Preliminary Quantitative Risk Assessment, Apron LTU, Cambridge Bay Airport, Victoria Island, Nunavut

Final

March 25, 2021

Prepared for:

Public Services and Procurement Canada
Environmental Services - Western Region
Suite 1650, 635 - 8th Ave SW
Calgary, Alberta T2P 3M3

Prepared by:

Stantec Consulting Ltd.

Project Number: 110220512

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Executive Summary

Stantec Consulting Ltd. (Stantec) was retained by Public Services and Procurement Canada (PSPC), on behalf of Transport Canada (TC), to conduct a preliminary quantitative risk assessment (PQRA) at the Apron Land Treatment Unit (LTU) located at the Cambridge Bay Airport (CBA) on Victoria Island, Nunavut. Although environmental assessment work related to the Apron LTU typically includes the Apron excavated area, for the purposes of this PQRA, the Apron excavated area is not included in the current scope of work. Stantec's scope of work was to assess potential risks to human and ecological receptors from exposure to petroleum hydrocarbons (PHC), benzene, toluene, ethylbenzene and xylenes (BTEX) and per- and polyfluoroalkyl substances (PFAS) previously identified in soil, groundwater, and sump water. The results of the PQRA are to be used to inform whether further remediation or risk management measures are required to mitigate risk to human health or the environment for the ongoing management and/or closure of the Site (which is the ultimate long-term objective for the Site).

The Apron LTU is located in the northwestern developed area of the CBA, which is restricted from public use. The area surrounding the airport is generally flat lying close to the roadside, with topography then sloping steeply towards the shoreline and West Arm of Cambridge Bay, which is approximately 180 m south of the CBA.

No contaminants of potential concern (COPCs) were identified in the human health risk assessment (HHRA) based on a screening against the applicable human health-based Canadian Council of Ministers of the Environment (CCME) and Health Canada guidelines/screening values for BTEX, PHCs and PFAS. Two receptors were considered in the HHRA: an Airport Worker and a Remediation Worker. Given the lack of COPCs in soil, groundwater, and sump water, no complete COPC-pathway-receptor combinations were identified in the HHRA. Therefore, toxicological risks to selected human receptors are acceptable.

PHCs in soil and PFAS in soil, groundwater, and sump water were identified as COPCs in the ecological risk assessment (ERA). Given the industrial setting of the Site and the absence of vegetation and natural habitat, the potential presence of terrestrial receptors, including species at risk (SAR), now and in the future, is limited. Therefore, toxicological risks to terrestrial receptors are acceptable.

Although dissolved PFAS in groundwater and sump water were identified as ecological COPCs for marine aquatic life, potential risks to marine aquatic life are acceptable based on the following.

- Given the presence of the liner and the berm within the Apron LTU, it is unlikely that sump water is migrating to groundwater or into Cambridge Bay. In addition, once the Apron LTU is decommissioned, water will no longer be accumulating in this area.
- Given the size of Cambridge Bay and that Cambridge Bay further connects to the Beaufort Sea, dilution of PFAS would occur.
- Groundwater discharge into Cambridge Bay would be limited to the area downgradient of the Apron LTU (approximately 180 m to the south) and mobile aquatic species would not spend their lifetime in this one area.

- Although immobile aquatic receptors (e.g., benthic invertebrates) could spend their lifetime in the area of groundwater discharge, the purpose of the ERA is to protect communities/populations of a species.
- If groundwater is discharging to Cambridge Bay, this process would be limited to the few months in the summer when the active layer thaws. During the colder months, the active layer would be frozen limiting any groundwater migration towards Cambridge Bay.

The long-term objective at the Site is to remediate the soil and decommission the LTU to achieve site closure. Based on the results of the PQRA, potential risks to human and ecological receptors from exposure to COPCs in soil, groundwater, and sump water are acceptable. Therefore, no further work, such as risk assessment (e.g., a detailed quantitative risk assessment), remediation or risk management measures, are required to mitigate risk to human health or the environment. Therefore, the Apron LTU can be decommissioned and the Site closed. Decommissioning of the Apron LTU should be completed in accordance with previous recommendations provided in Stantec's *Abandonment and Restoration Plan, Cambridge Bay Airport Apron Land Treatment Unit, Version 3* report, dated February 17, 2021.

The statements made in the Executive Summary are subject to the same limitations included in the Closure (**Section 8.0**) and are to be read in conjunction with the remainder of this report.

Abbreviations

AST	Aboveground Storage Tanks
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CBA	Cambridge Bay Airport
CCME	Canadian Council of Ministers of the Environment
COPCs	Contaminants of Potential Concern
CSM	Conceptual Site Model
CWS	Canada-Wide Standards
ECCC	Environment and Climate Change Canada
ERA	Ecological Risk Assessment
FCSAP	Federal Contaminated Sites Action Plan
FIGQG	Federal Interim Groundwater Quality Guidelines
FTA	Fire Training Area
HDPE	High-Density Polyethylene
HHRA	Human Health Risk Assessment
LNAPL	Light Non-Aqueous Phase Liquid
LTU	Land Treatment Unit
m BGS	Metres below ground surface
NU	Nunavut
NWB	Nunavut Water Board

PFAS	Per- and Polyfluoroalkyl Substances
PHC	Petroleum Hydrocarbons
PQRA	Preliminary Quantitative Risk Assessment
PSPC	Public Services and Procurement Canada
RAP	Remedial Action Plan
ROC	Receptor of Concern
SAR	Species at Risk
SQG	Soil Quality Guidelines
SSV	Soil Screening Value
TC	Transport Canada
VDEQ	Virginia Department of Environmental Quality
VEC	Valued Ecosystem Component

Per-and Polyfluoroalkyl Substances (PFAS) Abbreviations

PFBS	Perfluorobutanesulfonic Acid
PFBA	Perfluorobutanoic Acid
PFDA	Perfluorodecanoic Acid
PFDS	Perfluorodecanesulfonic Acid
PFDoA	Perfluorododecanoic Acid
PFHpS	Perfluoroheptanesulfonic Acid
PFHpA	Perfluoroheptanoic Acid
PFHxS	Perfluorohexanesulfonic Acid
PFHxA	Perfluorohexanoic Acid
PFOA	Perfluorooctanoic Acid
PFNA	Perfluorononanoic Acid
PFOS	Perfluorooctanesulfonic Acid
PFOSA	Perfluorooctane Sulfonamide
PFPeA	Perfluoropentanoic Acid
PFTeA	Perfluorotetradecanoic Acid
PFTriA	Perfluorotridecanoic Acid
PFUnA	Perfluoroundecanoic Acid

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Public Services and Procurement Canada (PSPC), on behalf of Transport Canada (TC), to conduct a preliminary quantitative risk assessment (PQRA) of the Apron Land Treatment Unit (LTU) (the Site) located at Cambridge Bay Airport (CBA) on Victoria Island, Nunavut (NU). The Apron LTU is approximately 55 m x 143 m and is located in the northwest corner of the airport property. It consists of a 0.5 m high berm and a geomembrane liner. A Site Location Plan is provided as **Figure 1, Appendix A**. Although environmental assessment work related to the Apron LTU typically includes the Apron excavated area, for the purposes of this PQRA, the Apron excavated area is included in the current scope of work.

Stantec's scope of work was to conduct a PQRA to assess potential risks to human and ecological receptors from exposure to petroleum hydrocarbons (PHC), benzene, toluene, ethylbenzene and xylenes (BTEX) and per- and polyfluoroalkyl substances (PFAS) previously identified at the Site (see Section 2.3 for details) in soil, groundwater, and sump water. The long-term objective at the Site is to remediate the soil and decommission the LTU to achieve site closure. The results of the PQRA are to be used to inform whether further remediation or risk management measures are required to mitigate risk to human health or the environment for the ongoing management and/or closure of the Site.

All chemicals (from anthropogenic and natural sources) have the potential to cause toxicological effects. However, the level of effect depends on the receptor (e.g., person, animal) being exposed, the route and duration of exposure (e.g., oral exposure for chronic durations), and the hazard (i.e., inherent toxicity) of the chemical. If all three components are present (**Figure 1-1**), the possibility of a toxicological risk exists. If any one of these three is not present, potential human and ecological risks cannot be present. If, for example, a receptor and a chemical are present but there is no means of the receptor encountering the chemical (i.e., an exposure pathway is not present), there would be no potential health risk. This PQRA was conducted following a widely-recognized framework that progresses from a qualitative initial Problem Formulation stage, through Exposure and Toxicity Assessments. The process culminates in a quantitative (and/or qualitative) Risk Characterization, including an evaluation of the uncertainties that are inherent in the risk assessment process.

Figure 1-1: Risk Venn Diagram

2.0 SITE CHARACTERIZATION

2.1 SITE HISTORY

The CBA has been operational as an airport since the 1950s. The CBA contains an air terminal building, airline offices, fuel storage and distribution equipment, aircrafts and one runway. The airport was transferred from TC to the Government of Northwest Territories in 1995, and from the Government of Northwest Territories to the Government of Nunavut in 1999. Under an airport operation transfer agreement between TC and the Government of Nunavut, the airport Apron area was identified as an area of environmental concern because historically it had three 100,000 L aboveground storage tanks (ASTs) that contained Avgas and Jet B Fuel. Although the ASTs were decommissioned and removed in 1992, no formal decommissioning procedures were documented, and soil sampling completed in 2009 indicated that there were exceedances of regulatory guidelines for petroleum hydrocarbon (PHC) identified in soil.

Soils within the airport Apron with chemical concentrations that exceeded guidelines were excavated (**Figure 1, Appendix A**) and relocated to the Apron LTU (**Figure 1, Appendix A**). This LTU was constructed after obtaining a permit from the Nunavut Water Board (NWB) in 2012. The Apron LTU covers an area of approximately 55 m by 143 m and contains approximately 4,000 m^3 of soil. A site plan of the Apron LTU is provided as **Figure 2, Appendix A**.

An additional LTU, the adjacent fire training area (FTA) LTU, was constructed in 2014 to receive soils from the FTA excavation area (**Figure 1, Appendix A**). During the construction of the FTA LTU, a drum cache was discovered within the FTA LTU footprint. Approximately 560 m^3 of soil impacted with PHCs, originating from the FTA LTU excavation area, was stockpiled on the Apron LTU while the FTA LTU was being constructed. The drum cache material was spread out and mixed in with the existing Apron LTU soil in August 2015. Starting in 2016, soil, groundwater, and sump water from the Apron LTU were analyzed for per- and polyfluoroalkyl substances (PFAS). Following the identification of PFAS in the Apron LTU soil and sump water, until the potential risk associated with exposure by human and ecological receptors to PFAS has been assessed, the sump water should not be discharged directly to the environment and the practice of recirculating sump water was adapted as the water management strategy for the Apron LTU, as a requirement of the NWB Licence.

Since 2015, annual monitoring events for soil, groundwater, and sump water have been conducted at the Apron LTU as a requirement of the NWB Licence, with the exception of 2020, where health and safety concerns arising from the COVID-19 pandemic restricted travel into/within Nunavut.

2.2 SITE DESCRIPTION

The Apron LTU is located in the northwestern developed area of the CBA, which is restricted from public use. The area surrounding the airport is generally flat lying close to the roadside, with topography then sloping steeply towards the shoreline and West Arm of Cambridge Bay, which is approximately 180 m south of the CBA.

During its construction, the base of the Apron LTU was graded and covered with a 60-mil (1.5 mm) high-density polyethylene (HDPE) geomembrane liner. The liner promotes drainage of runoff and leachate towards the single sump located in the southwest corner of the LTU and prevents infiltration of contaminants from the deposited soil into the groundwater. The liner was covered and compacted with a demarcation layer of granular material approximately 0.25 m thick. A berm, approximately 0.5 m above ground surface was constructed around the Apron LTU. As discussed in Section 2.1, PHC-impacted soil was excavated from the Apron area and relocated to the Apron LTU. The impacted soil placed from the Apron excavation and residual material from the drum cache encountered during FTA LTU construction has been spread uniformly across the Apron LTU liner at a depth of approximately 0.5 m. At the time of construction, five groundwater monitoring wells were installed surrounding the Apron LTU. Since 2014, landfarming activities including tilling, sump dewatering and recirculation, and soil sampling have been completed annually at the Apron LTU.

Ongoing water management includes monitoring that surface water continues to be contained within the LTU, the integrity of the berms is maintained, and conditions of the NWB Licence are met. Water management includes annual tilling of soils in the LTU to increase water capacity and pumping of water from the sumps over the tilled soil.

Landfarming, including tilling and aeration of soils, has been the primary treatment method for PHCs in the soils in the Apron LTU to date. Monitoring for PFAS concentrations in perimeter groundwater wells is completed annually (with the exception of 2020, as noted above), and additional soil samples were collected for analyses of PFAS parameters in 2016, 2018 and 2019.

2.3 DATA USED IN THE PQRA

As indicated above, landfarming activities have been completed annually at the Apron LTU since 2014. These landfarming activities are conducted to promote degradation of PHCs in soil. Therefore, data used in this PQRA were limited to soil and groundwater data collected since 2017 by Stantec and Arcadis Canada Inc. (Arcadis, 2017; Stantec, 2019; Stantec, 2020). Older data may no longer be representative of the conditions of the Apron LTU because of PHC degradation and the tilling and mixing of soils within the Apron LTU. Sump water data have only been collected in 2016 and 2017 (Arcadis, 2017) and were used in the PQRA. Data are presented in **Table B-1, Appendix B** for soil, **Table B-2, Appendix B** for groundwater and **Table B-3, Appendix B** for sump water. Groundwater monitoring wells locations/sump location and soil sampling locations are shown on **Figure 2** and **Figure 3, Appendix A**, respectively.

Although soil samples have been historically collected from shallow (between ground surface and approximately 0.3 metres below ground surface (m BGS)) and deeper (between 0.3 and 0.55 m BGS) depth intervals, it is Stantec's understanding that should the Apron LTU be decommissioned, soil will be spread across the area and deeper soil may end up at surface. Therefore, although soil concentrations reported in the deeper samples may be less accessible based on current conditions, during and following decommissioning, the soil concentrations reported in the deeper samples may become more accessible. As a result, no distinction was made between shallow and deep soil samples in the PQRA.

3.0 REGULATORY FRAMEWORK

Although the CBA is now territorially owned, TC currently holds the responsibility for the Apron LTU until the soil reaches the acceptable criteria, as outlined in the NWB Licence. Chemicals of potential concern (COPCs) were identified based on a comparison of chemical concentrations to criteria outlined in the NWB Licence and federal guidelines/screening values, where applicable.

As outlined by Stantec (2021) and per the NWB Licence, the land use for the Site is considered industrial, and soils are coarse-grained. Since there are no potable water wells within 250 m of the Site boundary, the Site is considered non-potable (Stantec, 2021). In addition, sump water that accumulates within the Apron LTU is not used as a potable water source. Since there are no buildings at or within the vicinity of the Apron LTU, migration of soil vapour from the subsurface into indoor air is not applicable.

The federal regulatory frameworks used to evaluate and compare the analytical soil data are the:

- *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* – Factsheets for benzene, toluene, ethylbenzene and xylenes (Canadian Council of Ministers of the Environment (CCME), 2021a);
- *Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale* (CCME, 2008b);
- *Summary Table: Health Canada Draft Guidelines, Screening Values and Toxicological Reference Values (TRVs) for Perfluoroalkyl Substances (PFAS)* (Health Canada, 2019); and
- *Interim Advice to Federal Custodian Departments for the Management of Federal Sites Containing Perfluorooctane Sulfonate (PFOS) and other Per-and Polyfluoroalkyl Substances (PFAS)* (Federal Contaminated Sites Action Plan (FCSAP), 2018).

As outlined by Stantec (2021), NWB directed TC to use the Ontario Ministry of the Environment, Conservation and Parks (MECP) 2011 Site Condition Standards (Under Ontario Regulation 153/04) for evaluation of parameter concentrations in groundwater. However, the MECP values are protective of freshwater aquatic receptors and since Cambridge Bay is a marine water body, the use of the federal guidelines protective of marine environments is considered more applicable. In addition, the federal guidelines considered in the PQRA are lower than the MECP values; therefore, a more conservative approach is applied. The federal regulatory frameworks used to evaluate and compare the analytical groundwater and sump data are the:

- *Canadian Water Quality Guidelines for the Protection of Aquatic Life* – Factsheets for benzene, toluene, and ethylbenzene (CCME, 2021b);
- *Guidelines for Canadian Drinking Water Quality Summary Table* (Health Canada, 2020);
- *Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites* (Federal Contaminated Sites Action Plan (FCSAP), 2016);
- *Summary Table: Health Canada Draft Guidelines, Screening Values and Toxicological Reference Values (TRVs) for Perfluoroalkyl Substances (PFAS)* (Health Canada, 2019);

- *Interim Advice to Federal Custodian Departments for the Management of Federal Sites Containing Perfluorooctane Sulfonate (PFOS) and other Per-and Polyfluoroalkyl Substances (PFAS)* (Federal Contaminated Sites Action Plan (FCSAP), 2018); and
- *Canadian Environmental Protection Act, 1999 Federal Environmental Quality Guidelines Perfluorooctane Sulfonate (PFOS)* (Environment and Climate Change Canada (ECCC), 2018).

According to FCSAP (2016), "*In areas in Northern Canada with permafrost, water may also be present at least part of the year in the active layer (the soil layer that thaws during the summer and re-freezes in the fall or winter). This water is also treated as groundwater for the purposes of this document.*". Therefore, although water present below ground surface may not be groundwater, it was treated as groundwater for the purposes of the risk assessment.

4.0 HUMAN HEALTH RISK ASSESSMENT

The purpose of the human health risk assessment (HHRA) is to evaluate potential risks to human receptors as a result of exposure to COPCs found at the Site. The HHRA process follows a widely recognized framework that progresses from a qualitative initial Problem Formulation step, through Exposure and Toxicity Assessments. The process culminates in a quantitative Risk Characterization, followed by the Conclusions and Recommendations stemming from the assessment. An Uncertainty Evaluation follows the Problem Formulation and Exposure and Toxicity Assessments to discuss the uncertainties inherent in the HHRA process. The primary guidance for conducting the HHRA is that of Health Canada, including:

- Federal Contaminated Site Risk Assessment in Canada Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0 (Health Canada, 2010a). Revised 2012;
- Federal Contaminated Site Risk Assessment in Canada Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors, Version 2.0 (Health Canada, 2010b); and,
- Federal Contaminated Site Risk Assessment in Canada Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals ($DQRA_{Chem}$); (Health Canada, 2010c).

4.1 PROBLEM FORMULATION

The objective of the Problem Formulation stage of the HHRA is the development of a focused understanding of which substances constitute COPCs, what human receptors are likely to be present at the Site for exposure, and how COPCs migrate from the source(s) and ultimately are taken up by, the human receptors at the Site. This information is summarized in a human health conceptual site model (CSM), which provides a visual depiction of the relevant pathways linking COPCs in various environmental media to the human receptors of interest in the HHRA (Figure 4-1).

4.1.1 Identification of Human Health COPCs

The COPCs for human health were identified by screening the maximum measured chemical concentrations of PHC, BTEX, and PFAS in soil, groundwater, and sump water against applicable federal human health-based guidelines/screening values. When a parameter does not have an applicable human health-based guideline/screening value and is below the limits of detection, the parameter is reasonably assumed to not be present at the Site at concentrations that result in unacceptable risks. In these cases, the parameter was not assessed further in the HHRA. Parameters with detection limits or detected concentrations that exceed applicable guidelines/screening values were considered for further assessment. Parameters that do not have guidelines but were at detectable concentrations, were considered on a case by case basis to determine if the parameter should be assessed further in the HHRA. A detailed description of the screening process is provided in **Section 4.1.1.1** for soil, **Section 4.1.1.2** for groundwater and **Section 4.1.1.2** for sump water.

4.1.1.1 COPCs in Soil

For the identification of human health COPCs in soil, maximum measured concentrations were screened against the applicable human health-based guidelines/screening values for industrial land use from the CCME soil quality guidelines (SQGs) (CCME, 2021a), the CCME CWS (CCME, 2008b) and Health Canada (Health Canada, 2019). Soil data are included in **Table B-1, Appendix B**; the human health soil screening table is included in **Table C-1, Appendix C**.

Maximum measured soil concentrations were below the available federal human health-based guidelines/screening values for benzene, toluene, ethylbenzene, and xylenes (BTEX), PHCs and PFAS; therefore, these were not identified as COPCs. A detectable concentration was reported for perfluoroheptane sulfonic acid (PFHpS); however, a Health Canada soil screening value (SSV) is not available. In the absence of a Health Canada SSV for PFHpS, Stantec compared the maximum measured concentration of PFHpS to the SSV for perfluorooctane sulfonic acid (PFOS), because they are both sulfonated PFAS and PFOS has the most conservative SSV of the sulfonated PFAS. Given that the maximum measured concentration of PFHpS (0.17 µg/kg) is well below the Health Canada SSV for PFOS (30,500 µg/kg), applied in the absence of a Health Canada SSV for PFHpS, PFHpS was not identified as a COPC.

The maximum measured concentrations of PHC F1 and PHC F2 were greater than the CCME CWS management limits. Management limits are discussed further in **Section 6.0**.

4.1.1.2 COPCs in Groundwater

For the identification of human health COPCs in groundwater, maximum measured concentrations were screened against the applicable human health drinking water quality guidelines and screening values from Health Canada. As discussed in **Section 3.0**, groundwater is not used as a potable water source; however, human receptors could come into contact with groundwater through on-Site activities (e.g., sampling) via splashing and hand-to-mouth contact (further discussed in **Section 4.1.3**). The human health drinking water guidelines and screening values from Health Canada were derived based on an adult receptor consuming 1.5 Litres / day (L/d) of water each day. Although Health Canada (2010a) provides a consumption rate of 1.5 L/d for a construction worker, that value is not representative of incidentally ingesting groundwater in an excavation or through sampling activities (via hand-to-mouth transfer). The Virginia Department of Environmental Quality (VDEQ) provides a lower consumption rate of 0.02 L/d that is more representative of water consumed by a worker through these types of activities. Thus, to account for incidental contact with groundwater, the Health Canada drinking water guidelines/screening values were modified to account for the lower ingestion rate. An example calculation is provided in **Appendix D**.

Maximum measured groundwater concentrations were below the modified Health Canada guidelines/ screening values for BTEX, PHCs and PFAS; therefore, these were not identified as COPCs. A detectable concentration was reported for perfluoropentanesulfonic acid (PFPeS); however, a Health Canada drinking water screening value is not available. In the absence of a Health Canada drinking water screening value for PFPeS, Stantec compared the maximum measured concentration of PFPeS to the modified drinking water guideline for PFOS, because they are both sulfonated PFAS and PFOS has the most conservative modified drinking water guideline of the sulfonated PFAS. Given that the maximum measured concentration of PFPeS (0.074 µg/L) is well below the modified drinking water guideline for PFOS (45 µg/L), applied in the absence of a drinking water screening value for PFPeS, PFPeS was not identified as a COPC.

4.1.1.3 COPCs in Sump Water

For the identification of human health COPCs in sump water, maximum measured concentrations were screened against the applicable human health guidelines and screening values from Health Canada. As discussed in **Section 3.0**, sump water is not used as a potable water source; however, human receptors could come into contact with sump water through on-Site activities (e.g., recirculation of sump water) via splashing and hand-to-mouth contact (further discussed in **Section 4.1.3**). As discussed in **Section 4.1.1.2**, Health Canada guidelines/screening values were modified to account for incidental contact with sump water to account for the lower ingestion rate (see example calculation in **Appendix D**). Sump water data are included in **Table B-3, Appendix B**; the human health sump water screening table is included in **Table C-3, Appendix C**.

Maximum measured sump water concentrations were below the modified Health Canada guidelines/ screening values for BTEX, PHCs and PFAS; therefore, these were not identified as COPCs.

4.1.2 Identification of Human Receptors

The Apron LTU is located in the northwestern developed area of the CBA which is restricted from public use. Although the area is not fenced, access by the public is not expected given surrounding land use is undeveloped and would not draw people to the area. Based on current (i.e., continued operation of the Apron LTU) and future (i.e., decommissioning the Apron LTU and reclamation of this area of the CBA) activities at the Site, the following human receptors were assumed to access the Site.

- Airport Worker
- Remediation Worker

The Airport Worker may be on-Site to perform operational and maintenance activities within the Site. Although the Airport Worker is not likely to spend their entire working day in the vicinity of the Site, it is conservatively assumed that the Airport Worker could be present 10 hours per day, 5 days per week, 48 weeks per year at the Site for a period of 35 years, in accordance with Health Canada guidance for industrial workers (Health Canada, 2010a).

The Remediation Worker is included as a receptor to represent any worker on-Site during activities such as the current annual sampling requirements (e.g., soil sampling) should the Apron LTU continue to operate or future soil sampling and/or decommissioning of the Apron LTU. It is assumed that the Remediation Worker would be conducting activities at the Site 10 hours a day, 5 days per week, 4 weeks per year for a period of one year.

4.1.3 Identification of Human Health Exposure Pathways

Exposure pathways are used to describe how a substance can move from impacted media (e.g., soil) to a point where it can enter the body. Only those pathways for which there is a reasonable potential for exposure were considered complete in the HHRA. A summary of the exposure pathways relevant to the human health receptors are presented in **Table 1**.

Table 4-1: Potential Exposure Pathways for a Human Health Receptor

Potential Exposure Route	Complete Exposure Pathway?	Justification
Dermal contact with soil	Yes	While present on-Site, the Airport Worker and Remediation Worker may come in direct contact with soil (incidental ingestion and dermal contact). No COPCs were identified in soil for the incidental ingestion and dermal contact pathways. Therefore, exposure to COPCs via these pathways are considered negligible. It is not anticipated that Airport Worker would undertake activities that would generate dust (such as construction activities) so particulate inhalation is not considered a complete pathway. In contrast, for the Remediation Worker, particulate inhalation is considered a complete pathway. The inhalation of soil particulates pathway is considered adequately assessed through the ingestion and dermal contact pathways.
Incidental ingestion of soil		
Inhalation of soil particulates	Yes	
Inhalation of vapours – indoors	No	There are no buildings present on-Site and no volatile COPCs were identified in soil. Therefore, exposure to COPCs via this pathway is incomplete.
Inhalation of vapours – outdoors	Yes	CCME (2006) does not provide human health-based guidelines for inhalation of vapours outdoors. CCME (2006) states that since there is less air circulation within a building and buildings are often under pressure due to heating, migration of vapours into buildings is a greater health concern than migration of vapours to outdoor air. Therefore, the dilution of vapours in outdoor air would result in essentially negligible exposure to COPCs through this pathway.
Inhalation of vapours – trench	No	It was assumed that the Airport Worker and Remediation Worker would not conduct work in a trench because of limitations relating to permafrost; therefore, exposure to COPCs via this pathway is incomplete.
Incidental ingestion/dermal contact with groundwater	Yes	The Remediation Worker could have incidental and dermal contact with groundwater during sampling. It was assumed that the Airport Worker would not come into contact with groundwater. No COPCs were identified in groundwater for the incidental ingestion and dermal contact pathways. Therefore, exposure to COPCs via these pathways are considered negligible for the Remediation Worker. Exposure to COPCs via this pathway for the Airport Worker are incomplete.

Table 4-1: Potential Exposure Pathways for a Human Health Receptor

Potential Exposure Route	Complete Exposure Pathway?	Justification
Incidental ingestion/dermal contact with sump water	Yes	The Airport Worker and Remediation Worker could have incidental and dermal contact with sump water while the Apron LTU is still active; however, this pathway would no longer be applicable once the Apron LTU was decommissioned. No COPCs were identified in sump water for the incidental ingestion and dermal contact pathways. Therefore, exposure to COPCs via these pathways are considered negligible.

4.1.4 Human Health Conceptual Site Model

The human health CSM is presented in **Figure 4-1**, below. The figure provides simplified representation of potential exposure pathways, linking sources and COPCs to each human receptor identified in **Section 4.1.2**.

4.1.5 Approach to Risk Characterization

Based on the results of the Problem Formulation, no human health COPCs were identified. Therefore, a quantitative evaluation is not required, and risk characterization is based on a qualitative evaluation only, as discussed further in **Section 4.2**. Therefore, the exposure and toxicity assessments have not been completed.

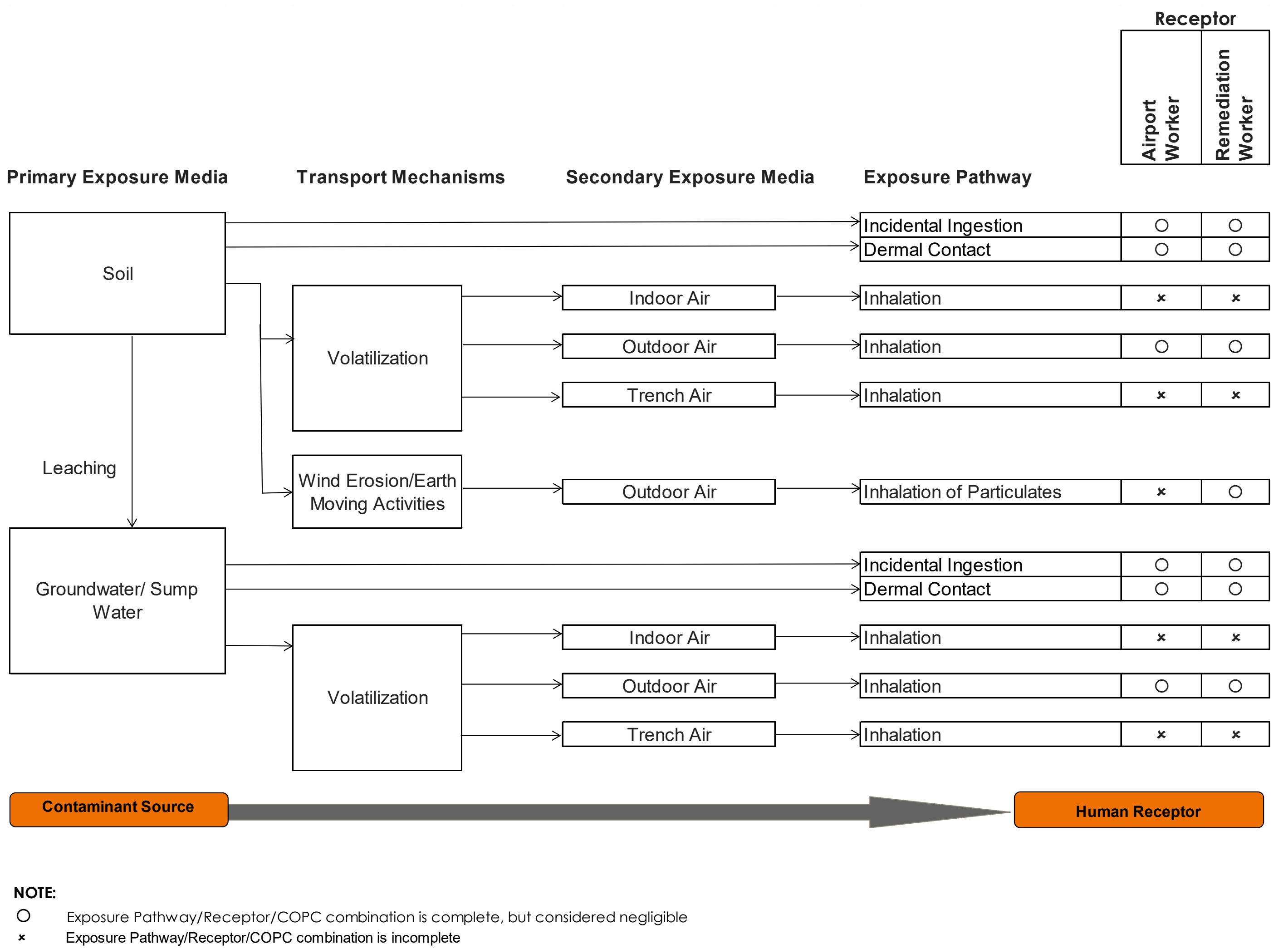


Figure 4-1: Human Health Conceptual Site Model

4.2 RISK CHARACTERIZATION

Typically, the Risk Characterization step in HHRA is based on the evidence linking COPCs with adverse human effects by combining information from the Exposure and Toxicity Assessments. However, given that there were no COPCs identified in the HHRA, formal Exposure and Toxicity Assessments are not required. Rather, risks for human receptors at the Site from possible exposure to COPCs measured in soil were characterized qualitatively. Based on this assessment of human health, toxicological risks to identified receptors are considered acceptable since concentrations in soil, groundwater and sump water are less than human health-based guidelines/screening values.

4.3 UNCERTAINTY EVALUATION

Uncertainty is inherent in many aspects of evaluating health risks to human receptors. The level of uncertainty is dependent upon the availability and quality of information, as well as the variability associated with many of the processes and factors being considered. Since uncertainty can influence the overall risk, it is important to identify and understand the uncertainties and potentially reduce the uncertainties through additional investigations. A discussion of the uncertainties identified for the HHRA is provided below.

4.3.1 Site Characterization

The soil sample collection program completed as part of the annual monitoring events was focused on the distribution of COPC concentrations across the Apron LTU. As a result, the soil data collected are representative of the Site for use in the HHRA. The level of uncertainty relating to soil characterization is low.

The groundwater samples collected as part of the annual monitoring events are representative of groundwater in the vicinity and downgradient of the Apron LTU. The level of uncertainty relating to groundwater characterization is low.

4.3.2 Receptor Selection

Human receptors that are most likely to frequent the Site at present or in the foreseeable future are considered in the HHRA. Other receptors could frequent the Site but are considered less exposed. Receptor selection is representative of Site activities, and the level of uncertainty with receptor selection is low.

4.3.3 Exposure Pathways

A number of pathways were considered in the HHRA. Based on the available information relating to the Site and the surrounding area, pathways that were considered applicable were considered in the HHRA. The level of uncertainty with exposure pathway selection is low.

5.0 ECOLOGICAL RISK ASSESSMENT

The purpose of the ecological risk assessment (ERA) is to evaluate the potential that ecological receptors (e.g., plants, soil invertebrates, mammals and birds, and off-Site aquatic life) may experience toxicologically induced changes in health as a result of exposure to COPCs found at the Site. As with the HHRA, the ERA process follows a widely recognized framework that progresses from a qualitative initial phase (Problem Formulation), through Exposure and Toxicity Assessments, and culminates in a quantitative Risk Characterization, followed by the Conclusions and Recommendations stemming from the assessment. Following the Problem Formulation and Exposure and Toxicity Assessments, a discussion of the uncertainties inherent to ERA is provided. The risk assessment methodology for this ERA uses guidance from the following documents:

- Ecological Risk Assessment Guidance Document, (CCME, 2020);
- Ecological Risk Assessment Guidance (Environment Canada, 2012) and associated modules;
- A Framework for Ecological Risk Assessment, General Guidance (CCME, 1996); and
- A Framework for Ecological Risk Assessment, Technical Appendices (CCME, 1997).

5.1 PROBLEM FORMULATION

The objective of the Problem Formulation is the development of a focused understanding of which chemicals assessed during the Site characterization are ecological COPCs, what ecological receptors are likely to be present at the Site, and how COPCs migrate from the source(s) and ultimately reach, and are taken up by, ecological receptors living at, near, or frequenting the Site. This information is summarized in an ecological CSM that provides a visual depiction of the relevant pathways linking the source of COPCs in various environmental media and biota to the ecological receptors considered in the ERA.

5.1.1 Identification of Ecological Health COPCs

The COPCs for ecological health were identified by screening the maximum measured chemical concentrations in soil, groundwater, and sump water against applicable federal ecological health-based guidelines. When a parameter does not have an applicable ecological health-based guideline and is below the limits of detection, the parameter is reasonably assumed to not be present at the Site at concentrations that result in unacceptable risks. In these cases, the parameter was not assessed further in the ERA. Parameters with detection limits or detected concentrations that exceed applicable guidelines were considered for further assessment. Parameters that do not have guidelines but were at detectable concentrations, were considered on a case by case basis to determine if the parameter should be assessed further in the ERA. A detailed description of the screening process is provided in **Section 5.1.1.1** for soil, **Section 5.1.1.2** for groundwater and **Section 5.1.1.3** for sump water.

5.1.1.1 COPCs in Soil

For the identification of ecological COPCs in soil, maximum measured concentrations were screened against the applicable ecological health-based guidelines for industrial land use from CCME SQGs (CCME, 2021a), the CCME CWS (CCME, 2008b) and FCSAP (FCSAP, 2018). Soil data are included in **Table B-1, Appendix B**; the ecological soil screening table is included in **Table C-4, Appendix C**.

Maximum measured concentrations of PHC F1, PHC F2 and PHC F3 in soil were greater than the CCME CWS ecological soil guidelines meant to be protective of soil direct contact. Therefore, PHC F1, PHC F2, and PHC F3 were identified as ecological COPCs. Maximum measured concentrations of BTEX, PHC F4 and PFOS in soil were either below the applicable ecological health-based guidelines or were not detected and were not identified as COPCs.

Detectable concentrations were reported for several PFAS[1]; however, federal ecological health-based guidelines are not available for these parameters. Therefore, these PFAS were identified as ecological COPCs in soil.

5.1.1.2 COPCs in Groundwater

For the identification of ecological COPCs in groundwater, maximum measured concentrations were screened against the applicable ecological health-based guidelines for industrial land use from FCSAP FIGQG (2016), FCSAP (2018) and CCME (2021b). Groundwater data are included in **Table B-2, Appendix B**; the ecological soil screening table is included in **Table C-5, Appendix C**.

Maximum measured groundwater concentrations were below the available FIGQG for BTEX and PHCs. In addition, the maximum measured PFOS concentration in groundwater was below the available PFOS groundwater guideline (FCSAP, 2018). Therefore, BTEX, PHCs and PFOS were not identified as COPCs. Detectable concentrations were reported for several PFAS[2]; however, federal ecological health-based guidelines are not available for these parameters. Therefore, these PFAS were identified as ecological COPCs in groundwater.

5.1.1.3 COPCs in Sump Water

For the identification of ecological COPCs in sump water, maximum measured concentrations were screened against the applicable ecological health-based guidelines for industrial land use from FCSAP FIGQG (2016), CCME (2021b) and ECCC (2018). Sump water data are included in **Table B-3, Appendix B**; the ecological soil screening table is included in **Table C-6, Appendix C**.

Maximum measured groundwater concentrations were below the available FIGQG and CCME guidelines for BTEX and PHCs. In addition, the maximum measured PFOS concentration in sump water was below the ECCC PFOS water quality guideline. Therefore, BTEX, PHCs and PFOS were not identified as

[1] perfluorobutanesulfonic acid (PFBS), perfluorobutanoic acid (PFBA), perfluoroheptanesulfonic acid (PFHpS), perfluoroheptanoic acid (PFHpA), perfluorohexanesulfonic acid (PFHxS), perfluorohexanoic acid (PFHxA), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA) and perfluoropentanoic acid (PFPeA)

[2] PFBS, PFBA, PFHpA, PFHxS, PFHxA, PFOA, PFNA, perfluoropentanesulfonic acid (PFPeS) and PFPeA

COPCs. Detectable concentrations were reported for several PFAS[3]; however, federal ecological health-based guidelines are not available for these parameters. Therefore, these PFAS were identified as ecological COPCs in sump water.

5.1.2 Identification of Ecological Receptors

For the purpose of ERA, it is neither practical, nor necessary, to individually assess each wildlife species that may potentially occupy, visit or live near a site. Instead, the potential for adverse effects is evaluated for a subset of valued ecosystem components (VEC) (also referred to as Receptors of Concern [ROC]) that may be exposed to COPCs at or near the Site. Ecological receptors are chosen by focusing on wildlife species that are:

- Indigenous to the area and would be potentially exposed to chemicals;
- Most likely to receive the greatest exposure to COPCs due to their habitat, behavioural traits and home range;
- Representative of the various levels in the trophic web at the site (e.g., carnivore, herbivore, insectivore); and,
- Classified as being rare or endangered (i.e., species of conservation concern, species at risk).

5.1.2.1 Habitat Information and Species at Risk

A desktop habitat assessment for the Site and surrounding area was completed by Stantec through the review of available Site photographs (**Appendix E**). The Apron LTU is located in a developed area of the CBA with limited fencing to deter access of this area by ecological receptors. The Apron LTU covers an area of approximately 55 m by 143 m and contains approximately 4,000 m^3 of soil. The west arm of Cambridge Bay is approximately 180 m south of the Apron LTU and an unnamed ephemeral water feature is located approximately 200 m north of the Apron LTU. The Apron LTU consists of mainly exposed soil with sparse vegetation (Photographs 1 through 3, **Appendix E**), while the land surrounding the Apron LTU consists of sparsely grassed areas with no trees (Photographs 4 and 5, **Appendix E**). Precipitation accumulates within the Apron LTU in the southwest corner where the single sump is located (Photographs 4 and 5, **Appendix E**). Should the Apron LTU be decommissioned, water accumulation will no longer occur since the soil will be spread out to match the surrounding grade.

Birds have been observed within the Apron LTU, specifically in the accumulated water in the southwest corner. However, birds are not expected to spend much time at the Apron LTU since a much larger and more food-rich water feature is located within 180 m of the Site (Cambridge Bay). In addition, mammals (e.g., foxes) have also been observed within the northwest portion of the CBA, including the Apron LTU; however, this area does not provide suitable habitat for mammals. Mammals are likely using the Site and the area as a means to access Cambridge Bay and time spent at the Site is transitory and limited in nature.

---

[3] PFBS, PFBA, PFHpA, PFHxS, PFHxA, PFOA and PFPeA

Based on the desktop habitat assessment for the Site and surrounding area, three bird species at risk (SAR) have ranges that overlap with the Site: Red Knot (shorebird), Red-necked Phalarope (wading bird) and Buff-breasted Sandpiper (shorebird). At times, these three SAR could potentially be found within the accumulated water in the southwest corner of the Apron LTU; however, as mentioned above, birds are not expected to spend much time at the Apron LTU since Cambridge Bay is located within 180 m of the Site and the Site is disturbed by an active airport.

Given the industrial setting of the Site, that vegetation is sparse and that there is no suitable habitat for long term use, the potential for the presence of terrestrial receptors, including SAR, now and in the future, is limited. Terrestrial receptors could use the Site for passage or as a transition location but are not anticipated to spend substantial time at the time, now or if the Apron LTU was decommissioned. Aquatic receptors are likely present in Cambridge Bay located close to the Site.

5.1.2.2 Identification of Receptors

On the basis of the above considerations, VECs are selected following the CCME and FCSAP Ecological Risk Assessment Guidance Documents (CCME, 2020c; Environment Canada, 2012) to represent the applicable habitats and trophic levels that may be present at the Site (**Table 5-1**). The selected VECs are considered representative of other species occupying a similar position in the food web such that results of the Risk Characterization stage for a selected VEC can be used to make inferences about risk to other species occupying a similar trophic level or guild. For example, if results of the ERA indicate that no unacceptable risk is expected for the collared lemming, an herbivorous mammal, then no unacceptable risks would be expected for other herbivorous mammalian species. Using these criteria, the VECs assessed in the ERA are expected to provide an adequate and conservative representation of the faunal and floral diversity at the Site. No individual SAR are assessed; if they were present, they are not expected to spend much time at the Apron LTU.

As previously mentioned, the Site is located in an industrial setting with sparse vegetation and limited habitat for mammal and bird species. While individual mammals and birds (e.g., foxes) may pass through the Site or utilize the Site, populations of these animals would not, and the presence of individuals would be short term and intermittent.

Table 5-1: Rationale for the Inclusion/Exclusion of Receptor Types

Receptor Group	Receptor Type	Included in the ERA (Yes/No)	Rationale	Surrogate VECs (if applicable)
Terrestrial				
Plants	Moss/Grass/Shrub	Yes	As discussed in **Section 5.1.2.1**, based on a review of existing Site photographs, plants at and surrounding the Site are sparse (**Appendix E**). As a result, plant communities are assessed qualitatively in **Section 5.2**.	Plant community

Table 5-1: Rationale for the Inclusion/Exclusion of Receptor Types

Receptor Group	Receptor Type	Included in the ERA (Yes/No)	Rationale	Surrogate VECs (if applicable)
Terrestrial				
Invertebrates	Soil/Aerial	Yes	Given the climate of the Site and that vegetation is limited, soil invertebrates are considered limited at the Site. As a result, invertebrate communities are assessed qualitatively in **Section 5.2**.	Invertebrate community
Mammals	Herbivorous	Yes	Individual species might be present within the Site; however, given the industrial setting of the Site and the limited terrestrial habitat, the Site is likely used for passage or as a transition location, but individual species are not anticipated to spend significant time at the time. The potential presence of terrestrial receptors making up communities or populations, including individual SAR, now and in the future, is limited. Mammals whose diet is comprised primarily of insects are not expected to be present at the Site based on the climate. Based on the above, mammals were assessed qualitatively in the ERA, as discussed in **Section 5.2**.	Collared Lemming, Caribou
	Insectivorous	No		Not Applicable
	Carnivorous	Yes		Arctic Fox, Polar Bear
	Omnivorous	Yes		Arctic Ground Squirrel
Birds	Herbivorous	Yes	Individual species might be present within the Site; however, given the industrial setting of the Site and the limited terrestrial habitat, the Site is likely used for passage or as a transition location. Individual species are not anticipated to spend significant time at the Site. The potential presence of terrestrial receptors making up communities or populations, including individual SAR, now and in the future, is limited. Based on the above, birds were assessed qualitatively in the ERA, as discussed in **Section 5.2**.	Willow Ptarmigan
	Insectivorous	Yes		Spotted Sandpiper
	Carnivorous	Yes		Snowy Owl
	Omnivorous	Yes		Long-tailed Duck, Canada Goose
Reptiles/ Amphibians	Carnivorous/Omnivorous	No	Given the northern climate, reptiles and amphibians would not be present at the Site or surrounding area. Therefore, reptiles and amphibians were not identified as a VEC.	Not Applicable
Aquatic				
Off-Site Aquatic Community	Aquatic Receptors (e.g., plants/ invertebrates/ fish)	Yes	Aquatic receptors are present in Cambridge Bay located 180 m south of the Site. Aquatic receptors are assessed qualitatively in **Section 5.2**.	Not Applicable

5.1.3 Identification of Ecological Exposure Pathways

Exposure pathways are used to describe how a substance can move from impacted media (e.g., soil) to a point of intake by an ecological receptor. Identifying the potential exposure pathways involves consideration of several factors. The life history traits of each ecological receptor (e.g., habitat, diet), features of the Site (e.g., biota, habitat suitability) and environmental fate and transport properties of each COPC comprise a few of the components taken into account when identifying potential pathways. Only those pathways for which there is a reasonable potential for exposure were considered complete in the ERA. A summary of potential exposure pathways for selected receptors, and pathway-specific rationale for inclusion or exclusion from the ERA, is shown in **Table 5-2**.

Table 5-2: Rationale for the Inclusion/Exclusion of Exposure Pathways for Selected Ecological Receptors

Receptor Group	Exposure Pathway	Complete Exposure Pathway?	Rationale
Plants	Direct Contact with soil	Yes	Plants are in direct contact with COPCs in soils.
	Direct Contact with groundwater	Yes	Plants could be in direct contact with COPCs in groundwater/sump water.
Invertebrates	Direct Contact with soil	Yes	Soil invertebrates are in direct contact with COPCs in soils.
	Direct Contact with groundwater	Yes	Soil invertebrates could be in direct contact with COPCs in groundwater/sump water.
Mammals	Water Consumption	Yes	Mammals may be exposed to COPCs in accumulated water within the Apron LTU. Once the Apron LTU is decommissioned, this pathway would no longer be relevant. Mammals may also be exposed to COPCs originating in groundwater and discharging to Cambridge Bay. However, mammals are unlikely to come into contact directly with groundwater.
	Food Consumption	Yes	Mammals will ingest COPCs via plant/prey consumption.
	Incidental Soil Ingestion	Yes	Incidental ingestion of soil is considered a complete exposure pathway for mammals.
	Dermal Exposure	No	Dermal absorption is not expected to provide a relevant source of exposure due in most part to the presence of fur, which can substantially reduce available skin surface area.
	Inhalation	No	CCME does not consider inhalation as an ecological exposure pathway. There are data limitations for exposure via inhalation (e.g., toxicity values) and soil ingestion is considered substantially more important than inhalation in terms of daily exposure dose.

Table 5-2: Rationale for the Inclusion/Exclusion of Exposure Pathways for Selected Ecological Receptors

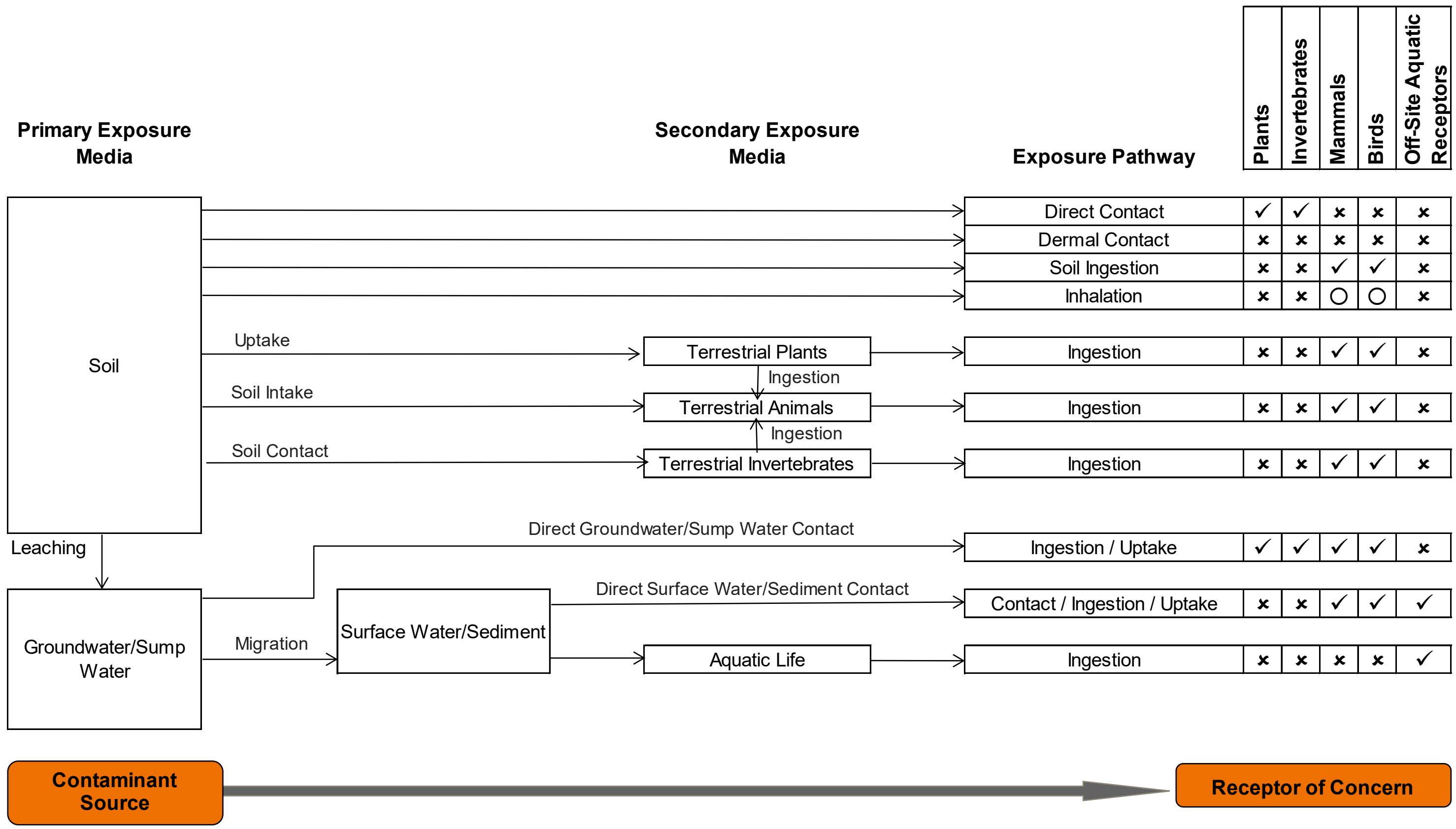
Receptor Group	Exposure Pathway	Complete Exposure Pathway?	Rationale
Birds	Water Consumption	Yes	Birds may be exposed to COPCs in accumulated water within the Apron LTU. Once the Apron LTU is decommissioned, this pathway would no longer be relevant. Birds may also be exposed to COPCs originating in groundwater and discharging to Cambridge Bay. However, birds are unlikely to come into contact directly with groundwater.
	Food Consumption	Yes	Birds will ingest COPCs via plant/prey consumption.
	Incidental Soil Ingestion	Yes	Incidental ingestion of soil is considered a complete exposure pathway for birds.
	Dermal Exposure	No	Dermal absorption is not expected to provide a relevant source of exposure due to the presence of feathers which can substantially reduce available skin surface area.
	Inhalation	No	CCME does not consider inhalation as an ecological exposure pathway. There are data limitations for exposure via inhalation (e.g., toxicity values) and soil ingestion is considered substantially more important than inhalation in terms of daily exposure dose.
Off-Site Aquatic Community	Direct contact (contact/ingestion/ uptake) with surface water/ sediment, food consumption	Yes	Off-Site aquatic receptors are in direct contact with surface water and sediment and could potentially come into contact with COPCs via these pathways.

5.1.4 Ecological Conceptual Site Model

The ecological conceptual site model for the Site is presented graphically in **Figure 5-1**. It provides a simplified representation of potential exposure pathways, linking sources and COPCs to each VEC.

5.1.5 Approach to Risk Characterization

Although ecological COPCs were identified as part of the Problem Formulation, exposure of ecological receptors to COPCs is limited. Therefore, a quantitative evaluation is not required, and risk characterization is based on a qualitative evaluation only, as discussed further in **Section 5.2**. Therefore, the exposure and toxicity assessments have not been completed.



NOTES:

✓ Exposure Pathway/Receptor/COPC combination is complete.

○ Exposure pathway complete, but considered negligible.

× Exposure Pathway/Receptor/COPC combination is incomplete.

Figure 5-1: Ecological Conceptual Site Model

5.2 RISK CHARACTERIZATION

For the complete exposure pathway-receptor-COPC combinations identified above, potential risks were characterized qualitatively for ecological receptors at the Site.

5.2.1 Soil

PHC F1, PHC F2, and PHC F3 and PFAS in soil were identified as ecological COPCs for soil contact. Given the absence of terrestrial habitat (little to no vegetation and invertebrates), the potential presence of terrestrial receptors (i.e., plants, soil invertebrates, mammals and birds) making up communities or populations, including individual SAR, now and in the future, is limited. Therefore, potential risks to terrestrial receptors are acceptable.

5.2.2 Groundwater

PFAS in groundwater were identified as ecological COPCs for direct contact with groundwater. As indicated in **Section 5.2.1**, the potential presence of terrestrial receptors (i.e., plants, soil invertebrates, mammals and birds) making up communities or populations, including individual SAR, now and in the future, is limited. Therefore, terrestrial receptors are unlikely to be exposed to COPCs in groundwater and risks to terrestrial receptors are acceptable.

PFAS in groundwater were also identified as ecological COPCs for marine aquatic life. PFAS in groundwater could be migrating from the area of the Apron LTU and into Cambridge Bay; however, potential risks to marine aquatic life are acceptable based on the following.

- Given the size of Cambridge Bay and that Cambridge Bay further connects to the Beaufort Sea, dilution of PFAS would occur.
- Groundwater discharge into Cambridge Bay would be limited to the area downgradient of the Apron LTU (approximately 180 m to the south) and mobile aquatic species would not spend their lifetime in this one area.
- Although immobile aquatic receptors (e.g., benthic invertebrates) could spend their lifetime in the area of groundwater discharge, the purpose of the ERA to protect communities/populations of a species.
- If groundwater is discharging to Cambridge Bay, this process would be limited to the few months in the summer when the active layer thaws. During the colder months, the active layer would be frozen limiting any groundwater migration towards Cambridge Bay.

5.2.3 Sump Water

PFAS in sump water were identified as ecological COPCs for direct contact with sump water. As indicated in **Section 5.2.1**, the potential presence of terrestrial receptors (i.e., plants, soil invertebrates, mammals and birds) making up communities or populations, including individual SAR, now and in the future, is limited. In addition, should the Apron LTU be decommissioned, water accumulation will no longer occur since the soil will be spread out to match the surrounding grade. Therefore, potential risks to terrestrial receptors exposed to COPCs in sump water are acceptable.

Given the presence of the liner and the berm within the Apron LTU, it is unlikely that sump water is migrating to groundwater or into Cambridge Bay. In addition, once the Apron LTU is decommissioned, water will no longer be accumulating in this area. Therefore, potential risks to aquatic receptors exposed to COPCs in sump water are acceptable.

5.3 UNCERTAINTY EVALUATION

Uncertainty is inherent in many aspects of evaluating health risks to ecological receptors. The level of uncertainty is dependent upon the availability and quality of information, as well as the variability associated with many of the processes and factors being considered. Since uncertainty can influence the overall risk, it is important to identify and understand the uncertainties and potentially reduce the uncertainties through additional investigations. A discussion of the uncertainties identified for the ERA is provided below.

5.3.1 Site Characterization

The soil sample collection program completed as part of the annual monitoring events was focused on the distribution of COPC concentrations across the Apron LTU. As a result, the soil data collected are representative of the Site for use in the HHRA. The level of uncertainty relating to soil characterization is low.

The groundwater samples collected as part of the annual monitoring events are representative of groundwater in the vicinity and downgradient of the Apron LTU. The level of uncertainty relating to groundwater characterization is low.

5.3.2 Receptor Selection

The potential uncertainty with the selection of a complete and relevant list of ecological receptors is addressed based on site settings and features. The result of the approach used to select receptors was a list of potential ROCs that may visit, inhabit or live near the Site. A conservative approach was adopted that resulted in a low degree of uncertainty that the potentially significant receptors were excluded in the ecological risk assessment.

5.3.3 Exposure Pathways

The uncertainty associated with the selection of ecological exposure pathways stems from the potential to omit a relevant pathway that would subsequently undermine the accuracy of the predicted exposure. However, no exposure pathways were determined to be relevant within the ecological risk assessment. The level of uncertainty associated with the selection of exposure pathways is low.

5.3.4 PFAS Toxicity

Little is known at this time about toxicity of PFAS to ecological receptors, and what is known is for limited substances (e.g., PFOS). It has been assumed that any toxicological risks associated with exposure to PFAS are acceptable. The level of uncertainty associated with PFAS toxicity is moderate.

6.0 INCORPORATION OF CWS PHC MANAGEMENT LIMITS

In addition to an assessment of human and environmental health risks related to the toxicity of PHCs, CWS PHC (CCME, 2008a) requires that management limits be considered at sites impacted with PHCs to address other scientific, technical and socio-economic factors. These include:

- Free phase formation
- Exposure of workers in trenches to PHC vapours
- Fire and explosive hazards
- Effects on buried infrastructure
- Aesthetic considerations
- Technological factors

PHC management limits for industrial land use, coarse textured soil are:

- PHC F1 – 700 mg/kg
- PHC F2 – 1,000 mg/kg
- PHC F3 – 3,500 mg/kg
- PHC F4 – 10,000 mg/kg

An exceedance of the management limit for PHC F1 (700 µg/g) was identified in one soil sample collected in 2017 (840 µg/g). In addition, exceedances of the management limit for PHC F2 (1,000 µg/g) were identified in two soil samples collected in 2018 and two soil samples collected in 2019, ranging in concentration from 1,500 to 2,300 µg/g.

In general, management limits apply to subsoils which CCME defines as soils at depths of 1.5 m and greater (CCME, 2008b). Given that soils on Site are shallow (i.e., up to 0.5 m in depth), the majority of the factors protected by the management limits do not apply on-Site. None the less, consideration was given to each factor below.

Perceptible free phase in soil depends on a number of factors, although CWS PHC reports that the residual saturation limit for most petroleum products and soil types occurs with total PHC concentrations in the range of 20,000 mg/kg to 30,000 mg/kg (CCME, 2008b). Concentrations of PHC in this range were not reported in soil samples collected at the Site. In addition, the presence of light non-aqueous phase liquid (LNAPL) was not observed; therefore, free phase hydrocarbons are not assumed to be present at the Site.

As previously mentioned, trench work is not anticipated given the presence of permafrost. Therefore, the management limit for exposure of workers in trenches as well as the effects of fire and explosive hazards are not applicable.

No buried utilities are present at the Site. As such, potential interaction of man-made buried utilities and identified impacts is negligible.

Aesthetic impacts such as visible staining, odours or visible plant damage are a subjective issue that Site managers may consider acceptable or unacceptable. Aesthetic concerns, such as visual staining, are not a concern at the Site from a human health perspective. A decision to remove stained soil, if present, would be a management decision based on aesthetic considerations.

CWS PHC management limits are provided as a guide to contaminated site managers so that scientific, technical, and socio-economic factors are considered. Based on the above assessment and given the shallow soils on-Site, it does not appear that exceedance of the management limits would result in unacceptable risk to receptors.

7.0 SUMMARY AND RECOMMENDATIONS

Stantec was retained to complete a PQRA at the Apron LTU located at the CBA on Victoria Island, NU. For the PQRA, soil, groundwater, and sump water data (PHCs, BTEX and PFAS) collected as part of the recent monitoring programs conducted by Arcadis (2017) and Stantec (2019; 2020) were used.

No COPCs were identified in the HHRA based on a screening against the applicable human health-based CCME and Health Canada guidelines/screening values for BTEX, PHCs and PFAS. Two receptors were considered in the HHRA: an Airport Worker and a Remediation Worker. Given the lack of COPCs in soil, groundwater, and sump water, no complete COPC-pathway-receptor combinations were identified in the HHRA. Therefore, toxicological risks to selected human receptors are acceptable.

PHCs in soil and PFAS in soil, groundwater, and sump water were identified as COPCs in the ERA. Given the industrial setting of the Site and the absence of vegetation and natural habitat, the potential presence of terrestrial receptors, including SAR, now and in the future, is limited. Therefore, toxicological risks to terrestrial receptors are acceptable.

Although dissolved PFAS in groundwater and sump water were identified as ecological COPCs for marine aquatic life, potential risks to marine aquatic life are acceptable based on the following.

- Given the presence of the liner and the berm within the Apron LTU, it is unlikely that sump water is migrating to groundwater or into Cambridge Bay. In addition, once the Apron LTU is decommissioned, water will no longer be accumulating in this area.
- Given the size of Cambridge Bay and that Cambridge Bay further connects to the Beaufort Sea, dilution of PFAS would occur.
- Groundwater discharge into Cambridge Bay would be limited to the area downgradient of the Apron LTU (approximately 180 m to the south) and mobile aquatic species would not spend their lifetime in this one area.
- Although immobile aquatic receptors (e.g., benthic invertebrates) could spend their lifetime in the area of groundwater discharge, the purpose of the ERA is to protect communities/populations of a species.
- If groundwater is discharging to Cambridge Bay, this process would be limited to the few months in the summer when the active layer thaws. During the colder months, the active layer would be frozen limiting any groundwater migration towards Cambridge Bay.

The long-term objective at the Site is to remediate the soil and decommission the LTU to achieve site closure. Based on the results of the PQRA, potential risks to human and ecological receptors from exposure to COPCs in soil, groundwater, and sump water are acceptable. Therefore, no further work, such as risk assessment (e.g., a detailed quantitative risk assessment), remediation or risk management measures are required to mitigate risk to human health or the environment. Therefore, the Apron LTU can be decommissioned and the Site closed. Decommissioning of the Apron LTU should be completed in accordance with previous recommendations provided by Stantec (2021).

8.0 CLOSURE

This report documents work that was completed in accordance with generally accepted professional standards at the time the services were provided. No other representations, warranties or guarantees are made concerning the accuracy or completeness of the data or conclusions contained within this report, including no assurance that this work has uncovered all potential liabilities associated with the identified property.

This report was undertaken exclusively for the purpose outlined herein and was limited to those contaminants, exposure pathways, receptors, and related uncertainties specifically referenced in this report. This work was specific to the site conditions and land use considerations described herein. All information received from the client or third parties in the preparation of this report has been assumed by Stantec to be correct. Stantec assumes no responsibility for any deficiency or inaccuracy in information received from others.

The opinions in this report can only be relied upon as they relate to the condition of the portions of the identified property that were assessed at the time the work was conducted. Activities at the property subsequent to Stantec's assessment may have significantly altered the property's condition. Stantec cannot comment on other areas of the property that were not assessed.

Conclusions made within this report consist of Stantec's professional opinion as of the time of the writing of this report and are based solely on the scope of work described in the report and the limited data available. They are not a certification of the property's environmental condition. This report should not be construed as legal advice.

This report has been prepared for the exclusive use of the client identified herein and any use by any third party is prohibited. Stantec assumes no responsibility for losses, damages, liabilities or claims, howsoever arising, from third party use of this report. For this report, the sampling was limited to specific areas and the analytical program was limited to the determination of the specific parameters indicated.

Should additional information become available which differs significantly from our understanding of conditions presented in this report, Stantec specifically disclaims any responsibility to update the conclusions in this report.

9.0 STANTEC QUALITY MANAGEMENT PROGRAM

This report, entitled **Preliminary Quantitative Risk Assessment, Apron LTU, Cambridge Bay Airport, Victoria Island, Nunavut** prepared for PSPC on behalf of TC, dated March 25, 2021, was produced by Stantec Consulting Ltd.

Regards,

STANTEC CONSULTING LTD.

Digitally signed by Sasha Richards
Date: 2021.03.25 11:30:07 -04'00'

Sasha Richards, M.Sc., P.Eng.
Environmental Engineer/Risk Assessor
Phone: (613) 852-7316

Sasha.Richards@stantec.com

Loren D. Knopper
2021.03.25 14:42:59 -04'00'

Loren Knopper, Ph.D.
Principal, Environmental Services
Phone: (905) 518-2854

Loren.Knopper@stantec.com

10.0 REFERENCES

Arcadis Canada Inc. (Arcadis). 2017. 2017 Environmental Monitoring Program at Cambridge Bay Airport Apron LTU. Dated December 1, 2017.

Canadian Council of Ministers of the Environment (CCME). 1996. A Framework for Ecological Risk Assessment (General Guidance).

CCME. 1997. A Framework for Ecological Risk Assessment (Technical Appendices).

CCME. 2006. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines.

CCME. 2008a. Canada Wide Standards for Petroleum Hydrocarbons (PHC) in Soil. Technical Supplement.

CCME. 2008b. Canada Wide Standards for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale. January 2008. PN 1399. ISBN 978-1-896997-77-3 http://www.ccme.ca/files/Resources/csm/phc_cws/pn_1399_phc_sr_std_1.2_e.pdf.

CCME. 2020. Ecological Risk Assessment Guidance Document.

CCME. 2021a. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health. Summary table and relevant factsheets. Available from: http://ceqg-rcqe.ccme.ca/. Last checked: February 2021.

CCME. 2021b. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Summary table and relevant factsheets. Available from: http://ceqg-rcqe.ccme.ca/. Last checked: February 2021.

Environment Canada. 2012. Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment Guidance. March 2012.

Environment and Climate Change Canada (ECCC). 2018. Canadian Environmental Protection Act, 1999 Federal Environmental Quality Guidelines Perfluorooctane Sulfonate (PFOS).

Federal Contaminated Sites Action Plan (FCSAP). 2016. Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites. Prepared by: Meridian Environmental Inc. June 2016, revised November 2016.

FCSAP. 2018. Interim Advice to Federal Custodian Departments for the Management of Federal Sites Containing Perfluorooctane Sulfonate (PFOS) and other Per-and Polyfluoroalkyl Substances (PFAS).

Health Canada. 2010a. Federal Contaminated Site Risk Assessment in Canada - Part 1: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0, September 2010, Revised 2012.

Health Canada. 2010b. Federal Contaminated Site Risk Assessment in Canada Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors, Version 2.0.

Health Canada. 2010c. Federal Contaminated Site Risk Assessment in Canada - Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals ($DQRA_{Chem}$).

Health Canada. 2019. Summary Table: Health Canada Draft Guidelines, Screening Values and Toxicological Reference Values (TRVs) for Perfluoroalkyl Substances (PFAS).

Health Canada. 2020. Guidelines for Canadian Drinking Water Quality Summary Table. Dated September 2020.

Stantec Consulting Ltd. (Stantec). 2019. 2018 Site Remedial Activities Supervision and Environmental Monitoring Program – Cambridge Bay Airport, Apron Land Treatment Unit and Excavation Area, Amendment 1. Dated March 2019.

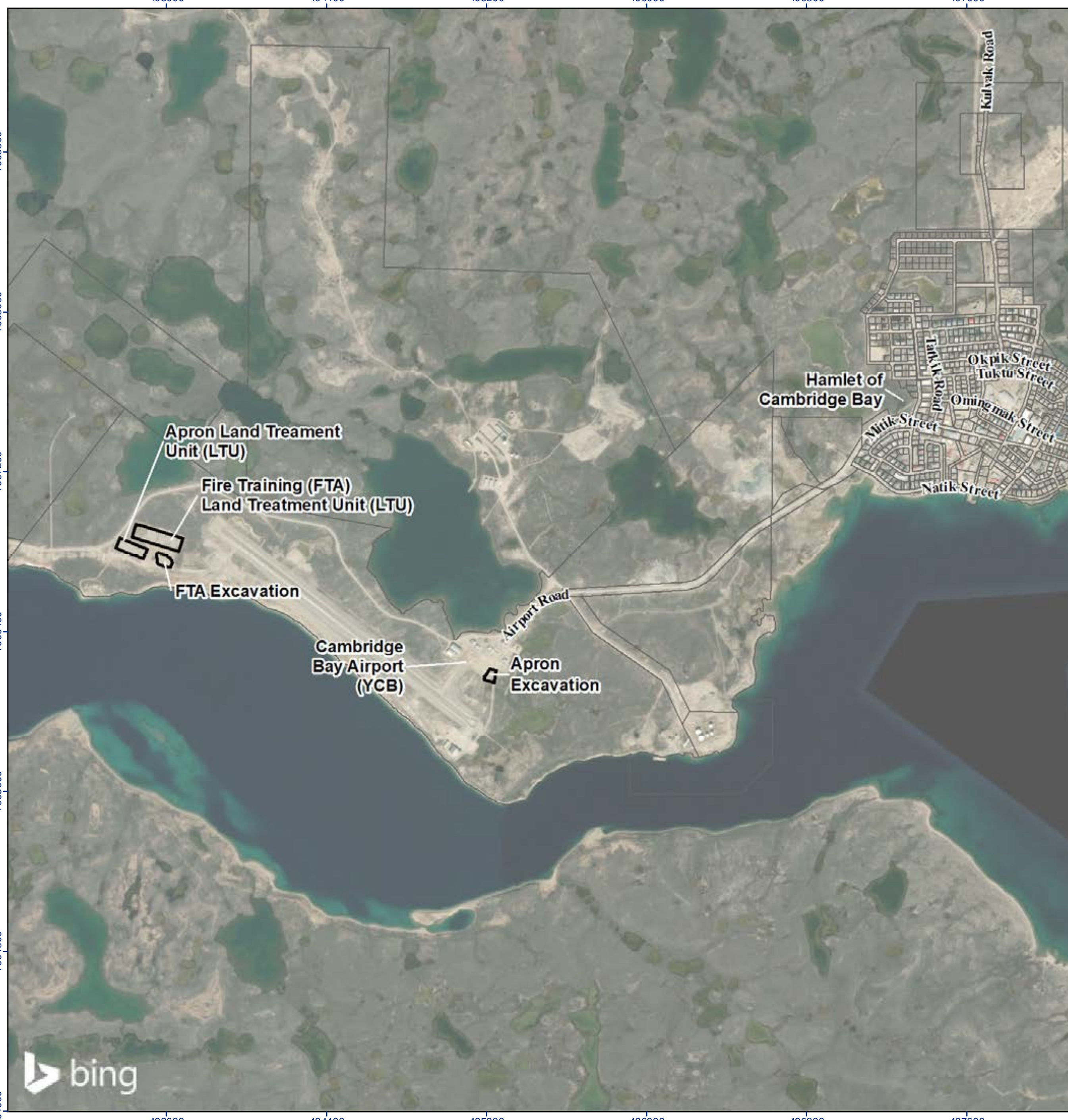
Stantec. 2020. 2019 Site Remedial Activities Supervision and Environmental Monitoring Program – Cambridge Bay Airport, Apron Land Treatment Unit and Excavation Area, Addendum. Dated March 2020.

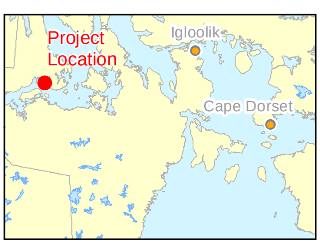
Stantec. 2021. Abandonment and Restoration Plan, Cambridge Bay Airport Apron Land Treatment Unit, Version 3. Dated February 17, 2021.

Virginia Department of Environmental Quality (VDEQ). 2020. Virginia Unified Risk Assessment Model – VURAM User Guide. For Risk Assessors. Updated June 2020. https://www.deq.virginia.gov/land-waste/land-remediation/voluntary-remediation.

APPENDIX A

Figures





Site Feature

Land Parcel

0 400 800 metres

(At original document size of 8.5x11)
1:30,000

N

Stantec

Project Location
Cambridge Bay
Nunavut

Prepared by MKuhl on 2021-02-16
TR by SRichards on 2021-02-17
IR by LKnopper on 2021-02-24

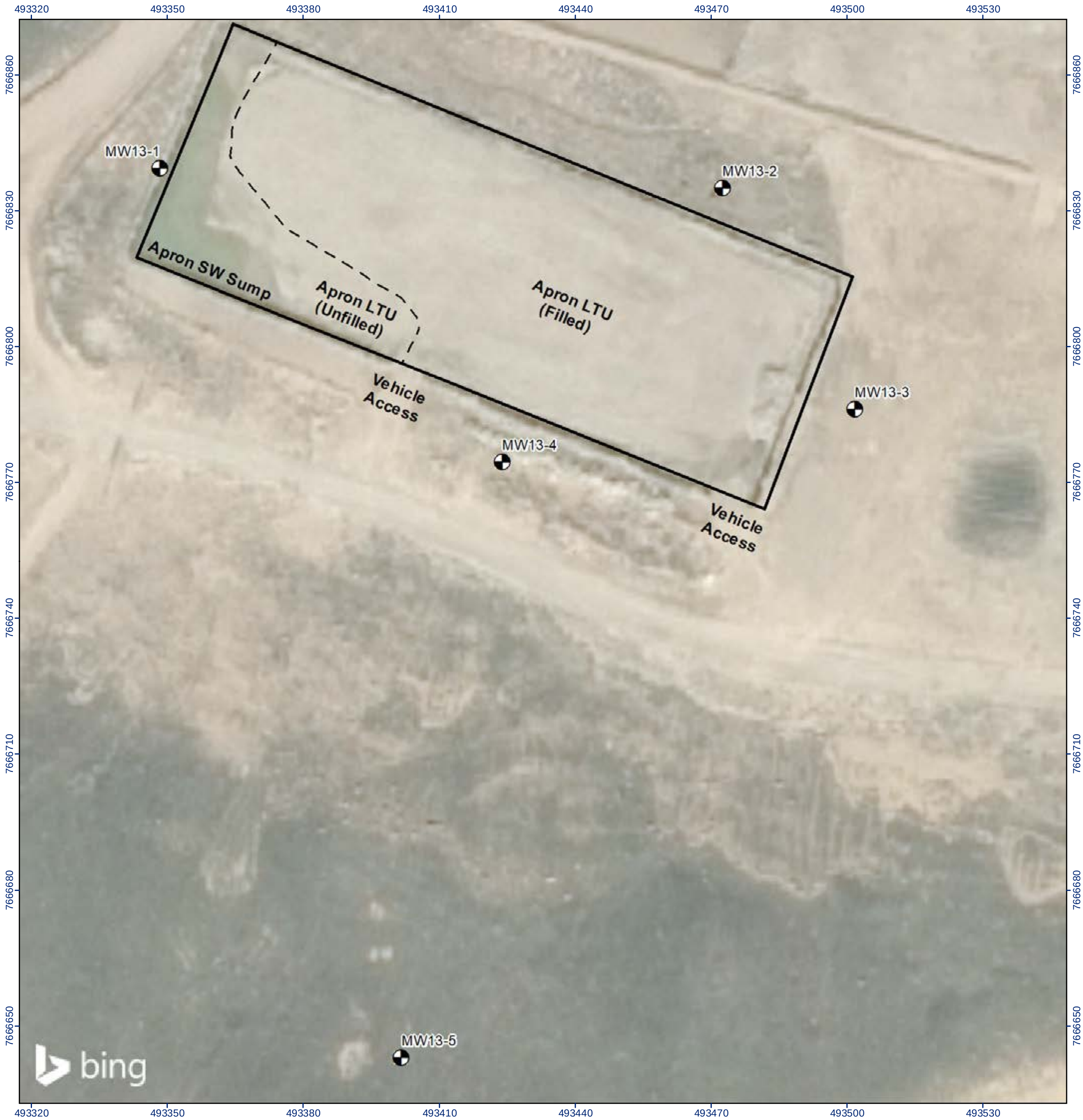
Client/Project 110220512
Public Services and Procurement Canada (PSPC)
for Transport Canada,
Cambridge Bay Airport, Apron LTU
Human Health and Ecological Risk Assessment

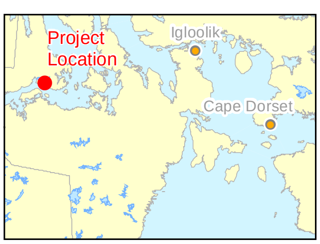
Figure No.
1

Title
Site Location Plan

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Data Sources: Geogratis, ©Department of Natural Resources Canada, All rights reserved.
3. Background: © 2021 Microsoft Corporation © 2021 Maxar ©CNES (2021) Distribution Airbus DS

\\Cd1001-c200\workgroup\1102\active\110220512\gis\figures\2021_cambridge_bay_apron_hera\fig_1_site_location_plan.mxd Revised: 2021-03-01 By: MKuhl





Approximate LTU Limits

Monitoring Well Location (Others 2013)

LTU Land Treatment Unit

0 15 30 metres

(At original document size of 8.5x11)
1:1,300

N

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Data Sources: Geogratis, ©Department of Natural Resources Canada, All rights reserved.
3. Background: © 2021 Microsoft Corporation © 2021 Maxar ©CNES (2021) Distribution Airbus DS

Stantec

Project Location
Cambridge Bay
Nunavut

Prepared by MKuhl on 2021-02-16
TR by SRichards on 2021-02-17
IR by LKnopper on 2021-02-24

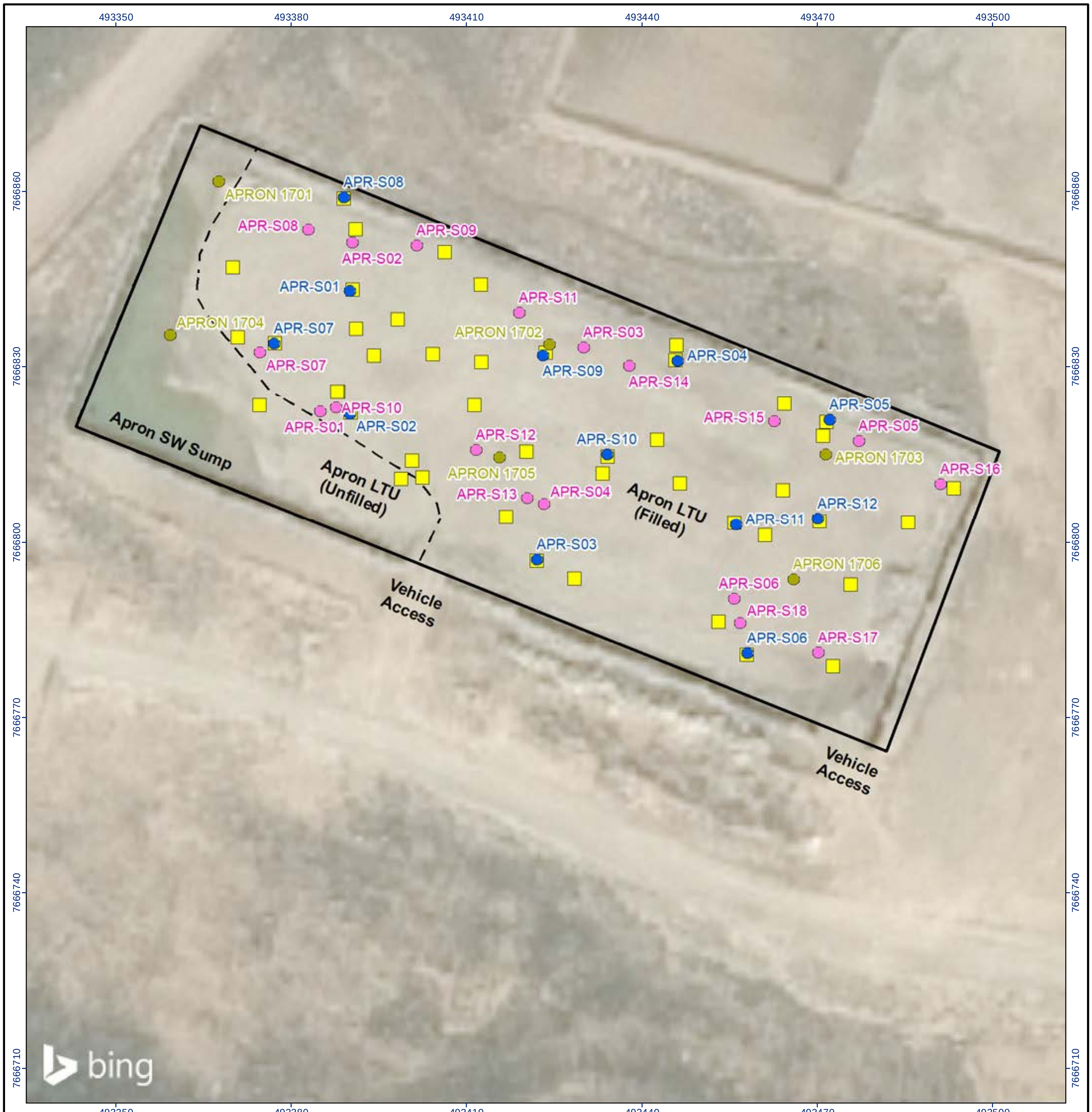
Client/Project 110220512
Public Services and Procurement Canada (PSPC) for Transport Canada,
Cambridge Bay Airport, Apron LTU
Human Health and Ecological Risk Assessment

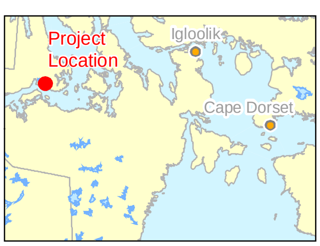
Figure No.
2

Title
Site Plan of Apron LTU

\\Cd1001-c200\workgroup\1102\active\110220512\gis\figures\2021_cambridge_bay_apron_hera\fig_2_site_plan_apron_ltu.mxd Revised: 2021-03-01 By: MKuhl

\\Cd1001-c200\workgroup\1102\active\110220512\gis\figures\2021_cambridge_bay_apron_hera\fig_3_hist_soil_sampling_locs.mxd Revised: 2021-03-23 By: djenkins





- Approximate LTU Limits
- Stantec Composite Soil Sampling Location (2019)
- Stantec Soil Sampling Location (2019)
- Stantec Soil Sampling Location (2018)
- Arcadis Soil Sampling Location (2017)

LTU Land Treatment Unit

0 15 30 metres

(At original document size of 8.5x11)
1:5,000

N

Stantec

Project Location
Cambridge Bay
Nunavut

Prepared by MKuhl on 2021-03-22
TR by SRichards on 2021-03-22
IR by LKnopper on 2021-03-22

Client/Project 110220512
Public Services and Procurement Canada (PSPC)
for Transport Canada,
Cambridge Bay Airport, Apron LTU
Human Health and Ecological Risk Assessment

Figure No.
3

Title
Historical Soil Sampling Locations

Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
2. Data Sources: Geogratis, ©Department of Natural Resources Canada, All rights reserved.
3. Background: © 2021 Microsoft Corporation © 2021 Maxar ©CNES (2021) Distribution Airbus DS

APPENDIX B

Data Tables

Table B-1
Summary of Soil Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Sample Location	Units	Highest Laboratory RDL	Number of Samples	Number of Samples with Detected Concentrations	Maximum	APRON 1701	APRON 1702	APRON 1703	APRON 1704		APRON 1705	APRON 1706	APR-S01	APR-S02	APR-S03		APR-S04	APR-S05	APR-S06	APR-S07	APR-S08	APR-S09	
Sample Date						5-Aug-17	5-Aug-17	5-Aug-17	5-Aug-17		5-Aug-17	5-Aug-17	13-Aug-18	13-Aug-18	13-Aug-18		13-Aug-18	13-Aug-18	13-Aug-18	14-Aug-18	14-Aug-18	14-Aug-18	
Sample ID						APRON 1701	APRON 1702	APRON 1703	APRON 1704	APRONDUP01 (Duplicate of APRON 1704)	APRON 1705	APRON 1706	APR-S01-0-0.3	APR-S02-0-0.3	APR-S03-0-0.3	Duplicate of APR-S03	APR-S04-0-0.3	APR-S05-0-0.3	APR-S06-0-0.3	APR-S07-05-0.55	APR-S08-05-0.55	APR-S09-05-0.55	Duplicate of APR-S09-0.5-0.55
Sample Depth						Not Available	Not Available	Not Available	Not Available		Not Available	Not Available	0.0-0.3 m BGS	0.0-0.3 m BGS	0.0-0.3 m BGS		0.0-0.3 m BGS	0.0-0.3 m BGS	0.0-0.3 m BGS	0.5-0.55 m BGS	0.5-0.55 m BGS	0.5-0.55 m BGS	
Sampling Company						Arcadis	Arcadis	Arcadis	Arcadis		Arcadis	Arcadis	Stantec	Stantec	Stantec		Stantec	Stantec	Stantec	Stantec	Stantec	Stantec	
Laboratory						Maxxam	Maxxam	Maxxam	Maxxam		Maxxam	Maxxam	Maxxam	Maxxam	Maxxam		Maxxam	Maxxam	Maxxam	Maxxam	Maxxam	Maxxam	
BTEX and Petroleum Hydrocarbons																							
Benzene	mg/kg	<0.005	46	4	0.045	<0.0050	<0.0050	<0.0050	0.038	0.045	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Toluene	mg/kg	<0.05	46	1	7.2	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Ethylbenzene	mg/kg	<0.01	46	4	1.6	<0.010	<0.010	<0.010	1.4	1.6	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes, Total	mg/kg	<0.045	46	8	6.6	<0.040	<0.040	<0.040	5.9	6.6	<0.040	<0.040	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045
PHC F1 (C6-C10 range) minus BTEX	mg/kg	<10	46	16	840	<10	<10	<10	830	840	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
PHC F2 (>C10-C16 range)	mg/kg	<10	46	39	2300	36	21	23	440	490	17	100	180	<10	16	<10	47	<10	27	80	120	12	<10
PHC F3 (>C16-C34 range)	mg/kg	<50	46	45	2100	<50	1500	1300	71	92	1900	520	150	150	1300	1100	550	780	83	97	250	110	94
PHC F4 (>C34-C50 range)	mg/kg	<50	46	26	1400	<50	1000	840	<50	<50	1400	270	<50	<50	870	760	320	520	<50	<50	<50	<50	<50
Per- and Polyfluoroalkyl Substances (PFAS)																							
Perfluorobutanesulfonic acid (PFBS)	µg/kg	<1.0	21	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10
Perfluorobutanoic acid (PFBA)	µg/kg	<1.0	21	9	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	0.12	<0.10	<0.10
Perfluorodecanoic Acid (PFDA)	µg/kg	<1.0	21	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10
Perfluorodecanesulfonic acid (PFDS)	µg/kg	<1.0	21	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10
Perfluorododecanoic Acid (PFDoA)	µg/kg	<1.0	21	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10
Perfluoroheptanesulfonic acid (PFHpS)	µg/kg	<1.0	21	4	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10
Perfluoroheptanoic Acid (PFHpA)	µg/kg	<1.0	21	10	0.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.15	0.3	0.12	0.11
Perfluorohexanesulfonic acid (PFHxS)	µg/kg	<1.0	21	15	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.44	0.93	0.38	0.28
Perfluorohexanoic Acid (PFHxA)	µg/kg	<1.0	21	10	0.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	0.31	0.11	<0.10
Perfluorooctanoic Acid (PFOA)	µg/kg	<1.0	21	13	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.21	0.74	0.23	0.18
Perfluorononanesulfonic acid (PFNS)	µg/kg	<1.0	7	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Perfluorononanoic Acid (PFNA)	µg/kg	<1.0	21	6	0.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	0.14	<0.10	<0.10
Perfluorooctanesulfonic acid (PFOS)	µg/kg	<1.0	21	21	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.1	18	3	1.9
Perfluorooctane Sulfonamide (PFOSA)	µg/kg	<1.0	21	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10
Perfluoropentanesulfonic acid (PFPeS)	µg/kg	<1.0	7	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Perfluoropentanoic Acid (PFPeA)	µg/kg	<1.0	21	9	0.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	0.28	0.12	<0.10
Perfluorotetradecanoic Acid (PFTeA)	µg/kg	<1.0	21	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10
Perfluorotridecanoic Acid (PFTriA)	µg/kg	<1.0	21	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10
Perfluoroundecanoic Acid (PFUnA)	µg/kg	<1.0	21	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10

Notes:
-: Parameter not analyzed / not available.
RDL: Reporting Detection Limit
BTEX: benzene, toluene, ethylbenzene, xylenes

Table B-1
Summary of Soil Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Sample Location	Units	Highest Laboratory RDL	Number of Samples	Number of Samples with Detected Concentrations	Maximum	APR-S10	APR-S11	APR-S12	APR-S13		APR-S14	APR-S15	APR-S16	APR-S17	APR-S18	APR-S01	APR-S02	APR-S03	APR-S04	APR-S05		APR-S06	APR-S07	
Sample Date						14-Aug-18	15-Aug-18	15-Aug-18	15-Aug-18		15-Aug-18	15-Aug-18	15-Aug-18	15-Aug-18	15-Aug-18	10-Aug-19	10-Aug-19	10-Aug-19	10-Aug-19	10-Aug-19	10-Aug-19	10-Aug-19	10-Aug-19	10-Aug-19
Sample ID						APR-S10-05-0.55	APR-S11-05-0.55	APR-S12-05-0.55	APR-S13-05-0.55	Duplicate of APR-S13-0.5-0.55	APR-S14-0.5-0.55	APR-S15-0.5-0.55	APR-S16-0.5-0.55	APR-S17-0.5-0.55	APR-S18-0.5-0.55	APR-SO1	APR-SO2	APR-SO3	APR-SO4	APR-SO5	QC-APR-01	APR-SO6	APR-SO7	QC-APR-02
Sample Depth						0.5-0.55 m BGS	0.5-0.55 m BGS	0.5-0.55 m BGS	0.5-0.55 m BGS		0.5-0.55 m BGS	0.5-0.55 m BGS	0.5-0.55 m BGS	0.5-0.55 m BGS	0.5-0.55 m BGS	0.5 m BGS	0.5 m BGS	0.5 m BGS	0.5 m BGS	0.5 m BGS	0.5 m BGS	0.5 m BGS	0.5 m BGS	0.5 m BGS
Sampling Company						Stantec	Stantec	Stantec	Stantec		Stantec	Stantec	Stantec	Stantec	Stantec	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory						Maxxam	Maxxam	Maxxam	Maxxam		Maxxam	Maxxam	Maxxam	Maxxam	Maxxam	BV	BV	BV	BV	BV	BV	BV	BV	BV
BTEX and Petroleum Hydrocarbons																								
Benzene	mg/kg	<0.005	46	4	0.045	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0058	<0.0050
Toluene	mg/kg	<0.05	46	1	7.2	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.050	<0.050	<0.050	<0.050	<0.050	7.2	<0.050	<0.050	<0.050
Ethylbenzene	mg/kg	<0.01	46	4	1.6	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes, Total	mg/kg	<0.045	46	8	6.6	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045	0.066	<0.045	<0.045	0.36	<0.045	<0.045	<0.045	<0.045	<0.045	<0.045
PHC F1 (C6-C10 range) minus BTEX	mg/kg	<10	46	16	840	<10	<10	32	180	390	<10	<10	<10	23	190	16	<10	580	<10	<10	<10	<10	90	79
PHC F2 (>C10-C16 range)	mg/kg	<10	46	39	2300	68	15	440	1800	1600	77	22	30	670	1500	50	29	1,500	32	<10	<10	2300	360	320
PHC F3 (>C16-C34 range)	mg/kg	<50	46	45	2100	290	380	260	290	300	1800	2100	960	430	430	170	180	290	1,000	300	660	660	200	200
PHC F4 (>C34-C50 range)	mg/kg	<50	46	26	1400	<50	220	<50	<50	<50	1100	1400	560	67	57	<50	<50	<50	700	220	530	110	<50	<50
Per- and Polyfluoroalkyl Substances (PFAS)																								
Perfluorobutanesulfonic acid (PFBS)	µg/kg	<1.0	21	1	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.1	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorobutanoic acid (PFBA)	µg/kg	<1.0	21	9	3.6	0.14	<0.10	<0.10	<0.10	0.97	0.26	<0.10	0.35	<0.10	<0.10	-	-	-	-	-	-	-	3.6	3.1
Perfluorodecanoic Acid (PFDA)	µg/kg	<1.0	21	0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorodecanesulfonic acid (PFDS)	µg/kg	<1.0	21	0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorododecanoic Acid (PFDoA)	µg/kg	<1.0	21	0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluoroheptanesulfonic acid (PFHpS)	µg/kg	<1.0	21	4	0.17	0.1	<0.10	0.12	<0.10	<0.10	0.14	<0.10	0.17	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluoroheptanoic Acid (PFHpA)	µg/kg	<1.0	21	10	0.86	0.33	0.13	0.22	<0.10	<0.10	0.61	0.3	0.86	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorohexanesulfonic acid (PFHxS)	µg/kg	<1.0	21	15	2.8	1.3	0.56	1.5	<0.10	<0.10	2.3	1.1	2.8	0.29	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorohexanoic Acid (PFHxA)	µg/kg	<1.0	21	10	0.84	0.37	0.15	0.14	<0.10	<0.10	0.47	0.32	0.84	0.13	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorooctanoic Acid (PFOA)	µg/kg	<1.0	21	13	1.6	0.55	0.26	0.53	<0.10	<0.10	1.3	0.58	1.6	0.14	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorononanesulfonic acid (PFNS)	µg/kg	<1.0	7	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorononanoic Acid (PFNA)	µg/kg	<1.0	21	6	0.39	0.17	<0.10	0.1	<0.10	<0.10	0.39	0.18	0.37	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorooctanesulfonic acid (PFOS)	µg/kg	<1.0	21	21	28	11	3.5	18	0.35	0.71	25	12	28	1	0.38	-	-	-	-	-	-	-	1.5	1.3
Perfluorooctane Sulfonamide (PFOSA)	µg/kg	<1.0	21	0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluoropentanesulfonic acid (PFPeS)	µg/kg	<1.0	7	0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.0	<1.0
Perfluoropentanoic Acid (PFPeA)	µg/kg	<1.0	21	9	0.98	0.4	0.16	<0.10	<0.10	<0.10	0.4	0.34	0.98	0.15	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorotetradecanoic Acid (PFTeA)	µg/kg	<1.0	21	0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluorotridecanoic Acid (PFTriA)	µg/kg	<1.0	21	0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0
Perfluoroundecanoic Acid (PFUnA)	µg/kg	<1.0	21	0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	<1.0	<1.0

Notes:
-: Parameter not analyzed / not available.
RDL: Reporting Detection Limit
BTEX: benzene, toluene, ethylbenzene, xylenes

Table B-1
Summary of Soil Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Sample Location Sample Date Sample ID Sample Depth Sampling Company Laboratory	Units	Highest Laboratory RDL	Number of Samples	Number of Samples with Detected Concentrations	Maximum	APR-S08 10-Aug-19 APR-SO8 0.5 m BGS STANTEC BV	APR-S09 10-Aug-19 APR-SO9 0.5 m BGS STANTEC BV	APR-S10 10-Aug-19 APR-S10 0.5 m BGS STANTEC BV	APR-S11 10-Aug-19 APR-S11 0.5 m BGS STANTEC BV	APR-S12 10-Aug-19 APR-S12 0.5 m BGS STANTEC BV	APR-COMP1 10-Aug-19 APR-COMP1 0.0-0.3 and 0.3-0.5 m BGS STANTEC BV	APR-COMP2 10-Aug-19 APR-COMP2 0.0-0.3 and 0.3-0.5 m BGS STANTEC BV	APR-COMP3 10-Aug-19 APR-COMP3 0.0-0.3 and 0.3-0.5 m BGS STANTEC BV	APR-COMP4 10-Aug-19 APR-COMP4 0.0-0.3 and 0.3-0.5 m BGS STANTEC BV
BTEX and Petroleum Hydrocarbons														
Benzene	mg/kg	<0.005	46	4	0.045	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0081	<0.0050
Toluene	mg/kg	<0.05	46	1	7.2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ethylbenzene	mg/kg	<0.01	46	4	1.6	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.1	<0.010	<0.010
Xylenes, Total	mg/kg	<0.045	46	8	6.6	<0.045	<0.045	<0.045	<0.045	<0.045	0.29	0.22	0.52	0.25
PHC F1 (C6-C10 range) minus BTEX	mg/kg	<10	46	16	840	<10	<10	36	<10	<10	120	210	180	130
PHC F2 (>C10-C16 range)	mg/kg	<10	46	39	2300	12	28	28	10	<10	370	530	610	670
PHC F3 (>C16-C34 range)	mg/kg	<50	46	45	2100	140	1500	520	570	350	530	730	790	730
PHC F4 (>C34-C50 range)	mg/kg	<50	46	26	1400	<50	1100	330	400	230	270	410	440	360
Per- and Polyfluoroalkyl Substances (PFAS)														
Perfluorobutanesulfonic acid (PFBS)	µg/kg	<1.0	21	1	0.1	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluorobutanoic acid (PFBA)	µg/kg	<1.0	21	9	3.6	<1.0	2.1	1.2	<1.0	<1.0	-	-	-	-
Perfluorodecanoic Acid (PFDA)	µg/kg	<1.0	21	0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluorodecanesulfonic acid (PFDS)	µg/kg	<1.0	21	0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluorododecanoic Acid (PFDoA)	µg/kg	<1.0	21	0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluoroheptanesulfonic acid (PFHpS)	µg/kg	<1.0	21	4	0.17	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluoroheptanoic Acid (PFHpA)	µg/kg	<1.0	21	10	0.86	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluorohexanesulfonic acid (PFHxS)	µg/kg	<1.0	21	15	2.8	2	2.3	<1.0	1.1	1.3	-	-	-	-
Perfluorohexanoic Acid (PFHxA)	µg/kg	<1.0	21	10	0.84	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluorooctanoic Acid (PFOA)	µg/kg	<1.0	21	13	1.6	1.1	1.3	<1.0	<1.0	<1.0	-	-	-	-
Perfluorononanesulfonic acid (PFNS)	µg/kg	<1.0	7	0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluorononanoic Acid (PFNA)	µg/kg	<1.0	21	6	0.39	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluorooctanesulfonic acid (PFOS)	µg/kg	<1.0	21	21	28	10	19	6.5	5.4	7.8	-	-	-	-
Perfluorooctane Sulfonamide (PFOSA)	µg/kg	<1.0	21	0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluoropentanesulfonic acid (PFPeS)	µg/kg	<1.0	7	0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluoropentanoic Acid (PFPeA)	µg/kg	<1.0	21	9	0.98	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluorotetradecanoic Acid (PFTeA)	µg/kg	<1.0	21	0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluorotridecanoic Acid (PFTriA)	µg/kg	<1.0	21	0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-
Perfluoroundecanoic Acid (PFUnA)	µg/kg	<1.0	21	0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-

Notes:
-: Parameter not analyzed / not available.
RDL: Reporting Detection Limit
BTEX: benzene, toluene, ethylbenzene, xylenes

Table B-2
Summary of Groundwater Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Sample Location Sample Date Sample ID Sampling Company Laboratory Laboratory Work Order Laboratory Sample ID Sample Type	Units	Highest Laboratory RDL	Number of Samples	Number of Samples with Detected Concentrations	Maximum	MW13-1 15-Aug-19 MW13-1 STANTEC BV B969005 WI1959	MW13-1 9-Aug-18 MW13-1 STANTEC Maxxam	MW13-1 30-Jul-17 MW13-1 Arcadis Maxxam	MW13-3 15-Aug-19 MW13-3 STANTEC BV B969005 WI1958	MW13-3 15-Aug-19 GW-QC-02 STANTEC BV B969005 WI1960 Field Duplicate	MW13-5 15-Aug-19 MW13-5 STANTEC BV B969005 WI1957
BTEX and Petroleum Hydrocarbons											
Benzene	mg/L	<0.00040	6	0	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Toluene	mg/L	<0.00040	6	0	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Ethylbenzene	mg/L	<0.00040	6	0	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Xylenes, Total	mg/L	<0.00089	6	0	<0.00089	<0.00089	<0.00080	<0.00080	<0.00089	<0.00089	<0.00089
PHC F1 (C6-C10 range)	mg/L	<0.10	6	0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PHC F2 (>C10-C16 range)	mg/L	<0.10	6	0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PHC F3 (C16-C34 Hydrocarbons)	mg/L	<0.20	1	0	<0.20	-	-	<0.20	-	-	-
PHC F4 (C34-C50 Hydrocarbons)	mg/L	<0.20	1	0	<0.20	-	-	<0.20	-	-	-
Per- and Polyfluoroalkyl Substances (PFAS)				0							
Perfluorobutane Sulfonate (PFBS)	µg/L	<0.020	5	3	0.075	<0.020	0.0092	-	0.075	0.075	<0.020
Perfluorobutanoic Acid (PFBA)	µg/L	<0.2	5	4	1.4	0.033	<0.2	-	1.3	1.4	0.052
Perfluorodecanoic Acid (PFDA)	µg/L	<0.040	5	0	<0.040	<0.020	<0.002	-	<0.040	<0.040	<0.020
Perfluorodecane Sulfonic Acid (PFDS)	µg/L	<0.040	5	0	<0.040	<0.020	<0.002	-	<0.040	<0.040	<0.020
Perfluorododecanoic Acid (PFDoA)	µg/L	<0.040	5	0	<0.040	<0.020	<0.002	-	<0.040	<0.040	<0.020
Perfluoroheptane Sulfonate (PFHpS)	µg/L	<0.040	5	0	<0.040	<0.020	<0.002	-	<0.040	<0.040	<0.020
Perfluoroheptanoic Acid (PFHpA)	µg/L	<0.040	5	5	0.73	0.050	0.043	-	0.67	0.73	0.022
Perfluorohexanesulfonic acid (PFHxS)	µg/L	<0.040	5	5	0.45	0.058	0.032	-	0.40	0.45	0.027
Perfluorohexanoic Acid (PFHxA)	µg/L	<0.40	5	5	2.9	0.10	0.120	-	2.9	2.9	0.15
Perfluorooctanic Acid (PFOA)	µg/L	<0.020	5	3	0.29	<0.020	0.014	-	0.26	0.29	<0.020
Perfluorononanesulfonic Acid (PFNS)	µg/L	<0.040	4	0	<0.040	<0.020	-	-	<0.040	<0.040	<0.020
Perfluorononanoic Acid (PFNA)	µg/L	<0.040	5	1	0.0047	<0.020	0.0047	-	<0.040	<0.040	<0.020
Perfluorooctane Sulfonate (PFOS)	µg/L	<0.020	5	3	0.26	<0.020	0.015	-	0.24	0.26	<0.020
Perfluorooctanesulfonamide (PFOSA)	µg/L	<0.040	5	0	<0.040	<0.020	<0.004	-	<0.040	<0.040	<0.020
Perfluoropentanesulfonic Acid (PFPeS)	µg/L	<0.020	4	2	0.074	<0.020	-	-	0.056	0.074	<0.020
Perfluoropentanoic Acid (PFPeA)	µg/L	<0.40	5	5	5.10	0.15	0.017	-	5.1	5.1	0.30
Perfluorotetradecanoic Acid (PFTeA)	µg/L	<0.040	5	0	<0.040	<0.020	<0.002	-	<0.040	<0.040	<0.020
Perfluorotridecanoic Acid (PFTriA)	µg/L	<0.040	5	0	<0.040	<0.020	<0.002	-	<0.040	<0.040	<0.020
Perfluoroundecanoic Acid (PFUnA)	µg/L	<0.040	5	0	<0.040	<0.020	<0.002	-	<0.040	<0.040	<0.020

Notes:
-: Parameter not analyzed / not available.
RDL: Reporting Detection Limit
BTEX: benzene, toluene, ethylbenzene, xylenes

Table B-3
Summary of Sump Water Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Sample Location Sample Date Sample ID Sampling Company Laboratory	Units	Highest Laboratory RDL	Number of Samples	Number of Samples with Detected Concentrations	Maximum	APRONSUMP 26-Jul-16 APRONSUMP Arcadis Maxxam	APRON SUMP 25-Jul-17 APRON SUMP Arcadis Maxxam
BTEX and Petroleum Hydrocarbons							
Benzene	mg/L	<0.00040	2	0	<0.00040	<0.00040	<0.00040
Toluene	mg/L	<0.00040	2	0	<0.00040	<0.00040	<0.00040
Ethylbenzene	mg/L	<0.00040	2	0	<0.00040	<0.00040	<0.00040
Xylenes, Total	mg/L	<0.00089	2	0	<0.00080	<0.00080	<0.00089
PHC F1 (C6-C10 range)	mg/L	<0.10	2	0	<0.10	<0.10	<0.10
PHC F2 (>C10-C16 range)	mg/L	<0.10	2	0	<0.10	<0.10	<0.10
Per- and Polyfluoroalkyl Substances (PFAS)							
Perfluorobutane Sulfonate (PFBS)	µg/L	<0.020	2	2	0.028	0.024	0.028
Perfluorobutanoic Acid (PFBA)	µg/L	<0.020	2	2	0.11	0.095	0.11
Perfluorodecanoic Acid (PFDA)	µg/L	<0.020	2	0	<0.020	<0.020	<0.020
Perfluorodecane Sulfonic Acid (PFDS)	µg/L	<0.020	2	0	<0.020	<0.020	<0.020
Perfluorododecanoic Acid (PFDoA)	µg/L	<0.020	2	0	<0.020	<0.020	<0.020
Perfluoroheptane Sulfonate (PFHpS)	µg/L	<0.020	2	0	<0.020	<0.020	<0.020
Perfluoroheptanoic Acid (PFHpA)	µg/L	<0.020	2	2	0.23	0.16	0.23
Perfluorohexanesulfonic acid (PFHxS)	µg/L	<0.020	2	2	0.2	0.2	0.2
Perfluorohexanoic Acid (PFHxA)	µg/L	<0.020	2	2	0.34	0.27	0.34
Perfluorooctanic Acid (PFOA)	µg/L	<0.020	2	2	0.078	0.078	0.05
Perfluorononanesulfonic Acid (PFNS)	µg/L	<0.020	0	N/A	-	-	-
Perfluorononanoic Acid (PFNA)	µg/L	<0.020	2	0	<0.020	<0.020	<0.020
Perfluorooctane Sulfonate (PFOS)	µg/L	<0.020	2	0	0.076	0.076	<0.020
Perfluorooctanesulfonamide (PFOSA)	µg/L	<0.020	2	0	<0.020	<0.020	<0.020
Perfluoropentanesulfonic Acid (PFPeS)	µg/L	<0.020	0	N/A	-	-	-
Perfluoropentanoic Acid (PFPeA)	µg/L	<0.020	2	2	0.49	0.34	0.49
Perfluorotetradecanoic Acid (PFTeA)	µg/L	<0.020	2	0	<0.020	<0.020	<0.020
Perfluorotridecanoic Acid (PFTriA)	µg/L	<0.020	2	0	<0.020	<0.020	<0.020
Perfluoroundecanoic Acid (PFUnA)	µg/L	<0.020	2	0	<0.020	<0.020	<0.020

Notes:
-: Parameter not analyzed / not available.
RDL: Reporting Detection Limit
BTEX: benzene, toluene, ethylbenzene, xylenes

APPENDIX C

Screening Tables

Table C-1
Human Health Screening of Soil Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Parameter	Units	Maximum	CCME CSQG, CWS			HC SSV[C]	Retained as Human Health COPC
			Ingestion [A, B]	Dermal Contact [A, B]	Management Limit [B]		
BTEX and Petroleum Hydrocarbons							
Benzene	µg/g	0.045	110	250	n/v	n/v	No
Toluene	µg/g	7.2	NA	NA	n/v	n/v	No
Ethylbenzene	µg/g	1.6	620,000	560,000	n/v	n/v	No
Xylenes, Total	µg/g	6.6	NA	NA	n/v	n/v	No
PHC F1 (C6-C10 range) minus BTEX	µg/g	840	RES		700	n/v	No - See Text in Section 4.1.1.1
PHC F2 (>C10-C16 range)	µg/g	2300	RES		1000	n/v	No - See Text in Section 4.1.1.1
PHC F3 (>C16-C34 range)	µg/g	2100	RES		3500	n/v	No
PHC F4 (>C34-C50 range)	µg/g	1400	RES		10000	n/v	No
Per- and Polyfluoralkyl Substances							
Perfluorobutanesulfonic acid (PFBS)	ug/kg	0.1	n/v	n/v	n/v	872000	No
Perfluorobutanoic acid (PFBA)	ug/kg	3.6	n/v	n/v	n/v	1630000	No
Perfluorodecanoic acid (PFDA)	ug/kg	<1.0	n/v	n/v	n/v	n/v	No
Perfluorodecanesulfonic acid (PFDS)	ug/kg	<1.0	n/v	n/v	n/v	n/v	No
Perfluorododecanoic acid (PFDoA)	ug/kg	<1.0	n/v	n/v	n/v	n/v	No
Perfluoroheptanesulfonic acid (PFHpS)	ug/kg	0.17	n/v	n/v	n/v	n/v	No - See Text in Section 4.1.1.1
Perfluoroheptanoic acid (PFHpA)	ug/kg	0.86	n/v	n/v	n/v	11410	No
Perfluorohexanesulfonic acid (PFHxS)	ug/kg	2.8	n/v	n/v	n/v	33000	No
Perfluorohexanoic acid (PFHxA)	ug/kg	0.84	n/v	n/v	n/v	11410	No
Perfluorooctanoic acid (PFOA)	ug/kg	1.6	n/v	n/v	n/v	9940	No
Perfluorononanesulfonic acid (PFNS)	ug/kg	<1.0	n/v	n/v	n/v	n/v	No
Perfluorononanoic acid (PFNA)	ug/kg	0.39	n/v	n/v	n/v	1200	No
Perfluorooctanesulfonic acid (PFOS)	ug/kg	28	n/v	n/v	n/v	30500	No
Perfluorooctane sulfonamide (PFOSA)	ug/kg	<1.0	n/v	n/v	n/v	n/v	No
Perfluoropentanesulfonic acid (PFPeS)	ug/kg	<1.0	n/v	n/v	n/v	n/v	No
Perfluoropentanoic acid (PFPeA)	ug/kg	0.98 (<1.0)	n/v	n/v	n/v	11410	No
Perfluorotetradecanoic acid (PFTeA)	ug/kg	<1.0	n/v	n/v	n/v	n/v	No
Perfluorotridecanoic acid (PFTriA)	ug/kg	<1.0	n/v	n/v	n/v	n/v	No
Perfluoroundecanoic acid (PFUnA)	ug/kg	<1.0	n/v	n/v	n/v	n/v	No
PFOS + PFOA	unitless	0.0011	n/v	n/v	n/v	[PFOS]/30500 + [PFOA]/9940 ≤1	No

Notes:

CCME	Canadian Council of Ministers of the Environment
CSQG	Canadian Environmental Quality Guidelines, Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, various fact sheets
A	Industrial land use and coarse-grained soil
CWS	Canada Wide Standards for PHC in Soil, Tier 1 (Revised Jan 2008, Table 5.3)
B	Industrial - Coarse-grained, Surface Soil
HC SSV	Health Canada Soil Screening Value
C	Summary Table: Health Canada Draft Guidelines, Screening Values and Toxicological Reference Values (TRVs) for Perfluoroalkyl Substances (PFAS). May, 2019.
PFOS+PFOA	Calculated as the reported concentration of each parameter divided by their screening values and added together. (Health Canada, 2019)
BTEX	Benzene, toluene, ethylbenzene and xylene
RES	Residual PHC formation. Calculated value exceeds 30,000 mg/kg and solubility limit for PHC fraction.
BOLD	Concentration exceeds the indicated component value. COPC assessed further in the risk assessment.
NA	Calculated guideline >1,000,000 mg/kg
n/v	No value provided by this source for this parameter (e.g., criteria not calculated)

Table C-2
Human Health Screening of Groundwater Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Parameter	Units	Maximum	Health Canada [A, B]	Retained as Human Health COPC
BTEX and Petroleum Hydrocarbons				
Benzene	mg/L	<0.00040	0.4	No
Toluene	mg/L	<0.00040	5	No
Ethylbenzene	mg/L	<0.00040	11	No
Xylenes, Total	mg/L	<0.00089	7	No
PHC F1 (C6-C10 range) minus BTEX	mg/L	<0.10	n/v	No
PHC F2 (>C10-C16 range)	mg/L	<0.10	n/v	No
PHC F3 (>C16-C34 range)	mg/L	<0.20	n/v	No
PHC F4 (>C34-C50 range)	mg/L	<0.20	n/v	No
Per- and Polyfluoralkyl Substances				
Perfluorobutanesulfonic acid (PFBS)	µg/L	0.075	1125	No
Perfluorobutanoic acid (PFBA)	µg/L	1.4	2250	No
Perfluorodecanoic acid (PFDA)	µg/L	<0.040	n/v	No
Perfluorodecanesulfonic acid (PFDS)	µg/L	<0.040	n/v	No
Perfluorododecanoic acid (PFDoA)	µg/L	<0.040	n/v	No
Perfluoroheptanesulfonic acid (PFHpS)	µg/L	<0.040	n/v	No
Perfluoroheptanoic acid (PFHpA)	µg/L	0.73	15	No
Perfluorohexanesulfonic acid (PFHxS)	µg/L	0.45	45	No
Perfluorohexanoic acid (PFHxA)	µg/L	2.9	15	No
Perfluorooctanoic acid (PFOA)	µg/L	0.29	15	No
Perfluorononanesulfonic acid (PFNS)	µg/L	<0.040	n/v	No
Perfluorononanoic acid (PFNA)	µg/L	0.0047	1.5	No
Perfluorooctanesulfonic acid (PFOS)	µg/L	0.26	45	No
Perfluorooctane sulfonamide (PFOSA)	µg/L	<0.040	n/v	No
Perfluoropentanesulfonic acid (PFPeS)	µg/L	0.074	n/v	No - See Text in Section 4.1.1.2
Perfluoropentanoic acid (PFPeA)	µg/L	5.1	15	No
Perfluorotetradecanoic acid (PFTeA)	µg/L	<0.040	n/v	No
Perfluorotridecanoic acid (PFTriA)	µg/L	<0.040	n/v	No
Perfluoroundecanoic acid (PFUnA)	µg/L	<0.040	n/v	No
PFOS + PFOA	unitless	0.0251	[PFOS]/45 + [PFOA]/15 ≤1	No

Notes:

Health Canada	
A	Guidelines for Canadian Drinking Water Quality Summary Table 2020. Maximum acceptable concentration. Value modified to account for a lower ingestion rate considered for incidental ingestion (splashing and hand to mouth contact) (VDEQ, 2020). See discussion in Section 4.1.1.2.
B	Summary Table: Health Canada Draft Guidelines, Screening Values and Toxicological Reference Values (TRVs) for Perfluoroalkyl Substances (PFAS) (May 2019). Value modified to account for a lower ingestion rate considered for incidental ingestion (splashing and hand to mouth contact) (VDEQ, 2020). See discussion in Section 4.1.1.2.
PFOS+PFOA	Calculated as the reported concentration of each parameter divided by their guideline and added together. (Health Canada, 2019)
BTEX	Benzene, toluene, ethylbenzene and xylene
BOLD	Concentration exceeds the indicated component value. COPC assessed further in the risk assessment.
n/v	No value provided by this source for this parameter (e.g., criteria not calculated)

Table C-3
Human Health Screening of Sump Water Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Parameter	Units	Maximum	Health Canada [A, B]	Retained as Human Health COPC
BTEX and Petroleum Hydrocarbons				
Benzene	mg/L	<0.00040	0.5	No
Toluene	mg/L	<0.00040	6	No
Ethylbenzene	mg/L	<0.00040	14	No
Xylenes, Total	mg/L	<0.00080	9	No
PHC F1 (C6-C10 range) minus BTEX	mg/L	<0.10	n/v	No
PHC F2 (>C10-C16 range)	mg/L	<0.10	n/v	No
Per- and Polyfluoralkyl Substances				
Perfluorobutanesulfonic acid (PFBS)	µg/L	0.028	1125	No
Perfluorobutanoic acid (PFBA)	µg/L	0.11	2250	No
Perfluorodecanoic acid (PFDA)	µg/L	<0.020	n/v	No
Perfluorodecanesulfonic acid (PFDS)	µg/L	<0.020	n/v	No
Perfluorododecanoic acid (PFDoA)	µg/L	<0.020	n/v	No
Perfluoroheptanesulfonic acid (PFHpS)	µg/L	<0.020	n/v	No
Perfluoroheptanoic acid (PFHpA)	µg/L	0.23	15	No
Perfluorohexanesulfonic acid (PFHxS)	µg/L	0.2	45	No
Perfluorohexanoic acid (PFHxA)	µg/L	0.34	15	No
Perfluorooctanoic acid (PFOA)	µg/L	0.078	15	No
Perfluorononanoic acid (PFNA)	µg/L	<0.020	1.5	No
Perfluorooctanesulfonic acid (PFOS)	µg/L	0.076	45	No
Perfluorooctane sulfonamide (PFOSA)	µg/L	<0.020	n/v	No
Perfluoropentanoic acid (PFPeA)	µg/L	0.49	15	No
Perfluorotetradecanoic acid (PFTeA)	µg/L	<0.020	n/v	No
Perfluorotridecanoic acid (PFTriA)	µg/L	<0.020	n/v	No
Perfluoroundecanoic acid (PFUnA)	µg/L	<0.020	n/v	No
PFOS + PFOA	unitless	0.0069	[PFOS]/45 + [PFOA]/15 ≤1	No

Notes:

Health Canada	
A	Guidelines for Canadian Drinking Water Quality Summary Table 2020. Maximum acceptable concentration. Value modified to account for a lower ingestion rate considered for incidental ingestion (splashing and hand to mouth contact) (VDEQ, 2020). See discussion in Section 4.1.1.2.
B	Summary Table: Health Canada Draft Guidelines, Screening Values and Toxicological Reference Values (TRVs) for Perfluoroalkyl Substances (PFAS) (May 2019). Value modified to account for a lower ingestion rate considered for incidental ingestion (splashing and hand to mouth contact) (VDEQ, 2020). See discussion in Section 4.1.1.2.
PFOS+PFOA	Calculated as the reported concentration of each parameter divided by their guideline and added together. (Health Canada, 2019)
BTEX	Benzene, toluene, ethylbenzene and xylene
BOLD	Concentration exceeds the indicated component value. COPC assessed further in the risk assessment.
n/v	No value provided by this source for this parameter (e.g., criteria not calculated)

Table C-4
Ecological Screening of Soil Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Parameter	Units	Maximum	CCME CSQG[A], CWS[B]		FCSAP[C]	Retained as Ecological Health COPC
			Soil Contact	Off-site Migration		
BTEX and Petroleum Hydrocarbons						
Benzene	µg/g	0.045	180	n/v	n/v	No
Toluene	µg/g	7.2	250	n/v	n/v	No
Ethylbenzene	µg/g	1.6	300	n/v	n/v	No
Xylenes, Total	µg/g	6.6	350	n/v	n/v	No
PHC F1 (C6-C10 range) minus BTEX	µg/g	840	**320**	n/a	n/v	**Yes**
PHC F2 (>C10-C16 range)	µg/g	2300	**260**	n/v	n/v	**Yes**
PHC F3 (>C16-C34 range)	µg/g	2100	**1700**	4300	n/v	**Yes**
PHC F4 (>C34-C50 range)	µg/g	1400	3300	RES	n/v	No
Per- and Polyfluoralkyl Substances						
Perfluorobutanesulfonic acid (PFBS)	µg/kg	0.1	n/v	n/v	n/v	**Yes**
Perfluorobutanoic acid (PFBA)	µg/kg	3.60	n/v	n/v	n/v	**Yes**
Perfluorodecanoic acid (PFDA)	µg/kg	<1.0	n/v	n/v	n/v	No
Perfluorodecanesulfonic acid (PFDS)	µg/kg	<1.0	n/v	n/v	n/v	No
Perfluorododecanoic acid (PFDoA)	µg/kg	<1.0	n/v	n/v	n/v	No
Perfluoroheptanesulfonic acid (PFHpS)	µg/kg	0.17	n/v	n/v	n/v	**Yes**
Perfluoroheptanoic acid (PFHpA)	µg/kg	0.86	n/v	n/v	n/v	**Yes**
Perfluorohexanesulfonic acid (PFHxS)	µg/kg	2.8	n/v	n/v	n/v	**Yes**
Perfluorohexanoic acid (PFHxA)	µg/kg	0.84	n/v	n/v	n/v	**Yes**
Perfluorooctanoic acid (PFOA)	µg/kg	1.6	n/v	n/v	n/v	**Yes**
Perfluorononanesulfonic acid (PFNS)	µg/kg	<1.0	n/v	n/v	n/v	No
Perfluorononanoic acid (PFNA)	µg/kg	0.39	n/v	n/v	n/v	**Yes**
Perfluorooctanesulfonic acid (PFOS)	µg/kg	28	n/v	200	61000	No
Perfluorooctane sulfonamide (PFOSA)	µg/kg	<1.0	n/v	n/v	n/v	No
Perfluoropentanesulfonic acid (PFPeS)	µg/kg	<1.0	n/v	n/v	n/v	No
Perfluoropentanoic acid (PFPeA)	µg/kg	0.98	n/v	n/v	n/v	**Yes**
Perfluorotetradecanoic acid (PFTeA)	µg/kg	<1.0	n/v	n/v	n/v	No
Perfluorotridecanoic acid (PFTriA)	µg/kg	<1.0	n/v	n/v	n/v	No
Perfluoroundecanoic acid (PFUnA)	µg/kg	<1.0	n/v	n/v	n/v	No

Notes:

CCME	Canadian Council of Ministers of the Environment
CSQG	Canadian Environmental Quality Guidelines, Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, various fact sheets
A	Industrial land use and coarse-grained soil
CWS	Canada Wide Standards for PHC in Soil, Tier 1 (Revised Jan 2008, Table 5.3)
B	Industrial - Coarse-grained, Surface Soil
FCSAP	Federal Contaminated Sites Action Plan (Version 1.4.1, April 2018)
C	Interim Advice to Federal Custodian Departments for the Management of Federal Sites Containing Perfluorooctane Sulfonate (PFOS) and other Per-and Polyfluoroalkyl Substances (PFAS).
BTEX	Benzene, toluene, ethylbenzene and xylene
RES	Residual PHC formation. Calculated value exceeds 30,000 mg/kg and solubility limit for PHC fraction.
BOLD	Concentration exceeds the indicated component value or detected concentration and no guideline available. COPC assessed further in the risk assessment.
n/v	No value provided by this source for this parameter (e.g., criteria not calculated)

Table C-5
Ecological Screening of Groundwater Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Parameter	Units	Maximum	FIGQG[A]		CCME[B]	FCSAP[C]	Retained as Ecological COPC
			Soil Organisms Direct Contact	Marine Life			
BTEX and Petroleum Hydrocarbons							
Benzene	mg/L	<0.00040	350	0.20	0.11	n/a	No
Toluene	mg/L	<0.00040	200	8.9	0.215	n/a	No
Ethylbenzene	mg/L	<0.00040	110	11	0.025	n/a	No
Xylenes, Total	mg/L	<0.00089	120	n/v	n/v	n/a	No
PHC F1 (C6-C10 range) minus BTEX	mg/L	<0.10	11	n/v	n/v	n/a	No
PHC F2 (>C10-C16 range)	mg/L	<0.10	3.1	n/v	n/v	n/a	No
PHC F3 (>C16-C34 range)	mg/L	<0.20	n/v	n/v	n/v	n/a	No
PHC F4 (>C34-C50 range)	mg/L	<0.20	n/v	n/v	n/v	n/a	No
Per- and Polyfluoralkyl Substances							
Perfluorobutanesulfonic acid (PFBS)	µg/L	0.075	n/v	n/v	n/v	n/v	**Yes**
Perfluorobutanoic acid (PFBA)	µg/L	1.4	n/v	n/v	n/v	n/v	**Yes**
Perfluorodecanoic acid (PFDA)	µg/L	<0.040	n/v	n/v	n/v	n/v	No
Perfluorodecanesulfonic acid (PFDS)	µg/L	<0.040	n/v	n/v	n/v	n/v	No
Perfluorododecanoic acid (PFDoA)	µg/L	<0.040	n/v	n/v	n/v	n/v	No
Perfluoroheptanesulfonic acid (PFHpS)	µg/L	<0.040	n/v	n/v	n/v	n/v	No
Perfluoroheptanoic acid (PFHpA)	µg/L	0.73	n/v	n/v	n/v	n/v	**Yes**
Perfluorohexanesulfonic acid (PFHxS)	µg/L	0.45	n/v	n/v	n/v	n/v	**Yes**
Perfluorohexanoic acid (PFHxA)	µg/L	2.9	n/v	n/v	n/v	n/v	**Yes**
Perfluorooctanoic acid (PFOA)	µg/L	0.29	n/v	n/v	n/v	n/v	**Yes**
Perfluorononanesulfonic acid (PFNS)	µg/L	<0.040	n/v	n/v	n/v	n/v	No
Perfluorononanoic acid (PFNA)	µg/L	0.0047	n/v	n/v	n/v	n/v	**Yes**
Perfluorooctanesulfonic acid (PFOS)	µg/L	0.26	n/v	n/v	n/v	6.8	No
Perfluorooctane sulfonamide (PFOSA)	µg/L	<0.040	n/v	n/v	n/v	n/v	No
Perfluoropentanesulfonic acid (PFPeS)	µg/L	0.074	n/v	n/v	n/v	n/v	**Yes**
Perfluoropentanoic acid (PFPeA)	µg/L	5.1	n/v	n/v	n/v	n/v	**Yes**
Perfluorotetradecanoic acid (PFTeA)	µg/L	<0.040	n/v	n/v	n/v	n/v	No
Perfluorotridecanoic acid (PFTriA)	µg/L	<0.040	n/v	n/v	n/v	n/v	No
Perfluoroundecanoic acid (PFUnA)	µg/L	<0.040	n/v	n/v	n/v	n/v	No

Notes:

FIGQG	Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites (Government of Canada, June 2016 (version 4) revised November 2016)
A	Table 3 Federal Interim Groundwater Guidelines - Generic Guidelines for Commercial and Industrial Land Use - Water Use/Exposure Pathway - (Tier 2) - Coarse
CCME	Canadian Council of Ministers of the Environment
B	Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Marine
FCSAP	Federal Contaminated Sites Action Plan (Version 1.4.1, April 2018)
C	Interim Advice to Federal Custodian Departments for the Management of Federal Sites Containing Perfluorooctane Sulfonate (PFOS) and other Per-and Polyfluoroalkyl Substances (PFAS).
BTEX	Benzene, toluene, ethylbenzene and xylene
BOLD	Concentration exceeds the indicated component value. COPC assessed further in the risk assessment.
n/v	No value provided by this source for this parameter (e.g., criteria not calculated)

Table C-6
Ecological Screening of Sump Water Analytical Results
Human Health and Ecological Risk Assessment
Cambridge Bay Airport, Apron Land Treatment Unit

Parameter	Units	Maximum	FIGQG[A]		CCME[B]	ECCC[C]	Retained as Ecological COPC
			Soil Organisms Direct Contact	Marine Life			
BTEX and Petroleum Hydrocarbons							
Benzene	mg/L	<0.00040	350	0.20	0.11	n/a	No
Toluene	mg/L	<0.00040	200	8.9	0.215	n/a	No
Ethylbenzene	mg/L	<0.00040	110	11	0.025	n/a	No
Xylenes, Total	mg/L	<0.00080	120	n/v	n/v	n/a	No
PHC F1 (C6-C10 range) minus BTEX	mg/L	<0.10	11	n/v	n/v	n/a	No
PHC F2 (>C10-C16 range)	mg/L	<0.10	3.1	n/v	n/v	n/a	No
Per- and Polyfluoralkyl Substances							
Perfluorobutanesulfonic acid (PFBS)	µg/L	0.028	n/v	n/v	n/v	n/v	**Yes**
Perfluorobutanoic acid (PFBA)	µg/L	0.11	n/v	n/v	n/v	n/v	**Yes**
Perfluorodecanoic acid (PFDA)	µg/L	<0.020	n/v	n/v	n/v	n/v	No
Perfluorodecanesulfonic acid (PFDS)	µg/L	<0.020	n/v	n/v	n/v	n/v	No
Perfluorododecanoic acid (PFDoA)	µg/L	<0.020	n/v	n/v	n/v	n/v	No
Perfluoroheptanesulfonic acid (PFHpS)	µg/L	<0.020	n/v	n/v	n/v	n/v	No
Perfluoroheptanoic acid (PFHpA)	µg/L	0.23	n/v	n/v	n/v	n/v	**Yes**
Perfluorohexanesulfonic acid (PFHxS)	µg/L	0.2	n/v	n/v	n/v	n/v	**Yes**
Perfluorohexanoic acid (PFHxA)	µg/L	0.34	n/v	n/v	n/v	n/v	**Yes**
Perfluorooctanoic acid (PFOA)	µg/L	0.078	n/v	n/v	n/v	n/v	**Yes**
Perfluorononanoic acid (PFNA)	µg/L	<0.020	n/v	n/v	n/v	n/v	No
Perfluorooctanesulfonic acid (PFOS)	µg/L	0.076	n/v	n/v	n/v	6.8	No
Perfluorooctane sulfonamide (PFOSA)	µg/L	<0.020	n/v	n/v	n/v	n/v	No
Perfluoropentanoic acid (PFPeA)	µg/L	0.49	n/v	n/v	n/v	n/v	**Yes**
Perfluorotetradecanoic acid (PFTeA)	µg/L	<0.020	n/v	n/v	n/v	n/v	No
Perfluorotridecanoic acid (PFTriA)	µg/L	<0.020	n/v	n/v	n/v	n/v	No
Perfluoroundecanoic acid (PFUnA)	µg/L	<0.020	n/v	n/v	n/v	n/v	No

Notes:

FIGQG	Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites (Government of Canada, June 2016 (version 4) revised November 2016)
A	Table 3 Federal Interim Groundwater Guidelines - Generic Guidelines for Commercial and Industrial Land Use - Water Use/Exposure Pathway - (Tier 2) - Coarse
CCME	Canadian Council of Ministers of the Environment
B	Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Marine
ECCC	Environment and Climate Change Canada
C	Federal Environmental Quality Guidelines for Perfluorooctane Sulfonate (PFOS), dated June 2018 (Table 1, Water)
BTEX	Benzene, toluene, ethylbenzene and xylene
BOLD	Concentration exceeds the indicated component value. COPC assessed further in the risk assessment.
n/v	No value provided by this source for this parameter (e.g., criteria not calculated)

APPENDIX D

Sample Calculations

1.0 SAMPLE CALCULATIONS

This Appendix assists the reader in understanding how Stantec modified Health Canada's guideline/ screening values for the preliminary quantitative risk assessment (PQRA). The human health drinking water guidelines and screening values from Health Canada were derived based on an adult receptor consuming 1.5 Litres / day (L/d) of water each day. Although Health Canada (2010a) provides a consumption rate of 1.5 L/d for a construction worker, that value is not representative of incidentally ingesting groundwater in an excavation or through sampling activities (via hand-to-mouth transfer). The Virginia Department of Environmental Quality (VDEQ, 2020) provides a lower consumption rate of 0.02 L/d that is more representative of water consumed by a worker through these types of activities.

This example calculation focuses on Construction Worker exposure to PFOA (non-cancer) via incidental ingestion of groundwater. The current Health Canada drinking water guideline for PFOA is 0.2 µg/L.

The equation that Stantec used to calculate the modified drinking water/screening values is provided by Health Canada (2018) and shown below.

Modified drinking water guideline (mg/L) = (TDI x BW x DWAF) / C_w

Where:

Symbol	Characteristic	Units	Numeric Value	Source
TDI	Tolerable Daily Intake	mg/kg-bw-day	0.000021	Health Canada, 2018
BW	Body Weight	kg	70	Health Canada, 2010a
DWAF	Default Drinking Water Allocation Factor	unitless	0.2	Health Canada, 2010a, 2018
C_W	Incidental Groundwater Ingestion Rate	L/d	0.02	VDEQ, 2020

Calculation of the modified drinking water guideline for PFOA is shown below:

Modified drinking water guideline = *(TDI x BW x DWAF) / C_W*

= *(0.000021 x 70 x 0.2) / 0.02*

= *0.000294 / 0.02*

= *0.0147* mg/L (~15 µg/L)

2.0 REFERENCES

Health Canada. 2010a. Federal Contaminated Site Risk Assessment in Canada - Part 1: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0, September 2010, Revised 2012.

Health Canada. 2018. Guidelines for Canadian Drinking Water Quality Guideline Technical Document Perfluorooctanoic Acid (PFOA), December 2018.

Virginia Department of Environmental Quality (VDEQ). 2020. Virginia Unified Risk Assessment Model – VURAM User Guide. For Risk Assessors. Updated June 2020. https://www.deq.virginia.gov/land-waste/land-remediation/voluntary-remediation.

APPENDIX E

Site Photographs

Photo 1: Apron LTU. Exposed soil with sparse vegetation, facing west. Photo taken August 6, 2020.

Photo 2: Apron LTU. Exposed soil with sparse vegetation, facing northwest. Photo taken August 6, 2020.

Photo 3: Apron LTU. Exposed soil with sparse vegetation, facing north. Photo taken August 6, 2020.

Photo 4: Apron LTU. Precipitation accumulated within the southwest corner. Surrounding land consists of sparsely grassed areas with no trees, facing west. Photo taken August 6, 2020.

Photo 5: Apron LTU. Precipitation accumulated within the southwest corner. Surrounding land consists of sparsely grassed areas with no trees, facing north. Photo taken August 6, 2020.

Stantec

Client/Project	Date
Public Services and Procurement Canada Apron LTU, Cambridge Bay Airport, Victoria Island, Nunavut	March 25, 2021
	Project No. 110220512
Title	Page
PHOTOGRAPHIC RECORD	Page 1 of 1