/- 1	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH005	Gjoa Haven Power Plant	72 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH014	Gjoa Haven Cap Garage by Hamlet Garages	72 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH015	Gjoa Haven Hamlet Garages	72 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB004	Cambridge Bay Tank Farm	72 +/- 1	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant

Table 4-1 Summary of NCS Scoring for All Sites (cont'd)

Site Number	Site Name	NCS Score	Recommended Additional Work
MLCB012	Cambridge Bay Old Barrel Dump on Road to DND Station	72 +/- 1	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKU004	Kugaaruk Tank Farm	71 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB003	Cambridge Bay Quarry	71 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB014	Cambridge Bay Airport	71 +/- 1	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH001	Gjoa Haven Solid Waste Disposal	70 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG001	Kugluktuk Solid Waste Disposal	70 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG010	Kugluktuk Airport	70 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH004	Gjoa Haven Tank Farm	70 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB 015	Cambridge Bay Drum Incineration Site	70 +/- 1	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB010	Cambridge Bay Loran Tower	70 +/- 1	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
CLASS 2 SITES – Medium Potential			
MLGH013	Gjoa Haven Cap Garage by Airport	68 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG003	Kugluktuk Quarry	67 +/- 5	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH002	Gjoa Haven Sewage Disposal Facility	67 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant

Table 4-1 Summary of NCS Scoring for all Sites (cont'd)

Site Number	Site Name	NCS Score	Recommended Additional Work
CLASS 2 SITES – Medium Potential			
MLKU007	Kugaaruk Metals & Used Oil Storage	69 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB002	Cambridge Bay Sewage Disposal Facility	68 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA004	Taloyoak Tank Farm	68 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA010	Taloyoak Boneyard	68 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA006	Taloyoak NPC Bioremediation Site	68 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH010	Gjoa Haven Airport	67 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG004	Kugluktuk Tank Farm	67 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB013	Cambridge Bay Industrial Park Area	67 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA013	Taloyoak Crusher Area	67 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKU003	Kugaaruk Quarry	65 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG002	Kugluktuk Sewage Disposal	64 +/- 6	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA002	Taloyoak Sewage Disposal Facility	64 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKG007	Kugluktuk Metals Dump	63 +/- 6	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH009	Gjoa Haven Old Dumpsite NE of Community near Airport	63 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB007	Cambridge Bay Doctor's Residence 500SK294	63 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant

Table 4-1 Summary of NCS Scoring for All Sites (cont'd)

Site Number	Site Name	NCS Score	Recommended Additional Work
CLASS 2 SITES – Medium Potential			
MLCB008	Cambridge Bay Renewable Resources Office Blk.2, Lot 15, Plan 2649	63 +/- 1	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB001	Cambridge Bay Solid Waste Disposal	62 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA012	Taloyoak Area SW of Former Tank Farm	63 +/- 7	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLCB009	Cambridge Bay Old Dump near Town Water Supply	61 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA009	Taloyoak Old Dumpsite	60 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLTA011	Taloyoak Airport	59 +/- 2	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLKU002	Kugaaruk Sewage Disposal Facility	58 +/- 4	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
MLGH003	Gjoa Haven Quarry	51 +/- 3	Phase I / II ESA, Develop & Implement a Monitoring Plan. Further Work is the responsibility of the Site Occupant
CLASS 3 SITES – Medium Low Potential			
MLTA003	Taloyoak Quarry	45 +/- 2	No further assessment required
CLASS I SITES – Indeterminate Potential			
MLGH012	Gjoa Haven Water Lake	61 +/- 20	Further assessment is required before the site can be classified
MLKU006	Kugaaruk Old Tank Farm	53 +/- 15	Further assessment is required before the site can be classified
MLGH006	Gjoa Haven Old Tank Farm	53 +/- 15	Further assessment is required before the site can be classified

4.2 Background Conditions

Concentrations of contaminants of concern exceeding CCME guidelines were not found in the background samples collected in Cambridge Bay, Gjoa Haven, Kugaaruk and Taloyoak. Low level concentrations of PHCs were detected in some of the background samples.

Elevated concentrations of chromium (93mg/kg versus a guideline of 87mg/kg) and nickel (59mg/kg versus a guideline of 50mg/kg) exceeding the Commercial CCME CSQG were detected in the background surface soil sample KUG-BK-01 from Kugluktuk. A closer examination of the other samples

analysed for soil metals from Kugluktuk illustrates that elevated concentrations of both nickel (between 16-33mg/kg) and chromium (between 13-30 mg/kg) were detected. Other metals including arsenic, barium, cadmium, cobalt, copper, lead, vanadium and zinc were detected in all the soil samples from Kugluktuk.

It is unlikely that these concentrations would be naturally occurring so it would be reasonable to assume that the contamination could have been caused by an event such as a localized and unreported spill or as the result of cross contamination of the sampling equipment.

5 Discussion and Recommendations

5.1 Discussion

The following section provides a brief discussion of technical issues and areas of concern that were observed on a regular bais during the reporting process.

- Regulatory Framework - As discussed in Section 2.0, Sites investigated during this project are under the jurisdiction of the GN. NJWL has applied the guidelines/ standards/ criteria from various jurisdictions for other environmental investigations where no applicable provincial or federal criteria exist, and has obtained regulatory acceptance.
- Exposed Liner Material - It was noted at several Sites that the liner systems associated with containment cells have been exposed. The liner materials can easily damaged by heavy equipment and exposure to the elements; therefore, compromising the ability of the containment cell to contain spills.
- Aboveground Storage Tanks (ASTs) - Generally, buildings in each of the communities visited during this project are heated using heating oil; therefore, the buildings on and adjacent to the Site each have an AST. The ASTs are considered an area of environmental concern due to the potential fuel leakage during normal activities. Adjacent properties with ASTs located up or cross gradient of the Site are considered areas of environmental concern due to potential contaminant migration onto the subject Site.
- CCME National Classification System for Contaminated Sites (2008) Scoring - The CCME NCS scoring utilizes a very conservative model which may overstate the severity of the potential environmental hazards at the Site. During the completion of the scoring NJWL made the following notes with regards to the scoring system:
  - In the CCME NCS, contaminant characteristics are scored based on three factors including degree of hazard, contaminant quantity and the physical state of contaminants. Based on this scoring system, the presence of one 205 L drum containing waste oil on-site is considered to be a "*high concern contaminant – high concentration*" which has the highest scoring guideline. Further, the contaminant quantity associated with this single "drum of liquid" would also have the highest scoring guideline used in this category. Although this provides a conservative approach to the scoring of these sites, in some situations, this approach may cause the NCS score to be unnecessarily elevated.
  - The first exposure pathway examined as part of the CCME NCS scoring system is the groundwater exposure pathway. As an intrusive investigation was not part of the scope of this project, information describing the subsurface conditions including the presence of subsurface containment, the presence of permafrost, the depth to any aquifers and the hydraulic conductivity of confining layers was not collected. These sections were scored as unknowns and given a value equal to half of the maximum available for that section.
  - The second exposure pathway evaluated in the CCME NCS scoring system is the surface water exposure pathway. As a result, sites located near water bodies or the local drinking water source exhibit elevated scoring.
  - To evaluate the potential for contamination of the surface water exposure pathway, NJWL evaluated the topography at each Site. NCS specifies slopes greater than 15% grade to be considered a steep slope. As the majority of the Sites featured slopes less than 15% grade, the slopes were generally considered to be flat.

5.2 Recommendations

General recommendations are offered in this section. Site specific recommendations are provided with each Site Summary provided in **Appendix A**. General recommendations to comment on are as follows:

- GN should notify tenants of contaminated sites that their properties appear to be or are contaminated. Responsibility and liability for site impacts should be confirmed. If the risk of further on or off-site contamination is evident, the GN should direct the tenants to take immediate action to prevent further contamination.
- A territory wide plan for the investigation and management of sites with potential or confirmed contamination should be prepared to guide the GN's Contaminated Sites Program. With respect to follow-up action for sites included in this inventory, the GN (or tenants, depending on responsibility) should investigate the highest priority sites first (Class 1 and potentially some of the Class "I" sites) and could consider doing more than one community for the same type of site (e.g., – if all of the solid waste facilities are Class 1 sites, they may want to consider a program that investigates these sites in a set of communities in a single field season by the same field team).
- GN should work with all Departments which either own properties (e.g., Airports) or administer properties (e.g., Community and Government Services) and municipalities to take proactive action to prevent and manage environmental liabilities. Such action should include education on each party's responsibilities, preparation of standard environmental liability clauses for land leases and incorporation of Departmental sites in the aforementioned Contaminated Sites Program.
- During the Site visits, many of the Sites were observed to be in-filled with granular material. However, in many cases, the source(s) of the fill materials could not be confirmed. Therefore, NJWL recommends that the source of the fill be determined and/or soil samples be obtained to confirm that the infill is not an area of potential environmental concern.
- Background Metal Concentrations - Concentrations of metals exceeding the applicable guidelines have been identified at several Sites. Further investigation is required to determine if the elevated concentrations are attributed to anthropogenic sources or natural conditions. If the concentrations are determined to be naturally occurring, the exceedances identified during this project may be re-evaluated.
- Utility Poles - Wooden utility poles were observed at many of the Sites. The utility poles may have been treated with creosote or other wood preservatives; including pentachlorophenol (PCP), copper zinc arsenate (ACZA) and chromated copper arsenate (CCA). These compounds are considered to pose an environmental concern; therefore, NJWL recommends that a soil sampling program be conducted at these Sites to determine if any contamination is present on-site.

6 Closure

This report has been prepared for the sole benefit of the Government of Nunavut. The report may not be used by any other person or entity without the express written consent of Nunami Jacques Whitford Limited (NJWL) and the Government of Nunavut.

Any use that a third party makes of this report, or any reliance or decisions made based on it, are the responsibility of such third parties. NJWL accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The information and conclusions contained in this report are based upon work undertaken by trained professionals and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions presented in this report should not be construed as legal advice.

The conclusions presented in this report represent the best technical judgment of NJWL based on the data obtained from the work. The conclusions are based on the Site conditions encountered by NJWL at the time the work was performed at the specific testing and/or sampling locations, and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on the soil and groundwater conditions, as well as the history of the Site reflecting natural, construction and other activities. In addition, analysis has been carried out for a limited number of chemical parameters, and it should not be inferred that other chemical species are not present. Due to the nature of the investigation and the limited data available, NJWL cannot warrant against undiscovered environmental liabilities.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

This report was prepared by Carlos Philipovsky and Patricia Coyne under project management of Stephen Bourn, P.Eng; senior technical review was completed by Rob McCullough, BES, CET, CESA and Nick Lawson, B.Sc.

Yours truly,

NUNAMI JACQUES WHITFORD LIMITED

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PHASE II/III ENVIRONMENTAL SITE ASSESSMENT
CAMBRIDGE BAY AIRPORT, CAMBRIDGE BAY, NUNAVUT

Prepared for:

Public Works & Government Services Canada
800 Burrard Street
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On behalf of Transport Canada

Prepared by:

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FRANZ ENVIRONMENTAL INC.
♦ CONSULTING ♦ ENGINEERING ♦ TECHNOLOGIES ♦

Project No. 1748-0901
March 2010

PHASE II/III ENVIRONMENTAL SITE ASSESSMENT
DRAFT FIELD REPORT

CAMBRIDGE BAY AIRPORT CAMBRIDGE BAY, NUNAVUT

Prepared for:

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On behalf of Transport Canada

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Project No. 1748-0901
March 2010

EXECUTIVE SUMMARY

Franz Environmental Inc. (FRANZ) was retained by Public Works and Government Services Canada (PWGSC) and Transport Canada (TC), Prairie & Northern Region and Environmental affairs Division to complete a Phase II/III Environmental Site Assessment (ESA) at the Cambridge Bay Airport, Cambridge Bay, Nunavut. The work was completed to identify environmental liabilities and assess remediation/risk management options.

The Cambridge Bay Airport is near the West Arm of Cambridge Bay, 3km west of the Hamlet of Cambridge Bay on the southeast side of Victoria Island in Nunavut, Canada. The site covers an area of approximately 140 ha. The site has been used as an Airport since the 1950s. Operations conducted on site include: airline offices, airport manager office, petroleum/fuel storage and distribution, aircraft and vehicle maintenance.

The scope of the investigation addressed terms stipulated in the June 2009 request for proposal (RFP) and included:

- Reviewing historical environmental reports and archival information;
- Developing a detailed sampling and analytical plan;
- Conducting intrusive soil, groundwater, and vegetation investigation to assess the level and extent of contamination from identified APECs; and
- Conducting a preliminary remedial options analysis/plan.

The work was completed to identify environmental liabilities and assess remediation/risk management options at 6 areas of potential environmental concern (APECs). Identified APECs and potential contaminants of concern (PCOCs) are summarized in Table A below:

Table A: Summary of APECs and PCOCs

APEC	DESCRIPTION	PCOCs
1	Historical Screening Plant / Boneyard	BTEX, F1-F4, PAH, VOC, Glycols, Metals, PCBs and Pesticides
2	TC Shoreline Disposal Area	BTEX, F1-F4, PAH, VOC, Metals, PCBs and Pesticides
3	Firefighter Training Area	BTEX, F1-F4, PAH, VOC, Lead, PCBs and PFOS.
4	Former F.H. Ross Tank Site	BTEX, F1-F4, PAH and Metals.
5	Former AST Location North of Building T-5	BTEX, F1-F4, PAH, VOC and Metals.
6	Former AST Location West of Building T-4	BTEX, F1-F4, PAH, VOC and Metals.

The intrusive site investigation conducted by FRANZ in 2009 included installing thirty seven (37) test pits, fifteen (15) groundwater monitoring wells installed, as well as collecting one (1) surface water sample and seven (7) aboveground foliage vegetation samples within the 6 APECs. The ESA identified the following 3 Areas of Environmental Concern (AECs):

Table B: Summary of AECs and COCs

AEC	Description	Contaminated Media	COC	Estimated Volume (m^3)	Estimated Area (m^2)
2	TC Shoreline Area	Soil	Cu and As	20	-
3	Firefighter Training Area	Soil	Benzene, Ethylbenzne and F2 fraction	15,000	-
		Groundwater	Benzene, Naphthalene and Pb	-	2,500
4	Former F.H. Ross Tank Site	Soil	BTEX, F1-F4 fractions and Pb	3,500 (Pb ≈ 10)	-
		Groundwater	Naphthalene, Toluene, and Zn	-	300

FRANZ recommends PHC contaminated soils and groundwater (including metals) in AEC 3, and 4 be excavated and treated in an onsite land treatment facility (LTF). PHC and lead co-

contaminated soils in AEC 4 should be segregated in the LTF and metals contamination disposed/treated offsite or managed (e.g., risk assessment) onsite. Additional investigation should be conducted at both AEC 3 and 4 to fully delineate the extent of the leading edge of PHC contaminated soil.

FRANZ recommends additional investigation at AECs 2 and 4 to delineate the extent of metals impacted soils and groundwater. Post-remediation groundwater monitoring should be conducted at AECs 3 and 4 to assess if COCs (e.g., Zn, naphthalene) attenuate following soil remediation activities. Chemical analytical results can be utilized in support of a detailed ecological and human health risk assessment for these AECs.

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1.0 INTRODUCTION

FRANZ Environmental Inc. (FRANZ) was retained by Public Works and Government Services Canada (PWGSC) and Transport Canada (TC), Prairie & Northern Region and Environmental affairs Division to complete a Phase II/III Environmental Site Assessment (ESA) at the Cambridge Bay Airport, Cambridge Bay, Nunavut (Figure 1).

This project was completed based on discussions with PWGSC/Transport Canada, a review of the Terms of Reference (ToR) and our July 2009 Proposal P-3027 titled "Proposal for Environmental Site Investigation, Cambridge Bay Landfill/Boneyard Cambridge Bay, Nunavut".

1.1 Purpose and Project Objectives

The purpose of this project was to undertake a Phase II and Phase III Environmental Site Assessment (ESA) at six areas of potential environmental concern (APECs) at the Cambridge Bay Airport, which are:

- APEC 1 – Screening Plant / Boneyard
- APEC 2 – TC Shoreline Disposal Area
- APEC 3 – Fire Training Area
- APEC 4 – Former F.H. Ross Tank Site
- APEC 5 – Former AST Location North of Building T-5
- APEC 6 – Former AST Location West of Building T-4

Transport Canada will use this report to demonstrate due diligence and reduce liabilities in order to direct remediation/risk management activities these sites. Project objectives include the following:

- Review of previous studies and reports for the site;
- Obtain representative soil, water and vegetation samples in all six APECs;
- Determine the source, type, and nature of potential contamination in soil, water, and vegetation and identify areas of environmental concern (AEC);
- Calculate NCS scores for each AEC; and
- Conduct a remedial options analysis/plan.

1.2 Site Background

The Cambridge Bay Airport is near the West Arm of Cambridge Bay, 3km west of the Hamlet of Cambridge Bay on the southeast side of Victoria Island in Nunavut, Canada. The Airport has been in operation since the 1950s and serves as a major transportation centre in the Central Arctic. The Airport's administration and control was transferred from Transport Canada to the Government of the Northwest Territories in 1995. Since 1999, the airport has been owned by the Government of Nunavut (GN).

The following buildings are present in the north-eastern part of the site: a terminal building, the airport maintenance garage as well as five other buildings used for storage. The Airport runway is located southwest of the buildings, parallel to the shore. A gravel road looping around the runway from the terminal building is also present onsite.

1.3 Project Team

This project was undertaken by a multi-disciplinary team of experienced professionals. Key individuals and their respective roles are summarized below:

- Steve Livingstone, M.Sc., P.Geo, Senior Hydrogeologist, Reviewer
- James Smith, B.Sc., Environmental Scientist, Project Manager
- Viviane Dubois Cote, M.Sc., P.Geo, Environmental Scientist
- Miguel Madrid, M.Sc., Environmental Scientist
- Jennifer Keenliside, HBSc., CEPIT, Junior Environmental Scientist
- Elliot Tonasket, Environmental Technician, Columbia Environmental Ltd.

2.0 STUDY AREA CHARACTERISTICS

2.1 Site Overview

The Airport is a civil airport located near the West Arm of Cambridge Bay, 3km west of the Hamlet of Cambridge Bay. The following buildings are present in the north-eastern part of the site: the Air Terminal Building (ATB), the airport maintenance garage as well as five other buildings used for storage. The Airport runway is located southwest of the buildings, parallel to the shore. A gravel road looping around the runway from the terminal building is also present onsite. The site covers an area of approximately 140 ha.

2.2 Current and Future Land Use

The site has been used as an Airport since the 1950s. Operations conducted on site include the following: airline offices, airport manager office, petroleum/fuel storage and distribution, aircraft and vehicle maintenance.

FRANZ understands that there are no current plans for development on the airport property.

2.3 Climate

Cambridge Bay is within a climatic zone characteristic of the Arctic Circle. The average daily temperature range is –33.0 ºC to 8.4 ºC. The average monthly temperature is below freezing for ten months of the year. The average annual precipitation is 138.8 mm. There is 69.6 mm annual rainfall and 82.1 mm annual snowfall (www.climate.weatheroffice.ec.gc.ca). The site is in the zone of continuous permafrost. Polar desert conditions limit vegetation to prostrate dwarf trees and lichens and mosses.

2.4 Natural Environment – Overview

The study area lies within the Arctic Lowlands physiographic region with local relief generally measuring less than 20 m. Several water bodies surround the Airport. The west arm of Cambridge Bay (marine environment) abuts the property boundary and is approximately 300 m south of the airport runway. An offsite freshwater lake abuts the north property boundary with several smaller freshwater bodies east and west of the runway.

Regionally, predominant vegetation consists primarily of tundra. Shrubs are less common, giving way to communities of grasses, sedge, lichens, mountain avens, and other flowers.

Mammalian species in the area include caribou, red fox, musk-ox, and brown and collared lemmings. Various bird species frequent the area on a regular/seasonal basis. Swans and geese were observed during the site visit. M.M. Dillon (1994) indicated geese and seagulls are likely attracted by the fact that the airport runway is clear of snow in the spring and must occasionally be chased off; historically, a few bird strikes have been reported.

Aquatic species, including ringed seals, inhabit the west arm and occasionally the shoreline to the south and west of the Airport. Char and lake trout return to inland freshwater to spawn in the late summer or early fall. Other fish in the freshwater bodies include cisco (M.M. Dillon, 1994). The most sensitive fisheries in the area include arctic char and lake trout.

There are no agriculture or forestry activities in the area.

2.4.1 Species at Risk

Data from available resources on regional species form the basis for developing a list of species that use or could potentially use or inhabit the sites. This list focused on species designated as protected under the federal Species at Risk Act (SARA).

The SARA database was searched for information on species at risk that may occupy the Cambridge Bay Airport sites and the risk status for each species (endangered, threatened and special concern). The following at-risk species was identified in the database as having habitat located in the vicinity of the Cambridge Bay Airport sites:

- Bowhead Whale *(Balaena mysticetus)* Bering-Chukchi - Beaufort population – Special Concern, Schedule 1.

3.0 PHYSICAL SITE CHARACTERISTICS

This section describes the physical setting of the site, including topography, drainage as well as subsurface and surficial geology.

3.1 Regional and Local Topography

Topographic Map 77D2 shows that the regional topography in the Cambridge Bay area is relatively flat, with elevations ranging between 0 and 80 m above mean sea level (amsl). A few peaks of higher elevation are observed on the topographic map. Mount Pelly, 17 km northeast of the Airport, is the highest peak in the area and reaches 600 m amsl.

The approximate elevation at the Airport is 15m amsl. The site topography is flat, except along the shores of Cambridge Bay, where it drops steeply to sea level.

3.2 Regional and Local Drainage

The Airport regional drainage is part of the Arctic Ocean Drainage Basin. Site surface water is inferred to follow topography and drain to the South and Southwest, towards the Cambridge Bay.

3.3 Geological Characterization

This section summarizes information collected with regards to regional and site specific bedrock and soil characteristics.

3.3.1 Regional Bedrock Geology

Regional bedrock geology consists of sedimentary rocks of the Arctic Platform. According to Geological Survey of Canada (Harrison et al., 2008), this formation is up to 3 km thick and is overlying the Canadian Shield. In and around the Airport, bedrock geology consists of Cambrian to Devonian flat-lying to gently dipping carbonates.

A study of the mineral potential of the Canadian Arctic islands, conducted by Dewing et al. (2007) indicated that although little exploration has been conducted on Victoria Island, it has mineral exploration potential for copper deposits, base metals volcanic massive sulphide (VMS) deposits and Zn-Pb Mississippi Valley Types (MVT) deposits. According to the Geological Survey of Canada: Mineral Deposits of Canada website (http://gsc.nrcan.gc.ca/mindep/) VMS

deposits are major sources of zinc, copper, lead, silver and gold, and significant sources for cobalt, tin, selenium, manganese, cadmium, indium, bismuth, tellurium, gallium, and germanium. They also indicate that lead and zinc are the primary commodities of MVT deposits, with arsenic, copper, cobalt, nickel, cadmium, silver, indium, germanium, gallium, antimony, bismuth, molybdenum, selenium, and gold commonly associated.

3.3.2 Regional Surficial Soils

The Geological Survey of Canada (Sharpe, 1993) indicates that glacial till deposits are predominant in the Airport area. The deposits are 1 to 5 m thick and are locally interbedded or underlaid by sand and gravel. The Canada Permafrost Map (NRCAN, 1995) indicates that the Airport is in a zone of continuous permafrost. Permafrost conditions have been documented throughout the airport property indicating an active layer of 1.5 to 2.4 m below ground surface (bgs) (M.M. Dillon, 1994).

3.3.3 Local Scale Geology

The geology of Cambridge Bay airport consists of a varying thickness of glacial and glaciofluvial deposits overlying a bedrock sequence of Silurian and Ordovician sediments. The surficial geology is characterized by the presence of extensive glacial and glaciofluvial deposits consisting primarily of sandy clay and silt tills containing abundant fragments of weathered bedrock.

Soils encountered during sampling conducted at the Airport in August 2009 are described in Section 9 and in the Test Pit and Borehole Logs (Appendix C). In some areas, peat or organic topsoil was observed as a surficial layer (no thicker than 0.15 m). Soils observed in the test pits conducted consist mostly of medium sand to sandy silt, with some gravel and cobbles, light grey to medium brown. Water seepage was encountered at depths ranging from 0.5 to 1.3m below ground surface (bgs) in some of the test pits. When possible, test pits were conducted to permafrost, which was encountered between 1.3 and 2.2 m bgs.

At shoreline sample locations, weathered clay overlying sand and silt was observed.

3.4 Hydrogeological Characterization

This section summarizes information collected with regards to regional and site specific hydrogeology.

3.4.1 Regional Hydrogeology

Victoria Island lies within the continuous permafrost zone. Permafrost occurs on the earth's surface where the ground has remained below 0°C continuously for a minimum of two years. In the continuous permafrost zone the ground remains frozen during the entire year, except for the uppermost soil layer which thaws out during the short summer. This upper layer of soil that is subjected to the annual freeze-thaw cycle is known as the active layer.

Groundwater in the continuous permafrost zone is confined to this shallow active layer. Based on the regional geology and the presence of permafrost, the groundwater flow is likely complex and controlled by topography, surface water bodies and bedrock structure. Vertical groundwater flow is limited by the shallow permafrost. The period of groundwater flow is highly influenced by climatic conditions and flow is likely also limited to the short summer season when the active layer thaws, thus allowing water to flow in this horizon. It is expected that the surface water bodies are expressions of the water table.

3.4.2 Site Hydrogeology

Land around the Cambridge Bay Airport is surrounded by lakes to the north and west, and the west arm of Cambridge Bay to the south. During subsurface investigation, permafrost was observed at depths between 1.3 and 2.1 m bgs. Groundwater flow is expected to follow surface topography, and appears to be directed towards the south and southeast, into Cambridge Bay, which is consistent with the local topography.

4.0 HISTORICAL ARCHIVAL REVIEW

This section presents information collected from various historical documents.

4.1 Sources of Information

The main sources of historical/archival information were obtained from aerial photographs and previous environmental reports. The historical reports reviewed include:

- M. M. Dillon Limited, 1994. Environmental Baseline Study.
- Dillon Consulting Limited, 1999. Cambridge Bay Environmental Baseline Study Reaudit. Proposal. August 1999.
- AGRA Earth & Environmental Limited, 1999. Remedial Action Plan Follow- Up, Cambridge Bay Airport, Nunavut Territory. Draft Report. November 1999.

4.2 Aerial Photographs

Aerial photographs were obtained from the National Air Photo Library in Ottawa, Ontario. Historical land use changes as well as potential sources of environmental impacts observed from the photographs were noted.

Aerial photographs of the area taken in 1951, 1960, 1965, 1969, 1976, 1981, 1985 and 1987 were available and are presented in Appendix B. Observations about current and historical land use for the subject properties and surrounding properties that were noted during the review of aerial photographs are summarized in Table 1.

Table 1: Summary of Aerial Photo Review

Date	Roll # (Scale)	Review
1951	A13313 – 376 (1:40,000)	The Site is vacant undeveloped land. No evidence of anthropogenic activity at or near the Site was identified.
1960	A17174-13, 33, 34, 35 (1:10,000)	The Airport has been constructed. A screening plant / boneyard is in use approximately 100m south of the runway; beyond the extent of APEC 1. A significant amount of grading is evident along the road that runs parallel to and between the runway and shoreline. Surface soils were graded towards the shoreline cliffs. Five ASTs (APEC 3) are present about 150m southeast of the ATB. The AST north of building T-5 (APEC 5) is present. The maintenance building is also now present.
1965	A19352 – 13, 14 (1:12,000)	The aircraft apron has been constructed between the runway and the Airport Terminal Building (ATB). Five ASTs (APEC 3) are present about 150m southeast of the ATB.
1969	A21284 – 16, 28 (1:12,000)	The 5 ASTs at APEC 3 are no longer present. . Three ASTs (APEC 4) are present about 60m south of the ATB.
1976	A24498 – 61, 68, 96 (1:5,000)	Machinery and gravel piles are observed directly south APEC 1. Metal drums and other structures are present along the shoreline parallel to the runway and at the northwest end of the Airport (APEC 2). The fire training area (FTA - APEC 3) is present along the west portion of the Airport.
1981	A25829 – 109, 112, 116 (1:5,000)	Machinery is observed south of APEC 1. The FTA (APEC 3) has been expanded and there is visual evidence of oil/diesel staining and a mock fuselage. A partial berm has been constructed around the tanks at APEC 4.
1985	A26791 – 15, 24, 78 (1:5,000)	The FTA (APEC 3) has increased significantly in size since 1981, and a berm has been built around fuselage area, where oil / diesel fuel appears to have accumulated. A small building has been built behind the 3 ASTs at APEC 4 to the northwest and the berm now encloses the ASTs.
1987	A27142 – 45, 47 (1:12,000)	The area of suspect soil staining at the FTA (APEC 3) has increased to about 1728m^2, almost reaching the berm on all sides. No other significant changes are observed.

4.3 Previous Environmental Investigations and Outcomes

Three environmental investigations have been conducted at the Airport over about the last 15 years to identify and delineate potential contamination. One report (Bonley, 1992) was not available for review; however, the following reports were reviewed and relevant information summarized:

- M. M. Dillon Limited, 1994. Environmental Baseline Study;
- AGRA Earth & Environmental Limited, 1999. Remedial Action Plan Follow-Up, Cambridge Bay Airport, Nunavut Territory. Draft Report. November 1999.

The following summarizes our review of historical reports:

M.M. Dillon Limited, 1994

M.M. Dillon (Dillon) conducted an Environmental Baseline Study (EBS) at the Airport in 1994. Most of the facilities operated by TC were visited as part of a site audit. The EBS also included a hydrogeological investigation designed to characterize the subsurface conditions and identify potential environmental concerns in APECs. Hazardous materials and fuels under TC operations were quantified and a storage tank inventory was prepared. Regulatory compliance was assessed and a mitigation action plan including cost estimates and priority rating was prepared.

Dillon identified potential environmental issues at 6 APECs. Preliminary soil and groundwater assessment were conducted at the site. For analysed parameters, soil concentrations were compared against Government of the Northwest Territories (GNWT) Environmental Guidelines for Site Remediation (Draft, 1994) and CCME Interim Canadian Environmental Guidelines for Contaminated Sites (1991). Groundwater concentrations where compared against Quebec Ministry of Environment (MOE) Summary of Contaminant Rehabilitation Policy (1988). Table 2 summarizes the findings and recommendations from subsurface investigation conducted at the APECs during the EBS.

Table 2: Findings and recommendations from subsurface investigation (Dillon, 1994)

APEC	Description	Investigation conducted	Investigation results		Recommendations
			Soil	Groundwater	
1	Screening Plant/ Boneyard	2 test pits, 1 installed as a monitoring well	No issues	Groundwater well dry.	Re-attempt groundwater sampling
2	TC Shoreline Disposal Area	1 test pit	No issues	Not sampled	Continue clean-up operations
3	Firefighting Training Area	1 grab sample and 3 test pits, 2 installed as monitoring wells	TPHC concentrations greater than GNWT guideline	TPHC, benzene and xylenes concentrations greater than Quebec MOE criteria	Annual monitoring and sampling of groundwater.
4	Former F.H. Ross Tank Site	1 test pit, installed as a monitoring well	No issues	No issues	Re-sampling of monitoring well
5	Former AST Location North of building T-5	1 test pit, installed as a monitoring well	TPHC concentrations greater than GNWT guideline.	TPHC benzene, toluene and xylenes concentrations greater than Quebec MOE criteria	Excavation and treatment of contaminated soil when upgrading existing AST. Annual monitoring of groundwater well until area is remediated.
6	Former AST Location West of Building T-4	1 test pit	No issues	Not sampled	No action recommended

*TPHC is for Total Petroleum Hydrocarbon in soil and Total Purgeable Hydrocarbon in groundwater

AGRA Earth & Environmental Limited, 1999

In 1999, AGRA Earth & Environmental Limited (AGRA) conducted a follow-up site investigation of the Airport to document the status of environmental mitigation activities, identify other areas of environmental non-compliance that were not assessed in the 1994 EBS, and to update the Airport remedial action plan .

Soil and groundwater assessment were conducted at the site. For analyzed parameters, soil concentrations were compared against Government of the Northwest Territories (GNWT) Environmental Guidelines for Site Remediation (Draft, 1994) and CCME Interim Canadian

Environmental Guidelines for Contaminated Sites (1991). Groundwater concentrations where compared against Guidelines for Canadian Drinking Water Quality (Health Canada, 1996) and CCME Interim Canadian Environmental Quality Criteria for Contaminated Sites (1991). Table 3 summarizes the findings and recommendations from subsurface investigation conducted at the APECs by AGRA.

Table 3: Findings and recommendations from subsurface investigation (AGRA, 1999)

APEC	Description	Investigation conducted	Investigation results		Other information	Recommendations
			Soil	Ground water		
1	Screening Plant/ Boneyard	No sampling conducted	-	-	Well damaged	Completion of a subsurface investigation
2	TC Shoreline Disposal Area	No sampling conducted	-	-	Debris identified along the shoreline behind DND Frontec facility.	Continue clean-up operations
3	Firefighting Training Area	Two grab soil samples collected; sampling of monitoring wells onsite and review of sampling conducted in 1998 by GNWT	HC[1] odours noted, soil not analysed	BTEX greater than GCDWQ and/or CCME guidelines	Tilling of surficial soils at the FTA was reportedly conducted 2 or 3 times over a period of 2 years before the AGRA investigation	Additional soil and groundwater monitoring to delineate the extent of hydrocarbon impacts.
4	Former F.H. Ross Tank Site	1 grab soil sample collected; and Sampling of monitoring well onsite	HC[1] staining and odours noted, soil not analysed	BTEX exceeding GCDWQ and/or CCME guidelines	-	Additional investigation to delineate the extent of hydrocarbon impacts.
5	Former AST Location North of building T-5	1 grab soil sample collected; and Sampling of monitoring well onsite and review of sampling conducted in 1998 by GNWT	HC[1] staining and odours noted, soil not analysed	BTEX exceeding GCDWQ and/or CCME guidelines	-	Additional investigation to delineate the extent of hydrocarbon impacts.
6	Former AST Location West of Building T-4	Not Investigated	-	-	-	-

A summary of the APECs and the potential contaminants of concern (PCOCs) are presented in section 5.

5.0 SUMMARY OF APECS AND PCOCS

Based on our review of historical information, FRANZ has prepared the following summary identifying relevant historical information for the 6 identified APECs. This information was used to prepare FRANZ's detailed sampling plan for our ESA. All of the APEC locations can be found on Figure 2.

5.1 APEC 1 – Historical Screening Plant / Boneyard

The Screening Plant / Boneyard is about 100m southwest of the Airport runway and was historically used for screening and stockpiling gravel and storing old discarded equipment. Aerial photographs did not identify screening plant/boneyard activities in APEC 1, however, a gap may exist in aerial photographs. FRANZ relied on previous sample locations identified by Dillon (1995) and AGRA (1999) to identify the location of APEC 1.

Based on our review, potential sources of contamination include petroleum hydrocarbons/ fuels, waste oil, metals, anti-freeze, Polychlorinated Biphenyls (PCBs), and pesticides. The following PCOCs were identified in soil and groundwater: Benzene, Toluene, Ethylbenzene and Xylenes (BTEX), Petroleum Hydrocarbon (PHC) fractions F1-F4, Polycyclic Aromatic Hydrocarbons (PAH), Volatile Organic Compounds (VOCs), glycols, metals, PCBs and pesticides. Historical investigation at this APEC did not identify any contaminants of concerns (COCs).

5.2 APEC 2 – TC Shoreline Disposal Area

The shoreline disposal area is found on the south side of airport lands, along the shoreline of Cambridge Bay's west arm. It extends for approximately 2km, from 300 m southwest of the Fire Fighting Training Area to downgradient of the Department of National Defence (DND) Frontec facility. FRANZ relied on previous sample locations identified by Dillon (1995) and AGRA (1999) to identify the location of APEC 2.

Based on our review, potential sources of contamination include petroleum hydrocarbons / fuels, waste oil, metals, anti-freeze, PCBs and pesticides. The following PCOCs were identified in soil and groundwater: BTEX, PHC fraction F1-F4, PAH, VOCs, glycols, metals, PCBs and pesticides. Historical investigation at this APEC did not identify any COCs.

5.3 APEC 3 – Fire Training Area

The former fire training area (FTA) is southwest of the runway along the west part of the airport. The former FTA consisted of an aircraft mock-up area where fuel and potentially other combustible/flammable waste liquids were burned for fire training exercises. It was enclosed in a containment berm about 40 cm high and constructed of local till material. ASTs were also historically present on site. According to AGRA (1999), tilling of the FTA to aerate the soil was to be completed by Transport Canada between 1995 and 1996 after it was taken out of use.

Based on the use of the FTA and historical investigation findings, the following potential sources of contamination include fuels (e.g., avgas, jet fuel), spent solvents, oils, and fire-fighting retardants. The following PCOCs were identified in soil and groundwater: BTEX, PHCs fraction F1-F4, PAHs, VOCs, lead, PCBs and Perfluoro Octane Sulfonates (PFOS). Historical investigation at this APEC identified BTEX as COCs in groundwater. The extent of contamination has not been delineated.

5.4 APEC 4 – Former F.H. Ross Tank Site

F.H. Ross and Associates conduct airport maintenance and aircraft fuelling. They formerly operated 3 bulk fuel ASTs about 60m south of the ATB. The ASTs were decommissioned in 1992; however, no formal decommissioning procedures were followed when the ASTs were relocated about 30m to the southeast (Dillon, 1995). Information regarding the former infrastructure was not available; however, the replacement system consists of three 100,000L ASTs containing Avgas and Jet B fuel.

Based on this information, potential sources of contamination are fuels (i.e., avgas, jet fuel). The following PCOCs were identified in soil and groundwater: BTEX, PHCs fraction F1-F4, PAHs and metals. Historical investigation at this APEC identified BTEX as COCs in groundwater. The extent of contamination has not been delineated.

5.5 APEC 5 – Former AST Location North of Building T-5

A former diesel AST (2,200L) associated with a fuel dispensing facility was present north of building T-5 (Powerhouse / Field Electrical Centre). The fuel dispensing facility was utilized by airport maintenance personnel for vehicle fuelling. Agra (1999) indicated the AST was installed on a concrete pad.

Based on this information, the potential source of contamination include petroleum hydrocarbons/fuels and metals. The following PCOCs were identified in soil and groundwater: BTEX, PHCs fraction F1-F4, PAH, VOCs and metals. Historical investigation at this APEC identified BTEX as COCs in groundwater. The extent of contamination has not been delineated.

5.6 APEC 6 – Former AST Location West of Building T-4

APEC 6 consists of a former AST installed west of the existing maintenance garage and fire-hall compound (Building T-4). Both Dillon (1995) and Agra (1999) noted that floor drains in Building T-4 drain onto the ground surface below the building. No indicators of contamination were noted and subsurface quality has not been investigated.

Based on this information, the potential source of contamination include petroleum hydrocarbons/fuels and metals. The following PCOCs were identified in soil and groundwater: BTEX, Hydrocarbon Fractions F1-F4, PAH, VOC and Metals. Historical investigation at this APEC did not identify any COCs.

5.7 APEC and PCOCs Summary

The APECs and PCOCs for each area are presented in Table 4.

Table 4: Summary of APECs and PCOCs

APEC	DESCRIPTION	PCOCs
1	Historical Screening Plant / Boneyard	BTEX, F1-F4, PAH, VOC, Glycols, Metals, PCBs and Pesticides
2	TC Shoreline Disposal Area	BTEX, F1-F4, PAH, VOC, Metals, PCBs and Pesticides
3	Firefighter Training Area	BTEX, F1-F4, PAH, VOC, Lead, PCBs and PFOS.
4	Former F.H. Ross Tank Site	BTEX, F1-F4, PAH and Metals.
5	Former AST Location North of Building T-5	BTEX, F1-F4, PAH, VOC and Metals.
6	Former AST Location West of Building T-4	BTEX, F1-F4, PAH, VOC and Metals.

6.0 REGULATORY REVIEW AND ENVIRONMENTAL QUALITY CRITERIA

In Nunavut, environmental site assessments and site remediation projects are typically based on the use of federally developed generic guidelines. Risk assessment principles have been used extensively in developing federal generic clean-up criteria for contaminated sites. However, as the term "generic" implies, they are intended for broad applications and are typically over-protective to avoid underestimating potential risks associated with a wide range of site conditions and potential land uses.

The following sections provide information and rationale with regards to the guidelines and standards used to assess the analytical results from samples collected by FRANZ in 2009 at Cambridge Bay Airport.

6.1 Federal Guidelines

The Contaminated Sites Management Working Group for federal government departments has defined a *contaminated site* as a site at which substances occur in concentrations that either: 1) are above background levels and pose, or are likely to pose, an immediate or long-term hazard to human health or the environment; or 2) exceed concentrations specified in guidelines and/or regulations

The federal CCME guidelines were derived based on potential impacts to humans and ecological receptors and also take into account potential risks to humans associated with the consumption of groundwater on the site. The CCME have not established an equivalent set of non-potable thresholds for federal lands.

The CCME Canadian Environmental Quality Guidelines (1999) publication compiles all previously released soil, sediment and surface water criteria and guidelines into one publication. Updates have been issued for selected chemicals over the past several years. Guidelines for soil and surface water are numerical limits intended to maintain, improve or protect environmental quality and human health at contaminated sites and were derived using toxicological data. There are four separate sets of guidelines for soil quality and five sets of guidelines for water quality. The guidelines are separated into groups for different types of land and water use.

Soil

The soil analytical results were compared to the CCME Canadian Environmental Quality Guidelines, specifically the Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CSQG), and with the Canada-Wide Standards (CWS) for Petroleum Hydrocarbons (PHC) in soil. These are applied to most federal contaminated sites. The guidelines are numerical limits intended to maintain, improve or protect environmental quality and human health at contaminated sites and were derived using toxicological data and aesthetic considerations.

The standards and guidelines adopted for this evaluation are as follows:

- Canadian Environmental Quality Guidelines (CEQGs; CCME, 2007) for commercial and industrial land use; and
- Canada-Wide Standards for Petroleum Hydrocarbon (CWS) in soil (CCME, 2008a) – Tier 1 Levels for commercial land use.

Surface Water

Canadian water quality guidelines are surface water guidelines intended to provide protection of freshwater and marine life from anthropogenic stressors such as chemical inputs or changes to physical conditions.

Groundwater

CCME guidelines apply at the “point of the consumption” indicating that AW guidelines apply to surface water quality and not directly to groundwater. Several jurisdictions (e.g., BC MOE) apply a conservative 10x dilution factor for the discharge of groundwater to surface water resulting in ground water guidelines/standards that are 10x greater than surface water guidelines/standards. In the absence of groundwater CCME AW standards and dilution directives, Franz applied provincial guidance when reviewing applicability of AW guidelines (see Section 6.2).

6.2 Territorial/Provincial Guidelines

In the absence of federal guidelines to assess the quality of groundwater at the site, water analytical results were compared against British Columbia Contaminated Sites Regulation (BC CSR) Standards. Standards from BC were selected over other nearby provinces as BC regulations include groundwater discharges to both freshwater and marine receptors. The legislation governing contaminated sites in British Columbia consists of the *Environmental Management Act (EMA, 2004*) and the *Contaminated Sites Regulation* (BC CSR, 1997). The Environmental Management Act creates a comprehensive framework for the assessment and remediation of contaminated sites. In British Columbia, a site is considered contaminated when the concentration of any substance found on that site is greater than the numerical standards defined in the BC CSR.

Under the BC CSR, water standards for groundwater are provided in Schedule 6 of the CSR and Protocol 7 which regulates petroleum hydrocarbons covered in both the BC Hazardous Waste Regulation, 2006 (HWR) and CSR. Depending on the use of the water at a contaminated site or site under investigation, the BC CSR designated four water-use categories including aquatic life, irrigation, livestock, and drinking water use.

The standards that were applied for this Site are the BC CSR Schedule 6 AW (aquatic life). For substances included in Schedule 6 of the BC CSR, one generic numerical water standard is provided for each regulated substance for each water use category. Standards for some substances are dependent on water pH or hardness.

Based on direction of groundwater flow and proximity to the water bodies around the Site, standards developed for protection of marine aquatic life were applied at all APECs while standards developed for protection of freshwater aquatic life were also applied at APECs 4, 5 and 6.

6.3 Other Guidelines

In absence of guidelines for perfluorooctane sulfonate (PFOS) in the CCME documents, PFOS analytical results were compared against the Minnesota Pollution Control Agency (MPCA) standards.

6.4 Designated Substances

Criteria, rationale and regulatory jurisdictions for each component of the designated substances property survey are presented in Table 5.

Table 5: Summary of Criteria for the Selection of Environmental Quality Guidelines

Material Type	Classifications	Evaluation Criteria
PCBs in Soils	PCBs in soils are regulated under the Canadian Environmental Protection Act (CEPA) and transported according to TDGA and CEPA.	PCB content >50 ug/g is considered a hazardous waste. Materials with PCBs above the CCME soil criteria (e.g., 1.3 ug/g) but below 50 ug/g is not hazardous waste
Liquids/Chemicals	Waste solvents and liquids are a contaminant under the EPA of Nunavut and must be managed as a hazardous waste.	Absence/presence of liquids/chemicals in containers.
Batteries	Waste batteries are a contaminant under the EPA of Nunavut and must be managed as a hazardous waste	Absence/presence of waste batteries.

6.5 Vegetation Evaluation Guidelines

In the absence of federal guidelines to assess the quality of vegetation at the site, the Ontario Ministry of the Environment (MOE) Upper Limit of Normal (UNL) guidelines were applied. The Ontario MOE ULN contaminant guidelines represent the expected maximum concentrations of contaminants in surface soil (non-agricultural), foliage (deciduous and current year coniferous trees and shrubs) grass, moss bags and/or snow from areas of Ontario not subject to the influence of point sources of emissions.

7.0 FIELD INVESTIGATION

7.1 Field Reconnaissance

Detailed site visits of all six APECs were conducted by FRANZ personnel on August 26, 2009 to confirm historical sample locations and potential and observed contaminant source areas. Photos of each APEC can be found in Appendix D. Table 6 summarizes the observations compiled during the site visit:

Table 6: Summary of Field Observations

APEC	Description	Observations
1	Screening Plant/ Boneyard	• No debris or material were stored onsite; site vacant; • No surficial staining observed; • Vegetation present, no sign of stress; and area was saturated.
2	TC Shoreline Disposal Area	• Small amount of debris such as wood and metal drums observed along the east end of the shoreline; • Abandoned excavation pit along northwest end of APEC; • No vegetation along the shoreline; • Vegetation present on upgradient slope of excavation pit at the northwest end of the APEC, no sign of stress; • No surficial staining observed; and • No evidence of sheen, refuse or debris was observed in the water.
3	Firefighting Training Area	• Site vacant; • Very little vegetation is present, no sign of stress; • No surficial staining observed; and • Hydrocarbon sheen observed in ponded water within the APEC.
4	Former F.H. Ross Tank Site	• Only structures present onsite are aboveground pipes linking the ASTs present east of the APEC to the dispensing cabinets located west of the APEC; • Gravel surface; ; • Gravel surface; and • No surficial staining observed.
5	Former AST Location North of building T-5	• Empty drums stored; • Gravel surface • No vegetation; and • No surficial staining observed.
6	Former AST Location West of Building T-4	• Building T-4 used as a maintenance garage; • Gravel surface; no surficial staining observed • No vegetation; and • No surficial staining observed.

7.2 Preparation of a Detailed Sampling Plan

FRANZ reviewed historical information and knowledge collected during the site visit to prepare a detailed sampling plan. The sampling plan was developed to perform a detailed assessment of the site with respect to soil, groundwater, and vegetation quality. It was based on discussions with PWGSC/Transport Canada, a review of the Terms of Reference (ToR) from the Request for Proposal (RF) dated June 2009 and a review of the available historical reports. The sampling plan described our proposed sampling methods and types of measurements/analyses to be conducted during the Phase II ESA including:

- Proposed sampling locations and quantities;
- Proposed sampling or measurement methods;
- Parameters being sampled;
- Description of objectives with rationale;
- Proposed QA/QC methods;
- Proposed background sampling protocols; and
- Proposed health and safety plan.

During the field activities, areas of environmental concern were assessed in accordance with the proposed scope of work. Following the initial site visit, sampling locations were modified as required to target the most likely impacted areas and/or to attempt coarse grid delineation of impacts.

7.3 Health and Safety Procedures

FRANZ field programs are always subject to a site-specific Health and Safety Plan (HSP). We use a Corporate Health and Safety Plan as a general guide in developing the site-specific plan to which all team members and subcontractors must adhere. Protection of the public and personnel from exposure to any contaminated materials at the site was priority during the field program.

Prior to conducting any of the onsite work, a site-specific health and safety plan was developed, distributed and discussed with all field personnel (see Appendix E). As a minimum, full personal protective equipment (e.g., hard hats, safety glasses, reflective vests and Nitrile gloves) was

worn at all times during field activities. Tyvek overalls and respirators were available to all field personnel.

7.4 Subsurface Sampling Methodology

7.4.1 Test Pit Excavations and Soil Sampling

Test-pitting was considered the appropriate method for conducting observations of soil conditions and collecting soil samples in the areas of potential environmental concern (APECs). Between August 29, 2009 and August 30, 2009, a total of 37 test pits were excavated by FRANZ personnel up to a maximum depth of 2.2 m. At least one soil sample from each test pit was collected and analyzed for PCOCs. Test pits were completed with a backhoe to the maximum achievable depth, with the exception of 2-TP-5 to -10, which were completed with a hand trowel.

At each test pit location (Figures 3 to 10), composite soil samples were collected using a decontaminated trowel and nitrile gloves. Depending on the depth of the test pit, the nature of the stratigraphy, and evidence of contamination, composite samples generally were collected over a range of 0.5 - 1.0m. Prior to sampling, soil descriptions including approximate grain size, colour, moisture content, stratigraphy and any evidence of contamination were recorded. Following the completion of the test pit field log (Appendix C) and prior to backfilling the pit to grade, soil samples were collected and stored in sealable polyethylene bags (for soil vapour headspace analysis) and dedicated glass sample containers (for laboratory analysis).

Two background soil samples for metals were collected in areas that appeared to be free of influence by human activities or land filling. Selected laboratory analyses for each sample are presented in Appendix G.

Following sample collection, the jarred soils were refrigerated and/or stored on ice in laboratory-supplied coolers from the day of collection until delivery to the Maxxam Analytics laboratory (for soil) in Vancouver, B.C.

7.4.2 Field Vapour Screening

Vapour screening is a frequently used method for detecting and measuring the quantity of volatile organic compounds present in soil. When taken continuously from the ground surface to the end of a test pit, vapour readings can provide an indication of the relative level of

contamination and whether it derived from a localized source or migrated from a more distant one. As a result, field screening is a useful tool to facilitate selection of samples to be submitted for laboratory analysis. All soil samples collected by FRANZ were screened for soil vapour concentrations.

During the investigation, field vapour screening was completed in-situ by partially filling and sealing standard volumes of soil into dedicated polyethylene bags. Samples were stored at room temperature to equilibrate. Gas samples were retrieved by inserting a small tube into the sample bag and analyzed with an RKI Eagle organic vapour meter (calibrated to hexane), and the concentration of combustible gases present (other than methane) by volume (ppm) was measured. The results of the soil vapour headspace analyses are included in the test pit logs (Appendix C)

7.4.3 Groundwater Sampling

A total of fifteen groundwater samples were collected from the six APECs in 2009. No downgradient or background groundwater samples were collected.

The groundwater samples were collected from the monitoring wells in each APEC. Each well was purged and developed using a dedicated disposable PVC bailer (3X the volume), and allowed to sit for approximately 24 hours before sampling occurred. The monitoring well locations used during the field program corresponded with many of the test pit locations. Specific sample locations for each site are indicated on Figures 3 to 10.

The samples were collected from the monitoring wells into laboratory supplied sample containers. Field parameters including pH, temperature and conductivity were measured at each monitoring well (done within 24 hours of well installation). Each sample was labelled and refrigerated and/or kept on ice until they were delivered to the project laboratory. Water samples were delivered via Canadian North Cargo to the Maxxam Analytics laboratory in Yellowknife, NWT. Results of the field parameters are presented in Appendix H.

7.5 Surface Water Sampling

One surface water sample was collected from the shore of the pond area at the west edge of APEC 4, in order to investigate for potential impact from APEC 4 to surface water at the site (Figure 9).

The sample was collected from a depth of 0-15 cm below the water surface with dedicated disposable PVC bailers, and placed into laboratory supplied sample containers. Field parameters including pH, temperature and conductivity were measured at the time of sampling. The sample was labelled and refrigerated and/or kept on ice until it was delivered to the project laboratory in Yellowknife, NWT via Canadian North Cargo. Results of the field parameters are discussed in Section 9.

7.6 Vegetation Sampling

The ESA included collecting seven aboveground foliage vegetation samples at three APECs and one background location. Samples were not taken from the same species due to limited vegetation. Samples were refrigerated and/or kept on ice until they were delivered to the project laboratory in Yellowknife, NWT. Specific sample locations are indicated on Figures 3 to 10.

7.7 Selection Criteria for Soil and Groundwater Chemical Analyses

Soil and groundwater were analyzed based upon three distinct rationales:

1) To delineate, confirm or refute potential soil impacts related to historical or current land use;
2) To provide a better understanding of contaminant concentrations in the soil and groundwater; and
3) To generate a thorough understanding of environmental receptors, as well as fate and transport of the potential contaminants of concern (PCOCs).

Soil and groundwater sample selection for contaminant analyses was based on a review of previous soil analyses completed on site, as well as visual site inspection of potential source areas and natural environmental pathways and receptors.

7.8 Site Survey

A complete site survey consisting of georeferencing site features and sample locations with the use of a Differential Global Positioning System (DGPS) unit horizontally accurate to <30 cm was conducted. The survey data was placed on an air photo (Google Earth, 2009) and ortho-rectified to correspond with data points collected during the survey.

8.0 QA/QC

The purpose of the quality assurance/quality control (QA/QC) program was to confirm that field sampling methods and laboratory analyses were reliable. In implementing the QA/QC program, FRANZ verified that the quality of the reported results was suitable to support the environmental impact (and human health/ecological risk) conclusion drawn from the data.

The 2009 field program included the following QA/QC protocol elements:

- Decontamination (TSP wash and distilled water rinse) of sampling equipment/ instrumentation between all sample locations;
- New/disposable chemical-resistant nitrile gloves for each sampling event;
- Sampling in accordance with documented and generally accepted industry practices;
- Proper documentation of all aspects of the sampling program, with particular detail to the introduction of potential bias;
- Elimination of sample headspace for all volatile parameters (soils and water);
- Collection of one blind analytical duplicate for approximately every 10 samples of environmental media or per sample event;
- Calculation of the relative percent difference between a sample and its duplicate for comparison to acceptable variance guidelines; and
- Calibration of field instruments.

8.1 Data Reduction and Validation

Investigation results data reduction involved summary tabulation of analytical results and field observation transcriptions. Following data reduction, data validation was performed to ensure raw data was not altered and an audit trail was applied for managing data. Data validation was also performed to verify the quantitative and qualitative reliability of the information. A comparative review of sample collection records, chain-of-custody records, holding times, dilution factors, estimated quantitation limits (EQLs), and laboratory and field QC sample records were evaluated against original laboratory reports and found to be within control limits (Appendix G).

8.2 Data Validation of QA/QC Samples

FRANZ quantitatively assessed the analytical quality of the data through calculating the relative percent difference (RPD) between each sample and its corresponding duplicate using the following equation:

$$RPD = | X_1 – X_2 | / X_{avg} \text{ X } 100$$

Where X_1 and X_2 are the concentrations and X_{avg} is the mean of these two values, and RPD is the percent difference between each sample and its corresponding duplicate.

The target levels of precision for this project are:

1) Organics in soil: 50% for PAH; 40% for BTEX/VPH and EPH and glycols
2) Metals in soil: 30%
3) Organics in water: 30% for most volatile and other typical organics
4) Metals in water: 20%

These levels are specified in the Recommended Data Quality Objectives (DQOs) for Laboratory Duplicates which are derived from Measurement Uncertainty (MU) estimates obtained from four major BC analytical laboratories. MU values, according to the Technical Sub-committee of the BC Environmental Laboratory Quality Assurance Advisory Committee (BCELQAAC), which presented the recommendations, are lab estimates of the 95% confidence interval around chemical measurement results, as determined according to CAEAL and internationally recognized guidelines.

The recommendations for soil and groundwater were presented by the Technical Sub-committee of the BCELQAAC, in a letter to the Environmental Management Branch, MOE, dated October 24, 2005, as a revision to the Technical Guidance document, and are generally accepted throughout the industry.

- Relative percent difference was not calculated if either the sample or its duplicate were less than method detection limits, or if either the sample or its duplicate were less than five times the reported detection limits, for soil and groundwater.

- Both components of the sample/duplicate pair were assessed against Standards/ Guidelines.

The following discussion presents the results of the Relative Percent Difference (RPD) calculations. Duplicate analysis results can be found in Appendix G.

RPD result for sample/duplicate pair 2-09TP-5/ is greater than the target level of precision for Bismuth (33.3%). We attribute the marginally elevated RPD to sample heterogeneity, a function of co-located replicate sampling. Concentrations for all other sample/duplicate pair were all within the acceptable precision. Therefore, the sample results are considered valid and were kept as part of the assessment.

RPD result for sample/duplicate pair 6-09-MW1/FR-1 is greater than the target level of precision for Manganese (88.89%). RPD results for sample/duplicate pair 1-09-6M/FR3 is greater than the target level of precision for Calcium (25.00%), Iron (36.84%), Manganese (28.57%), Potassium (42.86%), Sodium (55.74%), Srontium (37.84%) and Uranium (73.68%). compliant levels for these metals are noted in both sample and duplicate, therefore the RPD value is not material to the classification of this sample against the Standard. The lab made a note with regard to the metals analysis, that detection limits for certain dissolved metals were increased due to high concentrations of other dissolved metals in the samples. This may account for the apparent dissymmetry between sample and duplicate results.

All other parameters for all other samples, including metals, PAHs, PHCs and VOCs remained within the acceptable precision and therefore the concentrations do not change the outcome of the assessment and have been kept as part of the assessment. All other parameters had acceptable RPD precision.

Duplicated analysis was completed on the vegetation samples for metals. All of the concentrations were all within the acceptable precision. Therefore, the sample results are considered valid and were kept as part of the assessment.

RPD calculation results indicate that we can rely on this data set for our assessment.

9.0 INVESTIGATION RESULTS AND DISCUSSION

Samples from soil, water and vegetation were collected at six identified APECs and analyzed for selected PCOCs. The analytical results can be found in Figures 3 to 10 and in Appendix G. Test pit logs are presented in Appendix C.

Background samples were collected for soil and vegetation in undisturbed areas 2-3 km west of the airport terminal building for comparison purposes (see Figures 3 to 10).

9.1 Background Metal Sampling

Two soil samples were collected in order to investigate for background metal levels in the area. Chemical analytical results (Figures 3 to 10, Appendix G) did not exceed the CCME guidelines. pH for background samples was elevated (between 8.17 and 8.34).

One vegetation sample was collected in order to investigate for background metal levels in the area. Chemical analytical results (Figures 3 to 10, Appendix G) did not exceed the Ontario MOE UNL guidelines.

9.2 APEC 1 –Screening Plant / Boneyard

Six test pits were conducted at APEC 1, and they were all installed as monitoring wells. At the test pit locations, the observed soil profile was described as sand and silt from 0.0 m to a maximum depth of 1.7 m bgs (Appendix C). Four test pits were conducted until permafrost was reached at depths of 1.2 to 2.5 m bgs.

Vegetation samples were collected at two locations within APEC 1 (1-09-VG1 and 1-09-VG2).

<u>Soil</u>

Analytical results (Figure 3, Appendix G) indicate all soil samples were less than the CCME guidelines; however, pH levels at four test pit locations were just above the CCME guideline. pH levels at both background soil sampling locations also had elevated pH levels, therefore, it appears to be naturally occurring and not from anthropogenic activities.

Groundwater

All analytical results (Figure 4, Appendix G) indicate that concentrations for all PCOCs were less than the BC CSR AW (Marine Life) standards.

Vegetation

Chemical analysis results (Figure 3, Appendix G) were less than the Ontario MOE "ULN Guidelines, with the exception of molybdenum (2.6 ug/g) at 1-VG-2. A molybdenum (Mo) concentration greater than the guideline could be a natural occurrence, and not from anthropogenic activities. As regional geology indicates that there is a potential for base metals deposit on Victoria Island which could impact the regional background metal levels.

Summary

No contaminants of concern (COCs) were identified in soil and groundwater at APEC 1. Molybdenum in vegetation is present in concentrations greater than the Ontario MOE ULN guideline. It is possible that elevated Mo concentrations in vegetation are a natural occurrence.

9.3 APEC 2 – TC Shoreline Disposal Area

A small amount of debris, including wood and metals drums were observed along the east end of the shoreline during the investigation conducted by FRANZ in 2009. No evidence of sheen, refuse or debris was observed in the water. Four test pits were conducted in the northwest end of the APEC, one of them being installed as a monitoring well. Soil profile from 0.0 m to 0.9 m bgs was described as sand with some silt (Appendix C). Six test pits were conducted in the southeast end of the APEC (along the shoreline), and the soil profile from 0.0 m to 0.6 m bgs was described as shale and sand with some debris in the area. Debris observed included empty rusted metal drum lids, plastic drums and wood debris. Vegetation samples were collected at two locations within APEC 2 (2-09-VG1 and 2-09-VG2).

Soil

Chemical analytical results (Figure 5 and Appendix G) indicate copper (Cu) and arsenic (As) in concentrations greater than the CCME guidelines at two test pit locations (2-09-TP5 and 2-09-TP6) along the shoreline between 0-0.6m bgs. Cu and As concentrations greater than the guidelines could be a natural occurrence, and not from anthropogenic activities, as regional geology indicates that there is a potential for base metals deposit on Victoria Island which could cause elevated regional background metal levels.

Concentrations for all other parameters were less than the CCME guidelines.

Groundwater

Analytical results (Figure 5 and Appendix G) indicate concentrations for all PCOCs were less than the BC CSR AW (Marine Life) standard.

Vegetation

Chemical analytical results (Figure 5, Appendix G) indicate all vegetation samples submitted for metals analysis were less than the Ontario MOE ULN guidelines.

Summary

Copper (Cu) and arsenic (As) were identified as COCs in soil at APEC 2. The depth of metal-impacted soil is 0-0.6m bgs. Cu and As contamination may be from anthropogenic sources from historical metal debris discarded at the site as although naturally occurring sources are not uncommon in the region, noted concentrations are elevated when compared to analyzed background concentrations. This APEC was retained as an AEC and the contamination is expected to be localized (about 50m^2- see figure 11). No COCs were identified in groundwater at APEC 2.

9.4 APEC 3 – Fire Training Area

At the time of the investigation conducted by FRANZ in 2009, empty drums were observed to be stored in the area. No surficial staining was observed. The 2,200 L diesel AST was not observed during the field work in 2009. Six test pits were excavated and three were installed as monitoring wells. The soil profile observed from 0.0 m to 2.1 m bgs was sand and gravel from 0 to 0.5m, underlain by sand to silty sand with some gravel (Appendix C). Hydrocarbon odour and staining were encountered in some test pits, and hydrocarbon sheen was observed in ponded water within the APEC during the site visit. Permafrost was encountered in test pit 3-09-5M at a depth of 2.1 m.

Soil

Chemical analytical results (Figure 6, Appendix G) indicate Benzene, Ethylbenzene and/or PHC fraction F2 exceed the CCME guidelines at 4 test pits (3-09-4M-1, 3-094M, 3-09-5M and 3-09-6M) between 0-2m bgs. Concentrations for all other PCOCs were less than the CCME guidelines.

Groundwater

Chemical analytical results (Figure 7, Appendix G) identified Benzene and lead (Pb) exceeding the BC CSR AW (Marine Life) standard in one (3-09-4M) monitoring well. Naphthalene is exceeding the BC CSR AW (Marine Life) standard in two (3-09-4M and 3-09-5M) monitoring wells. Elevated PHC F1 (3.5 mg/L) and F2 (3.8 mg/L) detected at the APEC is indicative of petroleum impact; however, there were no referenced standards/guidelines. Concentrations for all other parameters were less than the BC CSR AW (Marine Life) standards.

Vegetation

Chemical analytical results (Figure 6, Appendix G) were less than the Ontario MOE "ULN Guidelines.

Summary

Benzene, Ethylbenzene and F2 were identified as COCs in soil. The depth of hydrocarbon-impacted soil is from 0 to 2 m bgs. The estimated volume of hydrocarbon contaminated soil is 15,000 m^3; however, the extent of contamination has not been fully delineated to the south and east (Figure 12).

Pb, Benzene and Naphthalene were identified as COCs in groundwater. The estimated area of Pb and Benzene-impacted groundwater is about 1,600 m^2 while the estimated area of Naphthalene-impacted groundwater area is about 2,500m^2. Contaminated groundwater was only identified in the soil impacted zone and appears to be attenuating downgradient (south) as far as the leading edge of the soil contamination. The area of confirmed contamination has been identified as AEC 3.

The approximate extents of contamination are presented in Figure 12.

9.5 APEC 4 – Former F.H. Ross Tank Site

Eight test pits were excavated at APEC 4 and two were installed as monitoring wells. The soil profile observed from 0.0 m to 2.0 m was a silty sand to sand and gravel. Petroleum hydrocarbon-like odours and staining were observed in some test pits. Permafrost was encountered at depths ranging between 1.3 and 1.6 m across the site (Appendix C). One surface water sample was also collected in a ponded area adjacent to the south of the APEC.

Soil

Chemical analytical results (Figure 8, Appendix G) indicate Pb concentrations exceeded the CCME guideline at one test pit (4A-09-5) between 1.3-1.5m bgs. Benzene, Toluene, Ethylbenzene, Xylenes (BTEX) and/or PHC fractions F1-F4 concentrations were greater than the CCME guidelines at four test pits (4A-09-3M, 4A-09-4, 4A-09-5 and 4A-09-8) between 0-2m bgs. Concentrations for all other PCOCs were less than CCME guidelines.

Groundwater

Chemical analytical results (Figure 9, Appendix G) indicate Naphthalene and Toluene (monitoring well 4A-09-3M) and Zn (monitoring well 4A-09-2M) exceeded the BC CSR AW (Marine Life) standard. Elevated PHC F1 (1.6 mg/L) and F2 (1.4 mg/L) detected at the APEC is indicative of petroleum impact; however, there were no referenced standards/guidelines. Concentrations for all other PCOCs were less than the BC CSR AW (Marine and Freshwater Life) standards.

Surface Water

Chemical analytical results (Figure 9, Appendix G) indicate all PCOCs met the applicable CCME FWAL guidelines. The aluminum (Al) guidelines (CCME, YEAR) are pH dependant; however, FRANZ was unable to obtain field pH measurements. A pH of >7 was estimated for surface water based on field pH measurements for APEC groundwater, soil pH levels, and regional geology (Harrison, 2007).

Summary

Pb was identified as a COC in soil at APEC 4. The depth of Pb impacted soil is from 1.3 to 1.5 m bgs. Soil Pb concentrations were limited to one location despite the presence of considerably more PHC contamination and therefore, Pb contamination does not appear to be

associated with historical use of avgas and therefore is probably a localized occurrence. Although not fully delineated to the east and west, the volume of Pb contaminated soil on site is estimated to be 10 m^3.

Benzene, Ethylbenzene, Toluene, Xylenes and PHC fractions F1-F4 were identified as COCs in soil at APEC 4. The depth of PHC contaminated soil is from 0 to 2 m bgs. The estimated volume of contamination is 3,500 m^3; however, the extent of contamination has not been fully delineated (Figure 13).

Naphthalene was identified as a COC in groundwater at APEC 4. The estimated area covered by Naphthalene-impacted groundwater is estimated to be 300 m^2; however, the leading edge of the plume has not been fully delineated.

Zinc was identified as a COC in groundwater at APEC 4. The area covered by Zn-impacted groundwater is estimated to be about 300 m^2. Anthropogenic sources of Zn contamination were not identified; however, metals may be mobilizing through microbial oxidation/reduction associated with petroleum hydrocarbon degradation.

The area of soil and groundwater contaminated by petroleum, naphthalene, and zinc has been identified as AEC 4.

9.6 APEC 5 – Former AST Location North of Building T-5

Four test pits were conducted at APEC 5 and one was installed as a monitoring well. The soil profile observed from 0.0 m to 2.2 m was described as sandy gravel with organic layers (Appendix C). Petroleum hydrocarbons like odours were noted at 5-09-TP4.

Soil

Chemical analytical results (Figure 10, Appendix G) indicate sample concentrations for all PCOCs were less than the CCME guidelines.

Groundwater

Chemical analytical results (Figure 10, Appendix G) indicate all PCOCs in groundwater samples were less than the BC CSR AW (Marine and Freshwater Life) standards.

Summary

No COCs were identified in soil and groundwater at APEC 5.

9.7 APEC 6 – Former AST Location West of Building T-4

One test pit was conducted at APEC 6 and installed as a monitoring well. The soil profile observed from 0.0 m to 1.5 m was described as silt, sand and gravel with organics between 0.1 m and 0.2 m (Appendix C).

Soil

Chemical analytical results (Figure 10, Appendix G) indicate sample concentrations for all PCOCs were less than the CCME guidelines.

Groundwater

Chemical analytical results (Figure 10, Appendix G) indicate that concentrations for all PCOCs were less than the BC CSR AW (Marine and Freshwater Life) standards.

Summary

No COCs were identified in soil and groundwater at APEC 6.

10.0 AREAS OF ENVIRONMENTAL CONCERN

Table 7 lists the AECs present at the Cambridge Bay airport, as well as descriptions of the contaminated media.

Table 7: AECs at the Cambridge Bay Airport

AEC	Description	Contaminated Media	COC	Estimated Volume (m^3)	Area (m^2)
2	Cu and As exceedences in soil at the TC Shoreline Area	Soil	Cu and As	20	-
3	Firefighter Training Area	Soil	Benzene, Ethylbenzne and F2 fraction	15,000	-
		Groundwater	Benzene, Naphthalene and Pb	-	2,500
4	Former F.H. Ross Tank Site- HC in soil and groundwater	Soil	BTEX, F1-F4 fractions and Pb	3,500 (includes 10m^3 Pb)	-
		Groundwater	Naphthalene, Toluene, and Zinc	-	300

11.0 NCSCS SCORING

The NCSCS is a tool to aid in the evaluation of contaminated sites. The CCME National Classification System for Contaminated Sites (NCSCS) was revised in 2008 to supersede the 1992 NCS system and also the Federal Contaminated Sites Action Plan (FCSAP) scoring system (2005 version, developed by Franz Environmental Inc.). The revised system retains the general classification structure of Class 1, 2, 3, "I" or "N" based on the site's current or potential adverse impact on human health and/or the environment.

A score was generated for each APEC.

- The site score for AEC 2 (now AEC 2) is 55.6 which classifies the TC Shoreline Disposal Area as a Class 2 site (Medium Priority for Action) (See Appendix I).
- The site score for AEC 3 (now AEC 3) is 71.7 which classifies the FTA as a Class 1 site (High Priority for Action) (See Appendix I). Also, pre-screening also identifies the Site as a Class 1 Site.
- The site score for AEC 4 (now AEC 4) is 76.4 which classifies the Former F.H. Ross Tank Site as a Class 1 site (High Priority for Action) (See Appendix I).

12.0 CONCEPTUAL REMEDIAL ACTION PLAN

This conceptual remedial action plan outlines the options to mitigate potential contaminant exposure to human and ecological receptors. A human health risk assessment (HHRA) and ecological risk assessment (ERA) are being completed as part of this contract (provided as a separate report). The HHRA/ERA will identify the potential risks to human health and environmental receptors based on the appropriate pathways, concentrations and chemicals of concern. The extent of impacts, impacted media and final contaminant remediation approaches may be guided by the outcome of the HHRA/ERA. As such, the HHRA/ERA coupled with this conceptual plan could be used as the basis for a more detailed remedial management plan.

12.1 Contaminant Impacts

Elevated metals, PHC, BTEX, and PAHs exist on Site and it is our opinion that the soil, groundwater, and surface water chemistry reflect the environmental impacts associated with fire training, fuel storage/use, and land-filling activities on site. A summary of the contaminant impacts is provided in the table below:

AEC	Description	COC	Impacted Media
2	TC Shoreline Area	Copper, and arsenic	Soil
3	Fire-fighter Training Area	Benzene, Ethylbenzene, F2 fraction, naphthalene and lead	Soil and groundwater
4	Former F.H. Ross Tank Site	BTEX, F1-F4 fractions, naphthalene, toluene lead, and zinc	Soil and Groundwater

12.2 Remedial Options Reviewed

FRANZ conducted a detailed options analysis (Appendix J) to assess remediation options for Site remediation. The assessment focussed on 6 technologies that have been employed for Site COCs including:

- Excavation and onsite biological *ex-situ* treatment;
- Risk assessment;
- Excavation and offsite disposal;
- *In-situ* treatment: Multi phase extraction;
- In-situ chemical oxidation; and
- Monitored natural attenuation.

12.3 Remedial Options Ranking

FRANZ ranked these remedial options in accordance with technological, regulatory, and Site specific factors. The specific criteria to evaluate these options were:

- Long term effectiveness;
- Applicability
- Limitations;
- Overall protection of human health and the environment;
- Regulatory acceptance;
- Timeframe; and
- Cost effectiveness.

A score of 1 to 5 was applied to each of the criteria with the highest score being awarded to the most preferred outcome. Total scores were summed and options ranked according to score; the higher the score rendered the option more preferred. Total rankings ranged from a score of 12 to 28 with protection of human health and the environment, and regulatory acceptance providing the largest range in scores amongst the approaches (Appendix J).

12.4 Preferred Remedial Options

FRANZ selected the three top ranked options as the "preferred" options that warranted further discussion. Only the top three options were selected as viable approaches as there was significant separation in scores between the top three (scores were 28, 27, and 22 out of a possible 35) and bottom three (scores were 17, 16, and 12 out of a possible 35) remedial options. The three top ranked remedial options include.

- **Option 1**: Excavation and onsite biological *ex-situ* remediation;
- **Option 2**: Risk assessment; and
- **Option 3**: Excavation and offsite disposal.

12.4.1 Option 1 – Excavation and Onsite biological *Ex-situ* Remediation

In this option, PHC contaminated soil and groundwater from AECs 3, and 4 would be removed, consolidated and treated in an engineered land treatment facility (LTF). The LTF would be constructed at a suitable location, as close as possible to AECs 3 and 4, to minimize contaminated material handling and transport. Excavation and placement in the LTF would be conducted at a rate of about 1500m^3 annually with a treatment time of about 2 years.

Amendments (e.g., nutrients, water) would be added soils aerated as needed to accelerate the treatment process. Treated soils can be re-used as backfill material.

The remaining 2 options are considered reasonable approaches to remediate the metals contaminated soils ($30m^3$). This is not expected to add significantly to the cost as metals contamination appears to be readily accessible, limited, and localized.

12.4.2 Option 2 – Risk Assessment

This option includes data review and assessment to prepare a conceptual site model to identify contaminant hazards, exposure pathways, and receptors. A data-gap analysis is conducted and additional investigation may/not be required to delineate contamination. Data is modeled to assess Site specific contaminant risks. If unacceptable risks to human health or ecological receptors are identified, mitigative actions (e.g., hot-spot removal) may be required; however, complete source removal is often unlikely.

A screening level risk assessment is currently being completed to determine the potential risks to human and ecological receptors. The outcome of the screening level risk assessment will be used to guide the long-term strategies for the Site.

12.4.3 Option 3 – Excavation and Offsite Disposal

This option involves excavation and off-site disposal/treatment of contaminated soils/groundwater from AECs 2, 3, and 4. Contaminated material would be consolidated and transported offsite via barge/ship to a licensed treatment facility. Significant amounts of backfill would be required or approval from the Airport authority to re-grade some of the excavated areas would be required.

12.5 Summary of Mitigation Costs

Based on the above discussion, FRANZ prepared a conceptual remedial plan with estimated associated costs (Appendix K). The approach is based on techniques outlined in Option 1 through 3 and spans a period of approximately 9 years (including monitoring). The indicative cost estimate (total of about $8.2 million); however, it is our understanding that more detailed cost estimates would be completed as part of a future Remediation/Risk Management Plan, as the relevant strategies and options are carried forward.

13.0 CONCLUSIONS AND RECOMMENDATIONS

FRANZ was retained by Public Works and Government Services Canada (PWGSC) and Transport Canada (TC), Prairie & Northern Region and Environmental affairs Division to complete a Phase II/III Environmental Site Assessment (ESA) at the Cambridge Bay Airport, Cambridge Bay, Nunavut.

Review of historical documents identified the following Areas of Potential Environmental Concern (APECs) and Potential Contaminants of Concern (PCOCs) summarized in Table 8.

Table 8: APECs at the Cambridge Bay Airport

APEC	DESCRIPTION	PCOCs
1	Historical Screening Plant / Boneyard	BTEX, F1-F4, PAH, VOC, Glycols, Metals, PCBs and Pesticides
2	TC Shoreline Disposal Area	BTEX, F1-F4, PAH, VOC, Metals, PCBs and Pesticides
3	Firefighter Training Area	BTEX, F1-F4, PAH, VOC, Lead, PCBs and PFOS.
4	Former F.H. Ross Tank Site	BTEX, F1-F4, PAH and Metals.
5	Former AST Location North of Building T-5	BTEX, F1-F4, PAH, VOC and Metals.
6	Former AST Location West of Building T-4	BTEX, F1-F4, PAH, VOC and Metals.

The intrusive site investigation conducted by FRANZ in 2009 included a total of thirty seven (37) test pits, fifteen (15) groundwater samples collected from monitoring wells installed, one (1) surface water sample and seven (7) aboveground foliage vegetation samples within the 6 APECs. The ESA identified the following three Areas of Environmental Concern (AECs) as presented in Table 9.

Table 9: AEC Findings and Recommendations at the Cambridge Bay Airport

AEC	Description	Contaminated Media	COC	Estimated Volume (m^3)	NCS	Recommendation
2	Cu and As exceedences in soil along the Shoreline	Soil	Cu and As	20	56 Med Priority	- Additional investigation. Remediate (excavation and offsite disposal or risk assessment)
3	Fire-fighter Training Area	Soil	Benzene, Ethylbenzene and F2 fraction	15,000	72 High Priority	-Delineate PHC contaminated soils. -Excavate and treat in an onsite LTF.
		Groundwater	Benzene, Naphthalene and Pb	-		- Excavate with PHC contaminated soils
4	Former F.H. Ross Tank Site	Soil	BTEX, F1-F4 fractions and Pb	3,500 (includes $10m^3$ for Pb)	76 High Priority	-Delineate extent of PHC contamination. - Excavate and treat PHC contaminated soils in LTF. - Segregate Pb contaminated soils and disposed offsite or manage (risk assessment) onsite.
		Groundwater	Naphthalene, Toluene, and Zn	-		-Naphthalene and Toluene excavated and treated in LTF -Resample and delineate PHC and Zn contamination.

Relevant findings and conclusions identified during the ESA with respect to identified AECs includes:

- the estimated volume metals and PHC contaminated soil identified at the Cambridge Bay Airport is about $30m^3$ and $18,500m^3$ respectively. The extent of petroleum contamination has not been fully delineated in both AEC 3 and 4;
- some uncertainty exists with respect to the presence and extent of metals contaminated soil at AEC 2, and 4. Some of these elements (e.g., As) may be naturally occurring in the area; however, site concentrations exceed other site/background concentrations

suggesting contamination is from anthropogenic sources. If present, contamination is expected to be localized;

- PHC contaminated groundwater was identified in soils at both AECs 3, and 4. The leading edge of PHC groundwater contamination was not fully delineated at AEC 4 due to scope limitations, airport operations, and buried utilities. Indicators of unregulated petroleum (PHC F1 and F2) impact was also identified;
- metals contaminated groundwater was detected within the PHC soil contaminated zone in AECs 3 and 4. Anthropogenic contaminant sources were not identified and exceedences may have resulted from natural element mobilization from PHC contaminant degradation; and
- No evidence of PFOS impact was identified in AEC 3; however, the AEC was not fully characterized for this PCOC.

FRANZ recommends PHC contaminated soils and groundwater (including metals) at AECs 3, and 4 be excavated and treated in an onsite land treatment facility (LTF). We assume a 7,000m^3 capacity LTF could be constructed at the Airport. Considering prevailing climatic conditions at Cambridge Bay (relatively cold temperatures, short summer), we estimate that up to 3,500m^3 of PHC contaminated soil can be cycled through the LTF annually. Prior to initiating full-scale remediation, FRANZ recommends a bench-scale treatment program be completed to confirm treatment projections/feasibility. Also, additional soil and groundwater sampling should be conducted to fully delineate the extents of PHC contamination; however, the work can be completed before or concurrent with remediation activities. Groundwater monitoring should be conducted following soil remediation activities at AEC 3, and 4 as part of a natural attenuation assessment.

FRANZ recommends additional investigation to delineate the extent of metals contamination at AECs 2, and 4. Post-remediation groundwater monitoring should be conducted at AEC 4 to assess if COCs (i.e., Zn and naphthalene) attenuate following soil petroleum hydrocarbon remediation activities. Chemical analytical results can be utilized in support of an ecological and human health risk assessment for these AECs.

14.0 REFERENCES

Dewing, K., Turner, E. and Harrison, J.C., 2007. Geological History, Mineral Occurrences and Mineral Potential of the Sedimentary Rocks of the Canadian Arctic Archipelago *in* Goodfellow, W.D., ed., Mineral Deposits of Canada: A synthesis of Major Deposit-Types, District Metallogeny, the Evolution of Geological Provinces and Exploration Methods: Geological Association of Canada, Mineral Deposits Division, Special Publication No. 5, p. 733-753

British Columbia Ministry of the Environment, 2009. Contaminated Sites Regulation.
BC Reg. 375/96

Canadian Council of Ministers of the Environment, 1999. Canadian Environmental Quality Guidelines for the Protection of Aquatic Life.

Environment Canada. National Climate Data and Information Archive. Canadian Climate Normals 1971-2000. www.climate.weatheroffice.ec.gc.ca (accessed on October 27, 2009).

Geological map of the Arctic. Geological Survey of Canada, Open File, 5816.

Harrison, J C; St-Onge, M R; Petrov, O; Strelnikov, S; Lopatin, B; Wilson, F; Tella, S; Paul, D; Lynds, T; Shokalsky, S; Hults, C; Bergman, S; Jepsen, H F; Solli, A, 2008

Natural Resources Canada, 1995. National Atlas of Canada, 5th Edition, MCR 4177

Ontario Ministry of the Environment, 1989. "Upper Limits of Normal" Contaminant Guidelines for Phytotoxicology Samples.

Sharpe, D R, 1993. Surficial Geology, Cambridge Bay, District of Franklin, Northwest Territories. Geological Survey of Canada, 1825A.

15.0 LIMITATIONS

The conclusions in this report are based on information collected from the investigation locations chosen for this study. The locations were selected based on the best information available to us at the time of this study. This does not preclude the possibility that different conditions may be present elsewhere on the property. No investigative method can completely eliminate the possibility of obtaining partially imprecise or incomplete information; it can only reduce this possibility to an acceptable level.

Professional judgement was exercised in gathering and analysing the information obtained. Like all professional persons rendering advice, we cannot act as absolute insurers of the conclusions we reach; we commit ourselves to care and competence in reaching those conclusions. Our undertaking therefore, is to perform our work, within the limits prescribed by our client, with the usual thoroughness and competence of the profession. No other warranty or representation, expressed or implied, is included or intended in this report.

Sincerely,

Franz Environmental Inc.

Jennifer Keenliside, HBSc., CEPIT

Viviane Dubois-Côté, M.Sc., P. Geo

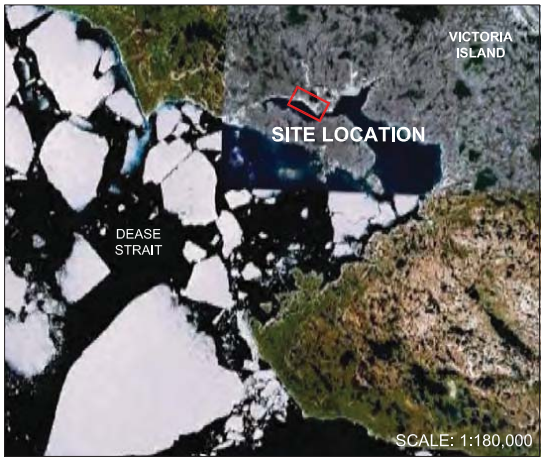
Miguel Madrid, M.Sc.

Steve Livingstone, M.Sc., P.Geo.

James Smith, B.Sc.

APPENDIX A

Figures



LEGEND

Extent of Study Area

References:

Google Earth satellite image, 2009
Site location based on dGPS coordinates (NAD 83)

Title: STUDY AREA

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CONSULTING ENGINEERING TECHNOLOGIES

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Date: MARCH 2010

Client: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA / TRANSPORT CANADA

Scale: See figures for scale

FIGURE 1

1748-0901/CAD/Cambridge Bay.dwg FINAL Mar 1/10

LEGEND

- Area of Potential Environmental Concern (APEC)
- Background Soil Sampling Location (Franz 2009)
- Background Vegetation Sampling Location (Franz 2009)
- YCB-01 Soil/Groundwater Sample Location - Dillon 1995
- 99-1 Soil/Groundwater Sample Location - AGRA 1999

APEC #	Description
1	Screening Plant / Boneyard
2	Shoreline Disposal Area
3	Former Fire Training Area
4	Former F.H. Ross Tank Farm
5	Former AST North of Building T-5
6	Former AST West of Building T-4

APPROXIMATE SCALE 1:6,800

200 150 100 50 0 200

metres

References:
Google Earth satellite image, 2009
APEC locations based on dGPS coordinates (UTM - NAD 83)
Sampling locations derived from historical reports

Title: APEC LOCATIONS

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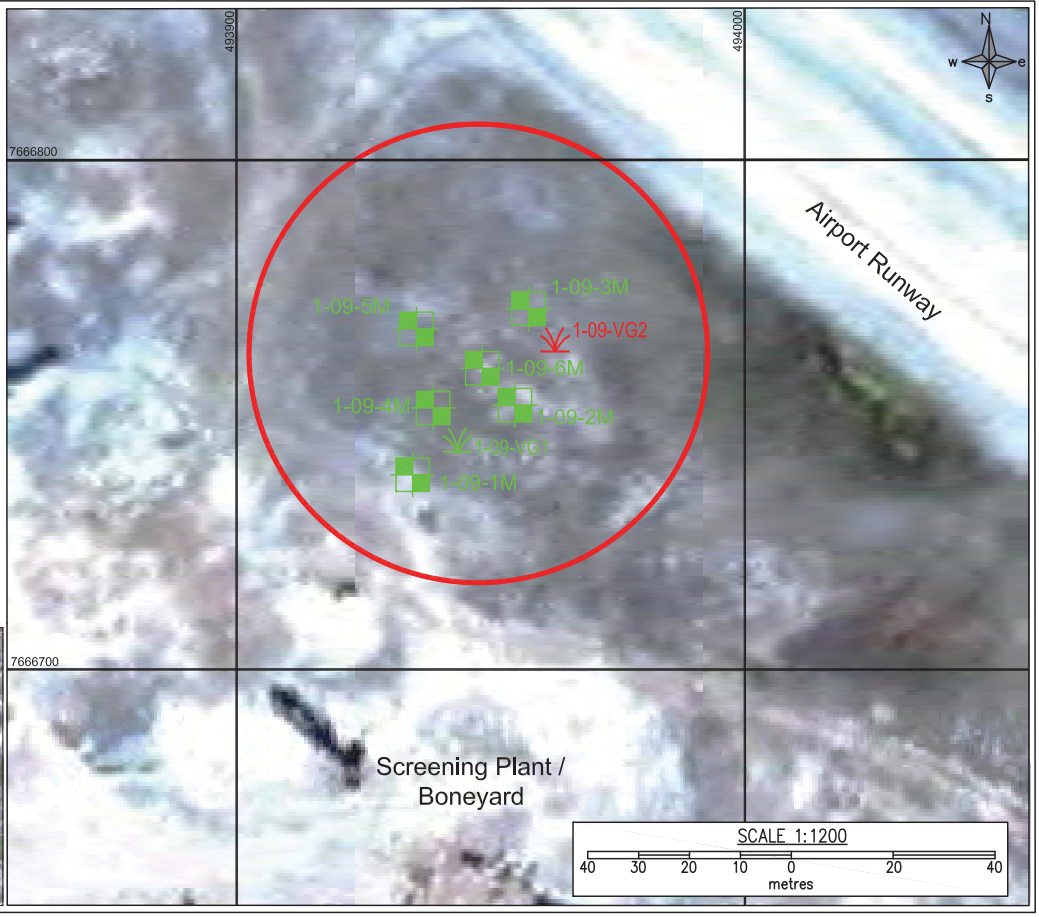
Scale: 1 : 6,600

FIGURE 2

1748-0901/CAD/Cambridge Bay.dwg FINAL Mar 1/10

VEGETATION

Station ID	MOE Vegetation Guidelines (ppm)	1-09-VG2
Duplicate ID		
Date		2/Sep/09
Lab report ID		A948579
Molybdenum	1.5	2.6



LEGEND

- Extent of APEC
- Soil Sample (TP); compliant with CCME guidelines
- Vegetation Sample (VG); compliant with Ontario MOE guidelines
- Vegetation Sample (VG); exceeds Ontario MOE guidelines

References:
Google Earth satellite Image, 2009
No exceedances were found for soil in APEC 1
Analytical results for soil and vegetation are in ug/g and can be found in Appendix G
Site locations based on dGPS coordinates (UTM - NAD 83)
CCME Soil Guidelines for Commercial land use (2008)
Vegetation analytical results compared to Ontario MOE Vegetation Guidelines

Title: APEC 1 - Screening Plant / Boneyard Sampling Locations and Analytical Results (Soil & Vegetation)

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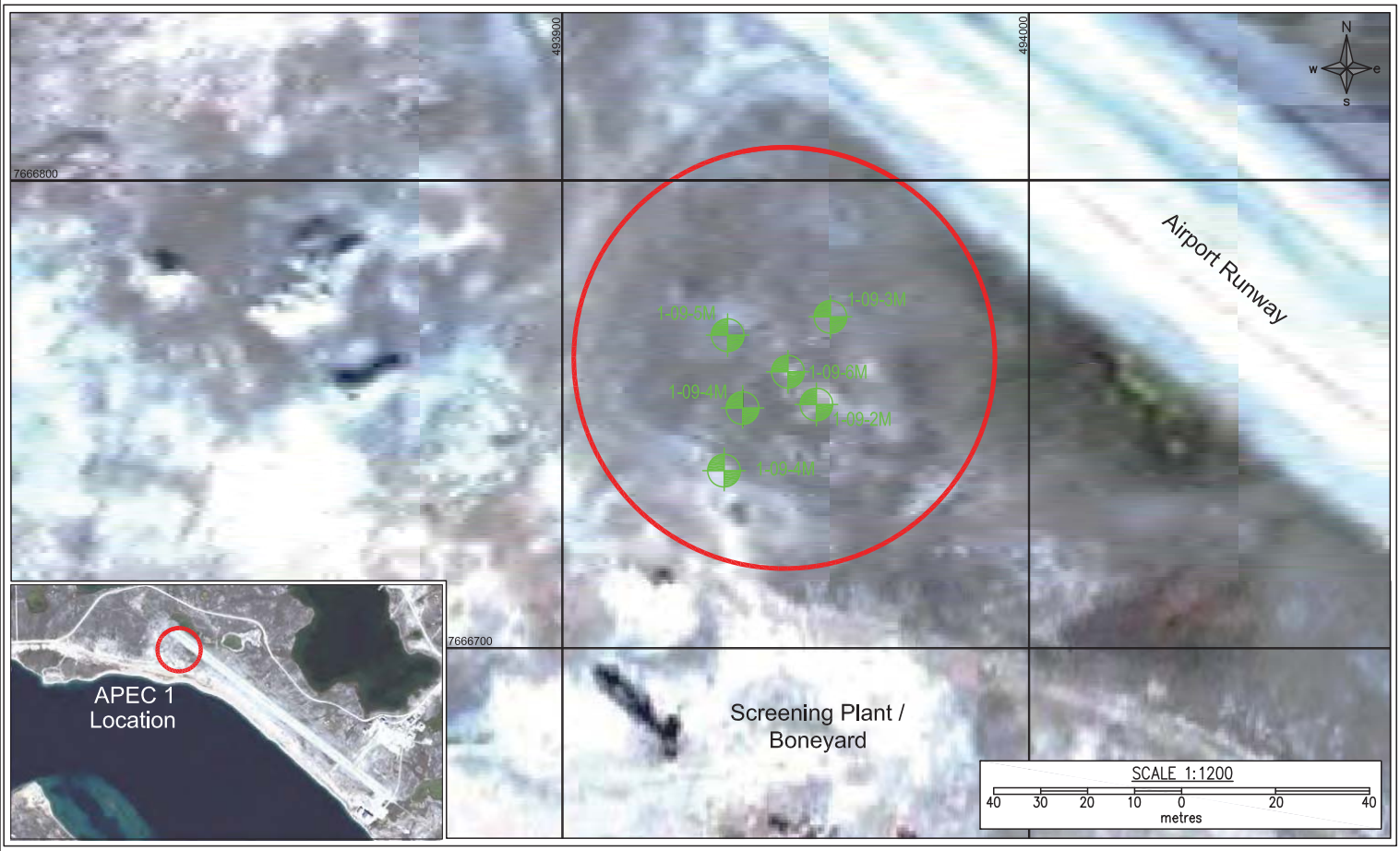
Scale: 1 : 1,200

FIGURE 3

1748-0901/CAD/Cambridge Bay.dwg FINAL Mar 1/10



LEGEND

- Extent of APEC
- Groundwater Sample (GW); compliant with BC-CSR guidelines

References:
Google Earth satellite image, 2009
No exceedances were found for groundwater in APEC 1
Analytical results for groundwater are in ug/L and can be found in Appendix G
Site locations based on dGPS coordinates (UTM - NAD 83)
British Columbia Contaminated Site Regulation (CSR) for Marine Receptors (2009)

Title: APEC 1 - Screening Plant / Boneyard Sampling Locations and Analytical Results - Groundwater

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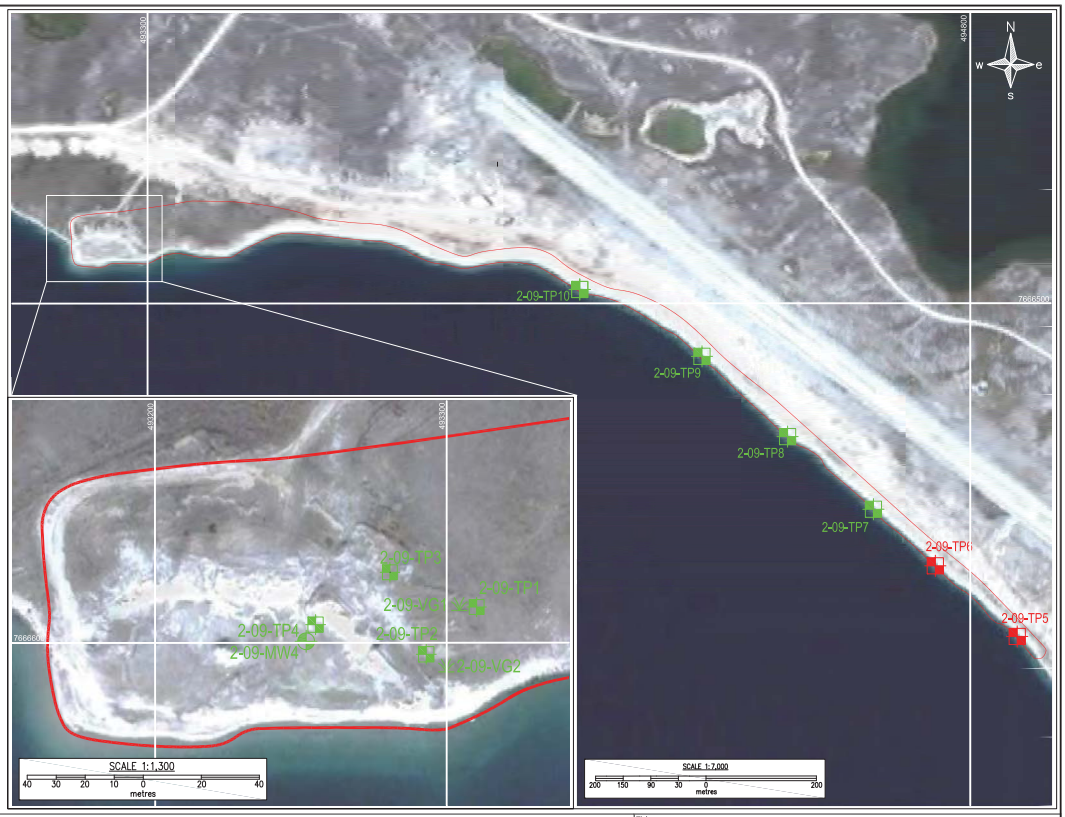
Scale: 1 : 1,200

FIGURE 4

1748-0901/CAD/Cambridge Bay.dwg FINAL Mar 1/10

SOIL

Station ID	CCME Soil (Commercial)	2-09-TP5	2-09-TP5	2-09-TP6
Field label		2-09-TP5-1	GR2	2-09-TP6-1
Duplicate ID		GR2	2-09-TP5-1	
Date		29/Aug/09	29/Aug/09	29/Aug/09
Lab report ID		A947822	A947822	A947822
Depth (m)		0.4 – 0.6	0.4 – 0.6	0.2 – 0.6
Metals				
Arsenic	12	3.3	2.0	40.6
Copper	91	94.5	102.0	24.5



LEGEND

- Extent of APEC
- Soil Sample (TP); compliant with CCME guidelines
- Soil Sample (TP); exceeds CCME guidelines
- Groundwater Sample (GW); compliant with BC-CSR guidelines
- Vegetation Sample (VG); compliant with Ontario MOE guidelines

References:
Google Earth satellite Image, 2009
No exceedances were found in vegetation or groundwater at APEC 2
Analytical results for soil and vegetation are in ug/g and can be found in Appendix G
Analytical results for groundwater are in ug/L and can be found in Appendix G
Site locations based on dGPS coordinates (UTM - NAD 83)
CCME Soil Guidelines for Commercial land use (2008)
British Columbia Contaminated Sites Regulations (CSR) for Marine Receptors (2009)
Vegetation analytical results compared to Ontario MOE Vegetation Guidelines

Title: APEC 2 - Shoreline Disposal Area Sampling Locations and Analytical Results - Soil, Vegetation & Groundwater

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Scale: See figures for scale

FIGURE 5

1748-0901/CAD/Cambridge Bay.dwg FINAL Mar 1/10