Environment

Public Works and Government Services Canada

Phase II/III Environmental Site Investigation, Firefighter Training Area, Cambridge Bay Airport, Cambridge Bay, NU - DRAFT

Prepared by:

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Project Number:

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Date:

November, 2010

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November 22, 2010

Ms Rae-Ann Sharp
Environmental Specialist
Public Works and Government Services Canada
401-1230 Government Street
Victoria, BC V8W 3X4

Dear Ms. Sharp:

Project No: 60164535

Regarding: Phase II/III Environmental Site Investigation Firefighter Training Area, Cambridge Bay Airport, Cambridge Bay, Nunavut

We are pleased to provide you with one (1) DRAFT electronic copy of the Phase II/III Environmental Site Investigation Firefighter Training Area, Cambridge Bay, Nunavut.

If you have any questions or comments regarding the attached please contact the undersigned at 780.486.7057.

Sincerely,
AECOM Canada Ltd.

Nick Oke, M.Sc., P.Chem.
Senior Environmental Scientist
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NO:slm

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Revision Log

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Executive Summary

AECOM was contracted by Public Works and Government Services (PWGSC) on behalf of Transport Canada (TC) to conduct a Phase II/III Environmental Site Assessment (ESA) on the former Firefighter Training Area (FFTA) at the Cambridge Bay Airport in Cambridge Bay, NU.

Administration and control of the airport was transferred from Transport Canada to the Government of the Northwest Territories and later to the Government of Nunavut. As part of the Arctic A Transfer Agreement between Transport Canada and the Government of Northwest Territories in 1995, Transport Canada agreed to address certain environmental issues that were identified in environmental baseline studies. The FFTA was identified as a potential area of concern in 1994. Since then all infrastructure on the site has been dismantled and removed and the bermed area was bulldozed. The former FFTA was tilled over two summers in the mid-1990s.

PWGSC contracted Franz Environmental to conduct a Phase II/III ESA and a Human Health and Environmental Risk Assessment for the Cambridge Bay Airport in 2009. The Phase II/III ESA recommended further assessment of the FFTA to determine the extent of contamination.

AECOM conducted a site visit to Cambridge Bay in October 2010. Only soil samples were collected during the site visit as site conditions precluded the collection of groundwater samples. From the results of the soil sampling program as well as the sampling program conducted by Franz in 2009, AECOM has:

1. Refined the previously reported contamination plume.
2. Updated the National Contaminated Site Classification (NCSC) score.
3. Conducted a remedial/risk option analysis.

The following table is a summary of the results of the Phase II/III ESA.

Table 1. Phase II/III ESA Results Summary

Parameter	AEC 3 – FFTA
Contaminants of Concern	Benzene, Ethylbenzene, Petroleum Hydrocarbon F2 Fraction
Estimated Area of Plume	3312 m^2
Estimated Volume	6624 m^3
NSCS score	67.2, Class 2 Site (Medium Priority for Action)
Preferred Remedial/Risk Option	In-situ Landfarming

Table of Contents

List of Tables

Appendices

1. Introduction

1.1 Scope

AECOM was retained by Public Works and Government Services Canada (PWGSC) on behalf of Transport Canada (TC) to conduct two Phase II/III Environmental Site Assessments (ESA) at the Cambridge Bay Airport; the Firefighter Training Area (FFTA) and the Transport Canada Shoreline Area (TCSA). These areas were two of three identified as Areas of Environmental Concern (AEC) in a previous Phase II/III ESA that was conducted for the entire airport property. This report is for the Firefighter Training Area (the site) and the Transport Canada Shoreline Area Phase II/III ESA will be submitted under a separate cover.

The intent of the Terms of Reference (TOR) provided to AECOM is to have an environmental consultant conduct a Phase II/III ESA to further characterize the extent, types and levels of contamination and chemicals of concern at the site and develop a remedial action plan that includes an option analysis and cost estimate.

Figure 1 located in Appendix A is a Site Plan showing the layout of the site and its location on the airport property.

1.2 Background

The Cambridge Bay Airport is located near the West Arm of Cambridge Bay 3 km west of the Hamlet of Cambridge Bay, Nunavut. Cambridge Bay is on the southeast side of Victoria Island in the Kitikmeot region of Nunavut. The airport covers an area of approximately 140 ha and has been used as an airport since the 1950s. Administration and control of the airport was transferred from Transport Canada to the Government of the Northwest Territories and later to the Government of Nunavut. As part of the Arctic A Transfer Agreement between Transport Canada and the Government of Northwest Territories in 1995, Transport Canada agreed to address certain environmental issues that were identified in environmental baseline studies. The FFTA was identified as an Area of Environmental Concern (AEC) in 1994.

2. Site Description

2.1 Subject Property Description

The Cambridge Bay Airport is not on federally owned land and is not listed in the Federal Real Property Directory. The Cambridge Bay Airport is on untitled land owned by the Government of Nunavut with a legal description of Quad 77/2, Lot 1004, Plan #2958.

The Cambridge Bay Airport is on the northeast shore of the West Arm of Cambridge Bay. The airport is approximately 3 km west of the Hamlet of Cambridge Bay.

2.1.1 APEC 3 - Firefighter Training Area (FFTA)

The FFTA is located southwest of the northwest end of the runway. In the M.M.Dillon Limited1994 report, Cambridge Bay Airport Environmental Baseline Study, the training area was bermed, unlined and measured approximately 4.5 m x 3 m. Fuel storage was provided by an above ground storage tank (AST) farm and pipe system formerly located west of the bermed area.

In the 1999 AGRA draft report, Remedial Action Plan Follow-up Cambridge Bay Airport, it was reported that the FFTA was in use for a brief period after the transfer of the Cambridge Bay Airport from Transport Canada to the Government of Northwest Territories. Transport Canada returned to the site and removed the AST and the associated piping, then tilled the area to aerate the soil. Tilling was reported to have been completed on two or three occasions from 1994 to 1996.

The Franz Phase II/III ESA identified the following potential sources of contamination (PCOC) while developing their sample plan, fuels (e.g. avgas, jet fuel), spent solvents, oils and firefighting retardants. The PCOCs identified for soil and groundwater were: BTEX, petroleum hydrocarbon (PHC) fraction F1 - F4, polycyclical aromatic hydrocarbons (PAHs), volatile organic carbons (VOCs), lead, polychlorinated biphenyls (PCBs) and perfluoro octane sulfonates (PFOS). After the field sampling program, Franz concluded that for soil benzene, ethylbenzene and PHC fraction F2 exceed the Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health at four test pits between 0 and 2 metres below ground surface (mBGS). Concentrations for all other PCOCs were less than the CCME guidelines. For groundwater, benzene and lead were identified exceeding the British Columbia Contaminated Sites Regulation for Aquatic Life (Marine Life) (BC CSR AW (Marine Life)) standard in one (3-09-4M) monitoring well. Naphthalene exceeded the BC CSR AW (Marine Life) standard in two (3-09-4M and 3-09-5M) monitoring wells. Concentrations for all other parameters were less than the BC CSR AW (Marine Life) standards.

2.2 Previous Environmental Reports

PWGSC provided AECOM with the following previous environmental reports for the Cambridge Bay Airport:

- M.M. Dillon Limited, Cambridge Bay Airport Environmental Baseline Study, November 1994.
- Agra Earth and Environmental Limited, DRAFT Remedial Action Plan Follow-up Cambridge Bay Airport Nunavut Territory, November 1999.
- Franz Environmental Inc., Phase II/III Environmental Site Assessment Cambridge Bay Airport Landfill/Boneyard, Cambridge Bay, NU, 2010.
- Franz Environmental Inc., Human Health and Ecological Risk Assessment Cambridge Bay Airport, Cambridge Bay, NU, 2010.

Reviews of each of these documents are provided in the following sections.

2.2.1 M.M. Dillon Limited, Cambridge Bay Airport Environmental Baseline Study, November 1994

M.M. Dillon was contracted to conduct an environmental baseline study for the Cambridge Bay Airport on behalf of Transport Canada to identify potential environmental liabilities at the airport prior to its transfer from Transport Canada to the Government of the Northwest Territories. The Cambridge Bay Airport Environmental Baseline Study was divided into three parts, Part A contains the Executive Summary, Part B details the site audit and tank assessments of Transport Canada and airport tenants. The site audit and tank assessments examined the various facilities on the property for compliance with environmental legislation. Part C documents the investigation of the airport grounds, or the land surrounding the facilities, to determine the type and extent of impact that historic and current activities are having on the environment. The electronic copy of the report provided to AECOM starts at page 73, the middle of Part B. Descriptions of both the FFTA and TCSA are included in the sections provided.

The FFTA is referenced twice in the report, Part B Section 5.6.2 and Part C Section 3.3.1. A summary of the findings regarding the FFTA are described below:

- The FFTA had above ground storage tanks (ASTs) removed from the site; however, the piping has remained. The training area was bermed, unlined and measured approximately 4.5 m by 3 m. The FFTA was identified as a target for hydrogeological investigation due to long-term fuel usage at the site. The site consists of an aircraft mock-up area where fuel is periodically burned as part of firefighting training exercises. A containment berm, constructed of local till material, surrounds the aircraft mock-up area. Fuel storage was provided by an aboveground storage tank farm and pipe system formerly located to the west of the mock-up area.

An environmental status investigation of the FFTA at Cambridge Bay Airport was conducted by EBA Engineering Consultants Ltd in November, 1993. This study identified the spread of suspected contamination beyond the southeast corner of the bermed area. The recommendation of the assessment investigation indicated that immediate remediation of the 750 m^3 of contaminated soils was not imperative due to a CCME classification score of low risk potential to human health and the environment. Remediation of the contaminated soil was recommended only as part of a final decommissioning program.

2.2.2 Agra Earth and Environmental Limited, DRAFT Remedial Action Plan Follow-up Cambridge Bay Airport Nunavut Territory, November 1999

Public Works and Government Services Canada (PWGSC) contracted Agra Earth and Environmental in 1999 to conduct a follow-up site investigation of the Cambridge Bay Airport and update the remedial action plan. The activities and operations of the airport and its tenants were reviewed to document whether previous remedial action plan recommendations (M.M. Dillon Limited, 1994) have been implemented and to identify any additional areas of environmental concern and/or areas of non-compliance other than those situations outlined in the 1994 baseline study. The focus of the AGRA investigation was on priority 1 and 2 findings for those tenant and airport operations and associated recommendations. Each tenant operation was investigated to identify: a) whether or not previous recommendations had been carried out, b) additional areas of environmental concern were evident, and c) to identify new recommendations for each area of environmental concern and/or non-compliance issues.

A summary of the information provided regarding the FFTA is described below:

- Interviews conducted during the remedial action plan follow-up reported that the FFTA was only in use for a brief period after the transfer of the Cambridge Bay Airport to the GNWT.
- Transport Canada returned to the site and removed the AST and associated piping and tilled the area to aerate soils. Tilling was reported to have been completed on two or three occasions over a 2 year period, with the last tilling completed in 1996.

- Groundwater samples were collected from the monitoring wells for hydrocarbon analysis and a limited soil sampling program was completed to evaluate the presence of hydrocarbon contamination in the vicinity of the former FFTA.
- Historic groundwater sampling and sampling completed as a component of this investigation reported concentration of BTEX in excess of both the GCDWQ and the CCME criteria.
- Additional soil and groundwater monitoring is recommended in the vicinity of the former FFTA to delineate the extent of hydrocarbon impacts and to determine if contaminants are moving towards Cambridge Bay.

2.2.3 Franz Environmental Inc., Phase II/III Environmental Site Assessment Cambridge Bay Airport Landfill/Boneyard, Cambridge Bay, NU, 2010

Franz Environmental (Franz) was retained by PWGSC and TC to complete a Phase II/III ESA at the Cambridge Bay Airport. The work was completed to identify environmental liabilities and assess remediation/risk management options at six areas of potential environmental concern (APECs).

The intrusive site investigation conducted by Franz in 2009 included installing 37 test pits, 15 groundwater monitoring wells as well as collecting one surface water sample and seven above ground foliage vegetation samples within the six APECs. The ESA identified three Areas of Environmental Concern (AECs).

Table 2. AECs Identified in the Franz 2010 Phase II/III of the Cambridge Bay Airport

AEC	Description	Contaminated Media	Contaminant of Concern (COC)	Estimated Volume (m^3)	Estimated Area (m^2)
2	TC Shoreline Area	Soil	Cu and As	20	-
3	Firefighter Training Area	Soil	Benzene, Ethylbenzene PHC, F2 fraction	15,000	-
		Groundwater	Benzene Naphthalene Pb	-	2500
4	Former F.H. Ross Tank Site	Soil	BTEX PHC, F1-F4 fractions Pb	3500	-
		Groundwater	Naphthalene Toluene Zn	-	300

For AEC3 Phase II/III ESA Franz recommended the following.

FFTA:

- Petroleum hydrocarbon (PHC) contaminated soils and groundwater (including metals) in AEC 3 (FFTA) and 4 to be excavated and treated in an onsite land treatment facility (LTF).
- Additional investigation should be conducted at both AEC 3 (FFTA) and 4 to fully delineate the extent of the leading edge of the PHC contaminated soil.
- 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.

2.2.4 Franz Environmental Inc., Human Health and Ecological Risk Assessment Cambridge Bay Airport, Cambridge Bay, NU, 2010

Franz Environmental Inc. (Franz) was retained by PWGSC on behalf of Transport Canada to complete a risk assessment for the Cambridge Bay Airport. The risk assessment report consists of a preliminary human health and qualitative ecological risk assessment. The work was conducted to assess if environmental conditions at areas of potential environmental concern present a potential risk to human and ecological receptors.

Human Health Risk Assessment

The human health risk assessment was conducted in accordance with Health Canada PQRA guidance documents (Health Canada, 2004, 2007, 2009 updates). Screening chemicals of potential concern (COPC) for the human health assessment was completed by comparing maximum concentrations of contaminants in media primarily with federal CCME guidelines and standards. COPC in environmental media onsite and used as inputs in the human health assessment are:

- Soil – PHC Fraction F2, benzene, ethylbenzene, toluene, xylenes, arsenic, copper and lead.
- Groundwater – PHC Fraction F1 and F2, benzene, ethylbenzene, benzo(a)pyrene and lead.

The following human receptors were identified:

- Adult airport employees involved in operational and maintenance activities on-site.
- Remedial workers involved in site remediation.

The following exposure pathways were identified:

- Incidental ingestion of soil particles and inhalation of soil particles (fugitive dust and vapours).
- Dermal contact with soil.
- Dermal contact with groundwater.

The human health risk assessment concluded that there were unacceptable risks to the remediation worker from oral/dermal exposure to PHCs in soils on-site. Management of potential oral/dermal exposure to PHCs and benzene in soils and ground water should include the remediation worker's adherence to a site specific health and safety plan.

Ecological Risk Assessment

A qualitative evaluation of COPC, receptors and relevant exposure pathways was conducted to develop an Ecological Conceptual Site Model for both the "foreshore" and "terrestrial" sub-sites and to support an ecological risk assessment (ERA) of the property as a whole.

Screening of COPC for ecological assessment was initially completed by comparing maximum concentrations of contaminants in media primarily with federal CCME guidelines and standards. The COPCs identified in environmental media were further screened into two smaller sub-site, "foreshore sub-site" APEC 1, AEC 2, AEC 3 and a "terrestrial sub-site" AEC 4, APEC 5 and APEC 6. COPC from the initial screening process identified to potentially harm ecological receptors were:

- Soil – PHC Fraction F1, F2, F3 and F4, benzene, ethylbenzene, toluene, xylene, arsensic, copper and lead

- Groundwater – PHC Fraction F1, F2, benzene, toluene, xylenes, aluminum, cadmium, iron, nickel, strontium, zinc, manganese and naphthalene.

The ERA considered species known or likely to be on or in the immediate vicinity of the sites. Routes of environmental exposure pathways for ecological receptors identified at the sites include:

- Leaching of subsurface contamination into groundwater and transport into surface waters in the site vicinity, followed by trans-dermal uptake by aquatic species (higher and lower trophic levels) through contact with surface water and sediments.
- Ingestion of contaminated surface waters (terrestrial and aquatic).
- Ingestion of contaminated food items (aquatic and terrestrial) as well as ingestion of contaminated soil (terrestrial) or sediment (aquatic).
- Inhalation of volatile soil contaminants (terrestrial).
- Direct dermal contact with contaminated soil (terrestrial).

There were seven preliminary ERA conclusions. The four conclusions relating to the “foreshore” sub-site, which contains both the FFTA and the TCSA are:

- PHC F2 and lead in soil represent medium risk to terrestrial plants at the “foreshore” sub-site through dermal contact and to soil invertebrates via contaminated soil ingestion.
- Volatile COPC in soil represent low risk to burrowing terrestrial receptors (e.g. small burrowing mammals) exposed via inhalation of soil vapours at the “terrestrial” or “foreshore” sub-sites.
- Estimated COPC concentrations in receiving marine water at the “foreshore” sub-site indicate PHCs F1, F2, aluminum, nickel, iron, cadmium and toluene from discharging groundwater may represent medium risks to aquatic invertebrates exposed vial dermal contact and ingestion of contaminated water. Estimated PHC F1 and F2 concentrations in surface water may represent a medium risk to piscivorous fish exposed via ingestion of contaminated food.
- Estimated concentration in receiving marine water at the “foreshore” sub-site indicate xylene, aluminum and naphthalene from discharging groundwater may represent medium risks to piscivorous shorebirds exposed via ingestion of contaminated marine water and food items.

The recommendations stemming from the ERA were to refine the human health and ecological exposure scenarios to better reflect actual patterns of exposure for onsite receptors, refine the statistical database/input parameters to determine the most appropriate statistic values (e.g. 95% upper confidence limits) for contaminant concentrations and to conduct an ERA in which site specific modeling of ecological receptors exposure to contaminants is applied to quantitatively assess risks to ecological receptors. A site specific ERA will require further investigation and data collection.

3. Environmental Quality Guidelines/Standards

A sampling plan was developed to delineate the contamination at the FFTA prior to the site visit in October 2010. AECOM intended to collect soil and groundwater. Weather conditions did not permit the collection of groundwater samples only soil samples. Therefore the following discussion on environmental quality guidelines and standards will be limited to soil.

As the Cambridge Bay Airport is located in Nunavut the applicable guidelines are the Environmental Guideline for Contaminated Site Remediation published in 2009 by the Department of Environment, Government of Nunavut.

The remediation criteria in the Nunavut guidelines follow the Canadian Council Minister of the Environment (CCME) Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil (2008) and the Canadian Environmental Quality Guidelines (1999, updated 2007).

The guidelines selected for comparison of the analytical sample results are:

- Environmental Guideline for Contaminated Site Remediation, Government of Nunavut:
  - Appendix 3 – Remediation Criteria for Petroleum Hydrocarbons.
  - Appendix 4 – Remediation Criteria for Other Contaminants.

Another contaminant of concern raised in the Franz Phase II/III ESA for the FFTA is perfluorooctane sulfonate (PFOS). PFOS has become a contaminant of concern for Transport Canada at former firefighter training areas at airports across Canada because it is a component of aqueous film forming foam (AFFF). AFFF was used during firefighting exercises. There are no federal, territorial or provincial standards or guidelines for PFOS levels in soil.

4. Environmental Site Assessment Investigation

4.1 Methodology

A sampling program was developed to determine the extent of contamination at the FFTA. Franz (2010) estimated an area of contamination for the FFTA, although significant portions of the delineation were not confirmed via analytical results. Within the tilled area of the FFTA sample results for both soil and groundwater exceeded criteria identified in the 2010 Phase II/III ESA. Therefore, the proposed sampling program for the FFTA included both media.

Background soil and groundwater samples were collected during the Franz 2010 Phase II/III ESA therefore background samples were not collected.

The environmental site investigation team was in Cambridge Bay October 4 to 6, 2010 to complete the sampling program. Site photographs taken during the site visit can be found in Appendix E.

4.1.1 Soil

AECOM proposed to collect soil samples from test pits around the perimeter of the estimated area of contamination of the Franz 2010 Phase II/III and then in a concentric circle around the Franz estimated area. The delineation of contaminated soil at the FFTA was completed for the contaminants of concern identified in the Franz 2010 Phase II/III and under the Government of Nunavut Environmental Guideline for Contaminated Site Remediation

At the time of the site visit, the surface was frozen across the site but could still be excavated using a backhoe. The tilled area of the FFTA was frozen solid and could not be excavated below any significant depth. Therefore no soil samples were collected within the tilled area of the FFTA. The Franz estimated extent of contamination is located on the eastern half of the tilled area. Therefore the north, east and south sides of the estimated extent of contamination were sampled, but the west side could not be sampled as it runs through the tilled area. Four test pits around the Franz estimated perimeter and four test pits approximately 5 m from the estimated perimeter of the contaminated area were excavated. Test pit locations are shown on Figure 1.0 in Appendix A and test pit logs can be found in Appendix B.

Soil samples were collected from the eight test pits excavated by a backhoe. A pin flag with a numerical identifier was placed where samples were taken to allow the position to be surveyed. The location of each test pit was surveyed using a hand-held GPS unit. Sample locations and depths are presented in Tables C1 and C2 in Appendix C.

Samples were collected with a metal putty knife that was cleaned between samples with a “soil wash” or wiped, as required. Samples were generally collected at the surface, approximately 0.5 m and at 1.5 to 2 m below the surface. The soil collected at each of the sample locations was frozen at the time of sampling. The soil was placed in jars provided by the laboratory. The jars were completely filled (no headspace) and the samples kept cool until shipment to the laboratory. Two field duplicate samples were collected for the sample set, given a separate numerical label and submitted blind to the laboratory. A review of quality assurance and quality control (QA/QC) for field and laboratory methodologies is provided in Section 4.3 and Tables C3 and C4 in Appendix C.

Field screening of the soil samples with a gas monitor was intended; however, the sensor on the field screening equipment was broken in transit up to Cambridge Bay therefore instrumented headspace testing was not completed and field screening was limited to visual and olfactory assessment.

4.1.2 Groundwater

AECOM had planned to install drive-point wells to collect groundwater samples both up and down-gradient of the Franz estimated area of contamination. When the test pits were dug for the soil samples no water was observed, therefore no drive-point wells were installed.

4.2 Results

4.2.1 Analytical Results

The results of the contaminated soil delineation are described below, specifically where sample results exceeding guidelines were detected.

All sample results were below applicable guidelines except for one sample result, CB-17; from test pit TP10-05 at a depth of 2 m. The soil sample exceeded the guideline for the PHC F2 fraction. The results for the samples collected in TP10-05 at 60 cm below surface, CB-15 and CB-16 (duplicate), were both below applicable guidelines.

Soil samples for PFOS were collected from the surface of all test pits except test pit TP10-03 where the sample was collected at 120 cm below surface. PFOS sample results were above detection limit for all surface samples and below detection limit for the subsurface sample, indicating the presence of PFOS in surface soil. PFOS concentrations ranged from 730 µg/kg to <25 µg/kg.

Complete summaries of the analytical results for the sample locations shown on the site drawings can be found in Tables C1 and C2 in Appendix C.

The contaminant plume perimeter and estimated depths were generated by assuming a linear rate of contaminant concentration decline between adjacent samples. The concentration difference between adjacent samples was divided by the distance between them to derive a rate of concentration decline/metre and to estimate the point at which the concentration would be equivalent to the guidelines.

As no groundwater samples were collected, AECOM has limited the estimate of contamination to soil. AECOM used both the samples collected by Franz in 2009 and the results of the 2010 AECOM sampling program to estimate the extent of soil contamination at the FFTA. The approximate area of soil contamination is 3312 m^2 and is shown on Figure 1 in Appendix A. The majority of the approximate area of contamination is in the tilled area; since it was frozen solid during the AECOM site visit the depth of contamination was not verified. Therefore the depth of contamination in the tilled area estimated by Franz was used to calculate the approximate depth of contamination. Franz encountered permafrost in test pit 3-09-5M at a depth of 2.1 m. Test pit 3-09-5M was located in the southeast corner of the tilled area within the approximate area of contamination. No other test pits dug by Franz or AECOM encountered permafrost at the FFTA. For estimation purposes, AECOM estimated a depth of contamination of 2 m across the entire area of contamination. The estimated volume of contaminated soil is 6624 m^3.

4.2.2 Test Pit Summary

Eight test pits were dug with a backhoe for the sampling program. Depths of test pits ranged from 2.5 m to 4 m with most test pits at 3 mBGS. The soil profile observed from 0 to 3 mBGS was loose, coarse grained sand with cobbles, trace silt and trace clay. The soil was gleyed approximately 1 to 2 m below ground surface for all test pits east and south of the tilled area (TP10-03, TP10-04, TP10-05, TP10-06, TP10-07, and TP10-08). Hydrocarbon odours were experienced in test pits TP10-05 and TP10-06.

Test pit logs for all the test pits can be found in Appendix B. The sample results for each of the test pits can be found in Table C1 and C2 in Appendix C.

4.3 Quality Assurance/Quality Control

In order to confirm that the sampling and analytical data collected for the FFTA was interpretable, defensible and comparable, a Quality Assurance and Quality Control (QA/QC) program was implemented for the project. QA/QC measures were taken in both the collection and analysis of the environmental sampling program. The following sections outline the QAQC program completed during the investigation.

4.3.1 Summary of QA/QC Results

Quality Control (QC) measures used in the collection, preservation, shipment, and analysis of samples included the following:

- All sampling containers were provided by the laboratory and were new.
- No sample containers were reused.
- Field notes including test pit logs were recorded during the investigation.
- All samples were kept cool prior to shipment to the laboratory.
- Samples were assigned unique sample control numbers and transported under chain of custody procedures.
- The analytical laboratory has proficiency certification issued by the Canadian Association for Laboratory Accreditation (CALA) for the specific analyses conducted.

The laboratory certificate analysis identified that, although the site assessment team followed the standard AECOM protocols, there was headspace identified in the containers for the samples listed in Table 3 once they arrived at the laboratory.

Table 3. Samples Identified by the Laboratory with Headspace

AGAT Laboratory Identification	AECOM Sample Identification	Test Pit No	Depth of Sample (cm)
2052942	CB-09	TP10-03	50
2052944	CB-11	TP10-04	50
2052945	CB-12	TP10-04	150
2052954	CB-17	TP10-05	200
2052959	CB-20	TP10-06	200
2052962	CB-23	TP10-07	150
2052978	CB-26	TP10-08	50

The soil collected for all samples were frozen and therefore it is assumed that as the soil thawed headspace developed in some of the containers.

Quality Assurance (QA) measures established for the investigation included collection of duplicate field samples at a rate of approximately 10%. A blind duplicate sample consists of a second aliquot of an individual sample that is submitted to the analytical laboratory under a separate label such that the analytical laboratory has no prior knowledge that it is a duplicate.

The relative percent difference (RPD) between duplicate results was used to assess overall sampling precision. The RPD is a measure of the variability between two duplicate analyses and is calculated by the following equation:

$$RPD = 100 \times ((2 \times (x1 - x2))/(x1 + x2))$$

Where x1 is the primary result and x2 is the blind duplicate result.

Table C3 and C4 in Appendix C compares sample analysis between the original samples and their duplicates. Acceptable RPD values vary on the analytical parameters, the sample matrix and the concentrations of analytes in the sample. Acceptable RPD values vary based on the analytical parameters, the sample matrix, and the concentrations of analytes in the samples. For metals in soils acceptable RPD values are 35% and for organics in soils (PHCs and PCBs), the acceptable RPD values are 50%. Only when concentrations are at least ten times the method detection limit are RPD calculations considered valid.

During this program, four field duplicates for soil samples were collected and were analyzed to provide an indication of the overall sampling and analytical precision. The blind field duplicates were analyzed for various parameters based on their location and expected contaminant(s) present. All duplicates were provided to the laboratory "blind"; no indication that the samples were duplicates was provided. The two parameter results that exceeded the RPD values of 35% for metals were for molybdenum and uranium. The concentrations of the set for molybdenum and uranium were less than 10 times the detection limit. The molybdenum and uranium RPD are therefore not considered to be strictly valid.

4.3.2 Laboratory QA/QC

The laboratory's QA/QC report is included with the analytical data in Appendix D. Laboratory QA/QC procedures included matrix spikes, spiked blanks, method blanks, laboratory duplicates and QC Standards. Matrix spikes are field samples that have a known concentration of the analyte added to the sample. This control generally identifies the effect of a matrix on a method's recovery efficiency. Spiked blanks are similar to matrix spikes with the exception that they are a blank matrix of distilled water. This sample is analyzed exactly as a normal sample is analyzed and is used to determine if the laboratory can make accurate and precise measurements. A method blank is a sample of distilled water that used to determine if any part of the analysis process is increasing the analyte or adding interferences to the sample. Laboratory duplicates determine if the method has accurate reproducibility. QC Standards have known concentration of the target analyte. This control determines if any analyte is being added or lost during the analysis process.

Overall, the data quality provided by the laboratory has been assessed to be within acceptable ranges.

4.4 Discussion

4.4.1 AECOM Field Program

The sample results from all soil samples were below applicable guidelines except one sample, CB-17, collected from test pit TP10-05 at a depth of 2 m. The soil sample exceeded the guideline for the PHC F2 fraction. This sample was also one of the samples that arrived at the laboratory with headspace in the container. Headspace in the sample container may cause some volatilization of petroleum hydrocarbons which may reduce the concentration of PHC in the soil during transit. Therefore the headspace does not impact the result exceeding the F2 fraction guideline.

4.5 Conclusions

As previously discussed, Franz estimated 15,000 m^3 of contaminated soil. Based on the results of the AECOM investigation, the parameters that exceeded the guidelines are benzene, ethylbenzene and PHC F2 fraction, the approximate surface area of contaminated soil is 3312 m^2 and an estimated volume of 6624 m^3.

Groundwater contamination was identified by Franz in 2010. As previously mentioned, AECOM could not determine the extent of groundwater contamination due to site conditions. However, as the source of groundwater contamination is the soil AECOM concludes that if the source is removed the groundwater contamination will attenuate over time. Groundwater should be monitored to confirm this conclusion.

PFOS was present in the surface soil of all the surface samples at the test pits collected but not in the one sub-surface sample collected. PFOS concentrations ranged from 730 µg/kg to <25 µg/kg.

5. Tabulated Contaminated Site Summary

5.1 Areas of Environmental Concern (AECs)

The FFTA is AEC3, identified in previous environmental reports, therefore it will be the only AEC presented in the table below. The table below comprises the AEC description from the Franz Phase II/III ESA as well as the information gathered during the AECOM sampling program.

Table 4. AEC Description

AEC	Contaminated Media	Contaminant of Concern (COC)	Estimated Volume (m^3) AECOM	Estimated Volume (m^3) Franz	Estimated Area (m^2) Franz
AEC 3	Soil	Benzene Ethylbenzene PHC, F2 fraction	6624	15,000	-
	Groundwater	Benzene Naphthalene Pb	-	-	2500

5.2 National Contaminated Site Classification

The National Contaminated Site Classification (NCSCS) was developed by CCME as a tool to aid in the evaluation of contaminated sites. Its purpose is to provide scientific and technical assistance in the identification and prioritization of sites, which may be considered to represent high, medium, or low risk. Sites must be classified on their individual characteristics in order to determine the appropriate classification (Class 1, 2, 3, or N) according to their priority for action, or Class INS (for sites that require further information before they can be classified).

All APECs identified in the Phase II/III ESA by Franz were scored using the NCSC. For AEC3, FFTA, the NCSC score was 71.7 which classifies the FFTA as a Class 1 site (High Priority for Action). In Franz (2010) the FFTA was automatically classified as a Class 1 site in the pre-screening checklist because there was hydrocarbon sheen in surface water at the site.

Based on the AECOM site investigation the NCSC classification was updated and the updated score is 67.5 which classifies the FFTA as a Class 2 site (Medium Priority for Action). The reduction from the previous screening is based largely on reducing:

- The contaminant characteristics, Franz scored the FFTA positively for the potential to damage utilities or infrastructure in the area. AECOM scored this section negatively as there are no utilities in the area.
- The exposure, inhalation risk, Franz had scored the texture of the soil as fine, AECOM scored the texture of the soil as coarse, therefore reducing the risk to human exposure from dust.

During the AECOM site visit there was no hydrocarbon sheen observed at the FFTA (nor were there any other significant adverse effects observed in the exposure zone) therefore the FFTA was not automatically classified as a Class 1 in the pre-screening checklist. The NCSC worksheets can be found in Appendix F.

6. Remedial/Risk Management Options Analysis

AECOM has developed the following remedial/risk management options analysis for the FFTA. First there is a discussion of the environmental risk and liability, a description of three remedial/risk management options and an options analysis.

6.1 Environmental Risk & Liability

In addition to the Phase II/III ESA completed by Franz in 2010, Franz was also contracted to conduct an environmental and human health risk assessment for the Cambridge Bay Airport. The conclusions of this risk assessment include:

- The human health risk assessment concluded that there were unacceptable risks to the remediation worker from oral/dermal exposure to PHCs in soils on-site. Management of potential oral/dermal exposure to PHCs and benzene in soils and ground water should include the remediation worker's adherence to a site specific health and safety plan.
- The ecological risk assessment conclusions for the FFTA were included in a larger area called the "foreshore" sub-site. Therefore the following conclusions were modified to represent the FFTA :
  - PHC F2 and lead in soil represent a medium risk to terrestrial plants at the "foreshore" sub-site through dermal contact and to soil invertebrates via contaminated soil ingestion.
  - Volatile COPC in soil represent low risk to burrowing terrestrial receptors (e.g. small burrowing mammals) exposed via inhalation of soil vapours at the "terrestrial" or "foreshore" sub-sites.

The Franz Human Health and Environmental Risk Assessment recommended further study to refine the human health and ecological exposure scenarios to better reflect actual patterns of exposure for onsite receptors, determine the most appropriate statistic values for contaminant concentrations and to conduct an ERA with site specific modeling of ecological receptors to contaminants to quantitatively assess risks to ecological repectors.

The liability associated with not undertaking the remediation is the cost of remediation the cost of remediation is described in the section below.

6.2 Remedial/Risk Options

The following are three options for remedial and risk management options for the FFTA.

1. Risk Management:

   The reason for contamination at the site is historic use as a firefighter training area. The site has not been used as a firefighter training area since 1995, shortly after the transfer of control of the airport from Transport Canada to the Government of Nunavut. Transport Canada removed the AST and associated piping then tilled the bermed area. The area was tilled two or three times in 1995 and 1996. Therefore there have been no additional sources of contamination at the FFTA. Based on the AECOM investigation, the approximate area of contamination has remained largely within the tilled area. However, even after 15 years, concentrations of PHC F2 fraction remain five to 10 times greater than the applicable guidelines.

   The approximate area of contamination could be monitored every two to three years to determine if the contaminant levels are attenuating and to ensure the contamination is not migrating further off the tilled area.

In addition, the plume area could be covered with non-hazardous local borrow material to prevent dermal exposure to the impacted soil. A source of borrow material would be required to cover the plume and the material would need to be hauled and graded to match the site topography.

2. In-Situ Landfarming with Biological treatment/Chemical Oxidization:

   This would involve excavating the contaminated area with a backhoe, applying fertilizer and mixing in-situ. The contaminated area would be divided into a grid, the backhoe would dig a trench along one side, fertilizer would be applied as a bulldozer is filling the trench. The backhoe then digs another trench adjacent to the one just filled continuing until the area has been completely excavated, fertilizer added and mixed with the bulldozer. This would constitute one treatment event. AECOM estimates that four treatment events would be required over two years. It is assumed that fertilizer would only be applied at every second treatment event. A test pit sampling program would be undertaken at the end of the second year to confirm treatment.

   Groundwater monitoring wells would be installed up and down gradient of the treatment cell at the same time as the first treatment event. Groundwater monitoring would then be conducted at each treatment event.

3. Ex-Situ Landfarming:

   Ex-situ landfarming would involve the excavation of the approximately 6624 m^3 of PHC F2, benzene, ethylbenzene impacted soil, and placing it in a bermed location. The soils could likely be landfarmed successfully over two seasons. The preferred location of the landfarm would be directly adjacent to the contaminated area. There may be sufficient room adjacent to the FFTA; however, access to the land would have to be negotiated with the Government of Nunavut.

   During the landfarming process, the excavation pit would have to be filled with granular material. The excavation could not be left open due to the safety hazard as well as the potential for permafrost degradation. An additional concern unique to this project is if water were to pond in the excavation, there would be a risk of attracting birds which would cause another safety concern for aircraft departing and arriving from the airport. Once it has been confirmed that the contaminated soil has been treated, it could be spread out adjacent to the former FFTA and the entire area regarded.

   Groundwater monitoring up and down gradient of the contaminated area will be required both pre and post-remediation.

   Ex-situ landfarming was recommended to treat PHC soil at the airport by Franz in 2010.

Table 5. Remedial/Risk Management Options Analysis

Remedial Option	Risk Management	In-situ Landfarming with Biological Treatment / Chemical Oxidation	Ex-situ Landfarming / Bioremediation
Description	• Implementation of soil and groundwater monitoring program as well as cover of plume area with local borrow.	• Mixing the soil in batches and applying fertilizer in-situ.	• Contaminated soils are excavated and placed within bermed treatment area.
			• Soils are periodically turned and nutrients added to optimize treatment conditions.
Applicability	• All contaminated soil types.	• Hydrocarbon contaminated soil (F1, F2, F3 fractions), BTEX.	• Hydrocarbon contaminated soils, including F1, F2 and F3 fractions, BTEX.

Remedial Option	Risk Management	In-situ Landfarming with Biological Treatment / Chemical Oxidation	Ex-situ Landfarming / Bioremediation
Advantages	• Inexpensive.	• Under optimal conditions can reduce concentrations below criteria.	• Contaminant concentrations reduced.
	• Eventual natural attenuation of contamination.	• Limits treatment footprint to the area of contaminated soil	• Method has been used extensively to treat pertroleum hydrocarbons in the Arctic
	• Minimal disruption to operations.		• Reduces the potential effects on surrounding environment during and post – remediation.
Disadvantages	• Does not actively remove contaminated soil, must wait for natural attenuation.	• Monitoring required.	• Access to land for treatment cells.
	• Long term monitoring required (costs spread over time)	• Difficult to confirm that target concentrations are met throughout the contaminated area.	• Impermeable membrane/low permeable soils required for containment.
Implementation	• Local borrow material required.	• Require the shipment of chemical/biological additive and equipment	• Adequate location and granular materials required for construction.
		• Groundwater monitoring during treatment	• Landfarm area to be identified
			• Geosynthetic liner required for perimeter landfarm containment.
Estimated Cost	• Costs for a 5 year risk management program with annual monitoring is $137,000, or $27,000 annually.	• Costs for a seasonal program with 4 site visits by a Professional Engineer is $270,000.	• Costs for a seasonal program with 2 site visits by a Professional Engineer is $615,000.

All three options can be undertaken using local resources in Cambridge Bay. Fertilizer for both the in-situ and ex-situ treatment options and liner required for the ex-situ option would have to be ordered and shipped to Cambridge Bay by sealift. For both options, storage would be required for the year two fertilizer in Cambridge Bay. Tables for the cost estimates can be found in Appendix E.

AECOM recommends in-situ landfarming option is further investigated as the preferred option for the remediation of the FFTA. Risk management is not suitable because of the results of the Franz environmental risk assessment. Ex-situ landfarming is over twice as expensive as in-situ landfarming and there are concerns regarding permafrost degradation as well as potentially attracting birds to the runway; therefore not the preferred option for the site.

7. Conclusions and Recommendations

7.1 Conclusions

The AECOM investigation has determined an approximate area of soil contamination at the FFTA to be 3312 m^2 and an estimated volume of 6624 m^3. Groundwater samples were not collected, due to site conditions; therefore, no additional information was gathered to refine the groundwater area estimates in the Franz Phase II/II ESA. AECOM has concluded that the source of groundwater contamination is the surrounding soil and once the soil is no longer contaminated the contamination in groundwater should naturally attenuate.

The NCSC classification was updated based on the AECOM site assessment and the updated score is 67.2 which classifies the FFTA as a Class 2 site (Medium Priority for Action).

Three remedial/risk assessment options were analyzed for the FFTA, risk management, in-situ landfarming and ex-situ landfarming. In-situ landfarming was selected as the preferred option for remediation of the site. The estimated remedial cost to pursue this option is $270,000.

7.2 Recommendations

AECOM recommends future monitoring of groundwater at the FFTA once the contaminated soil has been treated to meet the applicable guidelines to confirm the AECOM assumption that once the source of contamination is removed the groundwater contamination will naturally attenuate.

8. References

- Phase II & II Environmental Site Investigation Cambridge Bay Airport Fire Training Area, Cambridge Bay, Nunavut, September 2010.
- M.M. Dillon Limited, Cambridge Bay Airport Environmental Baseline Study, November 1994
- Agra Earth and Environmental Limited, DRAFT Remedial Action Plan Follow-up Cambridge Bay Airport Nunavut Territory, November 1999
- Franz Environmental Inc., Phase II/III Environmental Site Assessment Cambridge Bay Airport Landfill/Boneyard, Cambridge Bay, NU, 2010
- Franz Environmental Inc., Human Health and Ecological Risk Assessment Cambridge Bay Airport, Cambridge Bay, NU, 2010
- Environmental Guideline for Contaminated Site Remediation, Government of Nunavut, 2009

Appendix A

Figures

SAMPLE ID	GN COMMERCIAL (mg/kg)	3-09-4M-3	3-09-5M-2	3-09-6M-3	3-09-6M-3DUP-2	CB-17
TEST PIT ID		3-09-4M	3-09-5M	3-09-6M	3-09-6M	TP10-05
DEPTH (m)		2	0.5-1	1-2	1-2	2
BENZENE	0.03	1.2	<0.005	0.005	<0.005	<0.005
ETHYLBENZENE	0.082	0.08	<0.01	0.08	0.1	0.01
F2 FRACTION	260	16	1700	850	860	3610

KEY PLAN
SCALE: NTS

0 7.5 15 m SCALE 1:750

LEGEND:
- TEST PIT LOCATION (BY OTHERS)
- TEST PIT LOCATION (AECOM)
- APPROXIMATE CONTAMINATION PLUME

AECOM

Public Works and Government Services Canada
Cambridge Bay A/P FTA

Site Plan - Test Pit Location and Soil Contamination Plume
Figure 1.0

Appendix B

Test Pit Logs

PROJECT: Cambridge Bay	CLIENT:	TESTHOLE NO: **TP10-01**
LOCATION: Cambridge Bay		PROJECT NO.: 60164535
CONTRACTOR:	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	COMMENTS	DEPTH
0		SAND - major cobbles, trace silt, trace clay - light brown - loose, coarse grained	■	- sample submitted for laboratory anlaysis.	
		- dark brown	■	- sample submitted for laboratory analysis.	
1					1
2			■	- sample submitted for laboratory analysis.	2
		END OF TEST HOLE AT 2.5 m IN SAND Notes: 1) Test hole backfilled with excavated material upon completion.			
3					3
4					4
4.5					

AECOM

LOGGED BY:	COMPLETION DEPTH: 2.50 m
REVIEWED BY:	COMPLETION DATE:
PROJECT ENGINEER:	Page 1 of 1

LOG OF TEST HOLE BHLOGS.GPJ UMA WINN.GDT 11/2/10

PROJECT: Cambridge Bay	CLIENT:	TESTHOLE NO: **TP10-02**
LOCATION: Cambridge Bay		PROJECT NO.: 60164535
CONTRACTOR:	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	COMMENTS	DEPTH
0		SAND - major cobbles, trace silt, trace clay - dark brown - loose, coarse grained	■	- sample submitted for laboratory anlaysis.	
			■	- sample submitted for laboratory analysis.	
1					1
		SANDY CLAY - trace sand, trace silt	■	- sample submitted for laboratory analysis.	
2					2
3		END OF TEST HOLE AT 3.0 m IN SANDY CLAY Notes: 1) Test hole backfilled with excavated material upon completion.			3
4					4
4.5					

AECOM

LOGGED BY:	COMPLETION DEPTH: 3.05 m
REVIEWED BY:	COMPLETION DATE:
PROJECT ENGINEER:	Page 1 of 1

LOG OF TEST HOLE BHLOGS.GPJ UMA WINN.GDT 11/2/10

PROJECT: Cambridge Bay	CLIENT:	TESTHOLE NO: **TP10-03**
LOCATION: Cambridge Bay		PROJECT NO.: 60164535
CONTRACTOR:	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	COMMENTS	DEPTH
0		SAND - major rocks, minor silt, trace clay - light brown - loose, coarse grained	■	- sample submitted for laboratory anlaysis.	
		ORGANIC -black	■	- sample submitted for laboratory analysis.	
		SAND - major rocks, minor silt, trace clay - light brown - loose, moist, coarse grained			
1		- gleyed below 0.9 m	■	- sample submitted for laboratory analysis.	1
2					2
3					3
		END OF TEST HOLE AT 3.0 m IN SAND Notes: 1) Test hole backfilled with excavated material upon completion. 2) Sloughing observed at 1.2 m.			
4					4
4.5					

AECOM	LOGGED BY:	COMPLETION DEPTH: 3.05 m
	REVIEWED BY:	COMPLETION DATE:
	PROJECT ENGINEER:	Page 1 of 1

LOG OF TEST HOLE BHLOGS.GPJ UMA.WINN.GDT 11/2/10

PROJECT: Cambridge Bay	CLIENT:	TESTHOLE NO: **TP10-04**
LOCATION: Cambridge Bay		PROJECT NO.: 60164535
CONTRACTOR:	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⧄ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	COMMENTS	DEPTH
0		SAND - major rocks, minor silt, trace clay - dark brown - coarse grained	■	- sample submitted for laboratory anlaysis.	
		CLAY - minor sand, trace silt - dark brown	■	- sample submitted for laboratory analysis.	
		SAND - major clay, major silt - gleyed - moist at 1 m			
1			■	- sample submitted for laboratory analysis.	1
2					2
3					3
4		END OF TEST HOLE AT 4 m IN SAND Notes: 1) Test hole backfilled with excavated material upon completion.			4
4.5					

AECOM	LOGGED BY:	COMPLETION DEPTH: 3.96 m
	REVIEWED BY:	COMPLETION DATE:
	PROJECT ENGINEER:	Page 1 of 1

LOG OF TEST HOLE BHLOGS.GPJ UMA WINN.GDT 11/2/10

PROJECT: Cambridge Bay	CLIENT:	TESTHOLE NO: **TP10-05**
LOCATION: Cambridge Bay		PROJECT NO.: 60164535
CONTRACTOR:	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	COMMENTS	DEPTH
0		SAND - major rocks, minor silt, trace clay - light brown - loose, coarse grained	■	- sample submitted for laboratory anlaysis.	
		ORGANIC -black			
		SAND - major rocks, minor silt, trace clay - light brown - loose, moist, coarse grained	■	- sample submitted for laboratory analysis.	
1		- gleyed below 0.9 m			1
2			■	- sample submitted for laboratory analysis.	2
3					3
		END OF TEST HOLE AT 3.0 m IN SAND Notes: 1) Test hole backfilled with excavated material upon completion.			
4					4
4.5					

AECOM

LOGGED BY:	COMPLETION DEPTH: 3.05 m
REVIEWED BY:	COMPLETION DATE:
PROJECT ENGINEER:	Page 1 of 1

LOG OF TEST HOLE BHLOGS.GPJ UMA.WINN.GDT 11/2/10

PROJECT: Cambridge Bay	CLIENT:	TESTHOLE NO: **TP10-06**
LOCATION: Cambridge Bay		PROJECT NO.: 60164535
CONTRACTOR:	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ▨ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	COMMENTS	DEPTH
0		SAND - major rocks, minor silt, trace clay - light brown - loose, coarse grained	■	- sample submitted for laboratory anlaysis.	
			■	- sample submitted for laboratory analysis.	
1		ORGANIC -black			1
		SAND - major rocks, minor silt, trace clay - light brown - loose, coarse grained			
2			■	- sample submitted for laboratory analysis.	2
		- gleyed below 2.5 m			
3		END OF TEST HOLE AT 3.0 m IN SAND Notes: 1) Test hole backfilled with excavated material upon completion.			3
4					4
4.5					

AECOM

LOGGED BY:	COMPLETION DEPTH: 3.05 m
REVIEWED BY:	COMPLETION DATE:
PROJECT ENGINEER:	Page 1 of 1

LOG OF TEST HOLE BHLOGS.GPJ UMA.WINN.GDT 11/2/10

PROJECT: Cambridge Bay	CLIENT:	TESTHOLE NO: TP10-07
LOCATION: Cambridge Bay		PROJECT NO.: 60164535
CONTRACTOR:	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ⧄ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Concentration ⊗ (ppm) 100 1000 10000	COMMENTS	DEPTH (m)
0		SAND - major rocks, minor silt, trace clay - light brown - loose, coarse grained	■			- sample submitted for laboratory anlaysis.	
			■			- sample submitted for laboratory analysis.	
1							1
			■			- sample submitted for laboratory analysis.	
		- gleyed					
2							2
3							3
		END OF TEST HOLE AT 3.0 m IN SAND Notes: 1) Test hole backfilled with excavated material upon completion.					
4							4
4.5							

AECOM

LOGGED BY:	COMPLETION DEPTH: 3.05 m
REVIEWED BY:	COMPLETION DATE:
PROJECT MANAGER:	Page 1 of 1

ENVIRONMENTAL KATIE.GPJ UMA.GDT PRINT: 10/11/10 By:

PROJECT: Cambridge Bay	CLIENT:	TESTHOLE NO: **TP10-08**
LOCATION: Cambridge Bay		PROJECT NO.: 60164535
CONTRACTOR:	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	COMMENTS	DEPTH
0		SAND - major rocks, minor silt, trace clay - light brown - loose, coarse grained	■	- sample submitted for laboratory anlaysis.	
			■	- sample submitted for laboratory analysis.	
1		- dark brown			1
			■	- sample submitted for laboratory analysis.	
2					2
		- gleyed			
3		END OF TEST HOLE AT 3.0 m IN SAND Notes: 1) Test hole backfilled with excavated material upon completion.			3
4					4
4.5					

AECOM

LOGGED BY:	COMPLETION DEPTH: 3.05 m
REVIEWED BY:	COMPLETION DATE:
PROJECT ENGINEER:	Page 1 of 1

LOG OF TEST HOLE BHLOGS.GPJ UMA.WINN.GDT 11/2/10

Appendix C

Analytical Results Tables

Table C1: Laboratory Analytical Results Compared to PCB, PFOS, BTEX and PHC F1 - F2 Fractions

Sample #	Laboratory ID	Test Pit	Depth	Aroclor 1242	Aroclor 1254	Aroclor 1260	PCB Total	PFOS	BTEX				(C6-C10)	F2 (C10-C16)	(C16-C34)	(C34-C50)
			cm	mg/kg	mg/kg	mg/kg	mg/kg	ug/kg	Benzene mg/kg	Toluene mg/kg	Ethylbenze mg/kg	Xylene mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
GN Remediation Criteria - PCB - Soil					-	-	33		-	-	-	-	-		-	-
GN Remediation Criteria - PHC F1 - F4 - soil				-	-	-	-		-	-	-	-	320	260	1,700	3,300
GN Remediation Criteria - BTEX - Soil				-	-	-	-		0.03	0.37	0.082	11	-	-	-	-
CB-01	HN7876	TP10-01	0	-	-	-	-	210	-	-	-	-	-	-	-	-
CB-02	2052934	TP10-01	60	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10
CB-03	2052935	TP10-01	150	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10
CB-04	HN7877	TP10-02	0	-	-	-	-	370	-	-	-	-	-	-	-	-
CB-05	2052937	TP10-02	50	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10
CB-06	2052938	TP10-02	150	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	14	<10
CB-07	HN7878	TP10-03	120	-	-	-	-	<25	-	-	-	-	-	-	-	-
CB-08	2052941	TP10-03	0	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	79	<10
CB-09	2052942	TP10-03	50	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	13	<10
CB-10	HN7879	TP10-04	0	-	-	-	-	650	-	-	-	-	-	-	-	-
CB-11	2052944	TP10-04	50	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10
CB-12	2052945	TP10-04	150	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10
CB-13	HN7880	TP10-05	0	-	-	-	-	520	-	-	-	-	-	-	-	-
CB-14	NH7881	TP10-05	0	-	-	-	-	730	-	-	-	-	-	-	-	-
CB-15	2052949	TP10-05	60	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	95	76	41
CB-16	2052951	TP10-05	60	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	103	116	48
CB-17	2052954	TP10-05	200	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	0.01	0.42	120	3,610	351	27
CB-18	HN7882	TP10-06	0	-	-	-	-	71	-	-	-	-	-	-	-	-
CB-19	2052958	TP10-06	50	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	39	78	<10
CB-20	2052959	TP10-06	200	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10
CB-21	HN7883	TP10-07	0	-	-	-	-	99	-	-	-	-	-	-	-	-
CB-22	2052961	TP10-07	50	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10
CB-23	2052962	TP10-07	150	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10
CB-24	HN7884	TP10-08	0	-	-	-	-	150	-	-	-	-	-	-	-	-
CB-25	2052972	TP10-08	120	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10
CB-26	2052978	TP10-08	50	<0.05	<0.05	<0.05	<0.05	-	<0.005	<0.05	<0.01	<0.05	<10	<10	<10	<10

Table C2: Laboratory Anaylitcal Results Compared to Applicable Guidelines, Metals

Sample #	Laboratory ID	Test Pit	Depth cm	Metals																
				Sb mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	Cd mg/kg	Cr mg/kg	Co mg/kg	Cu mg/kg	Pb mg/kg	Mo mg/kg	Ni mg/kg	Se mg/kg	Ag mg/kg	Tl mg/kg	Sn mg/kg	U mg/kg	V mg/kg	Zn mg/kg
GN Remediation Criteria - Metals -Soil					**12**	**2000**		**22**	**87**		**91**	**260**		**50**	**2.9**		**1**		**33**	**130**	**360**
CB-01	HN7876	TP10-01	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CB-02	2052934	TP10-01	60	<0.5	1.1	39	<0.5	<0.5	27.1	4.2	12.2	5	<0.5	16.1	<0.5	<0.5	<0.5	<0.5	0.8	14.3	12
CB-03	2052935	TP10-01	150	<0.5	1.8	38.4	<0.5	<0.5	15.2	5	8.9	5.7	<0.5	12.7	<0.5	<0.5	<0.5	<0.5	0.9	15.3	11
CB-04	HN7877	TP10-02	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CB-05	2052937	TP10-02	50	<0.5	2.1	35	<0.5	<0.5	15.6	3.5	7.6	4.6	0.5	10.7	<0.5	<0.5	<0.5	<0.5	0.9	17.3	13
CB-06	2052938	TP10-02	150	<0.5	2.5	37.3	<0.5	<0.5	13.8	4.5	7.3	5	<0.5	11.3	<0.5	<0.5	<0.5	<0.5	1.1	15.7	11
CB-07	HN7878	TP10-03	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CB-08	2052941	TP10-03	0	<0.5	1.8	32.4	<0.5	<0.5	31.7	3.4	6.2	6.9	0.6	17.7	<0.5	<0.5	<0.5	<0.5	0.8	15.1	12
CB-09	2052942	TP10-03	50	<0.5	1.3	20.2	<0.5	<0.5	10.3	1.9	5	3.3	<0.5	9	<0.5	<0.5	<0.5	<0.5	1.4	8.6	6
CB-10	HN7879	TP10-04	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CB-11	2052944	TP10-04	50	<0.5	1.9	37.8	<0.5	<0.5	18.5	5.4	10.3	6.2	<0.5	13.7	<0.5	<0.5	<0.5	<0.5	0.8	21	19
CB-12	2052945	TP10-04	150	<0.5	1.5	31	<0.5	<0.5	17.1	4	7.3	4.7	<0.5	12.3	<0.5	<0.5	<0.5	<0.5	0.9	15.5	13
CB-13	HN7880	TP10-05	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CB-14	NH7881	TP10-05	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CB-15	2052949	TP10-05	60	<0.5	1.7	24.5	<0.5	<0.5	45.6	3.1	6.2	5.7	1	24.8	<0.5	<0.5	<0.5	<0.5	1.1	11.5	8
CB-16	2052951	TP10-05	60	<0.5	2	27.1	<0.5	<0.5	35.3	3.1	6	6.5	0.7	19.8	<0.5	<0.5	<0.5	<0.5	0.7	11.8	7
CB-17	2052954	TP10-05	200	<0.5	0.7	13.8	<0.5	<0.5	5.6	1.4	2.9	6.9	<0.5	4.8	<0.5	3.1	<0.5	<0.5	0.8	8.3	5
CB-18	HN7882	TP10-06	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CB-19	2052958	TP10-06	50	<0.5	2.2	25.7	<0.5	<0.5	10.5	4.2	6.6	6.6	1.8	10.7	<0.5	<0.5	<0.5	<0.5	1	11.2	6
CB-20	2052959	TP10-06	200	<0.5	1.4	15.1	<0.5	<0.5	7.6	1.8	7.2	5.4	<0.5	7	<0.5	6.1	<0.5	0.7	0.6	9.5	6
CB-21	HN7883	TP10-07	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CB-22	2052961	TP10-07	50	<0.5	1.6	45.4	<0.5	<0.5	17.8	3.9	6	4.3	<0.5	13.2	<0.5	<0.5	<0.5	<0.5	0.7	13.8	10
CB-23	2052962	TP10-07	150	<0.5	1.9	36.6	<0.5	<0.5	16.6	4.4	7.2	5.5	0.6	13.4	<0.5	<0.5	<0.5	<0.5	1.1	15.9	13
CB-24	HN7884	TP10-08	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CB-25	2052972	TP10-08	120	<0.5	1.5	51.9	<0.5	<0.5	32.8	4.8	8.9	5.7	0.6	21	<0.5	<0.5	<0.5	<0.5	0.9	14.3	10
CB-26	2052978	TP10-08	50	<0.5	1.3	58.7	<0.5	<0.5	14.3	4.9	8.5	5.8	<0.5	12.4	<0.5	<0.5	<0.5	<0.5	1	14.2	12

Table C3: QA/QC Results, Organics

Sample #	Laboratory ID	Test Pit	Depth	F1 (C6-C10)	F2 (C10-C16)	F3 (C16-C34)	F4 (C34-C50)	PFOS
			cm	mg/kg				
Acceptable RPD - organics				**50**	**50**	**50**	**50**	**50**
CB-13	**HN7880**	TP10-05	0	-	-	-	-	520
CB-14	**NH7881**	TP10-05	0	-	-	-	-	730
			RPD	-	-	-	-	34
CB-15	**2052949**	TP10-05	60	<10	95	76	41	-
CB-16	**2052951**	TP10-05	60	<10	103	116	48	-
			RPD	-	8	42	16	-

Table C4: QA/QC Results, Inorganics

Sample #	Laboratory ID	Test Pit	Depth	Metals																
				Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Mo	Ni	Se	Ag	Tl	Sn	U	V	Zn
			cm	mg/kg																	
Acceptable RPD - inorganics				**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**	**35**
CB-15	**2052949**	TP10-05	60	<0.5	1.7	24.5	<0.5	<0.5	45.6	3.1	6.2	5.7	1	24.8	<0.5	<0.5	<0.5	<0.5	1.1	11.5	8
CB-16	**2052951**	TP10-05	60	<0.5	2	27.1	<0.5	<0.5	35.3	3.1	6	6.5	0.7	19.8	<0.5	<0.5	<0.5	<0.5	0.7	11.8	7
			RPD	-	16	10	-	-	25	0	3	13	**35**	22	-	-	-	-	**44**	3	13

Appendix D

Laboratory Certificates of Analysis

Your Project #: B0A0024
Your C.O.C. #: na

Attention: Jennifer Rispler
Maxxam Analytics
2021-41st Ave NE
Calgary, AB
T2E 6P2

Report Date: 2010/10/29

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B0E7612
Received: 2010/10/19, 09:08

Sample Matrix: Soil
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Moisture	9	N/A	2010/10/27	CAM SOP-00445	McKeague 2nd ed 1978
PFOS and PFOA in soil	9	2010/10/25	2010/10/26	CAM SOP-00894	In house method

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MARIJANE CRUZ, Project Manager
Email: MCruz@maxxam.ca
Phone# (905) 817-5756

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Maxxam Job #: B0E7612
Report Date: 2010/10/29

Maxxam Analytics
Client Project #: B0A0024

RESULTS OF ANALYSES OF SOIL

Maxxam ID		HN7876	HN7876	HN7877	HN7878	HN7879		
Sampling Date		2010/10/06	2010/10/06	2010/10/06	2010/10/06	2010/10/06		
COC Number		na	na	na	na	na		
	Units	**X73396\CB-01**	**X73396\CB-01 Lab-Dup**	**X73397\CB-04**	**X73398\CB-07**	**X73399\CB-10**	**RDL**	**QC Batch**
Inorganics								
Moisture	%	6	N/A	9	8	8	1	2311436
Miscellaneous Parameters								
Perfluoro-1-Octanesulfonate (PFOS)	ug/kg	210	210	370	<25	650	25	2307509
Perfluoro-n-Octanoic Acid (PFOA)	ug/kg	14	14	5.5	<2.5	10	2.5	2307509

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		HN7879	HN7880	HN7881	HN7882	HN7883		
Sampling Date		2010/10/06	2010/10/06	2010/10/06	2010/10/06	2010/10/06		
COC Number		na	na	na	na	na		
	Units	**X73399\CB-10 Lab-Dup**	**X73400\CB-13**	**X73401\CB-14**	**X73402\CB-18**	**X73403\CB-21**	**RDL**	**QC Batch**
Inorganics								
Moisture	%	9	12	10	11	7	1	2311436
Miscellaneous Parameters								
Perfluoro-1-Octanesulfonate (PFOS)	ug/kg	N/A	520	730	71	99	25	2307509
Perfluoro-n-Octanoic Acid (PFOA)	ug/kg	N/A	4.2	4.8	<2.5	3.4	2.5	2307509

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B0E7612
Report Date: 2010/10/29

Maxxam Analytics
Client Project #: B0A0024

RESULTS OF ANALYSES OF SOIL

Maxxam ID		HN7884		
Sampling Date		2010/10/06		
COC Number		na		
	Units	**X73404\CB-24**	**RDL**	**QC Batch**
Inorganics				
Moisture	%	10	1	2311436
Miscellaneous Parameters				
Perfluoro-1-Octanesulfonate (PFOS)	ug/kg	150	25	2307509
Perfluoro-n-Octanoic Acid (PFOA)	ug/kg	4.2	2.5	2307509

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B0E7612
Report Date: 2010/10/29

Maxxam Analytics
Client Project #: B0A0024

Package 1	2.7°C

Each temperature is the average of up to three cooler temperatures taken at receipt

RESULTS OF ANALYSES OF SOIL

PFOS and PFOA in soil: Matrix spike recovery could not be calculated (NC) due to the spiking level relative to the sample concentration.

Results relate only to the items tested.

Maxxam Analytics
Attention: Jennifer Rispler
Client Project #: B0A0024
P.O. #:
Project name:

Quality Assurance Report

Maxxam Job Number: MB0E7612

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
2307509	AR	Matrix Spike						
		[HN7876-01]	Perfluoro-1-Octanesulfonate (PFOS)	2010/10/26		NC	%	N/A
			Perfluoro-n-Octanoic Acid (PFOA)	2010/10/26		NC	%	N/A
		Spiked Blank	Perfluoro-1-Octanesulfonate (PFOS)	2010/10/26		99	%	N/A
			Perfluoro-n-Octanoic Acid (PFOA)	2010/10/26		105	%	N/A
		Method Blank	Perfluoro-1-Octanesulfonate (PFOS)	2010/10/26	<25		ug/kg	
			Perfluoro-n-Octanoic Acid (PFOA)	2010/10/26	<2.5		ug/kg	
		RPD [HN7876-01]	Perfluoro-1-Octanesulfonate (PFOS)	2010/10/26	1		%	20
			Perfluoro-n-Octanoic Acid (PFOA)	2010/10/26	2.2		%	20
2311436	NKO	RPD [HN7879-01]	Moisture	2010/10/27	1.2		%	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

Validation Signature Page

Maxxam Job #: B0E7612

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

ADAM ROBINSON, Technical Service

EWA PRANJIC, M.Sc., C.Chem, Scientific Specialist

==========

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AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

CLIENT NAME: AECOM CANADA LTD
SUITE 500, 13111 MERIDIAN ST NE
EDMONTON, AB T6S1G9

ATTENTION TO: Katie Scott

PROJECT NO: Cambridge Bay

AGAT WORK ORDER: 10E443107

SOIL ANALYSIS REVIEWED BY: Irina Gankovsky, Analyst

TRACE ORGANICS REVIEWED BY: Ron Brockbank, Trace Organics Supervisor

DATE REPORTED: Oct 27, 2010

PAGES (INCLUDING COVER): 15

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005, or at 1-866-764-7554

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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FAX (403)735-2771
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 10E443107

PROJECT NO: Cambridge Bay

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Katie Scott

CCME / Alberta Tier 1 Metals (soil)

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	CB-02 2052934	CB-03 2052935	CB-05 2052937	CB-06 2052938	CB-08 2052941	CB-09 2052942	CB-11 2052944	CB-12 2052945
Antimony	mg/kg	40	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/kg	12	0.5	1.1	1.8	2.1	2.5	1.8	1.3	1.9	1.5
Barium	mg/kg	2000	0.5	39.0	38.4	35.0	37.3	32.4	20.2	37.8	31.0
Beryllium	mg/kg	8	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	mg/kg	22	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	87	0.5	27.1	15.2	15.6	13.8	31.7	10.3	18.5	17.1
Cobalt	mg/kg	300	0.5	4.2	5.0	3.5	4.5	3.4	1.9	5.4	4.0
Copper	mg/kg	91	0.5	12.2	8.9	7.6	7.3	6.2	5.0	10.3	7.3
Lead	mg/kg	260	0.5	5.0	5.7	4.6	5.0	6.9	3.3	6.2	4.7
Molybdenum	mg/kg	40	0.5	<0.5	<0.5	0.5	<0.5	0.6	<0.5	<0.5	<0.5
Nickel	mg/kg	50	0.5	16.1	12.7	10.7	11.3	17.7	9.0	13.7	12.3
Selenium	mg/kg	2.9	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver	mg/kg	40	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tin	mg/kg	300	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	mg/kg	33	0.5	0.8	0.9	0.9	1.1	0.8	1.4	0.8	0.9
Vanadium	mg/kg	130	0.5	14.3	15.3	17.3	15.7	15.1	8.6	21.0	15.5
Zinc	mg/kg	360	1	12	11	13	11	12	6	19	13

Certified By:

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
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Certificate of Analysis

AGAT WORK ORDER: 10E443107

PROJECT NO: Cambridge Bay

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Katie Scott

CCME / Alberta Tier 1 Metals (soil)

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	CB-15 2052949	CB-16 2052951	CB-17 2052954	CB-19 2052958	CB-20 2052959	CB-22 2052961	CB-23 2052962	CB-25 2052972
Antimony	mg/kg	40	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/kg	12	0.5	1.7	2.0	0.7	2.2	1.4	1.6	1.9	1.5
Barium	mg/kg	2000	0.5	24.5	27.1	13.8	25.7	15.1	45.4	36.6	51.9
Beryllium	mg/kg	8	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	mg/kg	22	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	87	0.5	45.6	35.3	5.6	10.5	7.6	17.8	16.6	32.8
Cobalt	mg/kg	300	0.5	3.1	3.1	1.4	4.2	1.8	3.9	4.4	4.8
Copper	mg/kg	91	0.5	6.2	6.0	2.9	6.6	7.2	6.0	7.2	8.9
Lead	mg/kg	260	0.5	5.7	6.5	6.9	6.6	5.4	4.3	5.5	5.7
Molybdenum	mg/kg	40	0.5	1.0	0.7	<0.5	1.8	<0.5	<0.5	0.6	0.6
Nickel	mg/kg	50	0.5	24.8	19.8	4.8	10.7	7.0	13.2	13.4	21.0
Selenium	mg/kg	2.9	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver	mg/kg	40	0.5	<0.5	<0.5	3.1	<0.5	6.1	<0.5	<0.5	<0.5
Thallium	mg/kg	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tin	mg/kg	300	0.5	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5
Uranium	mg/kg	33	0.5	1.1	0.7	0.8	1.0	0.6	0.7	1.1	0.9
Vanadium	mg/kg	130	0.5	11.5	11.8	8.3	11.2	9.5	13.8	15.9	14.3
Zinc	mg/kg	360	1	8	7	5	6	6	10	13	10

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AGAT WORK ORDER: 10E443107

PROJECT NO: Cambridge Bay

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Katie Scott

CCME / Alberta Tier 1 Metals (soil)

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	CB-26 2052978
Antimony	mg/kg	40	0.5	<0.5
Arsenic	mg/kg	12	0.5	1.3
Barium	mg/kg	2000	0.5	58.7
Beryllium	mg/kg	8	0.5	<0.5
Cadmium	mg/kg	22	0.5	<0.5
Chromium	mg/kg	87	0.5	14.3
Cobalt	mg/kg	300	0.5	4.9
Copper	mg/kg	91	0.5	8.5
Lead	mg/kg	260	0.5	5.8
Molybdenum	mg/kg	40	0.5	<0.5
Nickel	mg/kg	50	0.5	12.4
Selenium	mg/kg	2.9	0.5	<0.5
Silver	mg/kg	40	0.5	<0.5
Thallium	mg/kg	1	0.5	<0.5
Tin	mg/kg	300	0.5	<0.5
Uranium	mg/kg	33	0.5	1.0
Vanadium	mg/kg	130	0.5	14.2
Zinc	mg/kg	360	1	12

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME (Com,F)

2052934-2052978 Results are based on the dry weight of the sample.

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AGAT WORK ORDER: 10E443107

PROJECT NO: Cambridge Bay

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Katie Scott

Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS)

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	CB-02 2052934	CB-03 2052935	CB-05 2052937	CB-06 2052938	CB-08 2052941	CB-09 2052942	CB-11 2052944	CB-12 2052945
Benzene	mg/kg	0.0068	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	mg/kg	0.08	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg	0.018	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylenes	mg/kg	2.4	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
C6 - C10 (F1)	mg/kg	320	10	<10	<10	<10	<10	<10	<10	<10	<10
C6 - C10 (F1 minus BTEX)	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
C10 - C16 (F2)	mg/kg	260	10	<10	<10	<10	<10	<10	<10	<10	<10
C16 - C34 (F3)	mg/kg	2500	10	<10	<10	<10	14	79	13	<10	<10
C34 - C50 (F4)	mg/kg	6600	10	<10	<10	<10	<10	<10	<10	<10	<10
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Moisture Content	%		1	8	8	9	8	10	15	11	8
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8 (BTEX)	%	50-150		98	96	96	96	95	96	96	96
Ethylbenzene-d10 (BTEX)	%	50-150		94	102	97	103	90	116	110	100
o-Terphenyl (F2-F4)	%	50-150		94	96	96	92	100	97	98	93

Parameter	Unit	G / S	RDL	CB-15 2052949	CB-16 2052951	CB-17 2052954	CB-19 2052958	CB-20 2052959	CB-22 2052961	CB-23 2052962	CB-25 2052972
Benzene	mg/kg	0.0068	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	mg/kg	0.08	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg	0.018	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylenes	mg/kg	2.4	0.05	<0.05	<0.05	0.42	<0.05	<0.05	<0.05	<0.05	<0.05
C6 - C10 (F1)	mg/kg	320	10	<10	<10	120	<10	<10	<10	<10	<10
C6 - C10 (F1 minus BTEX)	mg/kg		10	<10	<10	120	<10	<10	<10	<10	<10
C10 - C16 (F2)	mg/kg	260	10	95	103	**3610**	39	<10	<10	<10	<10
C16 - C34 (F3)	mg/kg	2500	10	76	116	351	78	<10	<10	<10	<10
C34 - C50 (F4)	mg/kg	6600	10	41	48	27	<10	<10	<10	<10	<10
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Moisture Content	%		1	7	7	18	8	5	8	10	8
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8 (BTEX)	%	50-150		95	94	95	95	94	96	94	95
Ethylbenzene-d10 (BTEX)	%	50-150		83	105	106	107	82	85	85	109
o-Terphenyl (F2-F4)	%	50-150		95	96	96	94	96	97	99	99

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AGAT WORK ORDER: 10E443107

PROJECT NO: Cambridge Bay

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Katie Scott

Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS)

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	CB-26 2052978
Benzene	mg/kg	0.0068	0.005	<0.005
Toluene	mg/kg	0.08	0.05	<0.05
Ethylbenzene	mg/kg	0.018	0.01	<0.01
Xylenes	mg/kg	2.4	0.05	<0.05
C6 - C10 (F1)	mg/kg	320	10	<10
C6 - C10 (F1 minus BTEX)	mg/kg		10	<10
C10 - C16 (F2)	mg/kg	260	10	<10
C16 - C34 (F3)	mg/kg	2500	10	<10
C34 - C50 (F4)	mg/kg	6600	10	<10
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A
Moisture Content	%		1	8
Surrogate	**Unit**	**Acceptable Limits**		
Toluene-d8 (BTEX)	%	50-150		94
Ethylbenzene-d10 (BTEX)	%	50-150		94
o-Terphenyl (F2-F4)	%	50-150		100

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Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS)

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME (Com,F)

2052934-2052938
Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

2052941
Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

Sample Non-conformance. Headspace in sample container.

2052942-2052945
Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.

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Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS)

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

2052949-2052951 Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

Sample Non-conformance. Headspace in sample container.

2052954 Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

2052958 Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.

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Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS)

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

Sample Non-conformance. Headspace in sample container.

2052959

Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

2052961

Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

Sample Non-conformance. Headspace in sample container.

2052962

Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).

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ATTENTION TO: Katie Scott

Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS)

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

2052972

Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

Sample Non-conformance. Headspace in sample container.

2052978

Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

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AGAT WORK ORDER: 10E443107

PROJECT NO: Cambridge Bay

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Katie Scott

Polychlorinated Biphenyls Analysis - Soil

DATE SAMPLED: Oct 06, 2010 | **DATE RECEIVED: Oct 12, 2010** | **DATE REPORTED: Oct 27, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	CB-02 2052934	CB-03 2052935	CB-05 2052937	CB-06 2052938	CB-08 2052941	CB-09 2052942	CB-11 2052944	CB-12 2052945
Aroclor 1242	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1260	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg	33	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**									
Decachlorobiphenyl	%	70-130		75	78	72	80	70	73	70	71

Parameter	Unit	G / S	RDL	CB-15 2052949	CB-16 2052951	CB-17 2052954	CB-19 2052958	CB-20 2052959	CB-22 2052961	CB-23 2052962	CB-25 2052972
Aroclor 1242	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1260	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg	33	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**									
Decachlorobiphenyl	%	70-130		74	72	72	73	75	74	73	76

Parameter	Unit	G / S	RDL	CB-26 2052978
Aroclor 1242	mg/kg		0.05	<0.05
Aroclor 1254	mg/kg		0.05	<0.05
Aroclor 1260	mg/kg		0.05	<0.05
Total Polychlorinated Biphenyls	mg/kg	33	0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**		
Decachlorobiphenyl	%	70-130		74

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to CCME (Com,F)

2052934-2052978 Results are based on the dry weight of the sample.
Recovery of decachlorobiphenyl surrogate added to sample prior to analysis: %
Arochlor Type:

Certified By:

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 10E443107

PROJECT NO: Cambridge Bay

ATTENTION TO: Katie Scott

Soil Analysis

RPT Date: Oct 27, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
CCME / Alberta Tier 1 Metals (soil)															
Antimony	300	2052934	< 0.5	< 0.5	0.0%	< 0.5	99%	70%	130%				100%	75%	125%
Arsenic	300	2052934	1.15	1.32	13.8%	< 0.5	98%	90%	110%				101%	75%	125%
Barium	300	2052934	39.0	40.2	3.0%	< 0.5	102%	90%	110%				117%	75%	125%
Beryllium	300	2052934	< 0.5	< 0.5	0.0%	< 0.5	106%	90%	110%				97%	75%	125%
Cadmium	300	2052934	< 0.5	< 0.5	0.0%	< 0.5	98%	90%	110%				98%	75%	125%
Chromium	300	2052934	80.1	85.0	5.9%	< 0.5	95%	90%	110%				90%	75%	125%
Cobalt	300	2052934	4.2	4.2	0.0%	< 0.5	94%	90%	110%				101%	75%	125%
Copper	300	2052934	12.2	10.7	13.1%	< 0.5	92%	90%	110%				100%	75%	125%
Lead	300	2052934	5.0	5.3	5.8%	< 0.5	96%	90%	110%				99%	75%	125%
Molybdenum	300	2052934	< 0.5	< 0.5	0.0%	< 0.5	93%	90%	110%				99%	75%	125%
Nickel	300	2052934	75.2	79.4	5.4%	< 0.5	96%	90%	110%				97%	75%	125%
Selenium	300	2052934	< 0.5	< 0.5	0.0%	< 0.5	102%	90%	110%				95%	75%	125%
Silver	300	2052934	< 0.5	< 0.5	0.0%	< 0.5	93%	90%	110%				100%	75%	125%
Thallium	300	2052934	< 0.5	< 0.5	0.0%	< 0.5	95%	90%	110%				101%	75%	125%
Tin	300	2052934	< 0.5	< 0.5	0.0%	< 0.5	95%	90%	110%				96%	75%	125%
Uranium	300	2052934	0.84	0.87	3.5%	< 0.5	95%	90%	110%				101%	75%	125%
Vanadium	300	2052934	14.3	15.8	10.0%	< 0.5	95%	90%	110%				111%	75%	125%
Zinc	300	2052934	12	13	8.0%	< 1	110%	90%	110%				104%	75%	125%

Certified By:

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TEL (403)735-2005
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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: AECOM CANADA LTD **AGAT WORK ORDER: 10E443107**

PROJECT NO: Cambridge Bay **ATTENTION TO: Katie Scott**

Trace Organics Analysis

RPT Date: Oct 27, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS)															
Benzene	882	2052934	< 0.005	< 0.005	NA	< 0.005	85%	80%	120%	102%	80%	120%	89%	60%	140%
Toluene	882	2052934	< 0.05	< 0.05	NA	< 0.05	84%	80%	120%	97%	80%	120%	84%	60%	140%
Ethylbenzene	882	2052934	< 0.01	< 0.01	NA	< 0.01	86%	80%	120%	101%	80%	120%	96%	60%	140%
Xylenes	882	2052934	< 0.05	< 0.05	NA	< 0.05	89%	80%	120%	101%	80%	120%	93%	60%	140%
C6 - C10 (F1)	882	2052934	< 10	< 10	NA	< 10	100%	80%	120%	94%	80%	120%	92%	60%	140%
C10 - C16 (F2)	687	2052934	<10	<10	NA	< 10	100%	80%	120%	100%	80%	120%	91%	60%	140%
C16 - C34 (F3)	687	2052934	<10	11	NA	< 10	100%	80%	120%	99%	80%	120%	88%	60%	140%
C34 - C50 (F4)	687	2052934	<10	<10	NA	< 10	100%	80%	120%	90%	80%	120%	85%	60%	140%
Polychlorinated Biphenyls Analysis - Soil															
Aroclor 1242	95	2053788	< 0.05	< 0.05	NA	< 0.05	108%	80%	120%	112%	70%	130%	100%	50%	150%
Aroclor 1254	95	2053788	< 0.05	< 0.05	NA	< 0.05	92%	80%	120%	85%	70%	130%	73%	50%	150%
Aroclor 1260	95	2053788	< 0.05	< 0.05	NA	< 0.05	96%	80%	120%	83%	70%	130%	98%	50%	150%
Total Polychlorinated Biphenyls	95	2053788	< 0.05	< 0.05	NA	< 0.05	99%	80%	120%	94%	70%	130%	90%	50%	150%

Certified By:

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
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Method Summary

CLIENT NAME: AECOM CANADA LTD **AGAT WORK ORDER: 10E443107**

PROJECT NO: Cambridge Bay **ATTENTION TO: Katie Scott**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Arsenic	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Barium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Beryllium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Cadmium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Chromium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010, SHEPPARD	ICP/MS
Cobalt	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Copper	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Lead	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Molybdenum	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Nickel	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Selenium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Silver	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Thallium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Tin	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Uranium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Vanadium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Zinc	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

Method Summary

CLIENT NAME: AECOM CANADA LTD **AGAT WORK ORDER: 10E443107**

PROJECT NO: Cambridge Bay **ATTENTION TO: Katie Scott**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	TO 0570	EPA SW-846 8260	GC/MS
Toluene	TO 0570	EPA SW-846 8260	GC/MS
Ethylbenzene	TO 0570	EPA SW-846 8260	GC/MS
Xylenes	TO 0570	EPA SW-846 8260	GC/MS
C6 - C10 (F1)	TO 0570	CCME Tier 1 Method	GC/FID
C6 - C10 (F1 minus BTEX)	TO 0570	CCME Tier 1 Method	GC/FID
C10 - C16 (F2)	TO-0560	CCME Tier 1 Method	GC/FID
C16 - C34 (F3)	TO-0560	CCME Tier 1 Method	GC/FID
C34 - C50 (F4)	TO 0560	CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	TO 0560	CCME Tier 1 Method	GC/FID
Moisture Content	TO 0560	CCME Tier 1 Method	GRAVIMETRIC
Toluene-d8 (BTEX)	TO 0570	EPA SW-846 8260	GC/MS
Ethylbenzene-d10 (BTEX)	TO 0570	EPA SW-846 8260	GC/MS
o-Terphenyl (F2-F4)	TO 0560	CCME Tier 1 Method	GC/FID
Aroclor 1242	TO 0410	EPA SW-846 3550 & 8080	GC/ECD
Aroclor 1254	TO 0410	EPA SW-846 3550 & 8080	GC/ECD
Aroclor 1260	TO 0410	EPA SW-846 3550 & 8080	GC/ECD
Total Polychlorinated Biphenyls	TO 0410	EPA SW-846 3550 & 8080	GC/ECD
Decachlorobiphenyl	TO 0410	EPA SW-846 3550 & 8080	GC/ECD

CHAIN OF CUSTODY RECORD

AGAT Laboratories Limited
2910-12th Street NE
Calgary, Alberta T2E 7P7
http://webearth.agatlabs.com

Phone: 403-735-2005
Fax: 403-735-2771
Toll free: 800-661-7174
environmental.agatlabs.com

Report To:
Company: AECOM
Contact: Katie Scott
Address: 17007-107 AVE
EDMONTON AB Postal Code: T5S 1G3
Phone: 780-930-0033 Fax: 780-486-7070
LSD:
Client Project #: Cambridge Bay

Bill Invoice To: SAME (Y) N) - circle
Company:
Contact:
Address:
Postal Code:
Phone: Fax:
PO/AFE#:

Report Information - reports to be sent to:
1. Name: Katie Scott
Email: katie.scott@aecom.com
2. Name:
Email:

Regulatory requirements (Check One):
- ☒ CCME
  - ☐ Agricultural
  - ☐ Residential/Park
  - ☒ Commercial
  - ☐ Industrial
  - ☐ Drinking Water
  - ☐ FWAL
- ☐ AB Tier 1
  - ☐ Natural Area
  - ☐ Agricultural
  - ☐ Residential/Park
  - ☐ Commercial
  - ☐ Industrial
- ☐ Other
  - ☐ BC CSR
  - ☐ D50 (Drilling)
  - ☐ SPIGEC

Report Format
- ☐ Single Sample per page
- ☒ Multiple Samples per page
- ☒ Excel Format Included

RUSH TURNAROUND REQUESTS
Upon filling out this section, client accepts that surcharges will be attached to this analysis. If NOT completed, regular TAT will be default.
- ☐ Less than 24 hours (200%)
- ☐ 24 to 48 hours (100 %)
- ☐ 48 to 72 hours (50%)

DATE REQUIRED:
PLEASE CONTACT LABORATORY TO NOTIFY

LABORATORY USE ONLY
Date and Time: '10 OCT 12 P7:12
Arrival temperature: 7.6
AGAT Job Number: 10E445107

Laboratory Use (Lab ID #)	Sample Identification	Sample Matrix	Date/Time Sampled	Comments- Site/ Sample Info. Sample Containment	# OF CONTAINERS	Detailed Soil Salinity (Sat. Paste)	CCME BTEX/F1-F4	Metals (Check Guideline)	Routine Water Potability	AB Class 2 Landfill	BC Landfill (Specify:)	D50 Detailed Soil Salinity (As received)	Microtox	Perfluoro Octane Sulfonates (PFOS)	HOLD FOR 1 YEAR	CONTAMINATED/HAZARDOUS (Y/N)
10E445133	CB-01	S	oct-6-2010 8:00am		2									X		
34	CB-02	S	oct-6-2010 8:10		2		X	X								
35	CB-03	S	oct-6-2010 8:20		2		X	X								
36	CB-04	S	oct-6-2010 8:30		1									X		
37	CB-05	S	oct-6-2010 8:40		2		X	X								
38	CB-06	S	oct-6-2010 8:50		2		X	X								
40	CB-07	S	oct-6-2010 9:00		2									X		
41	CB-08	S	oct-6-2010 9:10		1		X	X								
42	CB-09	S	oct-6-2010 9:20		2		X	X								
43	CB-10	S	oct-6-2010 9:30		2									X		
44	CB-11	S	oct-6-2010 9:40		2		X	X								
45	CB-12	S	oct-6-2010 9:50		2		X	X								

Samples Relinquished By (print name & sign)	Date/Time	Samples Received By (print name & sign)	Date/Time
Katie Scott KScott	oct-7-2010 9:00		
Samples Relinquished By (print name & sign)	Date/Time	Samples Received By (print name & sign)	Date/Time
Samples Relinquished By (print name & sign)	Date/Time	Samples Received By (print name & sign)	Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

NO: 0094569

CHAIN OF CUSTODY RECORD

AGAT Laboratories Limited
2910-12th Street NE
Calgary, Alberta T2E 7P7
http://webearth.agatlabs.com

Phone: 403-735-2005
Fax: 403-735-2771
Toll free: 800-661-7174
environmental.agatlabs.com

Report To:
Company: AECOM
Contact: Katie Scott
Address: 17001-107 Ave Edmonton AB Postal Code: T5S 1G3
Phone: 780-930-0083 Fax: 780-486-7070
LSD:
Client Project #: Cambridge Bay

Bill Invoice To: SAME (Y / N) - circle
Company:
Contact:
Address:
Postal Code:
Phone: Fax:
PO/AFE#:

Report Information - reports to be sent to:
1. Name: Katie Scott
Email: katie.scott@aecom.com
2. Name:
Email:

Regulatory requirements (Check One):
- ☒ CCME
  - ☐ Agricultural
  - ☐ Residential/Park
  - ☒ Commercial
  - ☐ Industrial
  - ☐ Drinking Water
  - ☐ FWAL
- ☐ AB Tier 1
  - ☐ Natural Area
  - ☐ Agricultural
  - ☐ Residential/Park
  - ☐ Commercial
  - ☐ Industrial
- ☐ Other
  - ☐ BC CSR
  - ☐ D50 (Drilling)
  - ☐ SPIGEC

Report Format
- ☐ Single Sample per page
- ☒ Multiple Samples per page
- ☒ Excel Format Included

RUSH TURNAROUND REQUESTS
Upon filling out this section, client accepts that surcharges will be attached to this analysis. If NOT completed, regular TAT will be default.
- ☐ Less than 24 hours (200%)
- ☐ 24 to 48 hours (100 %)
- ☐ 48 to 72 hours (50%)

DATE REQUIRED:
PLEASE CONTACT LABORATORY TO NOTIFY

LABORATORY USE ONLY
Date and Time: '10 OCT 12 P7:12
Arrival temperature: 7°C
AGAT Job Number:

Laboratory Use (Lab ID #)	Sample Identification	Sample Matrix	Date/Time Sampled	Comments- Site/ Sample Info. Sample Containment	# OF CONTAINERS	Detailed Soil Salinity (Sat. Paste)	CCME BTEX/F1-F4	Metals (Check Guideline)	Routine Water Potability	AB Class 2 Landfill	BC Landfill (Specify:)	D50 Detailed Soil Salinity (As received)	Microtox	Perfluoro octane Sulfonates (PFOS)					HOLD FOR 1 YEAR	CONTAMINATED/HAZARDOUS (Y/N)
2012946	CB-13	S	oct-6-2010 13:30		1									X						
47	CB-14	S	oct-6-2010 13:30		1									X						
48	CB-15	S	oct-6-2010 13:40		2		X	X												
49	CB-16	S	oct-6-2010 13:40		2		X	X												
50	CB-17	S	oct-6-2010 13:50		2		X	X												
51	CB-18	S	oct-6-2010 14:00		1									X						
52	CB-19	S	oct-6-2010 14:10		2		X	X												
53	CB-20	S	oct-6-2010 14:20		2		X	X												
60	CB-21	S	oct-6-2010 14:30		1									X						
61	CB-22	S	oct-6-2010 14:40		2		X	X												
62	CB-23	S	oct-6-2010 14:50		2		X	X												
64	CB-24	S	oct-6-2010 15:00		2									X						

Samples Relinquished By (print name & sign)	Date/Time	Samples Received By (print name & sign)	Date/Time
Katie Scott KScott	oct-7-2010 9:00		
Samples Relinquished By (print name & sign)	Date/Time	Samples Received By (print name & sign)	Date/Time
Samples Relinquished By (print name & sign)	Date/Time	Samples Received By (print name & sign) J-GWEBBOC	Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

NO: 0094570

AGAT Laboratories Limited
2910-12th Street NE
Calgary, Alberta T2E 7P7
http://webearth.agatlabs.com

Phone: 403-735-2005
Fax: 403-735-2771
Toll free: 800-661-7174
environmental.agatlabs.com

Report To:
Company: AECOM
Contact: Katie Scott
Address: 17007 - 107 AVE Edmonton AB Postal Code: T5S 1G3
Phone: 780-930-6033 Fax: 780-486-7070
LSD:
Client Project #: Cambridge Bay

Report Information - reports to be sent to:
1. Name: Kate Scott
Email: Kate.Scott@aecom.com
2. Name:
Email:

Report Format
☐ Single Sample per page
☑ Multiple Samples per page
☑ Excel Format Included

RUSH TURNAROUND REQUESTS
Upon filling out this section, client accepts that surcharges will be attached to this analysis. If NOT completed, regular TAT will be default.
☐ Less than 24 hours (200%)
☐ 24 to 48 hours (100 %)
☐ 48 to 72 hours (50%)
DATE REQUIRED:
PLEASE CONTACT LABORATORY TO NOTIFY

LABORATORY USE ONLY
Date and Time: '10 OCT 12 P7:12
Arrival temperature: 7°C
AGAT Job Number:

Bill Invoice To: SAME (Y / N) - circle
Company:
Contact:
Address:
Postal Code:
Phone: Fax:
PO/AFE#:

Regulatory requirements (Check One):
☑ CCME
☐ Agricultural
☐ Residential/Park
☑ Commercial
☐ Industrial
☐ Drinking Water
☐ FWAL
☐ AB Tier 1
☐ Natural Area
☐ Agricultural
☐ Residential/Park
☐ Commercial
☐ Industrial
☐ Other
☐ BC CSR
☐ D50 (Drilling)
☐ SPIGEC

Laboratory Use (Lab ID #)	Sample Identification	Sample Matrix	Date/Time Sampled	Comments- Site/ Sample Info. Sample Containment	# OF CONTAINERS	Detailed Soil Salinity (Sat. Paste)	CCME BTEX/F1-F4	Metals (Check Guideline)	Routine Water Potability	AB Class 2 Landfill	BC Landfill (Specify:)	D50 Detailed Soil Salinity (As received)	Microtox	Perfluoro octane Sulfonates (PFOS)	HOLD FOR 1 YEAR	CONTAMINATED/HAZARDOUS (Y/N)
245-2477	CB-25	S	oct-6-2010 15:10		2		X	X								
78	CB-26	S	oct-6-2010 15:20		2		X	X								

Samples Relinquished By (print name & sign)	Date/Time	Samples Received By (print name & sign)	Date/Time
Katie Scott KScott	oct-7-2010 9:00		
Samples Relinquished By (print name & sign)	Date/Time	Samples Received By (print name & sign)	Date/Time
Samples Relinquished By (print name & sign)	Date/Time	Samples Received By (print name & sign) J. OVERBYE	Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

NO: 0094571

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM Work order # 10E443107

RECEIVING BASICS:
*Complete CoC as well where required
Date and Time: 20 OCT 2010/19:12
Courier: 16290
Received by: J. GUERRA
Relinquished by:
Company: AECOM
Consultant:
Client left without count verified:

COC INFORMATION:
Received: Yes No Emailed to PM
Completed in full: Yes No If NO, why:
TURNAROUND TIME: REGULAR
COC Numbers: 0094569/571

SAMPLE QUANTITIES:
Coolers: 2 Bottles/Jars: 26 Bags: 20

TIME SENSITIVE ISSUES:
Earliest Date Sampled: 06 OCT 2010
Microbiology: Test:
Hydrocarbons: Test: BTEX/F1-F4
Samples are received >5 days after sampling: Yes No

ALREADY EXCEEDED? Yes No
Expiry:
Expiry: 13 OCT 2010

SPECIALTY ISSUES:
Legal Samples: Yes No
International Samples: Yes No
**Proper tape/labels applied: Yes No

Hazardous Samples:
Why hazardous:
Precaution taken: ND

SAMPLE REQUIREMENTS:
*Complete while logging in by login staff.
Correct bottles used for testing: Yes No
If No, explain:
Correct amount of sample for analysis: Yes No
If No, explain:
Are all samples labeled correctly: Yes No
If No, explain:

NON-CONFORMANCES:
3 temperatures of samples* and average of each cooler: (record differing temperatures on the CoC next to sample ID's)
(1) 7 + 8 + 7 = 7 °C (2) ___+___+___=___°C (3) ___+___+___=___°C (4) ___+___+___=___°C
*Jars used when available

Additional integrity issues (note here and on CoC next to the sample ID):
1) _____
2) _____
3) _____

Account Project Manager: _____ Have they been notified of the above issues: Yes No
Whom spoken to: _____ Date and Time: _____

ADDITIONAL NOTES:

SAMPLE INTEGRITY RECEIPT FORM – BRANCH Edmonton

AGAT Laboratories

RECEIVING BASICS:
***Complete CoC as well where required**
Date and Time: Oct 12- 11:50am
Received by: Kelita
Relinquished by: Peter - Canadian Natural
Sent Via: (Jazoo) AC Other

COC INFORMATION: Received – Yes No
Completed Yes No **TAT** - 5-7 48-72 24-48
COC #s - Emailed to CDM

SAMPLE QUANTITIES:
Coolers: 2 - **OR** -Bottles/Jars: Bags:

TIME SENSITIVE ISSUES:
Earliest Date Sampled: ?
Microbiology: Test:
Hydrocarbons: Test:
Are samples received >5 days after sampling: Yes No

ALREADY EXCEEDED? Yes No
Expiry:
Expiry:

(TEMPERATURE MUST BE MAINTAINED IF RECEIVED <10 DEGREES C)
3 temperatures of samples* and average of each cooler: (record differing temperatures on the CoC next to sample ID's)
(1) 6+5+7=6 °C (2) 9+7+8=8 °C (3) ___+___+___=___ °C (4) ___+___+___=___ °C
*(Jars when available)

Additional integrity issues (note here and on CoC next to the sample ID):
1)_____ 2)_____

ADDITIONAL NOTES:

Appendix E

Site Photographs

Photo	Image #	Descrption	Date
1	P1010047	TP10-01	6-Oct-2010
2	P1010048	TP10-01	6-Oct-2010
3	P1010049	TP10-01	6-Oct-2010
4	P1010050	MOV file of failed TP-02	6-Oct-2010
5	P1010051	MOV file of failed TP-02	6-Oct-2010
6	P1010052	Snow	6-Oct-2010
7	P1010053	Digging TP10-02	6-Oct-2010
8	P1010054	TP10-02 0-30 cm	6-Oct-2010
9	P1010055	TP10-02 0-30 cm	6-Oct-2010
10	P1010056	TP10-02 0-100 cm	6-Oct-2010
11	P1010057	TP10-02 0-100 cm	6-Oct-2010
12	P1010058	TP10-02 0-100 cm	6-Oct-2010
13	P1010059	TP10-02 0-100 cm	6-Oct-2010
14	P1010060	TP10-02 0-150 cm	6-Oct-2010
15	P1010061	TP10-02 bottom of hole	6-Oct-2010
16	P1010062	TP10-03 0-50 cm	6-Oct-2010
17	P1010063	TP10-03 0-50 cm	6-Oct-2010
18	P1010064	TP10-03 0-50 cm	6-Oct-2010
19	P1010065	TP10-03 0-50 cm	6-Oct-2010
20	P1010066	TP10-03 0-150 cm	6-Oct-2010
21	P1010067	TP10-03 bottom of hole	6-Oct-2010
22	P1010068	TP10-03 bottom of hole	6-Oct-2010
23	P1010069	TP10-04 surface	6-Oct-2010
24	P1010070	TP10-04 surface	6-Oct-2010
25	P1010071	TP10-04 0-30cm	6-Oct-2010
26	P1010072	TP10-04 0-100 cm	6-Oct-2010
27	P1010073	MOV file of TP10-04	6-Oct-2010
28	P1010074	TP10-04 0-150 cm	6-Oct-2010
29	P1010075	TP10-04 0-150 cm	6-Oct-2010
30	P1010076	TP10-04 bottom of hole	6-Oct-2010
31	P1010077	TP10-05 surface	6-Oct-2010
32	P1010078	TP10-05 surface	6-Oct-2010
33	P1010079	TP10-05 0-100 cm	6-Oct-2010
34	P1010080	TP10-05 bottom of hole	6-Oct-2010
35	P1010081	TP10-05 bottom of hole	6-Oct-2010
36	P1010082	TP10-05 bottom of hole	6-Oct-2010
37	P1010083	TP10-06 surface	6-Oct-2010
38	P1010084	TP10-06 0-50 cm	6-Oct-2010
39	P1010085	TP10-06 0-150 cm	6-Oct-2010
40	P1010086	TP10-06 bottom of hole	6-Oct-2010
41	P1010087	TP10-07 bottom of hole	6-Oct-2010
42	P1010088	TP10-08 0-50 cm	6-Oct-2010
43	P1010089	TP10-08 0-100 cm	6-Oct-2010
44	P1010090	TP10-08 0-150 cm	6-Oct-2010
45	P1010091	TP10-08 bottom of hole	6-Oct-2010
46	P1010092	TP10-08 bottom of hole	6-Oct-2010
47	P1010093	Looking east to APEC 3	6-Oct-2010
48	P1010094	Looking west frm TP10-08	6-Oct-2010
49	P1010095	TP10-07 on left, TP10-08 on right, road through middle	6-Oct-2010
50	Cambridge Bay, Nunavut 001	Digging testpit in tilled area of FFTA	5-Oct-2010
51	Cambridge Bay, Nunavut 002	Digging testpit in tilled area of FFTA	5-Oct-2010
52	Cambridge Bay, Nunavut 003	Digging testpit in tilled area of FFTA	5-Oct-2010
53	Cambridge Bay, Nunavut 004	Digging testpit in tilled area of FFTA	5-Oct-2010
54	Cambridge Bay, Nunavut 005	Digging testpit in tilled area of FFTA	5-Oct-2010
55	Cambridge Bay, Nunavut 006	View of ocean from FFTA	5-Oct-2010
56	Cambridge Bay, Nunavut 007	FFTA looking W	5-Oct-2010
57	Cambridge Bay, Nunavut 008	Digging testpit in tilled area of FFTA	5-Oct-2010
58	Cambridge Bay, Nunavut 009	Arctic hare	5-Oct-2010

59	Cambridge Bay, Nunavut 010	Arctic hare	5-Oct-2010
60	Cambridge Bay, Nunavut 011	Arctic hare	5-Oct-2010
61	Cambridge Bay, Nunavut 012	View of ocean from FFTA	5-Oct-2010
62	Cambridge Bay, Nunavut 013	Arctic hare	5-Oct-2010
63	Cambridge Bay, Nunavut 014	Testpit digging	5-Oct-2010
64	Cambridge Bay, Nunavut 015	Attempted testpit in FFTA tilled area	5-Oct-2010
65	Cambridge Bay, Nunavut 016	Attempted testpit in FFTA tilled area	5-Oct-2010
66	Cambridge Bay, Nunavut 017	Attempted testpit in FFTA tilled area	5-Oct-2010
67	Cambridge Bay, Nunavut 018	Attempted testpit in FFTA tilled area	5-Oct-2010
68	Cambridge Bay, Nunavut 019	Testpit dug outside of tilled area	5-Oct-2010
69	Cambridge Bay, Nunavut 020	Testpit dug outside of tilled area	5-Oct-2010
70	Cambridge Bay, Nunavut 021	Hill to AEC 2	5-Oct-2010
71	Cambridge Bay, Nunavut 022	Hill to AEC 2	5-Oct-2010
72	Cambridge Bay, Nunavut 023	Hill to AEC 2	5-Oct-2010
73	Cambridge Bay, Nunavut 024	Hill to AEC 2	5-Oct-2010
74	Cambridge Bay, Nunavut 025	Hill to AEC 2	5-Oct-2010
75	Cambridge Bay, Nunavut 026	Hill to AEC 2	5-Oct-2010
76	Cambridge Bay, Nunavut 027	Hill to AEC 2	5-Oct-2010
77	Cambridge Bay, Nunavut 028	Hill to AEC 2	5-Oct-2010
78	Cambridge Bay, Nunavut 029	Hill to AEC 2	5-Oct-2010
79	Cambridge Bay, Nunavut 030	Arctic hare	5-Oct-2010
80	Cambridge Bay, Nunavut 031	View of ocean	5-Oct-2010
81	Cambridge Bay, Nunavut 032	View of ocean	5-Oct-2010
82	Cambridge Bay, Nunavut 033	View of ocean	6-Oct-2010
83	Cambridge Bay, Nunavut 034	View of ocean	6-Oct-2010
84	Cambridge Bay, Nunavut 035		6-Oct-2010

Appendix F

National Contaminated Site Classification

CCME National Classification System for Contaminated Sites (2008)
Pre-Screening Checklist

Question	Response (yes / no)	Comment
1. Are **Radioactive material**, **Bacterial contamination** or **Biological hazards** likely to be present at the site?	No	If yes, do not proceed through the NCSCS. Contact applicable regulatory agency immediately.
2. Are there **no contamination exceedances** (known or suspected)? Determination of exceedances may be based on: 1) CCME environmental quality guidelines; 2) equivalent provincial guidelines/standards if no CCME guideline exists for a specific chemical in a relevant medium; or 3) toxicity benchmarks derived from the literature for chemicals not covered by CCME or provincial guidelines/standards.	No	If yes (i.e., there are no exceedances), do not proceed through the NCSCS.
3. Have **partial/incompleted or no environmental site investigations** been conducted for the Site?	No	If yes, do not proceed through the NCSCS.
4. Is there direct and signficant evidence of **impacts to humans** at the site, or off-site due to migration of contaminants from the site?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
5. Is there direct and significant evidence of **impacts to ecological receptors** at the site, or off-site due to migration of contaminants from the site?	No	Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are considered to be severe, the site may be categorized as Class 1, regardless of the numerical total NCSCS score. For the purpose of application of the NCSCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction.
6. Are there indicators of significant **adverse effects in the exposure zone** (i.e., the zone in which receptors may come into contact with contaminants)? Some examples are as follows: -Hydrocarbon sheen or NAPL in the exposure zone -Severely stressed biota or devoid of biota; -Presence of material at ground surface or sediment with suspected high concentration of contaminants such as ore tailings, sandblasting grit, slag, and coal tar.	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
7. Do measured concentrations of volatiles or unexploded ordnances represent an **explosion hazard**?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, and do not continue until the safety risks have been addressed. Consult your jurisdiction's occupational health and safety guidance or legislation on exposive hazards and measurement of lower explosive limits.

If none of the above applies, proceed with the NCSCS scoring.

CCME National Classification System for Contaminated Sites (2008)
Summary of Site Conditions

Subject Site:	**Test Site**	
Civic Address: *(or other description of location)*	Cambridge Bay Airport, Cambridge Bay, NT	
Site Common Name : *(if applicable)*	Firefighter Training Area (AEC 3)	
Site Owner or Custodian: *(Organization and Contact Person)*	Government of Nunavut, Shawn Maley (Director, Nunavut Airports) 867-645-8203	
Legal description *or* metes and bounds:	Lot 1004, QUAD77/D2, 79787 CLSR, 29558LTO	
Approximate Site area:	13,000 m2	
PID(s) : *(or Parcel Identification Numbers [PIN] if untitled Crown land)*	N/A	
Centre of site: *(provide latitude/longitude or UTM coordinates)*	Latitude: Longitude:	__69__ degrees __06__ min __40.4_ secs __105_ degrees __09__ min __42.8_ secs
	UTM Coordinate:	Northing _____ Easting _____
Site Land Use:	Current:	Commercial
	Proposed:	Commercial
Site Plan	**To delineate the bounds of the Site a site plan MUST be attached. The plan must be drawn to scale indicating the boundaries in relation to well-defined reference points and/or legal descriptions. Delineation of the contamination should also be indicated on the site plan.**	
Provide a brief description of the Site:	The former fire training area (FTA) is situated to the 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 was burned for fire fighting training purposes. It was, enclosed in a containment berm about 40cm high and constructedmade of local till material. An ASTs wereas also historically present on site. According to Agra (1999) Tilling of the FTA to aerate the soil was been completed by TC between 1995 and 1996 after it was taken out of use . The site was vacant and not in use during the investigation conducted by Franz in 2009 and by AECOM in 2010.	

CCME National Classification System for Contaminated Sites (2008)
Summary of Site Conditions

Affected media and Contaminants of Potential Concern (COPC):	Affected Media: Soil and groundwater COPC: BTEX, F1-F4, PAH, VOC, Lead, PCBs and PFOS.

Please fill in the "letter" that best describes the level of information available for the site being assessed

Site Letter Grade **C**

If letter grade is F, do not continue, you must have a minimum of a Phase I Environmental Site Assessment or equivalent.

Scoring Completed By:	**Sarah Gagné**
Date Scoring Completed:	**10-Nov-10**

CCME National Classification System for Contaminated Sites (2008)
User's Guide - Instructions

1) Please review the following overview of contents. The revised CCME National Classification System for Contaminated Sites (NCSCS) consists of a pre-screening checklist, summary of site conditions, summary score sheet, and three instruction/worksheet pages for the user to fill out: Contaminant Characteristics, Migration Potential and Exposure. For ease of printing, the method of evaluation for scoring each section of the worksheet is provided in a separate Instructions tab. Reference material is also provided to assist with the evaluation. A brief description of each sheet is as follows:

Pre-Screening Checklist - Used to determine if the Site can either be considered a Class 1 site (to be remediated immediately) or more information must be collected before the Site can be ranked, or other hazards exist at the Site that must be addressed first before the Site can be ranked using the revised NCSCS.

Site Description Sheet - Summarizes Site information. It also indicates the level of information available (Site Letter Grade) for the site to conduct the NCSCS scoring evaluation. The known/potential contaminants of concern and affected media will also be summarized here.

Contaminant Characteristics Instructions & Worksheet - Prompts the user for information related to the contaminants of potential concern (COPC) found at the site.

Migration Potential Instructions & Worksheet - Prompts the user for information related to physical transport processes which may move contamination to neighboring sites or re-distribute contamination within a site. Migration potential includes many of the exposure pathways, but is not limited to exposure pathways. Migration potential does not require clearly defined receptors.

Exposure Instructions & Worksheet - Prompts the user for information related to exposure pathways and receptors which may be located on the site.

Summary Score Sheet - Generates a total site score by adding up the scores generated on each of the three worksheets and provides the corresponding Site Classification. It also provides an estimate of certainty in the score provided (Certainty Percentage).

Reference Material - Additional information which may be useful to refer to when conducting the evaluation.
- Contaminant Hazard Ranking
- Examples of Persistent Substances
- Examples of Substances in the Various Chemical Classes
- Chemical-specific Properties
- Range of Values of Hydraulic Conductivity and Permeability

The worksheet titles and sub headings are as follows.

I. Contaminant Characteristics

1. Residency Media
2. Chemical Hazard
3. Contaminant Exceedance Factor
4. Contaminant Quantity
5. Modifying Factors

II. Migration Potential

1. Groundwater Movement
2. Surface water Movement
3. Soil
4. Vapour
5. Sediment Movement
6. Modifying Factors

III. Exposure

1. Human Receptors
   - A. Known Impact
   - B Potential
     - a. Land Use
     - b. Accessibility
     - c. Exposure Route
2. Human Modifying Factors
3. Ecological Receptors
   - A. Known Impact
   - B. Potential
     - a. Terrestrial
     - b. Aquatic
4. Ecological Modifying Factors
   - a. Species at Risk
   - b. Aesthetics
5. Other Receptors
   - a. Permafrost

CCME National Classification System for Contaminated Sites (2008)
User's Guide - Instructions

2) This is an electronic form which will prompt the user for information. Based on the answers provided, a score is calculated for the contaminated site in question. In most cases, the user will be asked to select amongst two or more choices in a drop down checklist. To access the drop down checklist, move the mouse towards the right side of the "action box". If a drop down is available, an arrow will appear, which must be selected to access the drop down choices. An "action box" requires input from the user. All action boxes have an amber background. action box

3) When assigning scores for each factor, it is highly recommended to give a rationale (a column has been provided for this purpose in Worksheets I, II and III). Information that would be useful in justifying the scores assigned may include: a statement of any assumptions, a description of site-specific information, and references for any data sources (e.g., site visit, personal interview, site assessment reports, or other documents consulted).

4) The Site Letter Grade is related to the level of information available for the Site (as defined by the User) and provides an indication of completeness of information based on the level of investigation and remediation work that has been carried out at the site. More detailed descriptions of the various categories are provided below.

Site Letter Grade:	*Detailed Descriptions:*
F	***Pre Phase I ESA –*** No environmental investigations have been conducted or there are only partial or incomplete Phase I ESA for the Site. It is not recommended to continue through the NCSCS when insufficient data are available. In these cases, it will generally be necessary to conduct a Phase I ESA or other site investigation tasks in order to complete the NCSCS scoring.
E	***Phase I ESA –*** A preliminary desk-top type study has been conducted, involving non-intrusive data collection to determine whether there is a potential for the Site to be contaminated and to provide information to direct any intrusive investigations. Data collected may include a review of available information on current site conditions and history of the property, a site inspection and interviews with personnel familiar with the Site. [Note: This stage is similar to "Phase I: Site Information Assessment" as described in Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997).]
D	***Limited Phase II ESA –*** An initial intrusive investigation and assessment of the property has been conducted, generally focusing on potential sources of contamination, to determine whether there is contamination present above the relevant screening guidelines or criteria, and to broadly define soil and groundwater conditions; samples have been collected and analyzed to identify, characterize and quantify contamination that may be present in air, soil, groundwater, surface water or building materials. [Note: This stage is similar to "Phase II: Reconnaissance Testing Program" as described in Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997).]
C	***Detailed Phase II ESA –*** Further intrusive investigations have been conducted to characterize and delineate the contamination, to obtain detailed information on the soil and groundwater conditions, to identify the contaminant pathways, and to provide other information required to develop a remediation plan. [Note: This stage is similar to "Phase III: Detailed Testing Program" as described in Guidance Document on the Management of Contaminated Sites in Canada (CCME 1997).]
B	***Risk Assessment with or without Remedial Plan or Risk Management Strategy –*** A risk assessment has been completed, and if the risk was found to be unacceptable, a site-specific remedial action plan has been designed to mitigate environmental and health concerns associated with the Site, or a risk management strategy has been developed.
A	***Confirmation Sampling –*** Remedial work, monitoring, and/or compliance testing have been conducted and confirmatory sampling demonstrates whether contamination has been removed or stabilized effectively and whether cleanup or risk management objectives have been attained.

5) A few terms are used throughout which require definition, they are as follows:

Known - refers to scores that are assigned based on documented scientific and/or technical observations

Potential - refers to scores that are assigned when something is not known, though it may be suspected

Allowed Potential - If, in a given category, known and potential scores are provided by the user, the checklist will typically default to the "known" score. If a "known" score is provided, the "allowed potential" score will equal zero. Exceptions can be found within the Modifying Factors categories in each worksheet where there are often several independent questions. Therefore, "known" and "potential" scores are allowed to contribute to the total modifying factor score.

Raw - refers to score totals which have not been adjusted down to the total maximum score for the given category. In most cases the possible total raw score is greater than the maximum allowed

CCME National Classification System for Contaminated Sites (2008)
User's Guide - Instructions

Note: For some questions in the worksheets, the option selected will determine whether a "known" or "potential" score is assigned. In these cases, if "Do Not Know" is selected, a score will automatically be listed as "potential", whereas all of the other options in the list will provide a "known" score.

6) Certainty Percentage: The ratio of “Known” to “Potential” responses reflects the relative certainty, or confidence, of the resulting final score and the classification. The NCSCS system defines this ratio as the “Certainty Percentage”. The Certainty Percentage is generated from the number of sections assigned scores based on “known” information divided by the total number of sections. A high percentage indicates that more is known about the Site, and therefore there is more confidence in the ranking, whereas a low percentage suggests that the ranking should be treated with caution.

7) Site Classification Categories: Sites should not be ranked relative to one another. Sites must be classifed on their individual characteristics in order to determine the appropriate classification (Class 1, 2, 3, or N) according to their priority for action, or Class INS (Insufficient Information) for sites that require further information before they can be classifed. The classification groupings are as follows:

Class 1 - High Priority for Action (Total NCSCS Score greater than 70)

The available information indicates that action (e.g., futher site characterization, risk management, remediation, etc.) is required to address existing concerns. Typically, Class 1 sites indicate high concern for several factors, and measured or observed impacts have been documented.

Class 2 - Medium Priority for Action (Total NCSCS Score between 50 and 69.9)

The available information indicates that there is high potential for adverse impacts, although the threat to human health and the environment is generally not imminent. There will tend not to be indication of off-site contamination, however, the potential for this was rated high and therefore some action is likely required.

Class 3 - Low Priority for Action (Total NCSCS Score between 37 and 49.9)

The available information indicates that this site is currently not a high concern. However, additional investigation may be carried out to confirm the site classification, and some degree of action may be required.

Class N - Not a Priority for Action (Total NCSCS Score less than 37)

The available information indicates there is probably no significant environmental impact or human health threats. There is likely no need for action unless new information becomes available indicating greater concerns, in which case the site should be re-examined.

Class INS - Insufficient Information (>15% of Responses are "Do Not Know")

There is insufficient information to classify the site. In this event, additional information is required to address data gaps.

8) Additional Complementary Tools to the NCSCS

The CCME Soil Quality Index (SoQI) is a complementary tool that focuses more on evaluating the relative hazard, by comparing contaminant concentrations with their respective soil quality guidelines. The SoQI uses three factors for its calculations, namely: 1) scope (% of contaminants that do not meet their respective guidelines), 2) frequency (% of individual tests of contaminants that do not meet their respective guidelines), and 3) amplitude (the amount by which the contaminants do not meet their respective guidelines). The soil quality index can be used to compare different contaminated sites with similar types of contamination as well as to see if the jurisdictional requirements have been met after remediation of a particular site.

The NCSCS was not developed for and is not readily applicable for the assessment of sites with a significant marine or aquatic component. Environmental conditions at marine and aquatic sites are best measured in the bed sediments as they act as long-term reservoirs of chemicals to the aquatic environment and to organisms living in or having direct contact with sediments. The CCME Sediment Quality Index (SeQI) provides a convenient means of summarizing sediment quality data and can complement the NCSCS. The SeQI provides a mathematical framework for assessing sediment quality conditions by comparing contaminant concentrations with their respective sediment quality guidelines.

CCME National Classification System (2008)

(I) Contaminant Characteristics

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
1. Residency Media (replaces physical state)				
Which of the following residency media are known (or strongly suspected) to have one or more exceedances of the applicable CCME guidelines? **yes** = has an exceedance or strongly suspected to have an exceedance **no** = does not have an exceedance or strongly suspected not to have an exceedance		Franz Soil assessed against CCME guidelines and exceedances found. Groundwater assessed agains BC CSR AW (Marine Life) standards and exceedances found. 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. No surface water on site. No sediment on site. AECOM AECOM conducted a Phase II/III ESA to attempt to delineate the extent of contamination at the site. Due to site conditions, ground was frozen, only the north, east and southern sides of the estimated extent of contamination (estimated by Franz in 2009) were able to be sampled for soil. The estimated extent of contamination was extended to the east approximately XXm. Ground water piezometers were not installed because no water was observed in the bottom of the test pits and the soil was frozen.	The overall score is calculated by adding the individual scores from each residency media (having one or more exceedance of the most conservative media specific and land-use appropriate CCME guideline). Summary tables of the Canadian Environmental Quality Guidelines for soil, water (aquatic life, non-potable groundwater environments, and agricultural water uses) and sediment are available on the CCME website at http://www.ccme.ca/publications/cegg_rcqe.html?category_id=124 . For potable groundwater environments, guidelines for Canadian Drinking Water Quality (for comparison with groundwater monitoring data) are available on the Health Canada website at http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html.	An increasing number of residency media containing chemical exceedances often equates to a greater potential risk due to an increase in the number of potential exposure pathways.
A. Soil	Yes			
Yes No Do Not Know				
B. Groundwater	Yes			
Yes No Do Not Know				
C. Surface water	No			
Yes No Do Not Know				
D. Sediment	No			
Yes No Do Not Know				
"Known" -score	4			
"Potential" - score	---			
2. Chemical Hazard				
What is the relative degree of chemical hazard of the contaminant in the list of hazard rankings proposed by the Federal Contaminated Sites Action Plan (FCSAP)?	High	Benzene, Ethylbenzene, F2 Fraction in soil; Benzene, Naphthalene and Pb in groundwater CCME National Classification system (2008) Document, Appendix VI, Table VI.1 - Hazard ranking of contaminants	The relative degree of chemical hazard should be selected based on the most hazardous contaminant known or suspected to be present at the site. The degree of hazard has been defined by the Federal Contaminated Sites Action Plan (FCSAP) and a list of substances with their associated hazard (Low, Medium and High) has been provided as a separate sheet in this file. *See Attached Reference Material for Contaminant Hazard Rankings.*	Hazard as defined in the revised NCS pertains to the physical properties of a chemical which can cause harm. Properties can include toxic potency, propensity to biomagnify, persistence in the environment, etc. Although there is some overlap between hazard and contaminant exceedance factor below, it will not be possible to derive contaminant exceedance factors for many substances which have a designated chemical hazard designation, but don't have a CCME guideline. The purpose of this category is to avoid missing a measure of toxic potential.
High Medium Low Do Not Know				
"Known" -score	8			
"Potential" - score	---			
3. Contaminant Exceedence Factor				
What is the ratio between the measured contaminant concentration and the applicable CCME guidelines (or other "standards")?	dium (10x to 10	Franz • Exceedances between 1X and 10 X CCME guidelines for soil: Benzene at 3-09TP-4M (0.5-2.1m) = max 1.2 µg/g Ethylbenzene at 3-09TP-6M (DUP2) (1.0-2.0m) = 0.1 µg/g F2 at 3-09TP-5M and 3-09TP-6M (0.5-2.0m) = max 1,700 µg/g • Exceedances between 1X and 100X BC CSR AW (Marine Life) standard in groundwater: Naphthalene at 3-09-4M and 3-09-5M = max 330 µg/L Benzene at 3-09-4M = 1,700 µg/L Lead at 3-09-4M = 100 µg/L AECOM • Exceedance between 10X and 100X CCME guidelines for soil: F2 at CB-17 from TP10-05 (2 m) = 3610 µg/g	Ranking of contaminant "exceedance" is determined by comparing contaminant concentrations with the *most conservative media-specific and land-use appropriate CCME* environmental quality guidelines. **Ranking should be based on contaminant with greatest exceedance of CCME guidelines.** Ranking of contaminant hazard as high, medium and low is as follows: High = One or more measured contaminant concentration is greater than 100 X appropriate CCME guidelines Medium = One or more measured contaminant concentration is 10 - 99.99 X appropriate CCME guidelines Low = One or more measured contaminant concentration is 1 - 9.99 X appropriate CCME guidelines Mobile NAPL = Contaminant is a non-aqueous phase liquid (i.e., due to its low solubility, it does not dissolve in water, but remains as a separate liquid) and is present at a sufficiently high saturation (i.e., greater than residual NAPL saturation) such that there is significant potential for mobility either downwards or laterally. Other standards may include local background concentration or published toxicity benchmarks. Results of toxicity testing with site samples can be used as an alternative. This approach is only relevant for contaminants that do not biomagnify in the food web, since toxicity tests would not indicate potential effects at higher trophic levels. High = lethality observed. Medium = no lethality, but sub lethal effects observed. Low = neither lethal nor sub lethal effects observed.	In the event that elevated levels of a material with no associated CCME guidelines are present, check provincial and USEPA environmental criteria. Hazard Quotients (sometimes referred to as a screening quotient in risk assessments) refer to the ratio of measured concentration to the concentration believed to be the threshold for toxicity. A similar calculation is used here to determine the contaminant exceedance factor (CEF). Concentrations greater than one times the applicable CCME guideline (i.e., CEF=>1) indicate that risks are possible. Mobile NAPL has the highest associated score (8) because of its highly concentrated nature and potential for increase in the size of the impacted zone.
Mobile NAPL High (>100x) Medium (10x to 100x) Low (1x to 10x) Do Not Know				
"Known" -score	4			
"Potential" - score	---			

CCME National Classification System (2008)

(I) Contaminant Characteristics

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
4. Contaminant Quantity (known or strongly suspected)				
What is the known or strongly suspected quantity of all contaminants? >10 hectare (ha) or 5000 m^3 2 to 10 ha or 1000 to 5000 m^3 <2 ha or 1000 m^3 Do Not Know	>10 hectare (ha) or 5000 m3	DRAFT AECOM Phase II/III Environmental Site Assessment Firefighting Training Area, Cambridge Bay Airport, Cambridge Bay, NU	Measure or estimate the area or quantity of total contamination (i.e, all contaminants known or strongly suspected to be present on the site). The "Area of Contamination" is defined as the area or volume of contaminated media (soil, sediment, groundwater, surface water) exceeding appropriate environmental criteria.	A larger quantity of a potentially toxic substance can result in a larger frequency of exposure as well as a greater probability of migration, therefore, larger quantities of these substances earn a higher score.
"Known" -score	9			
"Potential" - score	---			
5. Modifying Factors				
Does the chemical fall in the class of persistent chemicals based on its behavior in the environment? Yes No Do Not Know	Yes	Pb is persistent in the environment (http://www.inchem.org/documents/ehc/ehc/ehc003.htm)	Persistent chemicals, e.g., PCBs, chlorinated pesticides etc. either do not degrade or take longer to degrade, and therefore may be available to cause effects for a longer period of time. Canadian Environmental Protection Act (CEPA) classifies a chemical as persistent when it has at least one of the following characteristics: (a) in air, (i) its half-life is equal to or greater than 2 days, or (ii) it is subject to atmospheric transport from its source to a remote area; (b) in water, its half-life is equal to or greater than 182 days; (c) in sediments, its half-life is equal to or greater than 365 days; or (d) in soil, its half-life is equal to or greater than 182 days. This list does not include metals or metalloids, which in their elemental form do not degrade. However metals and metalloids form chemical species in the environment, many of which are not readily bioavailable.	*Examples of Persistent Substances are provided in attached Reference Materials*
Are there contaminants present that could cause damage to utilities and infrastructure, either now or in the future, given their location? Yes No Do Not Know	No			Some contaminants may react or absorb into underground utilities and infrastructure. For example, organic solvents may degrade some plastics, and salts could cause corrosion of metal.
How many different contaminant classes have representative CCME guideline exceedances? one two to four five or more Do Not Know	two to four	BTEX, PHC F2	For the purposes of the revised NCS ranking system, the following chemicals represent distinct chemical "classes": inorganic substances (including metals), volatile petroleum hydrocarbons, light extractable petroleum hydrocarbons, heavy extractable petroleum hydrocarbons, PAHs, phenolic substances, chlorinated hydrocarbons, halogenated methanes, phthalate esters, pesticides.	*Refer to the Reference Material sheet for a list of example substances that fall under the various chemical classes.*
"Known" - Score	4			
"Potential" - Score	---			

Contaminant Characteristic Total

Raw Total Scores- "Known"	29
Raw Total Scores- "Potential"	0
Raw Combined Total Scores	29
Total Score (Raw Combined / 40 * 33)	**23.9**

CCME National Classification System (2008)

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
1. Groundwater Movement				
A. Known COPC exceedances and an operable groundwater pathway within and/or beyond the property boundary.				
i) For **potable groundwater environments**, 1) groundwater concentrations exceed background concentrations and 1X the Guideline for Canadian Drinking Water Quality (GCDWQ) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater contamination. For **non-potable environments** (typically urban environments with municipal services), 1) groundwater concentrations exceed 1X the applicable non potable guidelines or modified generic guidelines (which exclude ingestion of drinking water pathway) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater impacts.	12	Groundwater exceeds BC CSR Aquatic Life (Marine Life) standard for Benzene, Naphthalene (3-09-4M and 3-09-5M) and Pb (3-09-4M) from the Franz Phase II/III ESA	Review chemical data and evaluate groundwater quality. The evaluation method concentrates on 1) a potable or non-potable groundwater environment; 2) the groundwater flow system and its potential to be an exposure pathway to known or potential receptors An aquifer is defined as a geologic unit that yields groundwater in usable quantities and drinking water quality. The aquifer can currently be used as a potable water supply or could have the potential for use in the future. Non-potable groundwater environments are defined as areas that are serviced with a reliable alternative water supply (most commonly provided in urban areas). The evaluation of a non-potable environment will be based on a site specific basis. Physical evidence includes significant sheens, liquid phase contamination, or contaminant saturated soils. Seeps and springs are considered part of the groundwater pathway. In Arctic environments, the potability and evaluation of the seasonal active layer (above the permafrost) as a groundwater exposure pathway will be considered on a site-specific basis.	The 1992 NCS rationale evaluated the off-site migration as a regulatory issue. The exposure assessment and classification of hazards should be evaluated regardless of the property boundaries. Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a groundwater supply source in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resources such as internet links. Note that for potable groundwater that also daylights into a nearby surface water body, the more stringent guidelines for both drinking water and protection of aquatic life should be considered. **Selected References** Potable Environments Guidelines for Canadian Drinking Water Quality:www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html Non-Potable Environments Canadian Water Quality Guidelines for Protection of Aquatic Life. CCME. 1999 www.ccme.ca Compilation and Review of Canadian Remediation Guidelines, Standards and Regulations. Science Applications International Corporation (SAIC Canada), report to Environment Canada, January 4, 2002.
ii) Same as (i) except the information is not known but strongly suspected based on indirect observations.	9			
iii) Meets GCDWQ for **potable environments**; meets non-potable criteria or modified generic criteria (excludes ingestion of drinking water pathway) for **non-potable environments** **or** Absence of groundwater exposure pathway (i.e., there is no aquifer (see definition at right) at the site or there is an adequate isolating layer between the aquifer and the contamination, and within 5 km of the site there are no aquatic receiving environments and the groundwater does not daylight).	0			
	12			
Score	12			
NOTE: If a score is assigned here for Known COPC Exceedances, then you can skip Part B (Potential for groundwater pathway) and go to Section 2 (Surface Water Pathway)				
B. Potential for groundwater pathway.				
a. Relative Mobility High Moderate Low Insignificant Do Not Know		not scored	Organics Koc (L/kg) / Metals with higher mobility at acidic conditions / Metals with higher mobility at alkaline conditions Koc < 500 (i.e., log Koc < 2.7) — pH < 5 — pH > 8.5 Koc = 500 to 5000 (i.e., log Koc = 2.7 to 3.7) — pH = 5 to 6 — pH = 7.5 to 8.5 Koc = 5,000 to 100,000 (i.e., log Koc = 3.7 to 5) — pH > 6 — pH < 7.5 Koc > 100,000 (i.e., log Koc > 5)	Reference: US EPA Soil Screening Guidance (Part 5 - Table 39) If a score of zero is assigned for relative mobility, it is still recommended that the following sections on potential for groundwater pathway be evaluated and scored. Although the Koc of an individual contaminant may suggest that it will be relatively immobile, it is possible that, with complex mixtures, there could be enhanced mobility due to co-solvent effects. Therefore, the Koc cannot be relied on solely as a measure of mobility. An evaluation of other factors such as containment, thickness of confining layer, hydraulic conductivities and precipitation infiltration rate are still useful in predicting potential for groundwater migration, even if a contaminant is expected to have insignificant mobility based on its chemistry alone.
	Do Not Know			
Score	2			
b. Presence of engineered sub-surface containment? No containment Partial containment Full containment Do Not Know		not scored	Review the existing engineered systems or natural attenuation processes for the site and determine if full or partial containment is achieved. Full containment is defined as an engineered system or natural attenuation processes, monitored as being effective, which provide for full capture and/or treatment of contaminants. All chemicals of concern must be contained for "Full Containment" scoring. Natural attenuation must have sufficient data, and reports cited with monitoring data to support steady state conditions and the attenuation processes. If there is no containment or insufficient natural attenuation process, this category is evaluated as high. If there is less than full containment or if uncertain, then evaluate as medium. In Arctic environments, permafrost will be evaluated, as appropriate, based on detailed evaluations, effectiveness and reliability to contain/control contaminant migration.	Someone experienced must provide a thorough description of the sources researched to determine the containment of the source at the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps, geotechnical reports or natural attenuation studies and other resources such as internet links. **Selected Resources:** United States Environmental Protection Agency (USEPA) 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. EPA/600/R-98/128. Environment Canada – Ontario Region – Natural Attenuation Technical Assistance Bulletin (TABS) Number 19 –21.
	Do Not Know			
Score	1.5			
c. Thickness of confining layer over aquifer of concern or groundwater exposure pathway 3 m or less including no confining layer or discontinuous confining layer 3 to 10 m > 10 m Do Not Know		not scored	The term "confining layer" refers to geologic material with little or no permeability or hydraulic conductivity (such as unfractured clay); water does not pass through this layer or the rate of movement is extremely slow. Measure the thickness and extent of materials that will impede the migration of contaminants to the groundwater exposure pathway. The evaluation of this category is based on: 1) The presence and thickness of saturated subsurface materials that impede the vertical migration of contaminants to lower aquifer units which can or are used as drinking water sources or 2) The presence and thickness of unsaturated subsurface materials that impede the vertical migration of contaminants from the source location to the saturated zone (e.g., water table aquifer, first hydrostratigraphic unit or other groundwater pathway).	
	Do Not Know			
Score	0.5			
d. Hydraulic conductivity of confining layer >10^{-4} cm/s or no confining layer 10^{-4} to 10^{-6} cm/s <10^{-6} cm/s Do Not Know		not scored	Determine the nature of geologic materials and estimate hydraulic conductivity from published material (or use "Range of Values of Hydraulic Conductivity and Permeability" figure in the Reference Material sheet). Unfractured clays should be scored low. Silts should be scored medium. Sand, gravel should be scored high. The evaluation of this category is based on: 1) The presence and hydraulic conductivity ("K") of saturated subsurface materials that impede the vertical migration of contaminants to lower aquifer units which can or are used as a drinking water source, groundwater exposure pathway or 2) The presence and permeability ("k") of unsaturated subsurface materials that impede the vertica	

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
	Do Not Know		c) The presence and permeability (K) of unsaturated subsurface materials that impede the vertical migration of contaminants from the source location to the saturated water table aquifer, first hydrostratigraphic unit or other groundwater pathway.	
Score	0.5			
B. Potential for groundwater pathway.				
e. Precipitation infiltration rate (Annual precipitation factor x surface soil relative permeability factor) High Moderate Low Very Low None Do Not Know		not scored	Precipitation Refer to Environment Canada precipitation records for relevant areas. Divide annual precipitation by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score). Permeability For surface soil relative permeability (i.e., infiltration) assume: gravel (1), sand (0.6), loam (0.3) and pavement or clay (0). Multiply the surface soil relative permeability factor with precipitation factor to obtain the score for precipitation infiltration rate.	
Score	Do Not Know 0.4			
f. Hydraulic conductivity of aquifer $>10^{-2}$ cm/s 10^{-2} to 10^{-4} cm/s $<10^{-4}$ cm/s Do Not Know		not scored	Determine the nature of geologic materials and estimate hydraulic conductivity of all aquifers of concern from published material (refer to "Range of Values of Hydraulic Conductivity and Permeability" in the Reference Material sheet).	
Score	Do Not Know 1			
Potential groundwater pathway total	5.9			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed.		
Groundwater pathway total	**12**			
2. Surface Water Movement				
A. Demonstrated migration of COPC in surface water above background conditions				
Known concentrations of surface water: i) Concentrations exceed background concentrations and exceed CCME CWQG for protection of aquatic life, irrigation, livestock water, and/or recreation (whichever uses are applicable at the site) by >1 X; or There is known contact of contaminants with surface water based on site observations. or In the absence of CWQG, chemicals have been proven to be toxic based on site specific testing (e.g. toxicity testing; or other indicator testing of exposure).	12		Collect all available information on quality of surface water near to site. Evaluate available data against Canadian Water Quality Guidelines (select appropriate guidelines based on local water uses, e.g., recreation, irrigation, aquatic life, livestock watering, etc.). The evaluation method concentrates on the surface water flow system and its potential to be an exposure pathway. Contamination is present on the surface (above ground) and has the potential to impact surface water bodies. Surface water is defined as a water body that supports one of the following uses: recreation, irrigation, livestock watering, aquatic life.	General Notes: Someone experienced must provide a thorough description of the sources researched to classify the surface water body in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resources such as internet links. Selected References: CCME. 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life www.ccme.ca CCME. 1999. Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) www.ccme.ca Health and Welfare Canada. 1992. Guidelines for Canadian Recreational Water Quality.
ii) Same as (i) except the information is not known but strongly suspected based on indirect observations.	8			
iii) Meets CWQG or absence of surface water exposure pathway (i.e., Distance to nearest surface water is > 5 km.)	0			
Score	Go to Potential ---			
NOTE: If a score is assigned here for Demonstrated Migration in Surface Water, then you can skip Part B (Potential for migration of COPCs in surface water) and go to Section 3 (Surface Soils)				
B. Potential for migration of COPCs in surface water				
a. Presence of containment No containment Partial containment Full containment Do Not Know			Review the existing engineered systems and relate these structures to site conditions and proximity to surface water and determine if full containment is achieved: score low if there is full containment such as capping, berms, dikes; score medium if there is partial containment such as natural barriers, trees, ditches, sedimentation ponds; score high if there are no intervening barriers between the site and nearby surface water. Full containment must include containment of all chemicals.	
Score	No containment 5			
b. Distance to Surface Water 0 to <100 m 100 - 300 m >300 m Do Not Know		Cambridge Bay 100 m to the South	Review available mapping and survey data to determine distance to nearest surface water bodies.	
Score	100 - 300 m 2			

CCME National Classification System (2008)

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
c. Topography Contaminants above ground level and slope is steep Contaminants at or below ground level and slope is steep Contaminants above ground level and slope is intermediate Contaminants at or below ground level and slope is intermediate Contaminants above ground level and slope is flat Contaminants at or below ground level and slope is flat Do Not Know	At/below and flat		Review engineering documents on the topography of the site and the slope of surrounding terrain. Steep slope = >50% Intermediate slope = between 5 and 50% Flat slope = < 5% Note: Type of fill placement (e.g., trench, above ground, etc.).	
Score	0			
d. Run-off potential High (rainfall run-off score > 0.6) Moderate (0.4 < rainfall run-off score <0.6) Low (0.2 < rainfall run-off score <0.4) Very Low (0 < rainfall run-off score < 0.2) None (rainfall run-off score = 0) Do Not Know	(0 < rainfall run-of	Annual precipitation 138.8 mm (Environment Canada website) and soils observed during site investigation by Franz in 2009 were described as silt to silty sand.	Rainfall Refer to Environment Canada precipitation records for relevant areas. Divide rainfall by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score). The former definition of "annual rainfall" did not include the precipitation as snow. This minor adjustment has been made. The second modification was the inclusion of permeability of surface materials as an evaluation factor. Permeability For infiltration assume: gravel (0), sand (0.3), loam (0.6) and pavement or clay (1). Multiply the infiltration factor with precipitation factor to obtain rainfall run off score.	Selected Sources: Environment Canada web page link:www.msc.ec.gc.ca Snow to rainfall conversion apply ratio of 15 (snow):1(water)
Very Low Score	0.4			
e. Flood potential 1 in 2 years 1 in 10 years 1 in 50 years Do Not Know	Do Not Know		Review published data such as flood plain mapping or flood potential (e.g., spring or mountain run-off) and Conservation Authority records to evaluate flood potential of nearby water courses both up and down gradient. Rate zero if site not in flood plain.	
Score	0.5			
Potential surface water pathway total	7.9			
Allowed Potential score	7.9	Note: If a "known" score is provided, the "potential" score is disallowed.		
Surface water pathway total	**7.9**			
3. Surface Soils (potential for dust, dermal and ingestion exposure)				
A. Demonstrated concentrations of COPC in surface soils (top 1.5 m)				
COPCs measured in surface soils exceed the CCME soil quality guideline. Strongly suspected that soils exceed guidelines COPCs in surface soils does not exceed the CCME soil quality guideline or is not present (i.e., bedrock).	12 9 0	Franz Benzene, Ethylbenzene and F2 fraction exceed applicable CCME guideline in soil (3-09-4M, 3-09-5M and 3-09-6M between 0-2m) AECOM F2 fraction exceed applicable CCME guideline in soil (CB-17 from test pit TP10-05 at 2 m)	Collect all available information on quality of surface soils (i.e., top 1.5 metres) at the site. Evaluate available data against Canadian Soil Quality Guidelines. Select appropriate guidelines based on current (or proposed future) land use (i.e, agricultural, residential/parkland, commercial, or industrial), and soil texture if applicable (i.e., coarse or fine).	Selected References: CCME. 1999. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health www.ccme.ca
	12			
Score	12			
NOTE: If a score is assigned here for Demonstrated Concentrations in Surface Soils, then you can skip Part B (Potential for a surface soils migration pathway) and go to Section 4 (Vapour)				
B. Potential for a surface soils (top 1.5 m) migration pathway				
a. Are the soils in question covered? Exposed Vegetated Landscaped Paved Do Not Know	Do Not Know	not scored	Consult engineering or risk assessment reports for the site. Alternatively, review photographs or perform a site visit. Landscaped surface soils must include a minimum of 0.5 m of topsoil.	The possibility of contaminants in blowing snow have not been included in the revised NCS as it is difficult to assess what constitutes an unacceptable concentration and secondly, spills to snow or ice are most efficiently mitigated while freezing conditions remain.
Score	4			
b. For what proportion of the year does the site remain covered by snow? 0 to 10% of the year 10 to 30% of the year More than 30% of the year Do Not Know	Do Not Know	not scored	Consult climatic information for the site. The increments represent the full span from soils which are always wet or covered with snow (and therefore less likely to generate dust) to those soils which are predominantly dry and not covered by snow (and therefore are more likely to generate dust).	
Score	3			
Potential surface soil pathway total	7			
Allowed Potential score	---	**Note: If a "known" score is provided, the "potential" score is disallowed**		
Soil pathway total	**12**			

CCME National Classification System (2008)

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
4. Vapour				
A. Demonstrated COPCs in vapour.				
Vapour has been measured (indoor or outdoor) in concentrations exceeding risk based concentrations. Strongly suspected (based on observations and/or modelling) Vapour has not been measured and volatile hydrocarbons have not been found in site soils or groundwater.	12 9 0 Go to Potential	Vapour not assessed	Consult previous investigations, including human health risk assessments, for reports of vapours detected.	
Score	---			
NOTE: If a score is assigned here for Demonstrated COPCs in Vapour, then you can skip Part B (Potential for COPCs in vapour) and go to Section 5 (Sediment)				
B. Potential for COPCs in vapour				
a. Relative Volatility based on Henry's Law Constant, H' (dimensionless) High (H' > 1.0E-1) Moderate (H' = 1.0E-1 to 1.0E-3) Low (H' < 1.0E-3) Not Volatile Do Not Know	High	Benzene (H'= 2.28E-01) Ethylbenzene (H' = 3.23E-01) Naphthalene (H' = 1.98E-02) CCME National Classification system (2008) Document, Appendix VI, Table VI.4 - Chemicalspecific properties	Reference: US EPA Soil Screening Guidance (Part 5 - Table 36) *Provided in Attached Reference Materials*	If the Henry's Law Constant for a substance indicates that it is not volatile, and a score of zero is assigned here for relative volatility, then the other three questions in this section on Potential for COPCs will be automatically assigned scores of zero and you can skip to section 5.
Score	4			
b. What is the soil grain size? Fine Coarse Do Not Know	Fine	Silt to silty sand observed during site investigation by Franz in 2009.	Review soil permeability data in engineering reports. The greater the permeability of soils, the greater the possible movement of vapours. Fine-grained soils are defined as those which contain greater than 50% by mass particles less than 75 µm mean diameter (D50 < 75 µm). Coarse-grained soils are defined as those which contain greater than 50% by mass particles greater than 75 µm mean diameter (D50 > 75 µm).	
Score	2			
c. Is the depth to the source less than 10m? Yes No Do Not Know	Yes	Contaminated soils found at depth between 0-2m	Review groundwater depths below grade for the site.	
Score	2			
d. Are there any preferential pathways? Yes No Do Not Know	No	No	Visit the site during dry summer conditions and/or review available photographs. Where bedrock is present, fractures would likely act as preferential pathyways.	Preferential pathways refer to areas where vapour migration is more likely to occur because there is lower resistance to flow than in the surrounding materials. For example, underground conduits such as sewer and utility lines, drains, or septic systems may serve as preferential pathways. Features of the building itself that may also be preferential pathways include earthen floors, expansion joints, wall cracks, or foundation perforations for subsurface features such as utility pipes, sumps, and drains.
Score	0			
Potential vapour pathway total	8			
Allowed Potential score	8	Note: If a "known" score is provided, the "potential" score is disallowed.		
Vapour pathway total	**8**			
5. Sediment Movement				
A. Demonstrated migration of sediments containing COPCs				
There is evidence to suggest that sediments originally deposited to the site (exceeding the CCME sediment quality guidelines) have migrated. Strongly suspected (based on observations and/or modelling) Sediments have been contained and there is no indication that sediments will migrate in future. **or** Absence of sediment exposure pathway (i.e., within 5 km of the site there are no aquatic receiving environments, and therefore no sediments).	12 9 0 Go to Potential	No sediment on site	Review sediment assessment reports. Evidence of migration of contaminants in sediments must be reported by someone experienced in this area.	Usually not considered a significant concern in lakes/marine environments, but could be very important in rivers where transport downstream could be significant.
Score	---			
NOTE: If a score is assigned here for Demonstrated Migration of Sediments, then you can skip Part B (Potential for Sediment Migration) and go to Section 6 (Modifying Factors)				

CCME National Classification System (2008)

(II) Migration Potential (Evaluation of contaminant migration pathways)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
B. Potential for sediment migration				
a. Are the sediments having COPC exceedances capped with sediments having no exceedances ("clean sediments")? Yes No Do Not Know	Do Not Know 2		Review existing sediment assessments. If sediment coring has been completed, it may indicate that historically contaminated sediments have been covered over by newer "clean" sediments. This assessment will require that cores collected demonstrate a low concentration near the top and higher concentration with sediment depth.	
b. For lakes and marine habitats, are the contaminated sediments in shallow water and therefore likely to be affected by tidal action, wave action or propeller wash? Yes No Do Not Know	Do Not Know 2		Review existing sediment assessments. If the sediments present at the site are in a river, select "no" for this question.	
c. For rivers, are the contaminated sediments in an area prone to sediment scouring? Yes No Do Not Know	Do Not Know 2		Review existing sediment assessments. It is important that the assessment is made under worst case flows (high yearly flows). Under high yearly flows, areas which are commonly depositional may	
Potential sediment pathway total Allowed Potential score **Sediment pathway total**	6 6 **6**	Note: If a "known" score is provided, the "potential" score is disallowed.		
6. Modifying Factors				
Are there subsurface utility conduits in the area affected by contamination? Yes No Do Not Know	No		Consult existing engineering reports. Subsurface utilities can act as conduits for contaminant migration.	
Known Potential	0 0			

Migration Potential Total	
Raw "known" total	24
Raw "potential" total	21.9
Raw combined total	45.9
Total (max 33)	**23.7**

Note: If "Known" and "Potential" scores are provided, the checklist defaults to known. Therefore, the total "Potential" Score may not reflect the sum of the individual "Potential" scores.

CCME National Classification System (2008)

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
1. Human				
A. Known exposure				
Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to humans as a result of the contaminated site. (Class 1 Site*)	22		*Where adverse effects on humans are documented, the site should be automatically designated as a Class 1 site (i.e., action required). There is no need to proceed through the NCS in this case. However, a scoring guideline (22) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class 1 sites).	Known adverse impact includes domestic and traditional food sources. Adverse effects based on food chain transfer to humans and/or animals can be scored in this category. However, the weight of evidence must show a direct link of a contaminated food source/supply and subsequent ingestion/transfer to humans. Any associated adverse effects to the environment are scored separately later in this worksheet. Someone experienced must provide a thorough description of the sources researched to evaluate and determine the quantified exposure/impact (adverse effect) in the vicinity of the contaminated site.
Same as above, but "Strongly Suspected" based on observations or indirect evidence.	10		This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients >1 for noncarcinogenic chemicals and incremental cancer risks that exceed acceptable levels defined by the jurisdiction for carcinogenic chemicals (for most jurisdictions this is typically either $>10^{-5}$ or $>10^{-6}$). Known impacts can also be evaluated based on blood testing (e.g. blood lead >10 ug/dL) or other health based testing.	**Selected References:** Health Canada – Federal Contaminated Site Risk Assessment in Canada Parts 1 and 2 Guidance on Human Heath Screening Level Risk Assessments (www.hc-sc.gc.ca/ewh-semt/pubs/contamsite/index_e.html) United States Environmental Protection Agency, Integrated Risk Information System (IRIS) http://toxnet.nml.nih.gov
No quantified or suspected exposures/impacts in humans.	0		This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 0.2 for non-carcinogenic chemicals and incremental lifetime cancer risks for carcinogenic chemicals that are within acceptable levels as defined by the jurisdiction (for most jurisdictions this is less than either 10^{-6} or 10^{-5}).	
	Go to Potential			
Score	---	No human activity on site		
NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Human Exposure) and go to Section 2 (Human Exposure Modifying Factors)				
B. Potential for human exposure				
a) Land use (provides an indication of potential human exposure scenarios)			Review zoning and land use maps over the distances indicated. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is in place. Agricultural land use is defined as uses of land where the activities are related to the productive capability of the land or facility (e.g., greenhouse) and are agricultural in nature, or activities related to the feeding and housing of animals as livestock. Residential/Parkland land uses are defined as uses of land on which dwelling on a permanent, temporary, or seasonal basis is the activity (residential), as well as uses on which the activities are recreational in nature and require the natural or human designed capability of the land to sustain that activity (parkland). Commercial/Industrial land uses are defined as land on which the activities are related to the buying, selling, or trading of merchandise or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	This is the main "receptor" factor used in site scoring. A higher score implies a greater exposure and/or exposure of more sensitive human receptors (e.g., children).
Agricultural Residential / Parkland Commercial Industrial Do Not Know				
	Commercial			
Score	1	Site is on airport lands		
b. Indicate the level of accessibility to the contaminated portion of the site (e.g., the potential for coming in contact with contamination)			Review location and structures and contaminants at the site and determine if there are intervening barriers between the site and humans. A low rating should be assigned to a (covered) site surrounded by a fence or in a remote location, whereas a high score should be assigned to a site th has no cover, fence, natural barriers or buffer.	
Limited barriers to prevent site access; contamination not covered Moderate access or no intervening barriers, contaminants are covered. Remote locations in which contaminants not covered. Controlled access or remote location and contaminants are covered Do Not Know				
	Access, not covered			
Score	2			
B. Potential for human exposure				
c) Potential for intake of contaminated soil, water, sediment or foods fo operable or potentially operable pathways, as identified in Worksheet II (Migration Potential).			If soils or potable groundwater are present exceeding their respective CCME guidelines, dermal contact is assumed. Exposure to surface water, non-potable groundwater or sediments exceeding their respective CCME guidelines will depend on the site. Select "Yes" if dermal exposure to surface water, non-potable groundwater or sediments is expected. For instance, dermal contact with sediments would not be expected in an active port. Only soils in the top 1.5 m are defined by CCME (2003) as surface soils. If contaminated soils are only located deeper than 1.5 m, direct contact with soils is not anticipated to be an operable contaminant exposure pathway.	Exposure via the skin is generally believed to be a minor exposure route. However for some organic contaminants, skin exposure can play a very important component of overall exposure. Dermal exposure can occur while swimming in contaminated waters, bathing with contaminated surface water/groundwater and digging in contaminated dirt, etc.
i) direct contact Is dermal contact with contaminated surface water, groundwater, sediments or soils anticipated? Yes No Do Not Know				
	Yes			
Score	3	Dermal contact could occur but unlikely as the site is in an area at the airport where no activities occur		
ii) inhalation (i.e., inhalation of dust, vapour)				Exposure via the lungs (inhalation) can be a very important exposure pathway. Inhalation can be via both particulates (dust) and gas (vapours). Vapours can be a problem where buildings have been built on former industrial sites or where volatile contaminants have migrated below buildings resulting in the potential for vapour intrusion.
Vapour - Are there inhabitable buildings on the site within 30 m of soils or groundwater with volatile contamination as determined in Worksheet II (Migration Potential)? Yes No Do Not Know			If inhabitable buildings are on the site within 30 m of soils or groundwater exceeding their respective guidelines for volatile chemicals, there is a potential of risk to human health (Health Canada, 2004). Review site investigations for location of soil samples (having exceedances of volatile substances) relative to buildings. Refer to (II) Migration Potential worksheet, 4B.a) *Potential for COPCs in Vapour* for a definition of volatility.	Assesses the potential for humans to be exposed to vapours originating from site soils. The closer the receptor is to a source of volatile chemicals in soil, the greater the potential of exposure. Also, coarser-grained soil will convey vapour much more efficiently in the soil than finer grained material such as clays and silts. General Notes; Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a vapour migration and/or dust generation in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including conta names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links.
	No			
Score	0			
Dust - If there is contaminated surface soil (e.g. top 1.5 m) , indicat whether the soil is fine or coarse textured. If it is known that surfac soil is not contaminated, enter a score of zero. Fine Coarse Surface soil is not contaminated or absent (bedrock) Do Not Know Texture			Consult grain size data for the site. If soils (containing exceedances of the CCME soil quality guidelines) predominantly consist of fine material (having a median grain size of 75 microns; as defined by CCME (2006)) then these soils are more likely to generate dusts.	Selected References; Canadian Council of Ministers of the Environment (CCME). 2006. Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. PN 1332www.ccme.ca Golder, 2004. Soil Vapour Intrusion Guidance for Health Canada Screening Level Risk Assessment (SLRA) Submitted to Health Canada, Burnaby, BC
	Coarse			
Score	1			
inhalation total	1			

CCME National Classification System (2008)

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
B. Potential for human exposure				
iii) Ingestion (i.e., ingestion of food items, water and soils [for children]), including traditional foods.			Review available site data to determine if drinking water (groundwater, surface water, private, commercial or municipal supply) is known or suspected to be contaminated above Guidelines for Canadian Drinking Water Quality. If drinking water supply is known to be contaminated, some immediate action (e.g., provision of alternate drinking water supply) should be initiated to reduce or eliminate exposure. The evaluation of significant potential for exceedances of the water supply in the future may be based on the capture zones of the drinking water wells; contaminant travel times; computer modelling of flow and contaminant transport.	**Selected References:** Guidelines for Canadian Drinking Water Quality www.hc-sc.gc.ca/hecs-sesc/water/publications/drinking_water_quality_guidelines/toc.htm Drinking water can be an extremely important exposure pathway to humans. If site groundwater or surface water is not used for drinking, then this pathway is considered to be inoperable. Consider both wild foods such as salmon, venison, caribou, as well as agricultural sources of food items if the contaminated site is on or adjacent to agricultural land uses.
Drinking Water: Choose a score based on the proximity to a drinking water supply, to indicate the potential for contamination (present or future).				
0 to 100 m 100 to 300 m 300 m to 1 km 1 to 5 km No drinking water present Do Not Know	No drinking water preser			
Score	0			
Is an alternative water supply readily available?				
Yes No Do Not Know	Yes	Water is supplied by truck		
Score	0			
Is human ingestion of contaminated soils possible?			If contaminated soils are located within the top 1.5 m, it is assumed that ingestion of soils is an operable exposure pathway. Exposure to soils deeper than 1.5 m is possible, but less likely, and the duration is shorter. Refer to human health risk assessment reports for the site in question.	
Yes No Do Not Know	Yes	Ingestion could occur but unlikely as the site is in an area at the airport where no activities occur		
Score	3			
Are food items consumed by people, such as plants, domestic animals or wildlife harvested from the contaminated land and its surroundings?			Use human health risk assessment reports (or others) to determine if there is significant reliance on traditional food sources associated with the site. Is the food item in question going to spend a large proportion of its time at the site (e.g., large mammals may spend a very small amount of time at a small contaminated site)? Human health risk assessment reports for the site in question will also provide information on potential bioaccumulation of the COPC in question.	
Yes No Do Not Know	No			
Score	0			
Ingestion total	3			
Human Health Total "Potential" Score	10	Note if a "Known" Human Health score is provided, the "Potential" score is disallowed.		
Allowed "Potential" Score	10			
2. Human Exposure Modifying Factors				
a) Strong reliance of local people on natural resources for survival (i.e., food, water, shelter, etc.)	Yes			
Yes No Do Not Know				
Known	6			
Potential	---			
Raw Human "known" total	6			
Raw Human "potential" total	10			
Raw Human Exposure Total Score	16			
Human Health Total (max 22)	**16.0**			
3. Ecological				
A. Known exposure				
Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to terrestrial or aquatic organisms as a result of the contaminated site.	18		Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are deemed to be severe, the s may be categorized as class one (i.e., a priority for remediation or risk management), regardless of the numerical total NCS score. For the purpose of application of the NCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction. If ecological effects are determined to be severe and an automatic Class 1 is assigned, there is no need to proceed through the NCS. However, a scoring guideline (18) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class sites). This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients >1. Alternatively, known impacts can also be evaluated based on a weight of evidence assessment involving a combination of site observations, tissue testing, toxicity testing and quantitative community assessments. Scoring of adverse effects on individual rare or endangered species will be completed on a case-by-case basis with full scientific justification.	CCME, 1999: Canadian Water Quality Guidelines for the Protection of Aquatic Life www.ccme.ca CCME, 1999: Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses www.ccme.ca Sensitive receptors- review: Canadian Council on Ecological Areas www.ccea.org. Ecological effects should be evaluated at a population or community level, as opposed to at the level of individuals. For example, population-level effects could include reduced reproduction, growth or survival in a species. Community-level effects could include reduced species diversity or relative abundances. Further discussion of ecological assessment endpoints is provided in *A Framework for Ecological Risk Assessment: General Guidance* (CCME 1996). Notes: Someone experienced must provide a thorough description of the sources researched to classify the environmental receptors in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links.
Same as above, but "Strongly Suspected" based on observations or indirect evidence.	12			
No quantified or suspected exposures/impacts in terrestrial or aquatic organisms	0		This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 1 and no other observable or measurable sign of impacts. Alternatively, it can be based on a combination of other lines of evidence showing no adverse effects, such as site observations, tissue testing, toxicity testing and quantitative community assessments.	
	Go to Potential			
Score	---			
NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Ecological Exposure) and go to Section 4 (Ecological Exposure Modifying Factors)				

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
B. Potential for ecological exposure (for the contaminated portion of the site)				
a) Terrestrial			Review zoning and land use maps. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is in place (indicate in the worksheet that future land use is the consideration).	
i) Land use				
Agricultural (or Wild lands) Residential/Parkland Commercial Industrial Do Not Know	Commercial		Agricultural land use is defined as uses of land where the activities are related to the productive capability of the land or facility (e.g., greenhouse) and are agricultural in nature, or activities related to the feeding and housing of animals as livestock. Wild lands are grouped with agricultural land due to the similarities in receptors that would be expected to occur there (e.g., herbivorous mammals and birds) and the similar need for a high level of protection to ensure ecological functioning. Residential/Parkland land uses are defined as uses of land on which dwelling on a permanent, temporary, or seasonal basis is the activity (residential), as well as uses on which the activities are recreational in nature and require the natural or human designed capability of the land to sustain that activity (parkland). Commercial/Industrial land uses are defined as land on which the activities are related to the buying, selling, or trading of merchandise or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	
Score	1	Site is on airport lands		
ii) Uptake potential				
Direct Contact - Are plants and/or soil invertebrates likely exposed to contaminated soils at the site?	Yes		If contaminated soils are located within the top 1.5 m, it is assumed that direct contact of soils with plants and soil invertebrates is an operable exposure pathway. Exposure to soils deeper than 1.5 m possible, but less likely.	
Yes No Do Not Know				
Score	1	Vegetation on site are native tundra/arctic species		
iii) Ingestion (i.e., wildlife or domestic animals ingesting contaminated food items, soils or water)				
Are terrestrial animals likely to be ingesting contaminated water at the site?			Refer to an Ecological Risk Assessment for the site. If there is contaminated surface water at the site, assume that terrestrial organisms will ingest it.	
Yes No Do Not Know	Yes			
Score	1			
Are terrestrial animals likely to be ingesting contaminated soils at the site?			Refer to an Ecological Risk Assessment report. Most animals will co-ingest some soil while eating plant matter or soil invertebrates.	
Yes No Do Not Know	Yes			
Score	1			
Can the contamination identified bioaccumulate?			Bioaccumulation of contaminants within food items is considered possible if: 1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics work sheet) and concentrations in soils exceed the most conservative CCME soil quality guideline for the intended land use, or 2) The contaminant in collected tissue samples exceeds the Canadian Tissue Residue Guidelines.	
Yes No Do Not Know	Yes			
Score	1			
Distance to sensitive terrestrial ecological area			It is considered that within 300 m of a site, there is a concern for contamination. Therefore an environmental receptor located within this area of the site will be subject to further evaluations. It is also considered that any environmental receptor located greater than 5 km will not be a concern for evaluation. Review Conservation Authority mapping and literature including Canadian Council on Ecological Areas link:www.ccea.org.	Environmental receptors include: local, regional or provincial species of interest or significance; arctic environments (on a site specific basis); nature preserves, habitats for species at risk, sensitive forests, natural parks or forests.
0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know	Do Not Know			
Score	1.5			
Raw Terrestrial Total Potential	6.5	Note if a "Known" Ecological Effects score is provided, the "Potential" score is disallowed.		
Allowed Terrestrial Total Potential	6.5			
B. Potential for ecological exposure (for the contaminated portion of the site)				
b) Aquatic			"Sensitive aquatic environments" include those in or adjacent to shellfish or fish harvesting areas, marine parks, ecological reserves and fish migration paths. Also includes those areas deemed to have ecological significance such as for fish food resources, spawning areas or having rare or endangered species.	
i) Classification of aquatic environment				
Sensitive Typical Not Applicable (no aquatic environment present) Do Not Know	Typical		"Typical aquatic environments" include those in areas other than those listed above.	
Score	1			
ii) Uptake potential				
Does groundwater daylighting to an aquatic environment exceed the CCME water quality guidelines for the protection of aquatic life at the point of contact?			Groundwater concentrations of contaminants at the point of contact with an aquatic receiving environment can be estimated in three ways: 1) by comparing collected nearshore groundwater concentrations to the CCME water quality guidelines (this will be a conservative comparison, as contaminant concentrations in groundwater often decrease between nearshore wells and the point of discharge). 2) by conducting groundwater modeling to estimate the concentration of groundwater immediately before discharge. 3) by installing water samplers, "peepers", in the sediments in the area of daylighting groundwater.	
Yes No (or Not Applicable) Do Not Know	Do Not Know			
Score	0.5			
Distance from the contaminated site to an important surface water resource				Environmental receptors include: local, regional or provincial species of interest or significance, sensitive wetlands and fens and other aquatic environments
0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know		Cambridge Bay 100m south of the site	It is considered that within 300 m of a site, there is a concern for contamination. Therefore an environmental receptor or important water resource located within this area of the site will be subject to further evaluation. It is also considered that any environmental receptor located greater than 5 km away will not be a concern for evaluation. Review Conservation Authority mapping and literature including Canadian Council on Ecological Areas link:www.ccea.org.	
	0 to 300 m			
Score	3			
			Bioaccumulation of food items is possible if:	

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

Test Site

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
Are aquatic species (i.e., forage fish, invertebrates or plants) that are consumed by predatory fish or wildlife consumers, such as mammals and birds, likely to accumulate contaminants in their tissues?			1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics work sheet) and concentrations in sediments exceed the CCME ISQGs. 2) The contaminant in collected tissue samples exceeds the CCME tissue quality guidelines.	
Yes				
No				
Do Not Know	No			
Score	0	No aquatic species on site		
Raw Aquatic Total Potential	4.5	Note if a "Known" Ecological Effects score is provided, the "Potential" score is disallowed.		
Allowed Aquatic Total Potential	4.5			
4. Ecological Exposure Modifying Factors				
a) Known occurrence of a species at risk.			Consult any ecological risk assessment reports. If information is not present, utilize on-line databas such as Eco Explorer. Regional, Provincial (Environment Ministries), or Federal staff (Fisheries and Oceans or Environment Canada) should be able to provide some guidance.	Species at risk include those that are extirpated, endangered, threatened, or of special concern. For a list of species at risk, consult Schedule 1 of the federal Species at Risk Act (http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1). Many provincial governments may also provide regionally applicable lists of species at risk. For example, in British Columbia, consult: BCMWLAP. 2005. Endangered Species and Ecosystems in British Columbia. Provincial red and blue lists. Ministry of Sustainable Resource Management and Water, Land and Air Protectionhttp://srmwww.gov.bc.ca/atrisk/red-blue.htm
Is there a potential for a species at risk to be present at the site?		http://www.sis.ec.gc.ca/ec_species/ec_species_e.phtml		
Yes				
No				
Do Not Know	No			
	0			
Score	---			
b) Potential impact of aesthetics (e.g., enrichment of a lake or tainting of food flavor).				
Is there evidence of aesthetic impact to receiving water bodies?	No		Documentation may consist of environmental investigation reports, press articles, petitions or other records.	This Item will require some level of documentation by user, including contact names, addresses, phone numbers, e-m addresses. Evidence of changes must be documented, please attach copy of report containing relevant information.
Yes				
No	0			
Do Not Know	---			
Is there evidence of olfactory impact (i.e., unpleasant smell)?	No		Examples of olfactory change can include the smell of a COPC or an increase in the rate of decay in an aquatic habitat.	
Yes				
No	0			
Do Not Know	---			
Is there evidence of increase in plant growth in the lake or water body?	No		A distinct increase of plant growth in an aquatic environment may suggest enrichment. Nutrients e.g., nitrogen or phosphorous releases to an aquatic body can act as a fertilizer.	
Yes				
No	0			
Do Not Know	---			
Is there evidence that fish or meat taken from or adjacent to the site smells or tastes different?	No		Some contaminants can result in a distinctive change in the way food gathered from the site tastes smells.	
Yes	0			
No	---			
Do Not Know				
Ecological Modifying Factors Total - Known	**0**			
Ecological Modifying Factors Total - Potentia	**---**			
Raw Ecological Total - Known	0			
Raw Ecological Total - Potential	11			
Raw Ecological Total	11			
Ecological Total (Max 18	**11.0**			
5. Other Potential Contaminant Receptors				
a) Exposure of permafrost (leading to erosion and structural concerns)				Plants and lichens provide a natural insulating layer which will help prevent thawing of the permafrost during the summer. Plants and lichens may also absorb less solar radiation. Solar radiation is turned into heat which can also cause underlying permafrost to melt.
Are there improvements (roads, buildings) at the site dependant upon the permafrost for structural integrity?	No		Consult engineering reports, site plans or air photos of the site. When permafrost melts, the stability of the soil decreases, leading to erosion. Human structures, such as roads and/or buildings are often dependent on the stability that the permafrost provides.	
Yes				
No	0			
Do Not Know	---			
Is there a physical pathway which can transport soils released by damaged permafrost to a nearby aquatic environment?	No		Melting permafrost leads to a decreased stability of underlying soils. Wind or surface run-off erosion can carry soils into nearby aquatic habitats. The increased soil loadings into a river can cause an increase in total dissolved solids and a resulting decrease in aquatic habitat quality. In addition, the erosion can bring contaminants from soils to aquatic environments.	
Yes				
No	0			
Do Not Know	---			
Other Potential Receptors Total - Known	**0**			
Other Potential Receptors Total - Potential	**0**			

Exposure Total	
Raw Human Health + Ecological Total - Known	6
Raw Human Health + Ecological Total - Potential	21
Raw Total	27
Exposure Total (max 34)	**20.0**

Only includes "Allowed potential" - if a "Known" score was supplied under a given category then the "Potential" score was not included.

CCME National Classification System (2008)
Score Summary

Scores from individual worksheets are tallied in this worksheet.
Refer to this sheet after filling out the revised NCS completely.

I. Contaminant Characteristics	Known	Potential
1. Residency Media	4	---
2. Chemical Hazard	8	---
3. Contaminant Exceedance Factor	4	---
4. Contaminant Quantity	9	---
5. Modifying Factors	4	---
Raw Total Score	29	0
Raw Total Score (Known + Potential)	29	
Adjusted Total Score (Raw Total / 40 *33)	**23.9**	(max 33)

II. Migration Potential	Known	Potential
1. Groundwater Movement	12	---
2. Surface Water Movement	---	7.9
3. Soil	12	---
4. Vapour	---	8
5. Sediment Movement	---	6
6. Modifying Factors	0	0
Raw Total Score	24	21.9
Raw Total Score (Known + Potential)	45.9	
Adjusted Total Score (Raw Total / 64 * 33)	**23.7**	(max 33)

III. Exposure	Known	Potential
1. Human Receptors		
A. Known Impact	---	
B Potential		
a. Land Use		1
b. Accessibility		2
c. Exposure Route		
i. Direct Contact		3
ii. Inhalation		1
iii. Ingestion		3
2. Human Receptors Modifying Factors	6	---
Raw Total Human Score	6	10
Raw Total Human Score (Known + Potential)	16	
Adjusted Total Human Score	16.0	(maximum 22)
3. Ecological Receptors		
A. Known Impact	---	
B. Potential		
a. Terrestrial		6.5
b. Aquatic		4.5
4. Ecological Receptors Modifying Factors	0	---
Raw Total Ecological Score	0	11
Raw Total Ecological Score (Known + Potential)	11	
Adjusted Total Ecological Score	11.0	(maximum 18)
5. Other Receptors	0	0
Total Other Receptors Score (Known + Potential)	0	
Total Exposure Score (Human + Ecological + Other)	**27.0**	
Adjusted Total Exposure Score (Total Exposure / 46 * 34)	**20.0**	(max 34)

Site Score

Test Site

Site Letter Grade	**C**
Certainty Percentage	**69%**
% Responses that are "Do Not Know"	**10%**
Total NCSCS Score for site	**67.5**
Site Classification Category	**2**

Site Classification Categories*:

Class 1 - High Priority for Action (Total NCS Score >70)
Class 2 - Medium Priority for Action (Total NCS Score 50 - 69.9)
Class 3 - Low Priority for Action (Total NCS Score 37 - 49.9)
Class N - Not a Priority for Action (Total NCS Score <37)
Class INS - Insufficient Information (>15% of responses are "Do Not Know")

* NOTE: The term "action" in the above categories does not necessarily refer to remediation, but could also include risk assessment, risk management or further site characterization and data collection.

CCME National Classification System (2008)

Contaminant Hazard Ranking

(Based on the Proposed Hazard Ranking developed for the FCSAP Contaminated Sites Classification System)

This information is used in Sheet I (Contaminant Characteristics), section 2 (Chemical Hazard).

Chemical/Parameter	Hazard	CEPA	Carcinogenicity	Notes
Acetaldehyde	H	*	PHC	
Acetone	L			
Acrolein	H	*		
Acrylonitrile	H	*	PHC	
Alachlor	M			
Aldicarb	H			
Aldrin	H			
Allyl Alcohol	H			
Aluminum	L			
Ammonia	L	*		
Antimony	H			
Arsenic	H	*		
Atrazine	M			
Azinphos-Methyl	H			
Barium	L			
Bendiocarb	H			
Benzene	H	*	CHC	BTEX
Benzidine	H	*	CHC	
Beryllium	H		CHC	
Biphenyl, 1,1-	M			
2,3,4,5-Bis(2-Butylene)tetrahydro-2-furfural	H			
Bis(Chloromethyl)Ether	H	*	CHC	
Bis(2-Chloroethyl)Ether	H		CHC	
Bis(2-Chloroisopropyl)Ether	H			
Bis(2-Ethylhexyl)Phthalate	H	*		PH
Boron	L			
Bromacil	M			
Bromate	M			
Bromochlorodifluoromethane	M	*		HM
Bromochloromethane	H	*		HM
Bromodichloromethane	H			HM
Bromoform (Tribromomethane)	H		PHC	HM
Bromomethane	M			HM
Bromotrifluoromethane	M	*		HM
Bromoxynil	H			
Butadiene, 1,3-	H	*	CHC	
Cadmium	H	*	CHC	
Carbofuran	M			
Carbon Tetrachloride (Tetrachloromethane)	H		PHC	HM
Captafol	M			
Chloramines	M	*		
Chloride	L			

Chemical/Parameter	Hazard	CEPA	Carcinogenicity	Notes
Chloroaniline, P-	H			
Chlorobenzene (mono)	M			
Chlorobenzilate	M			
Chlorodimeform	M			
Chloroform	H		PHC	HM
Chloromethane	M			
Chloromethyl Methyl Ether	M	*		
(4-Chlorophenyl)Cyclopropylmethanone, O-((4-Nitrophenyl)Methyl)Oxime	H			
Chlorinated Benzenes				
Monochlorobenzene	M			
Dichlorobenzene, 1,2- (O-DCB)	M			
Dichlorobenzene, 1,3- (M-DCB)	M			
Dichlorobenzene, 1,4- (P-DCB)	H			
Trichlorobenzene, 1,2,3-	M			
Trichlorobenzene, 1,2,4-	M			
Trichlorobenzene, 1,3,5-	M			
Tetrachlorobenzene, 1,2,3,4-	M			
Tetrachlorobenzene, 1,2,3,5-	M			
Tetrachlorobenzene, 1,2,4,5-	M			
Pentachlorobenzene	M			
Hexachlorobenzene	H			
Chlorinated Ethanes				
Dichloroethane, 1,1-	M			
Dichloroethane, 1,2- (Ethylene Dichloride (EDC))	H		PHC	
Trichloroethane, 1,1,1-	H	*		
Trichloroethane, 1,1,2-	M			
Tetrachloroethane, 1,1,1,2-	M			
Tetrachloroethane, 1,1,2,2-	M			
Chlorinated Ethenes				
Monochloroethene (Vinyl Chloride)	H	*	CHC	
Dichloroeth(yl)ene, 1,1-	H			
Dichloroeth(yl)ene, 1,2- (cis or trans)	M			
Trichloroeth(yl)ene (TCE)	H	*		
Tetrachloroeth(yl)ene (PCE)	H	*		
Chlorinated Phenols		*		
Monochlorophenols	M			
Chlorophenol, 2-	M			
Dichlorophenols				
Dichlorophenol, 2,4-	M			
Trichlorophenols				
Trichlorophenol, 2,4,5-	H			
Trichlorophenol, 2,4,6-	H		PHC	
Tetrachlorophenols				
Tetrachlorophenol, 2,3,4,6-	H			
Pentachlorophenol (PCP)	H			
Chloromethane	M			HM
Chlorophenol, 2-	M			CP
Chlorothalonil	H			

Chemical/Parameter	Hazard	CEPA	Carcinogenicity	Notes
Chlorpyrifos	H			
Chromium (Total)	M	*		
Chromium (III)	L	*		
Chromium (VI)	H	*	CHC	
Coal Tar	H		CHC	Refer to PAHs
Cobalt	L			
Copper	L			
Creosote	M	*		Refer to PAHs
Crocidolite	L			
Cyanide (Free)	H			
Cyanazine	M			
Dibenzofuran	H	*		DF
Dibromoethane, 1,2- (Ethylene Dibromide (EDB))	H		PHC	
1,2-Dibromo-3-Chloropropane	H		PHC	
Dibromochloromethane	M	*		HM
Dibromotetrafluoroethane	M			
Dichlorobenzene, 1,2- (O-DCB)	M			CB
Dichlorobenzene, 1,3- (M-DCB)	M			CB
Dichlorobenzene, 1,4- (P-DCB)	H			CB
Dichlorobenzidine, 3,3'-	H		PHC	
DDD	H			
DDE	H			
DDT	H		PHC	
Deltamethrin	M			
Diazinon	M			
Dicamba	H			
Dichloroethane, 1,1-	H			CEA
Dichloroethane, 1,2- (EDC)	H		PHC	CEA
Dichloroeth(yl)ene, 1,1-	H			CEE
Dichloroeth(yl)ene, Cis-1,2-	M			CEE
Dichloroeth(yl)ene, Trans-1,2-	M			CEE
Dichloromethane (Methylene Chloride)	H		PHC	HM
Dichlorophenol, 2,4-	M			CP
Dichloropropane, 1,2-	H			
Dichloropropene, 1,3-	H		PHC	
Diclofop-Methyl	H			
Didecyl Dimethyl Ammonium Chloride	H			
Dieldrin	H			
Dimethoate	H			
Diethyl Phthalate	M			PH
Diethylene Glycol	L			GL
Dimethyl Phthalate	M			PH
Dimethylphenol, 2,4-	L			
Dinitrophenol, 2,4-	M			
Dinitrotoluene, 2,4-	H			
Dinoseb	H			
Di-n-octyl Phthalate	H			
Dioxane, 1,4-	H		PHC	
Dioxins/Furans	H			
Diquat	M			

Chemical/Parameter	Hazard	CEPA	Carcinogenicity	Notes
Diuron	M			
Endosulfan	H			
Endrin	H			
Ethylbenzene	M			BTEX
Ethylene Dibromide (EDB)	H		PHC	
Ethylene Glycol	L			GL
Ethylene Oxide	H		CHC	
Fluoroacetamide	M			
Fluorides	L	*		
Glycols				
Ethylene Glycol	L			
Diethylene Glycol	L			
Propylene Glycol	L			
Glyphosate	M			
Halogenated Methanes				
Bromochlorodifluoromethane	M	*		
Bromochloromethane	M	*		
Bromodichloromethane	H		PHC	
Bromomethane	M			
Bromotrifluoromethane	M	*		
Chloroform	M		PHC	HM
Chloromethane	M			
Dibromochloromethane	M			
Dichloromethane (Methylene Chloride)	H		PHC	
Methyl Bromide	M	*		
Tetrachloromethane (Carbon Tetrachloride)	H			
Tribromomethane (Bromoform)	H			
Trihalomethanes (THM)	M			
Heptachlor	H			
Heptachlor Epoxide	H			
Hexachlorobenzene	H		PHC	
Hexachlorobutadiene	H			
Hexachlorocyclohexane, Gamma	H		PHC	
Hexachloroethane	H		PHC	
Hydrobromofluorocarbons (HBFCS)	M	*		
Hydrochlorofluorocarbons (HCFCS)	M	*		
3-Iodo-2-propynyl Butyl Carbamate	H			
Iron	L			
Lead	H	*		neurotoxins / teratogens
Lead Arsenate	H			
Leptophos	H			
Lindane	H			
Linuron	H			
Lithium	L			
Malathion	M			
Manganese	L			

Chemical/Parameter	Hazard	CEPA	Carcinogenicity	Notes
Mercury	H	*		
Methamidophos	H			
Methoxylchlor	H			
Methyl Bromide (Bromomethane)	M	*		
2-Methyl-4-chloro-phenoxy Acetic Acid	M			
Methyl Ethyl Ketone	L			
Methyl Isobutyl Ketone	L			
Methyl Mercury	H			
Methyl-Parathion	H			
Methyl Tert Butyl Ether (MTBE)	M			
Metolachlor	M			
Metribuzin	H			
Molybdenum	L			
Monochloramine	M			
Monocrotophos	H			
Nickel	H	*		CEPA - inhalation
Nitrilotriacetic Acid	H		PHC	
Nitrate	L			
Nitrite	M			
Nonylphenol + Ethoxylates	H	*		
Organotins				
Tributyltin	H			
Tricyclohexyltin	H			
Triphenyltin	H			
Parathion	H			
Paraquat (as Dichloride)	H			
Pentachlorobenzene	M			CB
Pentachlorophenol (PCP)	H			CP
Petroleum Hydrocarbons				Ranking based upon fraction of toxic and mobile components in product. Lighter compounds such as benzene are more toxic and mobile.
Petroleum Hydrocarbons (Gasoline)	H			
Petroleum Hydrocarbons (Kerosene incl. Jet Fuels)	H			
Petroleum Hydrocarbons (Diesel incl Heating Oil)	M			
Petroleum Hydrocarbons (Heavy Oils)	L			
Petroleum Hydrocarbons (CCME F1)	H			
Petroleum Hydrocarbons (CCME F2)	M			
Petroleum Hydrocarbons (CCME F3)	L			
Petroleum Hydrocarbons (CCME F4)	L			
Phenol	L			
Phenoxy Herbicides	M			
Phorate	H			
Phosphamidon	H			
Phthalate Esters				
Bis(2-Ethylhexyl)Phthalate	H	*		
Diethyl Phthalate	H			
Dimethyl Phthalate	H			
Di-n-octyl Phthalate	H			
Polybrominated Biphenyls (PBB)	H	*		
Polychlorinated Biphenyls (PCB)	H			

Chemical/Parameter	Hazard	CEPA	Carcinogenicity	Notes
Polychlorinated Terphenyls	H	*		
Polycyclic Aromatic Hydrocarbons	H	*	PHC	
Acenaphthene	M			
Acenaphthylene	M			
Acridine	H			
Anthracene	M			
Benzo(a)anthracene	H		PHC	
Benzo(a)pyrene	H		PHC	
Benzo(b)fluoranthene	H		PHC	
Benzo(g,h,i)perylene	H			
Benzo(k)fluoranthene	H		PHC	
Chrysene	M			
Dibenzo(a,h)anthracene	H		PHC	
Fluoranthene	M			
Fluorene	M			
Indeno(1,2,3-c,d)pyrene	H		PHC	
Methylnaphthalenes	M			
Naphthalene	M			
Phenanthrene	M			
Pyrene	M			
Quinoline	H			
Propylene Glycol	L			GL
Radium	H			
Radon	H			
Selenium	M			
Silver	L			
Simazine	M			
Sodium	L			
Strontium-90	H			
Strychnine	H			
Styrene	H			
Sulphate	L			
Sulphide	L			
2,3,7,8-Tetrachlorodibenzo-p-dioxins (TCDD)	H	*		DF
Tebuthiuron	H			
Tetrachloroeth(yl)ene (PCE)	H	*		CEE
Tetraethyl Lead	H			
Tetrachlorobenzene, 1,2,3,4-	H			CB
Tetrachlorobenzene, 1,2,3,5-	H			CB
Tetrachlorobenzene, 1,2,4,5-	H			CB
Tetrachloroethane, 1,1,1,2-	M			CEA
Tetrachloroethane, 1,1,2,2-	M			CEA
Tetrachlorophenol, 2,3,4,6-	H			CP
Tetramethyl Lead	H	*		
Thallium	M			
Thiophene	M			
Tin	L			
Toluene	M			BTEX
Toxaphene	H			

Chemical/Parameter	Hazard	CEPA	Carcinogenicity	Notes
Triallate	M			
Tribromomethane (Bromoform)	H			HM
Tributyltetradecylphosphonium Chloride	H	*		
Trichlorobenzene, 1,2,3-	H			CB
Trichlorobenzene, 1,2,4-	H			CB
Trichlorobenzene, 1,3,5-	H			CB
Trichloroethane, 1,1,1-	H	*		CEA
Trichloroethane, 1,1,2-	M			CEA
Trichloroeth(yl)ene (TCE)	H	*		CEE
Tricyclohexyltin Hydroxide	H			
Trichlorophenol, 2,4,5-	H			CP
Trichlorophenol, 2,4,6-	H		PHC	CP
Trifluralin	H			
Trihalomethanes (THM)	M			
Tris(2,3-Dibromopropyl)phosphate	H			
Tritium	L			
Uranium (Non-radioactive) / (Radioactive)	M/H			
Vanadium	M			
Vinyl Chloride	H	*	CHC	CEE
Xylenes	M			BTEX
Zinc	L			

H = High Hazard
M = Medium Hazard
L = Low Hazard
Hazard ratings based on a number of factors including potential human and ecological health effects.

PHC = Potential Human Carcinogen
CHC = Confirmed Human Carcinogen

BTEX = benzene, toluene, ethylbenzene, and xylenes
CB = chlorobenzenes
CEA = chlorinated ethanes
CEE = chlorinated ethenes
CP = chlorophenols
DF = dioxins and furans
GL = glycols
HM = halomethanes
PAH = polycyclic aromatic hydrocarbons
PH = phthalate esters

CCME National Classification System (2008)

Reference Material (Information to assist in scoring)

Examples of Persistent Substances

This information is used in Sheet I (Chemical Characteristics), section 5 (Modifying Factors).

aldrin	dieldrin	PCBs
benzo(a)pyrene	hexachlorobenzene	PCDDs/PCDFs (dioxins and furans)
chlordane	methylmercury	toxaphene
DDT	mirex	alkylated lead
DDE	octachlorostyrene	

Examples of Substances in the Various Chemical Classes

This information is used in Sheet I (Chemical Characteristics), section 5 (Modifying Factors).

Chemical Class	Examples *
inorganic substances (including metals)	arsenic, barium, cadmium, hexavalent chromium, copper, cyanide, fluoride, lead, mercury, nickel, selenium, sulphur, zinc; brines or salts
volatile petroleum hydrocarbons	benzene, toluene, ethylbenzene, xylenes, PHC F1
light extractable petroleum hydrocarbons	PHC F2
heavy extractable petroleum hydrocarbons	PHC F3
PAHs	Benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h0anthracene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene
phenolic substances	phenol, pentachlorophenol, chlorophenols, nonchlorinated phenols (e.g., 2,4-dinitrophenol, cresol, etc.)
chlorinated hydrocarbons	PCBs, tetrachloroethylene, trichloroethylene, dioxins and furans, trichlorobenzene, tetrachlorobenzene, pentachlorobenzene, hexachlorobenzene
halogenated methanes	carbon tetrachloride, chloroform, dichloromethane
phthalate esters	di-isononyl phthalate (DINP), di-isodecyl phthalate (DIDP), di-2-ethylhexyl phthalate (DEHP)
pesticides	DDT, hexachlorocyclohexane

* Note: Specific chemicals that belong to the various classes are not limited to those listed in this table. These lists are not exhaustive and are meant just to provide examples of substances that are typically encountered.

Chemical-specific Properties
(Adapted from USEPA Soil Screening Criteria)

The information on Koc is used in Sheet II (Migration Potential), section 1,B,a (Relative Mobility).
The information on the dimensionless Henry's law constant is used in Sheet II (Migration Potential), section 4,B,a (Relative Volatility).
The information on log Kow is used in Sheet III (Exposure), section 3,B,a,iii (Potential for Ecological Exposure - terrestrial ingestion), and section 3,B,b,ii (Potential for Ecological Exposure - aquatic uptake potential).

CAS No.	Compound	Solubility in Water @ 20-25°C (mg/L)	Henry's Law Constant (atm-m3/mol)	Dimensionless Henry's law constant (HLC [atm-m3/mol] * 41) (25 °C).	log Kow	Log Koc (L/kg)
83-32-9	Acenaphthene	4.24E+00	1.55E-04	6.36E-03	3.92	3.85
67-64-1	Acetone	1.00E+06	3.88E-05	1.59E-03	-0.24	-0.24
309-00-2	Aldrin	1.80E-01	1.70E-04	6.97E-03	6.5	6.39
120-12-7	Anthracene	4.34E-02	6.50E-05	2.67E-03	4.55	4.47
56-55-3	Benz(a)anthracene	9.40E-03	3.35E-06	1.37E-04	5.7	5.6
71-43-2	Benzene	1.75E+03	5.55E-03	2.28E-01	2.13	1.77
205-99-2	Benzo(b)fluoranthene	1.50E-03	1.11E-04	4.55E-03	6.2	6.09
207-08-9	Benzo(k)fluoranthene	8.00E-04	8.29E-07	3.40E-05	6.2	6.09
65-85-0	Benzoic acid	3.50E+03	1.54E-06	6.31E-05	1.86	—
50-32-8	Benzo(a)pyrene	1.62E-03	1.13E-06	4.63E-05	6.11	6.01
111-44-4	Bis(2-chloroethyl)ether	1.72E+04	1.80E-05	7.38E-04	1.21	1.19
117-81-7	Bis(2-ethylhexyl)phthalate	3.40E-01	1.02E-07	4.18E-06	7.3	7.18
75-27-4	Bromodichloromethane	6.74E+03	1.60E-03	6.56E-02	2.1	1.74
75-25-2	Bromoform	3.10E+03	5.35E-04	2.19E-02	2.35	1.94
71-36-3	Butanol	7.40E+04	8.81E-06	3.61E-04	0.85	0.84
85-68-7	Butyl benzyl phthalate	2.69E+00	1.26E-06	5.17E-05	4.84	4.76
86-74-8	Carbazole	7.48E+00	1.53E-08	6.26E-07	3.59	3.53
75-15-0	Carbon disulfide	1.19E+03	3.03E-02	1.24E+00	2	1.66
56-23-5	Carbon tetrachloride	7.93E+02	3.04E-02	1.25E+00	2.73	2.24
57-74-9	Chlordane	5.60E-02	4.86E-05	1.99E-03	6.32	5.08
106-47-8	*p-Chloroaniline*	5.30E+03	3.31E-07	1.36E-05	1.85	1.82
108-90-7	Chlorobenzene	4.72E+02	3.70E-03	1.52E-01	2.86	2.34
124-48-1	Chlorodibromomethane	2.60E+03	7.83E-04	3.21E-02	2.17	1.8
67-66-3	Chloroform	7.92E+03	3.67E-03	1.50E-01	1.92	1.6
95-57-8	2-Chlorophenol	2.20E+04	3.91E-04	1.60E-02	2.15	—
218-01-9	Chrysene	1.60E-03	9.46E-05	3.88E-03	5.7	5.6
72-54-8	DDD	9.00E-02	4.00E-06	1.64E-04	6.1	6
72-55-9	DDE	1.20E-01	2.10E-05	8.61E-04	6.76	6.65
50-29-3	DDT	2.50E-02	8.10E-06	3.32E-04	6.53	6.42
53-70-3	Dibenz(a,h)anthracene	2.49E-03	1.47E-08	6.03E-07	6.69	6.58
84-74-2	Di-n-butyl phthalate	1.12E+01	9.38E-10	3.85E-08	4.61	4.53
95-50-1	1,2-Dichlorobenzene	1.56E+02	1.90E-03	7.79E-02	3.43	2.79

CAS No.	Compound	Solubility in Water @ 20-25°C (mg/L)	Henry's Law Constant (atm-m3/mol)	Dimensionless Henry's law constant (HLC [atm-m3/mol] * 41) (25 °C).	log Kow	Log Koc (L/kg)
106-46-7	1,4-Dichlorobenzene	7.38E+01	2.43E-03	9.96E-02	3.42	2.79
91-94-1	3,3-Dichlorobenzidine	3.11E+00	4.00E-09	1.64E-07	3.51	2.86
75-34-3	1,1-Dichloroethane	5.06E+03	5.62E-03	2.30E-01	1.79	1.5
107-06-2	1,2-Dichloroethane	8.52E+03	9.79E-04	4.01E-02	1.47	1.24
75-35-4	1,1-Dichloroethylene	2.25E+03	2.61E-02	1.07E+00	2.13	1.77
156-59-2	cis-1,2-Dichloroethylene	3.50E+03	4.08E-03	1.67E-01	1.86	1.55
156-60-5	trans-1,2-Dichloroethylene	6.30E+03	9.38E-03	3.85E-01	2.07	1.72
120-83-2	2,4-Dichlorophenol	4.50E+03	3.16E-06	1.30E-04	3.08	—
78-87-5	1,2-Dichloropropane	2.80E+03	2.80E-03	1.15E-01	1.97	1.64
542-75-6	1,3-Dichloropropene	2.80E+03	1.77E-02	7.26E-01	2	1.66
60-57-1	Dieldrin	1.95E-01	1.51E-05	6.19E-04	5.37	4.33
84-66-2	Diethylphthalate	1.08E+03	4.50E-07	1.85E-05	2.5	2.46
105-67-9	2,4-Dimethylphenol	7.87E+03	2.00E-06	8.20E-05	2.36	2.32
51-28-5	2,4-Dinitrophenol	2.79E+03	4.43E-07	1.82E-05	1.55	—
121-14-2	2,4-Dinitrotoluene	2.70E+02	9.26E-08	3.80E-06	2.01	1.98
606-20-2	2,6-Dinitrotoluene	1.82E+02	7.47E-07	3.06E-05	1.87	1.84
117-84-0	Di-n-octyl phthalate	2.00E-02	6.68E-05	2.74E-03	8.06	7.92
115-29-7	Endosulfan	5.10E-01	1.12E-05	4.59E-04	4.1	3.33
72-20-8	Endrin	2.50E-01	7.52E-06	3.08E-04	5.06	4.09
100-41-4	Ethylbenzene	1.69E+02	7.88E-03	3.23E-01	3.14	2.56
206-44-0	Fluoranthene	2.06E-01	1.61E-05	6.60E-04	5.12	5.03
86-73-7	Fluorene	1.98E+00	6.36E-05	2.61E-03	4.21	4.14
76-44-8	Heptachlor	1.80E-01	1.09E-03	4.47E-02	6.26	6.15
1024-57-3	Heptachlor epoxide	2.00E-01	9.50E-06	3.90E-04	5	4.92
118-74-1	Hexachlorobenzene	6.20E+00	1.32E-03	5.41E-02	5.89	4.74
87-68-3	Hexachloro-1,3-butadiene	3.23E+00	8.15E-03	3.34E-01	4.81	4.73
319-84-6	a-HCH (a-BHC)	2.00E+00	1.06E-05	4.35E-04	3.8	3.09
319-85-7	b-HCH (b-BHC)	2.40E-01	7.43E-07	3.05E-05	3.81	3.1
58-89-9	g -HCH (Lindane)	6.80E+00	1.40E-05	5.74E-04	3.73	3.03
77-47-4	Hexachlorocyclopentadiene	1.80E+00	2.70E-02	1.11E+00	5.39	5.3
67-72-1	Hexachloroethane	5.00E+01	3.89E-03	1.59E-01	4	3.25
193-39-5	Indeno(1,2,3-cd)pyrene	2.20E-05	1.60E-06	6.56E-05	6.65	6.54
78-59-1	Isophorone	1.20E+04	6.64E-06	2.72E-04	1.7	1.67
7439-97-6	Mercury	—	1.14E-02	4.67E-01	—	—
72-43-5	Methoxychlor	4.50E-02	1.58E-05	6.48E-04	5.08	4.99
74-83-9	Methyl bromide	1.52E+04	6.24E-03	2.56E-01	1.19	1.02
75-09-2	Methylene chloride	1.30E+04	2.19E-03	8.98E-02	1.25	1.07
95-48-7	2-Methylphenol	2.60E+04	1.20E-06	4.92E-05	1.99	1.96
91-20-3	Naphthalene	3.10E+01	4.83E-04	1.98E-02	3.36	3.3
98-95-3	Nitrobenzene	2.09E+03	2.40E-05	9.84E-04	1.84	1.81

CAS No.	Compound	Solubility in Water @ 20-25°C (mg/L)	Henry's Law Constant (atm-m3/mol)	Dimensionless Henry's law constant (HLC [atm-m3/mol] * 41) (25 °C).	log Kow	Log Koc (L/kg)
86-30-6	N-Nitrosodiphenylamine	3.51E+01	5.00E-06	2.05E-04	3.16	3.11
621-64-7	N-Nitrosodi-n-propylamine	9.89E+03	2.25E-06	9.23E-05	1.4	1.38
1336-36-3	PCBs	—	—	—	5.58	5.49
87-86-5	Pentachlorophenol	1.95E+03	2.44E-08	1.00E-06	5.09	—
108-95-2	Phenol	8.28E+04	3.97E-07	1.63E-05	1.48	1.46
129-00-0	Pyrene	1.35E-01	1.10E-05	4.51E-04	5.11	5.02
100-42-5	Styrene	3.10E+02	2.75E-03	1.13E-01	2.94	2.89
79-34-5	1,1,2,2-Tetrachloroethane	2.97E+03	3.45E-04	1.41E-02	2.39	1.97
127-18-4	Tetrachloroethylene	2.00E+02	1.84E-02	7.54E-01	2.67	2.19
108-88-3	Toluene	5.26E+02	6.64E-03	2.72E-01	2.75	2.26
8001-35-2	Toxaphene	7.40E-01	6.00E-06	2.46E-04	5.5	5.41
120-82-1	1,2,4-Trichlorobenzene	3.00E+02	1.42E-03	5.82E-02	4.01	3.25
71-55-6	1,1,1-Trichloroethane	1.33E+03	1.72E-02	7.05E-01	2.48	2.04
79-00-5	1,1,2-Trichloroethane	4.42E+03	9.13E-04	3.74E-02	2.05	1.7
79-01-6	Trichloroethylene	1.10E+03	1.03E-02	4.22E-01	2.71	2.22
95-95-4	2,4,5-Trichlorophenol	1.20E+03	4.33E-06	1.78E-04	3.9	—
88-06-2	2,4,6-Trichlorophenol	8.00E+02	7.79E-06	3.19E-04	3.7	—
108-05-4	Vinyl acetate	2.00E+04	5.11E-04	2.10E-02	0.73	0.72
75-01-4	Vinyl chloride	2.76E+03	2.70E-02	1.11E+00	1.5	1.27
108-38-3	m-Xylene	1.61E+02	7.34E-03	3.01E-01	3.2	2.61
95-47-6	o-Xylene	1.78E+02	5.19E-03	2.13E-01	3.13	2.56
106-42-3	p-Xylene	1.85E+02	7.66E-03	3.14E-01	3.17	2.59

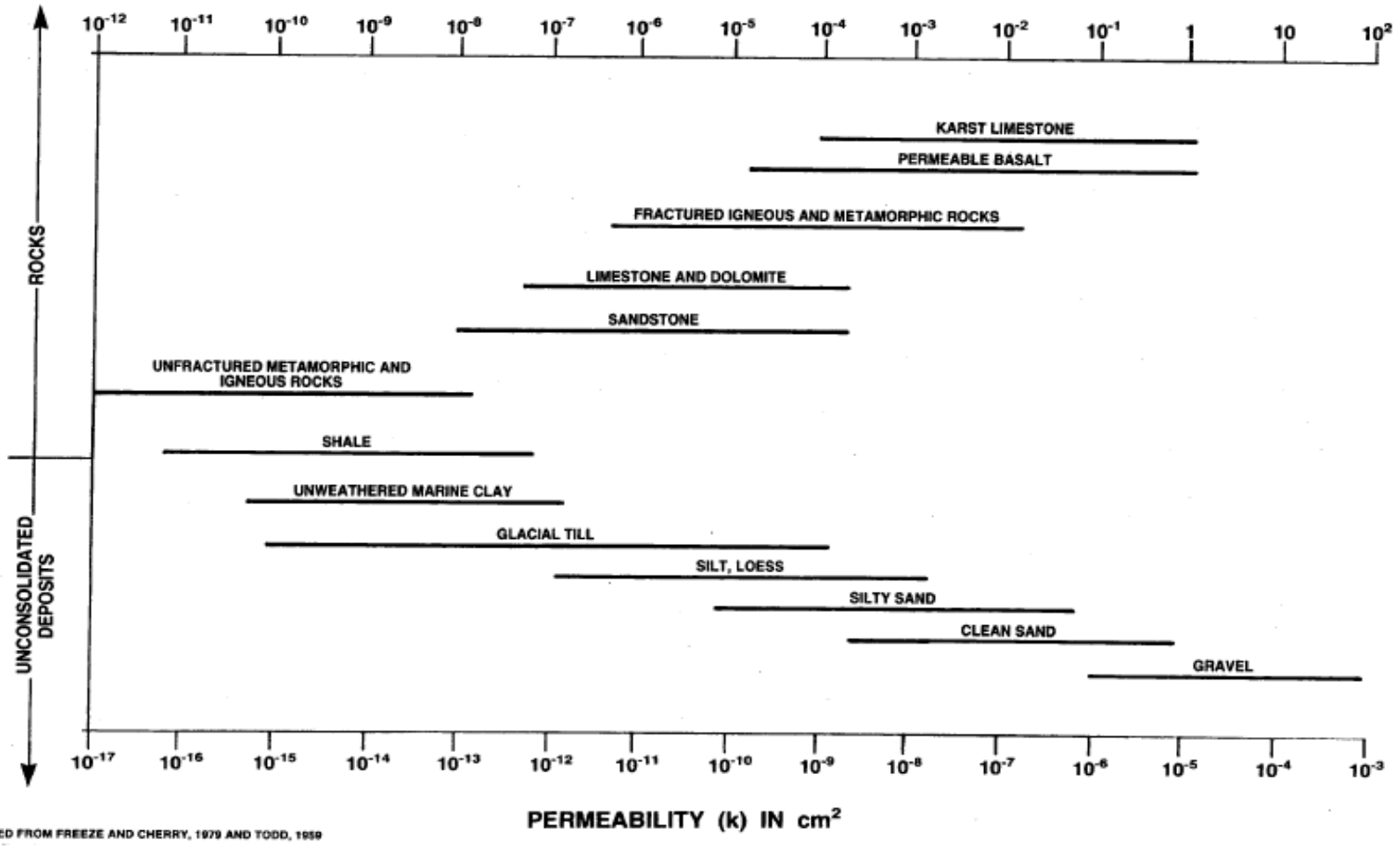
Source: United States Environmental Protection Agency. 1996. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128 (http://www.epa.gov/superfund/resources/soil/toc.htm#p5)

CAS = Chemical Abstracts Service

Kow = Octanol/water partition coefficient

RANGE OF VALUES OF HYDRAULIC CONDUCTIVITY AND PERMEABILITY

The information on Koc is used in Sheet II (Migration Potential), section 1,B,f (Hydraulic Conductivity)



MODIFIED FROM FREEZE AND CHERRY, 1979 AND TODD, 1959

Appendix G

Cost Estimates

Cambridge Bay Airport Firefighter Training Area – In-situ Cost Estimate

Cost Estimate – In-Situ	
Contractor	
- Labour	$38,840
- Material	$34,900
- Equipment	$119,350
Professional Fees	
- Site Visits	$50,600
- Reporting	$20,034
-Project Management	$5,804
Total	**$269,528**

Assumptions

Two years for treatment

Volume of material for treatment: 6624m^3

For treatment, trenches will be dug in approximately every 2 m

Bulldozer will push soil back into the trench with fertilizer

Each treatment event will take one week, four treatment events total, two per year

Fertilizer for treatment events will be shipped by barge to Cambridge Bay, approximate cost $20,000

Fertilizer for two treatment events can be stored in Cambridge Bay, one will need to be stored over the winter

Regrading will be completed by backhoe

Labour and equipment costs are based on AECOM experience in Nunavut

Installation of groundwater monitoring wells, two trips for groundwater monitoring during treatment

Airfares based on $2000/round trip

Hotels based on $225/nt/person

Meals & Incidentals based on Treas Board Travel Directive

Professional Fees include:

- Final delineation during first site visit
- Travel costs for four site visits, two for the first treatment events each year, two for groundwater monitoring
- Cost of equipment rentals, laboratory analysis and sample shipping

Cambridge Bay Airport Firefighter Training Area – Ex-situ Cost Estimate

Cost Estimate – Ex-Situ	
Contractor	
- Labour	$57,460
- Material	$420,440
- Equipment	$54,300
Professional Fees	
- Site Visits	$57,557
- Reporting	$19,080
-Project Management	$6,626
Total	**$615,463**

Assumptions

Two years for treatment
Volume of material for treatment: 6624m^3
Location of landfarm will be adjacent to contaminated area
Landfarm dimensions: 1 m deep, area 6624 m2, berms 1.5 m, 3:1 slope
Construction of landfarm: 1 week
Excavation of contaminated area to landfarm: 1 week
Contaminated area excavation will be filled with clean local granular material
Addition of fertilizer while filling the landfarm and once during the second year of operation
Fertilizer for treatment events will be shipped by barge to Cambridge Bay, approximate cost $20,000
Fertilizer for two treatment events can be stored in Cambridge Bay, one will need to be stored over the winter
The landfarm will be turned once each year for a total of two times, estimate two days for each turning
Once the soil is treated in the landfarm, it will be spread in the area of the landfarm
Spreading of treated soil and removal of liner/geotextile: 1 week
Regrading will be completed by backhoe
Labour and equipment costs are based on AECOM experience in Nunavut
Installation of groundwater monitoring wells, groundwater sampling prior and post remedial treatment
Airfares based on $2000/round trip
Hotels based on $225/nt/person
Meals & Incidentals based on Treas Board Travel Directive
Professional Fees include:
- Final delineation during first site visit
- Travel costs for two site visits, one for construction of landfarm and excavating contaminated soil, one for decommissioning landfarm and spreading of treated soil
- Cost of equipment rentals, laboratory analysis and sample shipping

Cambridge Bay Airport Firefighter Training Area – Risk Management Cost Estimate

Cost Estimate – Risk Management	
Contractor	
- Labour	$0
- Material	$0
- Equipment	$0
Professional Fees	
- Site Visits	$17,780
- Reporting	$7,240
-Project Management	$2,430
Total	**$27,450**

Total for Five Years of Monitoring **$137,251**

Assumptions

Labour and equipment costs are based on AECOM experience in Nunavut
Installation of 10 groundwater monitoring wells
Soil sampling based on 30 soil samples, test pits dug with back hoe
Airfares based on $2000/round trip
Hotels based on $225/nt/person
Meals & Incidentals based on Treas Board Travel Directive
Includes equipment rentals, laboratory analysis and sample shipping