Detailed Site Assessment

GARDEN RIVER OLD DUMP
in WOOD BUFFALO NATIONAL PARK

Prepared for:
Parks Canada Agency
Suite 1550 – 635 8th Avenue
Calgary, AB T2P 3M3

Prepared by:

Columbia Environmental Consulting Ltd.
RR#2, Site 55, Compartment 10
Penticton, BC V2A 6J7

Franz Environmental Inc.
308 – 1080 Mainland Street
Vancouver, BC V6B 2T4

Project No. 2018-1001
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EXECUTIVE SUMMARY

Franz Environmental Inc. (FRANZ) and Columbia Environmental Consulting Ltd. (COLUMBIA) were retained by Parks Canada Agency to complete a Detailed Site Assessment at the Garden River Old Dump in Wood Buffalo National Park, Alberta. This report is presented per the Terms of Reference for Solicitation number: 5P420-10-5048/A, closed on October 14, 2010. The Terms describe the requirements of a work program to complete a closure strategy and long-term risk management plan for the former dump. The site location is presented on Figure 1.

The former dump site is on the eastern end of the community of Garden River (aka Garden Creek), Alberta, within Wood Buffalo National Park, approximately 200km east of High Level, AB, and on the north shore of the Peace River. The dump site is expected to have been excavated and maintained without a liner in place. The volume and composition of waste in the former dump site is expected to be highly variable, as no restrictions were imposed on disposal. It is expected that dump closure in this area consisted of covering waste with fill/soil when the dump site was abandoned in 1998. The site comprises approximately 3400m^2 at the main dump, with offsite satellite debris areas both north and south of the site. The site is approximately 200m south of the Public Works Yard, and approximately 300m southeast of the Sister Gloria School building, within the Little Red River Cree Nation community (approx. pop. 400).

The project objectives were 1) to conduct a data gap analysis and the necessary fieldwork in order to complete the delineation and characterization of the former dump site, 2) to conduct a Human Health Risk Assessment in support of a long-term risk management plan, and 3) to provide a closure strategy.

Delineation of the Old Dump

We have determined the extents of the old dump by:

- Conducting a geophysical survey;
- Drilling six perimeter wells (two as background), and one additional well inside the dump, and collecting soil and groundwater samples at boreholes and from the surface of the dump;
- Making visual observations and talking to community members; and
- Analyzing the body of data collected since 2008 in order to assess the potential constituents of concern (PCOCs) associated with waste in soil and as leachate.

In the six perimeter wells, the analytical results of soil samples did not indicate influences from the dump, as there were no exceedances in Petroleum Hydrocarbons, BTEX, PAH, Metals, or VOCs. This confirms that the dump extents are as illustrated on Figure 2. Within the dump, the following were retained as PCOCs in soil: Arsenic, Boron, Cadmium, Copper, Lead, Naphthalene, Phenanthrene, Selenium, Tin, and Zinc.

The perimeter wells were placed to monitor the edge of a potential leachate plume. We analyzed for Petroleum Hydrocarbons, BTEX, PAH, and VOCs in groundwater, and there were no exceedances. Based on analytical results, the maximum extent of the potential leachate plume is bounded by the road on the north, the ravine on the east, the road on the west, and the perimeter well to the south (2018-10BH-3M). Exceedances in Dissolved Metals were detected across the study area, but were not attributable to the dump. Arsenic, Cadmium, Fluoride, Iron, Manganese, and Selenium Arsenic was retained as a PCOCs.

Human Health Risk Assessment

After reviewing the results of the Environmental Site Assessment, the PCOCs were screened, and Arsenic and Cadmium in soil, and Arsenic in groundwater were retained and used as inputs in the human health PQRA spreadsheets.

The human health risk assessment was conducted in accordance with Health Canada PQRA guidance documents (Health Canada, 2004, 2007, 2009 updates). COLUMBIA/FRANZ reviewed factors such as property/area use, current/proposed property/site activities, and access to identify potential human receptors. Three exposure scenarios were used:

Scenario A) the current, existing scenario, where groundwater is considered non-potable, and drinking water is sourced from the Peace River. Site use is considered transient and recreational.

Scenario B) a future scenario, where groundwater is considered potable, and site use is characteristic of a homestead.

Scenario C) a future scenario, where groundwater is considered non-potable, and drinking water is sourced from the Peace River. Site use is characteristic of a homestead.

When modelling receptor exposures, maximum Arsenic (16 ug/g) and Cadmium (5 ug/g) concentrations (identified in site soil during the investigation) were used. The following exposure pathways were identified: incidental ingestion of soil; inhalation of soil particulates; dermal contact with soil; and in Scenario B only, dermal contact with, and ingestion of, groundwater.

For non-carcinogenic effects, there are no unacceptable risks from long-term exposure to Arsenic and Cadmium in site surface soil for any receptor age group in the current Scenario A. There are however, unacceptable risks for receptors via oral exposure to Arsenic in site surface soil and groundwater in both future Scenarios B and C. There are no unacceptable risks via sub-chronic oral, dermal, and inhalation (i.e. short-term) exposures to Arsenic and Cadmium by toddlers identified in either the current Scenario A, or potential future Scenarios B and C.

For carcinogenic effects, Arsenic exposure via the oral/dermal pathway exceeded the ILCR (1.0E-05) for the adult receptor in both future Scenarios B and C, but not in the current Scenario A.

All of the risk calculations used in this HHRA are estimates only and do not represent actual risks.

If no action is taken to manage the future risks, then further refinement of the human health risk assessment is warranted. A site-specific HHRA will require as a minimum, further investigation and data collection from onsite surface soil and onsite vegetation, in conjunction with a country foods survey conducted with the local community, and a vegetation survey across the site to determine exposure of the general public to contaminants in onsite vegetation.

Landfill Closure Strategy and Risk Management

The outcome of the risk assessment indicates that remediation or risk management measures are not required to reduce the human health risks for the current use of the site, however, they are required for future activities. In the short term or the current scenario, no action is required to manage the concentrations of Arsenic and Cadmium in soil and groundwater onsite.

In the long term it is recommended that the dump be closed using the Alberta “Environmental Code of Practice for Landfills" as a guideline. The proposed end use is not identified, therefore the objective of closure is to ensure the integrity of the closed landfill with respect to the risk assessment scenario’s.

We recommend the following:

- Fence the boundary and add signage. See section 11.1, Site Closure Requirements.
- Consolidate, re-grade, cap, and re-vegetate the dump. See section 11.2, Final Cover Design, Sloping Requirements, Drainage Restoration and Runoff Control System, and section 11.3, Re-vegetation.
- Establish an annual groundwater monitoring program. See section 11.4, Groundwater Monitoring Plan.

- No drinking water wells should be installed within 200m, or downgradient of the site boundary. See section 11.5, Groundwater Protection Area.
- Annual landfill gas monitoring. See section 11.6, Landfill Gas Monitoring Plan and Protection Area.
- No structures should be placed within 200m of the site boundary. See section 11.6, Landfill Gas Monitoring Plan and Protection Area.
- During scheduled groundwater and landfill gas monitoring, the area should be inspected for integrity of the cap, as well as fencing and signage. See section 11.7, Annual Inspection and Contingency Plan.

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1.0 INTRODUCTION

Franz Environmental Inc. (FRANZ) and Columbia Environmental Consulting Ltd. (COLUMBIA) were retained by Parks Canada Agency to complete a Detailed Site Assessment at the Garden River Old Dump in Wood Buffalo National Park, Alberta. This report is presented per the Terms of Reference for Solicitation number: 5P420-10-5048/A, closed on October 14, 2010. The Terms describe the requirements of a work program to complete a closure strategy and long-term risk management plan for the former dump. The site location is presented on Figure 1.

The field investigation had two interests: 1) to determine the extents of the old dump, i.e., where the dump is not, and then characterize those offsite areas, and 2) to determine the degree of contamination inside the area defined as the old dump site, in order to risk assess that area. The Environmental Site Assessment report is the front half of this report, with the field investigation details beginning in section 7.0.

The risk assessment is the second half of this report, beginning in section 10.0, and consists of a preliminary human health risk assessment in support of the development of a Landfill Closure Strategy and Risk Management Plan for the site. The work was conducted to assess if environmental conditions at the Old Dump Site present a potential risk to various types of human receptors with access to the site.

1.1 Project Objectives

The purpose of this project was to undertake a data gap analysis and conduct the fieldwork necessary to complete the delineation and characterization of the former dump site in order to provide a closure strategy. The closure strategy will provide the basis for a long-term risk management plan so that site ownership may be successfully transferred.

To accomplish this goal, the objectives are:

- Review previous reports and conduct a data gap analysis;
- Conduct fieldwork to fill any data gaps in support of closure strategy;
- Conduct Human Health Risk Assessment in support of long-term risk management; and
- Prepare a report comprising landfill closure and long-term risk management plan.

FRANZ/COLUMBIA understands that the old dump may be part of a land-ownership transfer with an assessment of the environmental liability resulting from the current investigation.

1.2 Site Features and Background

The old dump is located on the eastern end of the community of Garden River (aka Garden Creek), Alberta, within Wood Buffalo National Park, approximately 200km east of High Level on the north shore of the Peace River. The dump is approximately 200m south of the Public Works Yard and 300m southeast of the Sister Gloria School in a Little Red River Cree Nation community of about 400. The river is approximately 275m south of the site.

The site area comprises approximately 3400m^2 at the main dump, with smaller satellite dumps both north and south. To the north there is a (approximately) 600m^2 area of debris, while to the south there are two smaller areas of debris and a borrow pit (see Figure 2). This was determined by conducting a geophysical survey, talking to community members, and making field observations.

The dump was an unlined excavation, with unrestricted content, therefore the composition of waste is expected to be highly variable but reflective of municipal/household waste. Closure consisted of placement of an interim cover using soil likely taken from the borrow pit south of the dump site, prior to abandonment in 1998.

1.3 Project Team

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

- Nick Dayal, Eng. L., Senior Review
- Graham Martens, R.P.Bio., Project Manager
- Michael Shum, Ph.D., P.Ag., R.P.Bio., Senior Risk Assessor
- Meagan Gourley, M.E.T., Junior Risk Assessor
- Bridget Trousdell, AScT, ESA report author
- Ryan Fletcher, C.Tech., Lead Field Technician, *Franz Environmental Inc.*
- Elliot Tonasket, Assistant Field Technician, *Columbia Environmental Consulting Ltd.*

Nick Dayal, Eng.L.

Mr. Dayal provided project coordination and senior review. Nick Dayal has more than 20 years of experience in the areas of contaminated sites management, environmental site assessments, contaminant hydrogeology, remedial options assessment, and remediation. He has managed numerous Phase I, II and III Environmental Site Assessments on a variety of industrial and commercial properties, and reviewed hundreds of reports including Phase I, II and III ESAs, risk assessments, remedial actions plans, and confirmation of remediation. Nick has conducted detailed quantitative human health/ecological risk assessments for petroleum hydrocarbon and metals impacted sites.

Graham Martens, R.P. Bio.

Mr. Martens provided project management. He is a Registered Professional Biologist with 17 years of experience in conducting environmental assessments including aquatic assessments and inventories, Phase I, II and III ESAs, preliminary quantitative risk assessments, ecological risk evaluations and remediation of contaminated sites. Graham has undertaken Project Management roles for numerous large scale environmental site assessment and remediation projects and has a Graduate Certificate in Project Management from Royal Roads University. Mr. Martens has and continues to work extensively with First Nations Communities and Federal Government Agencies with regard to natural resource management and the decision making processes.

Michael Shum, Ph.D, P.Ag., R.P.Bio.

Dr. Shum reviewed the risk assessment portion of this report. Dr. Shum is an environmental scientist with 17 years of experience in environmental site assessments, with a focus on risk assessments and environmental impact assessments. He has served as Senior Review, Project Manager, and Technical Specialist on numerous projects involving the execution of environmental site investigations and human health/ecological risk assessments, evaluation of risk management strategies, and environmental assessments of proposed energy and mining projects. He has prepared detailed study plans and provided technical support for projects throughout Canada and in Vietnam. He is a Registered Member of the British Columbia Institute of Agrologists and the Association of Professional Biologists of British Columbia.

Meagan Gourley, M.E.T.

Ms. Gourley wrote the risk assessment portion of this report. Ms. Gourley's work at Franz Environmental Inc. has included ecological and human health risk assessment, environmental site assessment and extensive field sampling (soil, groundwater, and soil vapour) experience on a variety of commercial sites in support of risk assessment, ex-situ remediation, and phased environmental site assessments for federal government

and private clients in Alberta, British Columbia, Yukon Territory and Nunavut. Ms. Gourley has academic training in the fields of pharmacology, toxicology, human health and ecological risk assessment. As part of her training Ms. Gourley has designed and conducted research experiments investigating xenobiotic cellular defence and detoxification mechanisms and the mechanism of action of pesticides, PAHs, metals, steroids, PCPPs, and solvents in invertebrate, mammalian, and piscine organisms; developed site-specific water quality guidelines; and has prepared risk assessment weight of evidence frameworks and detailed conceptual site models for contaminated terrestrial and aquatic systems.

Bridget Trousdell, AScT

Ms. Trousdell was the ESA report author. Ms. Trousdell has been involved, as supervisor and as technician, in numerous Phase I and II field investigations, both as a component of due diligence reporting and in support of Environmental Site Assessments, including soil, soil vapour, sediment and groundwater sampling. She has contributed to the development of vapour sampling protocols and procedures, and the design of sampling programs. She has also been involved as a technician in Phase III Site Remediations. Ms. Trousdell has many years of experience writing and editing reports, and has fieldwork experience in a variety of settings, including urban, rural, and remote wilderness locations, for federal government and private clients in Alberta, British Columbia, Manitoba, and Yukon Territory. Previous work managing projects has provided a strong background in critical path, time management and organizational skills. Ms. Trousdell is familiar with the application of a variety of guidelines, standards, and regulatory environments.

Ryan Fletcher, C.Tech., EPt

Mr. Fletcher was the lead Field Technician for the project. Mr. Fletcher is an environmental technician with five years of experience in environmental site assessments. He has worked on a wide variety of projects involving the different aspects of contaminated sites field investigation, supervision and management including Phase I, II and III ESAs, Risk Assessments, hydrogeological studies, hazardous waste investigation, soil and groundwater remediation, data management, and report writing. He is qualified in all aspects of field investigations including remote northern logistics planning, project coordination, supervision, borehole drilling, test pitting, water sampling, sediment sampling, hazardous materials sampling, surveying, and remediation. Mr. Fletcher has gained extensive experience corresponding with clients, contractors, and laboratories. He has considerable experience working in arctic and remote northern environments and managing both small and large scale field programs.

Elliot Tonasket, C.Tech.

Mr. Tonasket is a member of the Penticton Indian Band and a graduate of the Aboriginal Environmental Technician Certificate Program from the University of Vancouver Island. Over the past four years Elliott has developed a strong background in contaminated sites assessment, fisheries inventory and watershed restoration. Mr. Tonasket has worked on contaminated sites in Inuvik, NWT and BC, with particular attention paid to abandoned landfills and mining sites.

2.0 STUDY AREA CHARACTERISTICS

2.1 Site Overview

The 3400m^2 site was identified based on the results of the geophysical survey, discussions with community members, and field observations. The previous report had identified a larger area (approximately 8000m^2), possibly due to inclusion of the satellite debris areas to the north and south.

The old dump is located between an access roadway which leads from the Public Works Yard to the river on the west, and a ravine on the east, on the south side of a snowmobile/ATV trail which heads east off the roadway. This trail leads to a road which in turn leads to the sewage lagoon located 1.2 km crossgradient to the east. A historic meander separates the dump and the lagoon. The south site boundary is a man-made drainage ditch. The ravine varies in depth from approximately 3.5m deep at the northern extent to approximately 5.2m deep at the southern extent (measured from the top of the slope at the east edge of the dump), declining south toward the river at an average grade of 0.66%.

Approximately 50m north of the northern site boundary is a copse of trees and an area of magnetic anomalies detected during the geophysical survey. One piece of exposed metal debris was also observed in this area. Approximately 10m south of the south site boundary (drainage ditch) there is an area of suspected scattered surface debris, detected in the field by small and weak magnetic anomalies. Approximately 20m south of that is a second suspected area of debris in a copse of trees adjacent to a borrow pit. This area was detected in the field by large magnetic anomalies. A half-buried snowmobile was observed here. (See Figure 13 for Geophysical Transects.)

The results from the geophysical survey were consistent with the observations obtained through interviews with Garden River community members in regards to the extent of the dump site.

During the site investigation (December 13 – 20, 2010), it was observed that the old dump site was covered in scrub willow and alder. Several small pieces of scrap metal were observed on the surface; however, heavy snow cover limited the scope of visual observations at the time of the site visit.

2.2 Climate

The nearest weather station to Garden River is in High Level. The average temperature ranges from -21.6°C in January to 16.2°C in July (Canadian Climate Normals 1971 – 2000). The daily average for December is -19.7°C. In 2010, during the investigation, daily noon-time temperatures ranged from -28.9°C to -14°C. Daylight hours were limited to 9:30 am to 3:30 pm.

The average precipitation during May to October is 259.6mm (typically as rainfall). During November to April, precipitation is typically snowfall, with an average of 155.6cm. During the December 2010 investigation, 12.6cm of snow fell. Snow ground coverage was approximately 30cm.

The site is not in the zone of continuous or discontinuous permafrost.

3.0 PHYSICAL SITE CHARACTERISTICS

3.1 Regional and Local Topography

Situated in northeastern Alberta, south of the Caribou Mountains in the Footner Lake Forest, on the north shore of the Peace River, Garden River is at an elevation of 239m asl and slopes toward the river. The elevation of the Peace River, approximately 500m south of the main road, is 229m asl.

The site is approximately 275m north of the river at an elevation of 232m asl. It is generally flat, with a ravine as its east site boundary. South of the south site boundary, the land slopes toward the river, with a steep decline south of 2018-10BH-3M, the southern-most monitoring well.

3.2 Regional and Local Drainage

Drainage appears to be topographically controlled; the general direction of groundwater flow is toward the river. Surface water from the site is expected to flow in varying directions based on local micro-topography. As shown on Figure 2, surface water is likely to flow to either the east toward the ravine, or west toward the road, which both discharge into the Peace River located 277m south of the south site boundary.

An east-west aligned drainage ditch has been dug from the road to the ravine, and forms the south site boundary. This ditch carries surface water into the ravine, although there were no indications of surface water flow during the site visit.

Southwest of the site, at a point west of where the access road meets the river, a 12m horizontal seam of groundwater was observed to discharge (daylight) into the river at the toe of the riverbank. This groundwater discharge area contained orange staining; however, no odours or sheens were observed. It was not determined whether this was leachate from the dump site, or whether it was from the area west of the dump, which was formerly occupied by a community septic tile field. No groundwater discharge was observed on the east side of the access road, however full reconnaissance of the riverbank was not possible because it was steep and unsafe to investigate at the time of the site visit.

Leaching or seepage in the ravine was not evident during the site visit; however, the possibility of this occurring in the warmer and wetter months should not be ruled out.

3.3 Geological Characterization

3.3.1 Regional Bedrock Geology

The Interior Platform comprises most of Alberta (The Atlas of Canada). A platform is that part of a continent covered by flat-lying or gently tilted rock and underlain by very ancient rocks consolidated during deformations that preceded deposition of the overlying platform layer. The rocks of the platform layer are usually sedimentary. It is in this geological province that the majority of Canada's oil and gas reserves are located. The Interior Platform is also a source of coal, potash, salt, gypsum, limestone and other non-metallic products.

Alberta Geological Survey identifies the site as within the Ireton Formation of the Upper Devonian: greenish grey shale, calcereous shale and siltstone; marine. According to Research Council of Alberta Bulletin 26, *Some Characteristics and Physical Properties of Alberta Tills* (1969), the lithology of the till closely reflects that of the underlying bedrock.

3.3.2 Regional Surficial Soils

Per the Atlas of Canada, surficial materials comprise Alluvial Deposits along the Peace River. Soils in the study area generally ranges from silt to sand to gravel, with clay stringers in the upper 7m. Sand and gravel is generally below 6m bgs. No permafrost was encountered.

3.4 Hydrogeological Characterization

3.4.1 Regional Hydrogeology

The Peace River flows to the northeast toward the Slave River, a tributary of the Mackenzie River. The northeast corner of Alberta is the low point in the province and comprises a large drainage basin. According to Government of Alberta Agriculture and Rural Development, about 90% of rural Albertans rely on groundwater for household water supply. In Garden River, the drinking water supply is from surface water (Peace River) with a community water treatment facility.

In the Interior Plains geological province, the sandstone aquifers generally have the highest yield, of up to 500 gpm. In some buried sand and gravel channels, similar yields may be found. At points of discharge (springs), the limestone aquifer springs can have yields of 30,000 gpm.

3.4.2 Site Hydrogeology

Groundwater is expected to follow local topography and discharge into the river. Onsite groundwater flow direction inferred from groundwater elevation data collected in December, 2010, is to the south-southeast toward the river (see Figure 2).

3.4.2.1 Average Linear Groundwater Velocity

Particle size analyses and borehole logs indicate sand and gravel at the groundwater table. Successful slug tests could not be performed because the water table was not depressed enough with a slug to measure, i.e. the wells recharged so quickly that accurate measurements could not be taken. This, together with the particle size information, indicates that there is high hydraulic conductivity onsite.

Sieve analysis data shows that at 2018-10BH-6M, offsite to the northeast, there are approximately 15% fines. At all other wells, it is between 1% and 4%. Literature values for hydraulic conductivity in this type of unit are typically 10^{-3} m/s or 10^{-4} m/s. We will use 10^{-4} m/s for this site.

Hydraulic gradient is south toward the Peace River, 277m away. The site is at 232m asl and the river is at 229m asl. Therefore the topographic gradient is 3/277 = 0.0108 m/m.

The effective porosity for sand and gravel is assumed to be 0.25.

Using V = ki/ne then:

$V = 10^{-4} \times 0.0108 / 0.25$

$= 4.3E\text{-}6$ m/s

$= 136$ m/yr

277 / 136 = 2 yr

Based on this travel time, we can assume that leachate from the dump would have reached the delineation wells at the time of sampling.

4.0 HISTORICAL REVIEW

4.1 Sources of Information

The main source of information for this report is the site investigation conducted between December 13 and 20, 2010. Additional information was obtained from the 2006 AMEC Phase I ESA and the 2009 EBA environmental reports.

4.2 Previous Environmental Investigation and Outcomes

The following reports were reviewed and the data relied upon:

- *Phase I Environmental Site Assessment, Garden River Land Claim Selection Areas, Wood Buffalo National Park, Alberta,* prepared by AMEC Earth & Environmental for AMEC Infrastructure Ltd., November 2006.
- *Contaminated Site Assessment / Initial and Detailed Testing Programs, Wood Buffalo National Park, Various Locations in the Community of Garden River, Alberta*, prepared by EBA Engineering Consultants Ltd. for Parks Canada Agency, February 2009.

Per the EBA Contaminated Site Assessment, groundwater samples collected in March of 2008 exceeded applicable guidelines for cadmium, iron, manganese, selenium, and zinc. A single deep soil sample exceeded applicable guidelines for selenium.

4.3 Present Conditions

A cover was placed on the dump at some time since 1998, with material of indeterminate volume and thickness, and appears to be providing nourishment to scrub willow and alder. There is some evidence that the site is used by local residents for recreational purposes, e.g. for dirt bike or ATV activity, and potentially for disposal.

No signage was observed which would advise people to stay off the old dump site.

4.4 PCOCs

Based on the previous environmental assessment activities completed to date, and our site observations, the old dump site potential constituents of concern (PCOCs) in groundwater are identified as BTEX, PHCs, PAHs, Volatile Organic Compounds (VOCs), Glycols, and Metals. Pesticides were not included because there was no evidence to suggest there had ever been significant pesticide use in the community.

Although there is no typical leachate, there is evidence that some parameters are consistently found at landfills. Research completed at several landfills in Canada concluded that the similarity in leachate contaminants relates to the common constituents of domestic solid waste. Inorganic parameters include such elements as zinc, chromium, copper, lead, arsenic, aluminum, and mercury. Leachate can also contain petroleum, paints, household chemicals, solvents, glues, and inks.

PCOCs in soil are identified as BTEX, PHCs, PAHs, Volatile Organic Compounds (VOCs), Glycols, and Metals.

5.0 REGULATORY REVIEW AND ENVIRONMENTAL QUALITY CRITERIA

5.1 Regulatory Framework

The Contaminated Sites Management Working Group for federal government departments has defined a contaminated site as a site at which substances occur in concentrations that either: 1) are above background levels and pose, or are likely to pose, an immediate or long-term hazard to human health or the environment; or 2) exceed concentrations specified in guidelines and/or regulations. For the latter, the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CCME, 1999 and annual updates), including the Guidelines for Canadian Drinking Water Quality (Health Canada, December 2010) were applied in the numerical comparison of laboratory data.

Risk assessment principles have been used extensively in developing federal generic clean-up criteria for contaminated sites. However, as the term “generic” implies, they are intended for broad applications and are usually over-protective to avoid underestimating potential risks associated with a wide range of site conditions and potential land uses.

The CCME guidelines were derived from potential impacts to human and ecological receptors. The chemical data obtained during this assessment were preferentially compared to established CCME guidelines. The federal guidelines are relevant since the site(s) is within a national park.

Although the site is an old dump situated away from the current residences, in the future it may be used for other purposes. We have therefore selected to apply guidelines that will be protective of future uses, i.e. agricultural, and to consider drinking water guidelines despite the fact that community drinking water is treated surface (river) water. See below for details.

5.1.1 Federal Guidance

The CCME Canadian Environmental Quality Guidelines for soil, sediment and water are numerical limits intended to maintain, improve or protect environmental quality and human health at contaminated sites and have been derived using toxicological data.

5.1.1.1 Soil

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

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

- Canadian Environmental Quality Guidelines (CCME, 2007) for **agricultural land use**;
- Canada-Wide Standards for Petroleum Hydrocarbon (CWS) in soil (CCME, 2008) – Tier 1 Levels for **agricultural land use** in **fine-grained surface soils** and **coarse-grained subsoils**; and
- Agricultural land use guidelines/standards were also applied to offsite areas.

Although the site area is close to the Garden River Community within Wood Buffalo National Park, CCME Residential/Parkland Land Use Guidelines were not applied, as CCME distinguishes that this land use cannot be applied to “wild lands such as national or provincial parks”. Agricultural Land Use guidelines were selected in order to provide for protection of current transitory wildlife grazing and native flora, and potential future residential site use, livestock grazing, irrigation, and food cropping. Canada Wide Standards defines Agricultural lands as follows: “where the primary land use is growing crops or tending livestock. This also

includes agricultural lands that provide habitat for resident and transitory wildlife and native flora. Agricultural land may also include a farm residence."

Residential/Parkland assessment criteria may be applied in the future, based on land use designation.

5.1.1.2 Groundwater

Canadian water quality guidelines are intended to provide protection of freshwater and marine life from anthropogenic stressors such as chemical inputs or changes to physical conditions. The Federal Contaminated Sites Action Plan (FCSAP) Interim Guidelines are used for this evaluation. In order to consider future drinking water use, results were also compared to the Guidelines for Canadian Drinking Water Quality (Health Canada, December 2010).

The guidelines adopted for this evaluation are summarized as follows:

- FCSAP Tier 1 Interim Groundwater Guidelines for **agricultural land use**; and
- Guidelines for Canadian **Drinking Water** Quality (Health Canada, December 2010).

5.1.2 Chemical Evaluation – Process for Selection of Environmental Criteria

Chemical evaluation was conducted by comparing the detected concentrations for each substance to the most stringent applicable guideline. Where background concentrations for a chemical in the study area were higher than applicable criteria, then the background concentration may be selected as the appropriate point of comparison.

5.1.3 Chemical Evaluation – PAHs

The contamination of soil by polycyclic aromatic hydrocarbons (PAHs) is widespread in Canada because its sources, both anthropogenic and naturally-occurring, are ubiquitous. These substances are potentially cancer-causing agents. The CCME Soil Quality Guidelines address PAH concentrations in soil with regard to human health risks by providing numerically-calculated guidelines which take into account the potential synergistic effects of combinations of PAHs on cancer risk.

The guideline for PAHs presented on Table 1 shows 1) the Total Potency Equivalent (TPE) guideline (protection from direct contact with contaminated soil), 2) the Index of Additive Cancer Risk (IACR) guideline (protection for potable water resources), and 3) the environmental soil quality guideline (based on non-carcinogenic effects) of individual PAHs. Total Potency Equivalents and IACR were calculated for the ESA and risk assessment and did not exceed the stated human health guidelines for PAH concentrations in any soil samples. Soil analytical results were also compared with the stated soil quality guidelines for the protection of the environment (non-carcinogenic effects) in the ESA, and results are discussed in the applicable sections.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

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

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

- Decontamination (Alconox wash and distilled water rinse) of sampling equipment / instrumentation between all sample locations;
- Fresh, chemical-resistant nitrile gloves at each sampling location;
- Proper documentation of all aspects of the sampling program, with particular detail to the introduction of potential bias;
- Elimination of headspace for all volatile parameters (soils and water);
- Collection of one blind analytical duplicate for approximately every 10 samples of environmental media;
- Calculation of the relative percent difference between a sample and its duplicate; and
- Calibration of field instruments.

6.1 Data Reduction and Validation

Data reduction of the investigation results primarily involved summary tabulation of analytical results and transcription of field observations. Following data reduction, data validation was performed to ensure that the raw data was not altered and that an audit trail was developed for managing the data. Data validation was also performed to verify the quantitative and qualitative reliability of the information. A comparative review of sample collection records, chain-of-custody records, holding times, dilution factors, Estimated Quantitation Limits (EQLs), and laboratory and field QC sample records were evaluated against original laboratory reports.

6.2 Quality Assurance/Quality Control Samples

Laboratory reports detailing the handling and secure storage of samples, and the significant dates with respect to sample delivery, extraction, and analysis were reviewed by FRANZ/COLUMBIA and found to be within control limits.

External QA/QC samples in the form of blind duplicates were submitted for laboratory analysis. The nomenclature of each duplicate ensured that the sample number corresponding to the blind duplicate was not evident to the lab, allowing the external verification of laboratory accuracy and precision.

Total precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of replicate (duplicate) field samples and measures variability from both laboratory and field operations. The distinction between replicates and duplicates is as follows: Replicate, or co-located, samples are collected under comparable conditions adjacent in time or space. All groundwater and soil vapour duplicates fall into this category. Duplicate, or split, samples are homogenized and split into two portions before collection, as is possible with soils. However, due to concerns with contaminant volatilization, true duplicates were not collected. Therefore, we expect the replicate RPDs to be higher than typical duplicate RPDs. We will continue to use the wording, “duplicate”, throughout the report.

6.3 Data Validation of QA/QC Samples

Sampling procedures and laboratory analytical precision were evaluated by calculating the relative percent difference (RPD) for a sample and duplicate pair according to the following equation:

$RPD = | X_1 – X_2 | / X_{avg} X 100$

Where X_1 and X_2 are the concentrations and X_{avg} is the mean of these two values.

The following bulleted list presents the data quality objectives for this project. The target levels of precision for this project are:

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

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

These recommendations were presented by the Technical Sub-committee of the BCELQAAC, in a letter to the Environmental Management Branch, MOE, dated October 24, 2005, as a revision to the Technical Guidance document, and are generally accepted in BC. We believe it is appropriate to use these DQOs for the Garden River site because they are not specific to individual parameters but for classes of parameters, and the laboratories involved in the development are not specific to BC.

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

As a measure of conservatism, the higher of the two concentrations (sample and duplicate) is assessed against the guidelines.

6.4 Duplicate Analysis Results

Blind field duplicates were collected and submitted for BTEX (3), PHCs (3), PAHs (3), VOCs (3), Metals (3) and Glycols (3) analyses in soils. Blind field duplicates were collected and submitted for BTEX (1), PHCs (1), PAHs (1), VOCs (1), Metals (1), and Glycols (1) analyses in groundwater.

The following discussion presents the results of the RPD calculations. See Tables 11 and 12.

In the three sample/duplicate soil pairs analyzed, there were two exceedances of the project DQOs, however all are immaterial to site characterization for the following reasons:

<u>2018-10BH-1M-2 and 2018-10BH-Dup1:</u>

- RPD = 40% for Sulfate in soluble paste for salinity data, for which there is no guideline. These were replicate samples (see discussion at section 6.2), and a soluble paste is made from a small portion of each sample, therefore it could be anticipated that even within one sample, the pastes could have quite different compositions. The other six components exhibit from 0% to 30% RPD.

2018-10BH-2M-2 and 2018-10BH-Dup2:

- RPD = 55% for Sodium in soluble paste for salinity data, for which there is no guideline. These were replicate samples (see discussion at section 6.2), and a soluble paste is made from a small portion of each sample, therefore it could be anticipated that even within one sample, the pastes could have quite different compositions. The other six components exhibit from 0% to 26% RPD.

In the one sample/duplicate groundwater pair analyzed, there were two exceedances of the project DQOs in dissolved metals.

2018-10BH-2 and 2018-10BH-Dup1:

- RPD = 49% for Aluminum; RPD = 36% for Titanium. In both cases, both sample and duplicate were below guideline, therefore the imprecision in the analyses is not considered material to site characterization. RPDs for all other metals were < 12%.

The 2010 data set is considered valid and representative, and is being relied upon.

We reviewed the EBA QA/QC program and conclusions, and accept their conclusion that their field sampling methods were acceptable for the purposes of the assessment.

7.0 FIELD INVESTIGATION

7.1 Field Reconnaissance

During the investigation conducted by FRANZ/COLUMBIA personnel between December 13 and 20, 2010, informal interviews were conducted with members of the Garden River community (Public Works garage crew and Manager, Daniel Nanooch – resident in Garden River since 1970), photographs were taken, and general site reconnaissance, including a site survey was performed. Photographs are presented in Appendix A.

7.1.1 Site Observations

The dump site consists of two different surface types. The east half is topographically flat with slight undulations, and the west half is hummocky (i.e., containing many different elevations where loads of fill and debris have been deposited.)

Little waste debris was observed due to approximately 2 feet (60 cm) of snow cover across the site. Visible debris included small amounts of unidentified metal debris, a half buried snowmobile, and a vehicle chassis. The side of the ravine was forested and appeared clear of debris.

Based on observations during the drilling, the dump site appears to have been capped with a sand and/or gravel fill that ranges in depth from a metre to only a few centimetres depending on the area within the site. Therefore, it is concluded that a consistent landfill cap does not exist on the site.

Site drainage varies from area to area across the site; however, can be summarized as either draining east to the ravine or west to the road. Both surface pathways (the ravine and the road) decline to the south and discharge into the Peace River. The topography drops off quite steeply south of 2018-10BH-3M.

There is no direct active surface drainage (creeks or streams) associated with the dump site; however, man-made drainage ditches were present at the south site boundary and through the north debris area. Although no flowing water was observed during the investigation, it is possible that these man-made drainage channels would be seasonally active, i.e. during the spring thaw or heavy rains.

All significant site features were mapped, including: surface water pathways, debris, vegetations stands, roadways, topographical variances, sample locations (including historical when identifiable), instrumentation, fences, and buildings/structures.

The information collected, in conjunction with the complete historical records review, was used in the design of the detailed sampling plan and contributed to any modifications that occurred while onsite.

7.2 Detailed Sampling Plan

A sampling plan was prepared and designed to perform a detailed assessment of the site with respect to soil and groundwater. It was designed to delineate the extent of environmental impacts of the old dump. Two wells were installed to collect regional, background data. Five delineation wells were installed outside the known extent of the dump, and surface samples were collected from inside the dump.

The plan was based on a review of the Terms of Reference, discussions with senior personnel with landfill assessment experience and the client, and a review of the previous reports. The sampling plan described our sampling methods and types of measurements/tests to be conducted, including:

- Proposed sampling locations and quantities
- Proposed sampling or measurement methods

- Parameters being sampled
- Proposed QA/QC methods
- Proposed background sampling protocols
- Proposed health and safety plan, including contingency planning for extreme cold weather (separate)

Based on visual observations at the time of the field program, sampling locations were refined in order to select optimal well locations, and to increase coverage.

7.3 Health and Safety Procedures

FRANZ/COLUMBIA provided a Site-specific Health and Safety Plan (HSP) for the work in Garden River. We used the FRANZ Corporate Health and Safety Plan as a general guide. All team members and subcontractors must adhere to the prime contractor's HSP. The priority during this field program was the health and safety of all onsite personnel carrying out daily work activities in extreme winter weather conditions.

Prior to conducting any of the onsite work, the HSP was developed, distributed and discussed with field personnel. The Safety Kick-off Meeting was documented, and all site personnel signed off (Appendix B). A cold-weather JSA was developed, and particular attention was also paid to the driving conditions to and from High Level. An ice-fishing tent and propane heater was provided for the groundwater monitoring program. Workers were well-prepared for the conditions they encountered. Full personal protective equipment was worn during field activities.

7.4 Field Program Methodology

7.4.1 Utility Locates

Hawkeye Line Locators Inc. out of Grande Prairie, Alberta, conducted the utility locate work on December 14, 2010, prior to any ground disturbance onsite. They found no buried utilities using a Metrotech 810 RF line tracer which is capable of identifying and tracing metallic pipe or cable, water and gas distribution lines; and of inductive locating and blind searching. See Appendix C.

7.4.2 Borehole Drilling and Soil Sampling

Borehole drilling using an auger rig was considered the appropriate method for the soil conditions and to collect soil samples. Between December 15th and 18th, 2010, seven boreholes were drilled to a maximum depth of 9.5m bgs. Each full-depth borehole location was completed with a monitoring well installation. Of the seven borehole/monitoring well installations, five were installed to address delineation of the subject site and two were installed to address background conditions. Borehole cuttings were left adjacent to each installation.

In addition to the seven full-depth boreholes, six shallow boreholes were also drilled to a depth of 1.5m bgs to investigate soil conditions directly within the dump extents. Soil samples from the boreholes were collected and analyzed for potential contaminants of concern including metals, petroleum hydrocarbons (F1 to F4) including BTEX, volatile organic carbons (VOCs), polycyclic aromatic hydrocarbons (PAHs), glycols and particle size. Holes were refilled when sampling was complete. All boreholes were completed with a truck mounted solid stem auger drill rig provided and operated by Mobile Augers and Research Ltd, based out of Edmonton, AB.

At each borehole location, composite soil samples were collected off the solid stem auger using either a decontaminated trowel or a fresh pair of nitrile gloves. Attempts were made on sample station 2018-10BH-1M to obtain soil samples by use of split spoon sampling; however, due to lack of sample recovery, it was

decided to continue the remaining soil sampling by collecting the samples directly from the auger flights. Care was taken by both site personnel and Mobile Augers and Research Ltd. to ensure that sample depths were accurately represented and that soil auger creep was accounted for in the stratigraphy logging. Depending on the nature of the stratigraphy and any evidence of contamination, composite samples at surface were collected between 0 and 0.8m bgs and 0.8 to 1.5m bgs. Soil samples at depth were collected at 1.5m intervals, unless obvious changes in stratigraphy or evidence of chemical impacts warranted additional sampling. Prior to sampling, soil descriptions including approximate grain size, colour, moisture content, stratigraphy and any evidence of contamination were recorded in field borehole logs.

Following the completion of the borehole field log and prior to completing the monitoring well installation, soil samples were collected and stored in sealable polyethylene bags (for soil vapour headspace analysis) and dedicated, laboratory supplied, glass sample containers (for laboratory analysis). Following sample collection, jarred soils were stored on ice in laboratory-supplied coolers until delivery to the project laboratory. Extra sample was collected as a precaution against loss during transportation.

Borehole locations are shown on Figure 2. Borehole logs were prepared for all locations and are provided in Appendix D. The number of boreholes was sufficient to provide delineation of site impacts and to provide adequate site stratigraphy and groundwater characterization.

7.4.3 Field Vapour Screening

Vapour screening is a frequently used method for detecting and measuring the quantity of volatile organic compounds present in soil. When taken continuously from the ground surface to the end of a borehole, vapour readings can provide an indication of the relative level of contamination and whether it derived from a localized source or migrated from a more distant one. As a result, field screening is a useful tool to facilitate selection of samples to be submitted for laboratory analysis.

During the investigation, field vapour screening was completed in-situ by partially filling and sealing standard volumes of soil into dedicated polyethylene bags. The samples were then stored at room temperature, headspace vapours were allowed to develop and equilibrate in the sealed bag. Gas samples were retrieved by inserting a small tube into the bag which was attached to an RKI Eagle organic vapour meter (OVM). The concentration of combustible gases present (other than methane) by volume (ppm) of the calibrating gas (hexane) was measured. All soil samples for the entire depth of the boreholes were tested for head space vapours. The results of the soil vapour headspace analyses are included in the borehole logs, and can be found in Appendix D.

7.4.4 Monitoring Well Installations

Boreholes were completed as groundwater monitoring wells to collect groundwater samples for chemical analysis and to assess the overall hydrogeology of the site. Each groundwater well was completed using 50mm inside diameter (ID) PVC pipe casing and screen. The annular space around the screen was backfilled with clean silica sand. The remaining annulus to ground surface was backfilled with clean bentonite chips. A stick-up well casing was installed to protect the well from tampering and damage. The top of the PVC pipe casing was surveyed upon completion of the groundwater sampling program. Once the groundwater wells were installed, the wells were developed until the groundwater was free of sediment that could interfere with sample analysis (minimum of six annular well volumes per well were removed). Prior to sampling, a minimum of three annular well volumes were removed from the well. Purge water was biofiltered across the dump. Field measurements of pH, conductivity, turbidity, and ORP were collected.

7.4.5 Groundwater Sampling

The groundwater monitoring and sampling program included measurement of groundwater levels and collection of representative samples for chemical analysis.

Groundwater samples were collected using dedicated LDPE Waterra foot valves and tubing. After purging, a separate container was filled with purge water in which field parameters of pH, conductivity, turbidity, and ORP were collected inside a heated shelter (i.e., jobsite trailer). The water quality meter was calibrated in the field prior to use. Groundwater temperature was not collected due to ambient air temperatures ranging from -25 to -35°C which caused the probe to freeze up in the field. Samples for inorganics (specifically heavy metals) were field-filtered using high capacity 0.45 micron filters, and preserved with nitric acid.

One groundwater sample per monitoring well was submitted for chemical analysis (total of eight samples and one duplicate) of PCOCs including PHCs (F1 to F4) including BTEX, Metals, VOC, PAH, Glycols, and detailed salinity/routine chemistry. We doubled the sample volumes as a precaution against potential breakage during transportation to the laboratory.

7.4.6 Electromagnetic Surveying – Basic Principles and Equipment

To determine the extents of the buried debris onsite, FRANZ used the Geonics Ltd. EM61-HH (hand held) metal detection system. The EM61 geophysical technique allows easy determination of the location and lateral extent of buried metallic objects.

The EM61 method evaluates the magnitude of a secondary (induced) electromagnetic field in any buried metallic object caused by a primary electromagnetic field once the primary electromagnetic field is turned off.

The EM61-HH emits an electrical current from the horizontal transmitter coil located directly above the ground. The current in the coil is rapidly terminated, resulting in a strong electromotive force which induces (secondary) eddy currents in the ground. The eddy currents are caused by the presence of underground conductors. Eddy currents decay rapidly, and residual eddy currents are picked up by the receiver coil in the EM61-HH unit. The EM61-HH measures the difference in voltage from the transmitter coil at a specific time interval after the voltage has been shut off. If there are no underground conductors, the receiver coil registers near zero.

7.4.7 Electromagnetic Survey Methodology

Prior to conducting the survey, the EM61-HH unit was calibrated to correspond with the background magnetic field. This was accomplished by establishing a zeroing station in an area that contained old growth forest and was far away from any known or historical human activity. The area chosen was to the east of the site past the ravine.

The site was surveyed in a grid pattern determined by the field technician at the time of the survey and is presented in Figure 13. Survey lines were spaced approximately 4 to 5m apart and walked at a consistent pace. Electromagnetic responses were noted throughout the course of the survey. All electromagnetic surveying was conducted in real time and no “take home” data was collected. Once defined, the edges of the dump sites were clearly marked in the snow and then georeferenced using the Trimble GeoXH DGPS unit. All major magnetic anomalies were noted and georeferenced.

7.4.8 Site Survey

A complete site survey for the area investigated was carried out during the field program. The site survey consisted of geo-referencing site features and sample locations with the use of a Trimble GeoXH DGPS unit horizontally accurate to <1m. The GeoXH uses a WBAS satellite lock to obtain differential corrections in real time negating the requirement for post processing of data once back in the office. The observed accuracy

during the field program ranged from 0.35m to 0.78m. All single point locations (i.e., monitoring wells, control points, and site features) were collected by averaging 120 waypoints into one. All line features were collected by walking along the linear feature while collecting 1 waypoint per second.

The collected data was exported from Trimble GPS Pathfinder Office V4.10 into an ESRI Shape file using the following datum: UTM, zone 12N, WGS 1984. The purpose of exporting to an ESRI Shape file was to obtain all relevant GIS data collected in the field (i.e., feature identifications) eliminating instances of misinformation through data transfer. The ESRI Shape file was then imported into AutoCAD Map 3D and is therefore fully geo-referenced.

A 2009 Google Earth image was then imported and orthorectified as a backdrop to correspond with data points collected during the field survey.

Detailed levelling work was also conducted onsite using an Auto Level. Monitoring well 08MW05B was assigned an arbitrary 100.00m for the purpose of the elevation survey and was used as a temporary bench mark (TBM). All elevations onsite are in relation to one another for the purposes of reducing the data to real-life elevations at a later date. Elevations were taken for all monitoring well installations at the top of casing (TOC). Elevations were also collected at several locations throughout the site to gain a better understanding of general site topography in relation to surrounding areas. The topographic elevations were also marked using the DGPS unit for accurate horizontal placement. The elevation survey summary is presented as Appendix E.

7.5 Chemical and Physical Analysis

7.5.1 Chemical and Physical Analysis Program

AGAT Laboratories Ltd. was selected to complete the analytical testing for this project. AGAT is certified by the Canadian Association of Laboratory Accreditation (CALA), and follows strict internal quality assurance/quality control (QA/QC) protocols. Their Quality Assurance System is consistent with: The International Organization for Standardization's ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories' and the ISO 9000 series of Quality Management standards; all principles of Total Quality Management (TQM); all applicable safety, environmental and legal regulations and guidelines; methodologies published by the ASTM, NIOSH, EPA and other reputable organizations; and the best practices of other industry leaders. It includes replicate analyses, blank spikes, matrix spikes, instrument calibration, internal standards, method blanks and internal QC checks. A copy of the chain-of-custody forms used for sample submission is provided with the certified laboratory reports in Appendix F.

7.5.2 Analytical Program

The sampling and analytical program is summarized in the table below. Samples were analyzed for three reasons:

- to document metal, VOC, PAH, BTEX, PHC, glycol, and nutrient concentrations across the site;
- to delineate the extent of the old dump; and
- to provide data for a human health risk assessment toward risk management and landfill closure.

Summary of Analytical Sampling

Analysis	Soil	Groundwater	Total
PHCs	26 (3)	10 (1)	36
BTEX	26 (3)	10 (1)	36
Metals	23 (3)	10 (1)	33

Analysis	Soil	Groundwater	Total
VOCs	25 (3)	10 (1)	35
PAHs	25 (3)	10 (1)	35
Glycols	23 (3)	10 (1)	33
Grain Size (shallow)	3	–	10
Grain Size (deep)	7	–	

(X) Denotes number of QA/QC samples.

7.5.3 Physical Testing Program

Grain size analyses (+/- 0.075 microns) were completed on seven soil samples representative of the stratigraphy (coarse) at the water table offsite, and on three soil samples representative of the surface stratigraphy (fine) onsite. Grain size analyses at the water table was conducted to aid in the calculation of hydraulic conductivity. Grain size analyses of surface soils was conducted to address data collected for the risk assessment. Results are presented on Table 4.

7.5.4 Field Chemistry

Groundwater chemistry data was collected in the field prior to sample collection. After purging, a separate container was filled with purge water in which field parameters of pH, conductivity, turbidity, and ORP were collected inside a heated shelter (i.e., jobsite trailer). The meter was calibrated in the field prior to use. Groundwater temperature was not collected due to ambient air temperatures ranging from -25 to -35°C which caused the probe to freeze up in the field.

The analytical lab reported different results for both groundwater pH and conductivity, with higher pH values, and lower conductivity values; and that the sample with the high field turbidity measurement (2018-10BH-6M) of 205 NTU was also the one sample which exceeded the Drinking Water guideline for TDS. According to the borehole log, this well was installed in silt and clay. We use the field values in the report for the 2010 data, because they are more representative of the actual values.

Groundwater Field Chemistry Summary

	Date	Turbidity (NTU)	ORP (mV)	pH	EC (µS/cm)
2018-10BH-1M	Dec. 17	49.7	-59	7.52	995
2018-10BH-2M	Dec. 17	19.19	-41	7.11	2018
2018-10BH-3M	Dec. 17	37.8	-37	7.58	1138
2018-10BH-4M	Dec. 18	74.8	-35	7.60	970
2018-10BH-5M	Dec. 18	83.6	-44	7.48	942
2018-10BH-6M	Dec. 18	205	-73	7.14	1776
2018-10BH-7M	Dec. 18	64.1	-73	7.54	990
08MW04B	Dec. 18	22.1	-24	7.53	923
08MW05B	Dec. 18	111	-37	7.55	964

8.0 INVESTIGATION RESULTS

The objective of the investigation was to determine the extents of the old dump, i.e., where the dump is not, and then characterize the area. Determining the extents was achieved with the geophysical survey, the interviews, and the site observations. Characterization was achieved by drilling and installing monitoring wells and collecting soil and groundwater samples. This analytical data is added to that collected by EBA in 2008.

Having determined which areas are *not* in the dump, the degree to which those samples are compliant or non-compliant is secondary to the inference that they have not been impacted by the activities at the dump, and therefore findings may be attributable to background conditions.

The objective of determining the degree of contamination *inside* the old dump site was to be able to risk assess the area, and assess leachate migration. This was achieved by drilling and installing one monitoring well at the top of the ravine on the east site boundary, and collecting soil and groundwater samples; and collecting surface soil samples. This analytical is added to the body of evidence collected by EBA in 2008, which included samples collected at two onsite monitoring wells as well as surface soil samples.

8.1 2010 Work Program

8.1.1 Boreholes

Two background wells were installed in distant locations: 2018-10BH-6M, approximately 150m east-northeast (crossgradient) of the site, and 2018-10BH-7M, approximately 100m southwest (crossgradient) of the site. Locations were chosen that were highly unlikely to have been impacted by activities at the old dump.

Five delineation wells were installed in proximity to the site boundaries: 2018-10BH-1M, approximately 30m north of site; 2018-10BH-2M, at the east central site boundary (at the top of the ravine); 2018-10BH-3M, approximately 20m south of the south debris area; 2018-10BH-4M, approximately 20m off the northwest corner of the site; and 2018-10BH-5M, approximately 20m off the southwest corner of the site. Although 2018-10BH-2M was drilled to delineate the east site boundary (at the top of the ravine), it is within the old dump site, and the data collected there is included in the characterization of the dump site. It was not possible to drill any further east because of the ravine. Observations and interviews with the Public Works staff corroborated the view that significant dumping had not occurred into the ravine.

Samples from soil and groundwater were collected and analyzed for selected parameters including metals, benzene, toluene, ethylbenzene and xylenes (BTEX), PHC fractions F1 to F4, PAHs, VOCs, and glycols. Soil analytical results are presented on Figures 5 – 8 and Tables 1 – 4, and groundwater analytical results on Figures 9 – 12 and Tables 5 – 8. Historical data from EBA's 2009 report has been included in tables and figures. Samples collected in 2008 were compared to current applicable guidelines, and examined in the context of the 2010 investigation program.

One surficial soil sample was collected for analysis at each borehole, and either one or two samples at the water table. One groundwater sample was collected at each location. Particle size analysis at the groundwater table indicates that guidelines for coarse soils are applicable. See table below for summary.

EBA installed four onsite wells in 2008, however only two are viable: 08MW04B and 08MW05B. Groundwater results from these two wells are included in the investigation. There have been three sampling events at these wells – March and August 2008, and December 2010.

2010 Borehole Sample Summary

Borehole	Sample ID	Depth (m bgs)	Chemical Analysis	Particle Size Analysis
2018-10BH-1M	2018-10BH-1M-2	0.8 – 1.5	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-1M-6	6.1 – 7.6	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-1M-7	7.6 – 9.0	PHCs, BTEX, metals, VOCs, Glycols, Salinity	95.8% particles > 75 micron
	2018-10BH-1M	groundwater	PHCs, BTEX, metals, VOCs, Glycols, Anions, Nutrients	–
2018-10BH-2M	2018-10BH-2M-1	0 – 0.5	PHCs, BTEX	–
	2018-10BH-2M-2	0.5 – 1.6	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-2M-7	6.1 – 7.7	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-2M-8	7.7 – 9.0	PHCs, BTEX, VOCs	98.3% particles > 75 micron
	2018-10BH-2M	groundwater	PHCs, BTEX, metals, VOCs, Glycols, Anions, Nutrients	–
2018-10BH-3M	2018-10BH-3M-1	0 – 0.5	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-3M-7	6.1 – 7.7	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-3M-8	7.7 – 9.0	–	99.0% particles > 75 micron
	2018-10BH-3M	groundwater	PHCs, BTEX, metals, VOCs, Glycols, Anions, Nutrients	–
2018-10BH-4M	2018-10BH-4M-1	0 – 0.7	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-4M-8	9.0 – 10.7	PHCs, BTEX, metals, VOCs, Glycols, Salinity	98.9% particles > 75 micron
	2018-10BH-4M	groundwater	PHCs, BTEX, metals, VOCs, Glycols, Anions, Nutrients	–
2018-10BH-5M	2018-10BH-5M-1	0 – 0.5	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-5M-7	7.7 – 9.0	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-5M-8	9.0 – 10.7	–	98.0% particles > 75 micron
	2018-10BH-5M	groundwater	PHCs, BTEX, metals, VOCs, Glycols, Anions, Nutrients	–
2018-10BH-6M	2018-10BH-6M-1	0 – 0.5	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-6M-8	9.0 – 10.7	PHCs, BTEX, metals, VOCs, Glycols, Salinity	84.9% particles > 75 micron
	2018-10BH-6M	groundwater	PHCs, BTEX, metals, VOCs, Glycols, Anions, Nutrients	–
2018-10BH-7M	2018-10BH-7M-1	0 – 0.5	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-7M-7	7.7 – 9.0	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
	2018-10BH-7M-8	9.0 – 10.7	–	98.2% particles > 75 micron
	2018-10BH-7M	groundwater	PHCs, BTEX, metals, VOCs, Glycols, Anions, Nutrients	–

8.1.2 Surface Samples

In 2010, six shallow boreholes were drilled in order to collect surface soil samples to further characterize the dump site. 2018-10SS-1 and 2018-10SS-2 were located on the east half of the site. 2018-10SS-3 and 2018-10SS-4 were located near the incinerator off the northeast corner of the site, which is considered offsite, however we included that area because of its proximity to the incinerator. 2018-10SS-5 and 2018-10SS-6 were located on the west half of the site, where it was observed that loads of fill and debris had been piled. One soil sample was collected for analysis in the top 1m at each borehole. Particle size analysis indicates that guidelines for fine soils are applicable in this stratigraphic layer. See summary table below.

We are including all surface soil samples from the EBA investigation in the site characterization; 08SS46, 47, and 48 are within the old dump, and 08SS45 and 49 are outside.

Samples from soil and groundwater were collected and analyzed for selected parameters including metals, benzene, toluene, ethylbenzene and xylenes (BTEX), PHC fractions F1 to F4, PAHs, VOCs, and glycols.

2010 Surface Sample Summary

Borehole	Sample ID	Depth (m bgs)	Chemical Analysis	Particle Size Analysis
2018-10SS-1	2018-10SS-1	0 – 0.75	PHCs, BTEX, metals, VOCs, Glycols, Salinity	20.9% particles > 75 micron
2018-10SS-2	2018-10SS-2	0 – 0.75	PHCs, BTEX, metals, VOCs, Glycols, Salinity	13.4% particles > 75 micron
2018-10SS-3	2018-10SS-3	0 – 0.75	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
2018-10SS-4	2018-10SS-4	0 – 0.75	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
2018-10SS-5	2018-10SS-5	0 – 0.9	PHCs, BTEX, metals, VOCs, Glycols, Salinity	–
2018-10SS-6	2018-10SS-6	0 – 0.8	PHCs, BTEX, metals, VOCs, Glycols, Salinity	29.5% particles > 75 micron

8.2 Soil Analytical Results

By establishing background levels of constituents, we are able to draw meaningful, site-specific based conclusions. Soil analytical results are presented on Figures 5 – 8 and Tables 1 – 4.

While we have geophysical survey evidence as well as verbal and visual corroboration to provide delineation to the extents of the dump, we also applied descriptive statistics to certain parameters to assess population differences within and outside of the dump boundaries. For describing fill soils within the dump, we place less emphasis on discrete samples and more emphasis on indicators of bulk soil quality such as the mean and 95% upper confidence limit of the mean (UCLM). We then compare these bulk soil quality indicators to the CCME guideline.

Below are the stats with graphs of the soil results for the parameters of interest showing the results inside the area defined as the old dump site, outside the area, the guideline, and the mean and 95% UCLM of results from across the study area.

Concentrations that are less than detection limit have been assigned a value that is half the detection limit in order to include them in the statistical analysis. Outlier values have been removed from the graphs in order to provide more detail to the modal data; however they are presented in text boxes above the legend.

The east and west sides of the old dump site were observed to have different topographic features, described below.

East Side of Dump – All samples were compliant with applicable guidelines. This half of the old dump is described as flat with slight undulations, compared to the west half which has loads of fill and debris. No samples were collected here in 2008.

Samples considered to be on the east side: 2018-10SS-1, 2018-10SS-2, 2018-10BH-2M

West Side of Dump – This area is described as containing deposited loads of fill and debris, and due to being accessible from the road, is likely the more recently used portion of the old dump. Several PAH and metals exceedances were observed in samples collected on this side. These are discussed with statistics below.

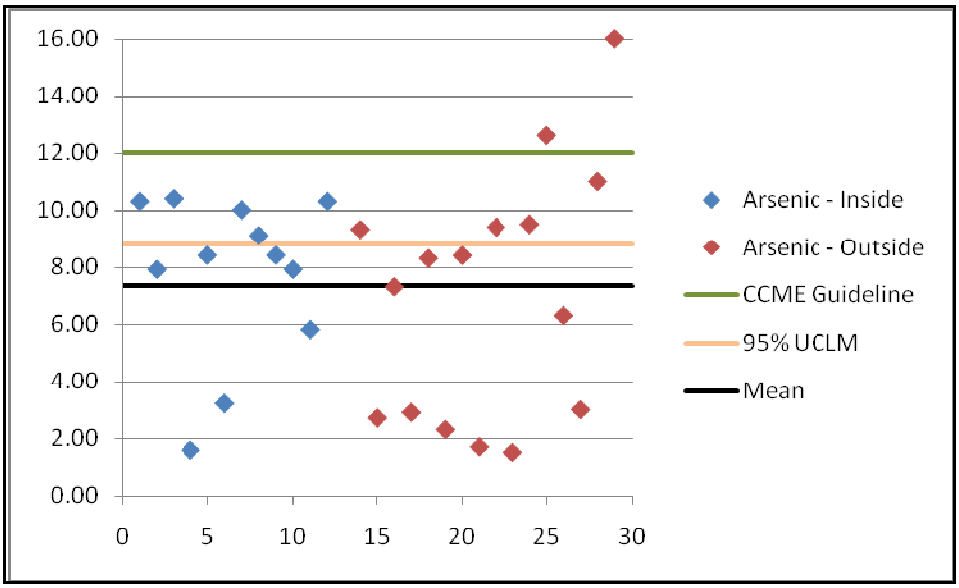
Samples considered to be on the west side: 2018-10SS-5, 2018-10SS-6, 08MW04 and 4B, 08MW05 and 5B, 08SS46, 08SS47, 08SS48

New Incinerator Location – At some time since the EBA investigation in 2008, the incinerator has been moved from its location near 08MW06. Two boreholes were drilled here: 2018-10SS-3 and 2018-10SS-4. At 2018-10SS-3, all samples were compliant. At 2018-10SS-4, we observed exceedances in metals.

Arsenic

Arsenic - Inside the Old Dump		Arsenic - Outside the Old Dump		Arsenic across the Study Area	
Mean	7.773	Mean	7.014	Mean	7.339
Standard Error	0.828	Standard Error	1.083	Standard Error	0.705
Median	8.4	Median	7.8	Median	8.35
Mode	10.3	Mode	-	Mode	8.4
Standard Deviation	2.868	Standard Deviation	4.333	Standard Deviation	3.732
Sample Variance	8.227	Sample Variance	18.775	Sample Variance	13.928
Kurtosis	0.832	Kurtosis	-0.612	Kurtosis	-0.416
Skewness	-1.283	Skewness	0.348	Skewness	-0.047
Range	8.83	Range	14.5	Range	14.5
Minimum	1.57	Minimum	1.5	Minimum	1.5
Maximum	10.4	Maximum	16	Maximum	16
Sum	93.27	Sum	112.23	Sum	205.5
Count	12	Count	16	Count	28
90th Percentile	10.3	90th Percentile	11.8	90th Percentile	10.58
Confidence Level(95.0%)	1.822	Confidence Level(95.0%)	2.309	Confidence Level(95.0%)	1.447

Arsenic Concentrations (ug/g) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



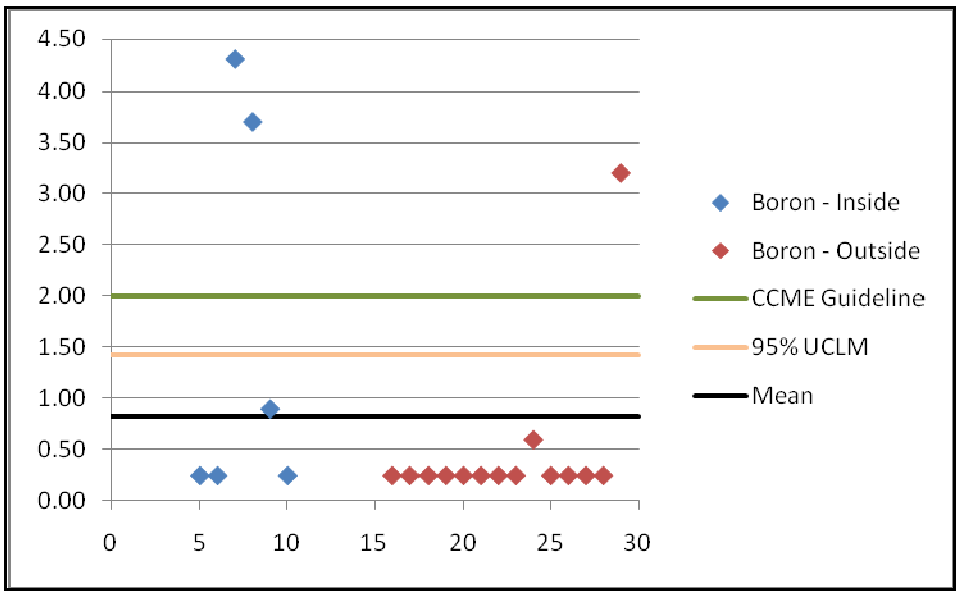
Arsenic: Exceeded at 2018-10SS-4 near the incinerator, and at 2018-10BH-6M, in the sample collected at 9.0 – 10.7m bgs which is a background, crossgradient location, 150m east-northeast of the site. Arsenic concentrations across the study area were generally below the CCME guideline, except for these two cases outside the old dump site. Across the study area, there were no cases where Arsenic was <DL. Twenty-eight samples were analyzed for this parameter (both 2008 and 2010 investigations). The mean and the 95% UCLM were below the CCME guideline.

Based on the distribution of Arsenic in the above graph, it appears that the concentrations in soil inside and outside of the dump area are a single population. The dump is not biasing the data. For the two samples that exceed the CCME guideline, they were not significantly higher than the guideline and they may be representative of the upper end of the population. It is possible that elevated Arsenic near the incinerator might be indicative of effects from the incinerator. Arsenic will be considered in the Risk Assessment.

Boron

Boron - Inside the Old Dump			Boron - Outside the Old Dump			Boron across the Study Area	
Mean	1.608		Mean	0.486		Mean	0.823
Standard Error	0.767		Standard Error	0.210		Standard Error	0.286
Median	0.575		Median	0.25		Median	0.25
Mode	0.25		Mode	0.25		Mode	0.25
Standard Deviation	1.879		Standard Deviation	0.787		Standard Deviation	1.277
Sample Variance	3.531		Sample Variance	0.619		Sample Variance	1.631
Kurtosis	-1.642		Kurtosis	13.506		Kurtosis	3.202
Skewness	0.939		Skewness	3.656		Skewness	2.147
Range	4.05		Range	2.95		Range	4.05
Minimum	0.25		Minimum	0.25		Minimum	0.25
Maximum	4.3		Maximum	3.2		Maximum	4.3
Sum	9.65		Sum	6.8		Sum	16.45
Count	6		Count	14		Count	20
90th Percentile	4		90th Percentile	0.495		90th Percentile	0.495
Confidence Level(95.0%)	1.972		Confidence Level(95.0%)	0.454		Confidence Level(95.0%)	0.598

Boron Concentrations (ug/g) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



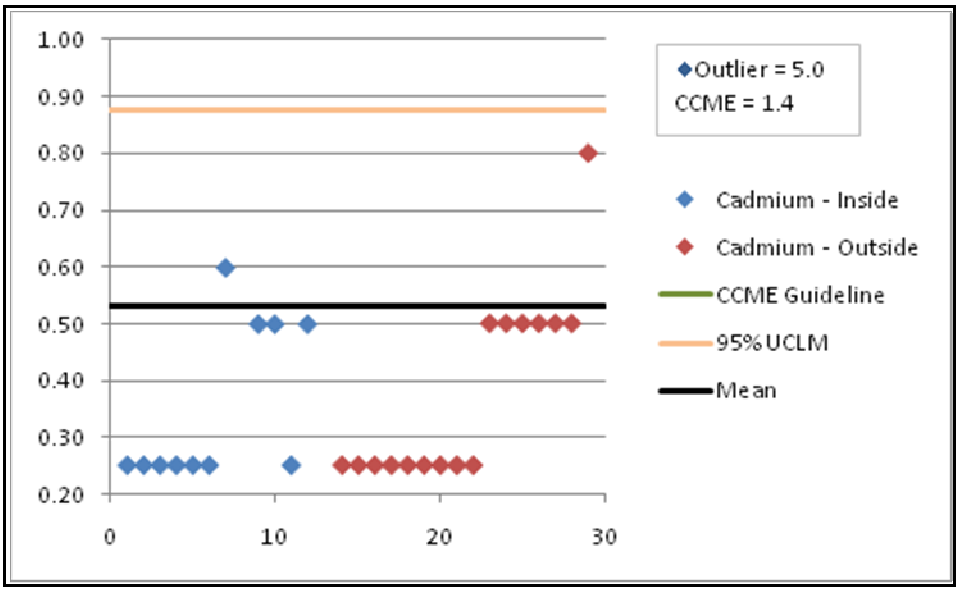
Boron: Exceeded at 2018-10SS-4 near the incinerator, and in two samples collected on the west side of the dump: 2018-10SS-5 and 2018-10SS-6. This element exceeds the guideline in three surface samples. The amount of Boron in soil can be directly related to the amount of organic plant matter. At 10SS-4, the borehole log describes “dark brown silt, very dark brown organics, decayed wood, wood debris”, thereby explaining high Boron levels. However, at the other two locations, the borehole logs identify fine to coarse sand and gravel with debris throughout. The debris is identified as plastic, wire, glass, Styrofoam, and screws, i.e. household detritus. As Boron is used in the production of glass and ceramics, and is found in detergents and fibreglass, it is likely directly related to the waste.

The mean and 95% UCLM of the boron concentrations were below the CCME guideline. Only three discrete samples were over the guideline. It is possible that the dump is likely biasing the data, and Boron should be considered a potential constituent of concern. This will be considered in the Risk Assessment.

Cadmium

Cadmium - Inside the Old Dump			Cadmium - Outside the Old Dump			Cadmium across the Study Area	
Mean	0.738		Mean	0.378		Mean	0.532
Standard Error	0.389		Standard Error	0.042		Standard Error	0.168
Median	0.25		Median	0.25		Median	0.25
Mode	0.25		Mode	0.25		Mode	0.25
Standard Deviation	1.349		Standard Deviation	0.166		Standard Deviation	0.889
Sample Variance	1.820		Sample Variance	0.028		Sample Variance	0.790
Kurtosis	11.689		Kurtosis	0.906		Kurtosis	26.209
Skewness	3.403		Skewness	1.110		Skewness	5.050
Range	4.75		Range	0.55		Range	4.75
Minimum	0.25		Minimum	0.25		Minimum	0.25
Maximum	5		Maximum	0.8		Maximum	5
Sum	8.85		Sum	6.05		Sum	14.9
Count	12		Count	16		Count	28
90th Percentile	0.6		90th Percentile	0.5		90th Percentile	0.53
Confidence Level(95.0%)	0.857		Confidence Level(95.0%)	0.089		Confidence Level(95.0%)	0.345

Cadmium Concentrations (ug/g) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



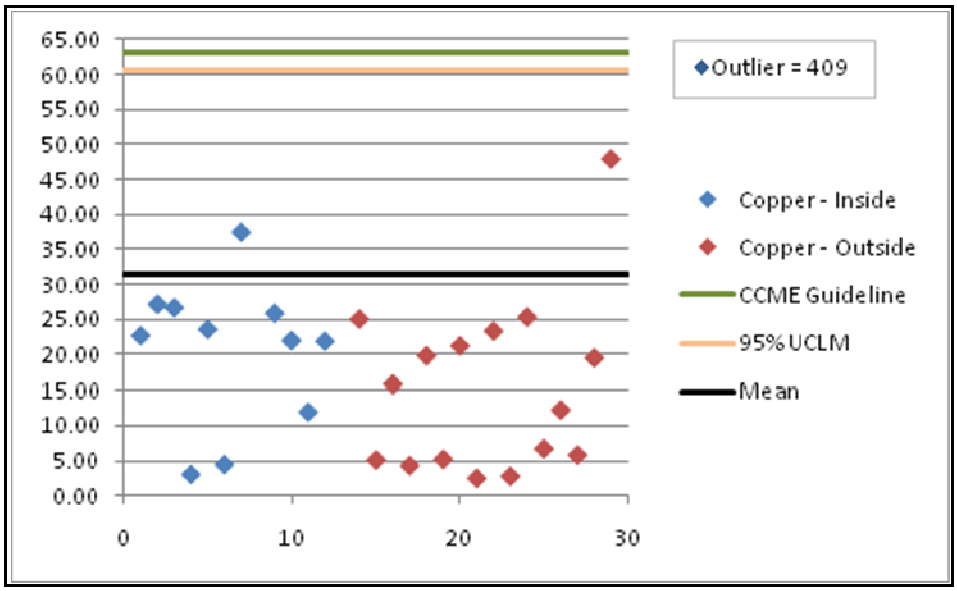
Cadmium: Exceeded in one surface sample (the outlier, 5 ug/g) collected on the west side of the dump: 2018-10SS-6. Cadmium was used as a pigment for many years, for corrosion-resistance in steel plating, and as a stabilizer in plastics. It is now used in nickel-cadmium batteries. This exceedance is likely directly related to the household detritus.

The mean and 95% UCLM are below the CCME guideline (1.4 ug/g). There is little difference in the means inside and outside the dump site. Because of the borehole log evidence, the waste associated with the dump is likely biasing the data, and Cadmium should be considered a potential constituent of concern. This will be considered in the Risk Assessment.

Copper

Copper - Inside the Old Dump			Copper - Outside the Old Dump			Copper across the Study Area	
Mean	53.075		Mean	15.244		Mean	31.457
Standard Error	32.481		Standard Error	3.033		Standard Error	14.146
Median	23.25		Median	14.1		Median	20.6
Mode	-		Mode	-		Mode	-
Standard Deviation	112.516		Standard Deviation	12.132		Standard Deviation	74.853
Sample Variance	12659.875		Sample Variance	147.191		Sample Variance	5602.98
Kurtosis	11.764		Kurtosis	2.082		Kurtosis	26.587
Skewness	3.416		Skewness	1.244		Skewness	5.099
Range	405.9		Range	45.3		Range	406.4
Minimum	3.1		Minimum	2.6		Minimum	2.6
Maximum	409		Maximum	47.9		Maximum	409
Sum	636.9		Sum	243.9		Sum	880.8
Count	12		Count	16		Count	28
90th Percentile	36.6		90th Percentile	25.25		90th Percentile	30.39
Confidence Level(95.0%)	71.489		Confidence Level(95.0%)	6.465		Confidence Level(95.0%)	29.025

Copper Concentrations (ug/g) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



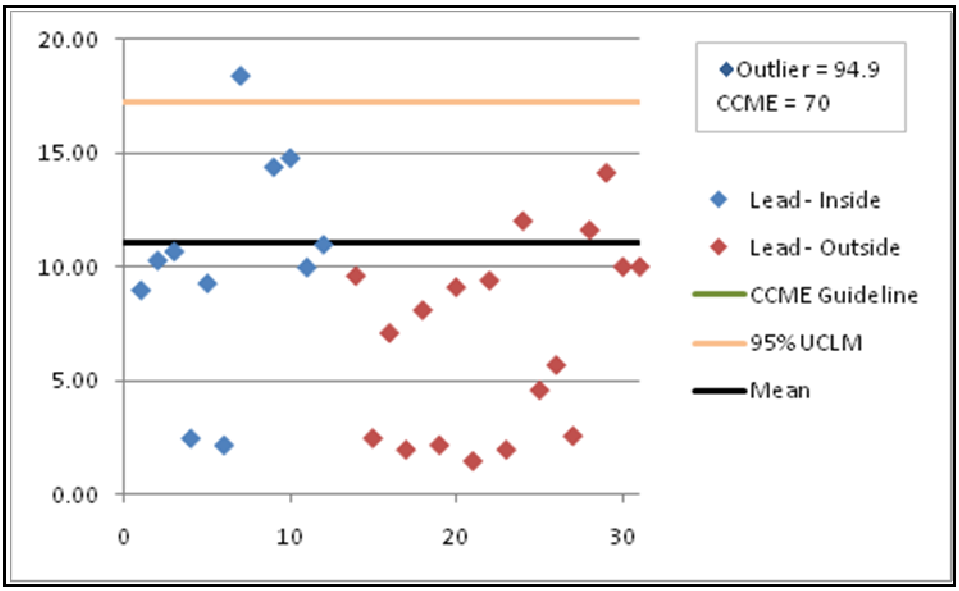
Copper: Exceeded in one surface sample (409 ug/g) collected on the west side of the dump: 2018-10SS-6. Copper is used in the manufacture of electrical and thermal conductor, i.e. wire, copper piping, and is also a constituent in many alloys. This exceedance is likely directly related to the household detritus.

The mean and 95% UCLM are below the CCME guideline however the data set shows evidence of extreme values (409 ug/g) that also are representative of the population. Because of the borehole log evidence, the waste associated with the dump is likely biasing the data, and Copper should be considered a potential constituent of concern. This will be considered in the Risk Assessment.

Lead

Lead - Inside the Old Dump			Lead - Outside the Old Dump			Lead across the Study Area	
Mean	17.292		Mean	6.894		Mean	11.053
Standard Error	7.179		Standard Error	0.961		Standard Error	3.007
Median	10.5		Median	7.6		Median	9.35
Mode	-		Mode	2		Mode	10
Standard Deviation	24.869		Standard Deviation	4.079		Standard Deviation	16.468
Sample Variance	618.464		Sample Variance	16.639		Sample Variance	271.183
Kurtosis	10.960		Kurtosis	-1.374		Kurtosis	25.204
Skewness	3.251		Skewness	0.045		Skewness	4.830
Range	92.7		Range	12.6		Range	93.4
Minimum	2.2		Minimum	1.5		Minimum	1.5
Maximum	94.9		Maximum	14.1		Maximum	94.9
Sum	207.5		Sum	124.1		Sum	331.6
Count	12		Count	18		Count	30
90th Percentile	18		90th Percentile	11.72		90th Percentile	14.52
Confidence Level(95.0%)	15.801		Confidence Level(95.0%)	2.029		Confidence Level(95.0%)	6.149

Lead Concentrations (ug/g) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



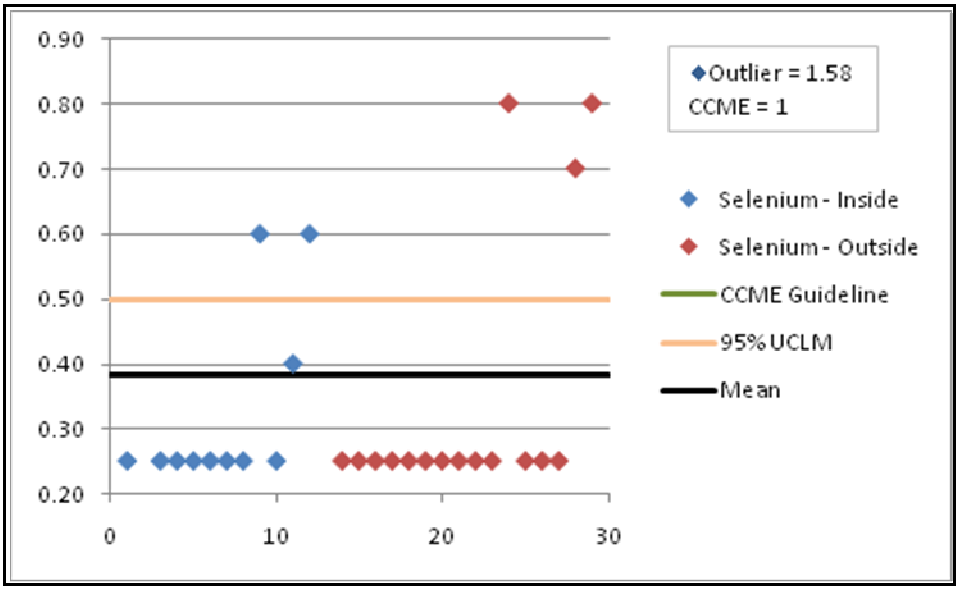
Lead: Identified in one surface sample (the outlier, 94.9 ug/g) collected on the west side of the dump: 2018-10SS-6. Lead is a component of lead-acid batteries and solder, bullets and shot, and old-fashioned toys. This exceedance is likely directly related to the household detritus.

Lead concentrations across the study area (with the exception of the 94.9 ug/g) were generally below the CCME guideline (70 ug/g). The mean and the 95% UCLM were also below the CCME guideline. Due to the small dataset and the significant possibility of other undetected extreme Lead concentrations, Lead is considered a potential constituent of concern and will be considered in the Risk Assessment.

Selenium

Selenium - Inside the Old Dump			Selenium - Outside the Old Dump			Selenium across the Study Area	
Mean	0.432		Mean	0.347		Mean	0.383
Standard Error	0.111		Standard Error	0.052		Standard Error	0.056
Median	0.25		Median	0.25		Median	0.25
Mode	0.25		Mode	0.25		Mode	0.25
Standard Deviation	0.386		Standard Deviation	0.209		Standard Deviation	0.295
Sample Variance	0.149		Sample Variance	0.044		Sample Variance	0.087
Kurtosis	8.361		Kurtosis	1.532		Kurtosis	9.696
Skewness	2.796		Skewness	1.813		Skewness	2.897
Range	1.33		Range	0.55		Range	1.33
Minimum	0.25		Minimum	0.25		Minimum	0.25
Maximum	1.58		Maximum	0.8		Maximum	1.58
Sum	5.18		Sum	5.55		Sum	10.73
Count	12		Count	16		Count	28
90th Percentile	0.6		90th Percentile	0.75		90th Percentile	0.73
Confidence Level(95.0%)	0.245		Confidence Level(95.0%)	0.112		Confidence Level(95.0%)	0.114

Selenium Concentrations (ug/g) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



Selenium: Exceeded in a single deep sample (7.6m bgs) collected at 08MW04B on the west side of the dump. The exceeding concentration is 1.58 ug/g, the outlier on the graph. In 2010 a deep sample was collected at 2018-10BH-5M (nearest deep borehole), and was non-detect. Selenium is used in glassmaking, and in pigments. Prior to its replacement with silicon, it was used as a semiconductor in electronics. Therefore it could be related to the waste material in the dump, and should be considered a potential constituent of concern.

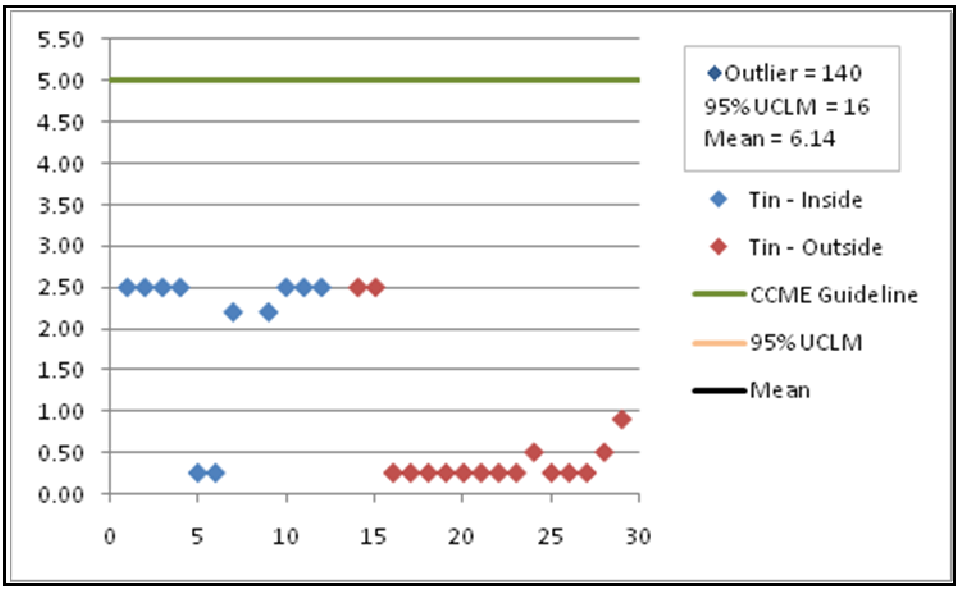
Selenium concentrations across the study area (with the exception of the exceedance) were below the CCME guideline (1 ug/g). The mean and 95% UCLM were also below the CCME Guideline. The mode value is 0.25 ug/g both inside and outside the dump, and the means are not significantly different. The waste associated with the dump could be biasing the data, however the data likely represents the variation in the Selenium population over the area. This will be considered in the Risk Assessment.

Tin

Tin - Inside the Old Dump			Tin - Outside the Old Dump			Tin across the Study Area	
Mean	13.533		Mean	0.603		Mean	6.145
Standard Error	11.500		Standard Error	0.190		Standard Error	4.962
Median	2.5		Median	0.25		Median	0.5
Mode	2.5		Mode	0.25		Mode	0.25
Standard Deviation	39.836		Standard Deviation	0.761		Standard Deviation	26.254
Sample Variance	1586.886		Sample Variance	0.578		Sample Variance	689.291
Kurtosis	11.986		Kurtosis	4.054		Kurtosis	27.899
Skewness	3.461		Skewness	2.284		Skewness	5.278
Range	139.75		Range	2.25		Range	139.75
Minimum	0.25		Minimum	0.25		Minimum	0.25
Maximum	140		Maximum	2.5		Maximum	140
Sum	162.4		Sum	9.65		Sum	172.05
Count	12		Count	16		Count	28
90th Percentile	2.5		90th Percentile	1.7		90th Percentile	2.5

Tin - Inside the Old Dump			Tin - Outside the Old Dump			Tin across the Study Area	
Confidence Level(95.0%)	25.310		Confidence Level(95.0%)	0.405		Confidence Level(95.0%)	10.180

Tin Concentrations (ug/g) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



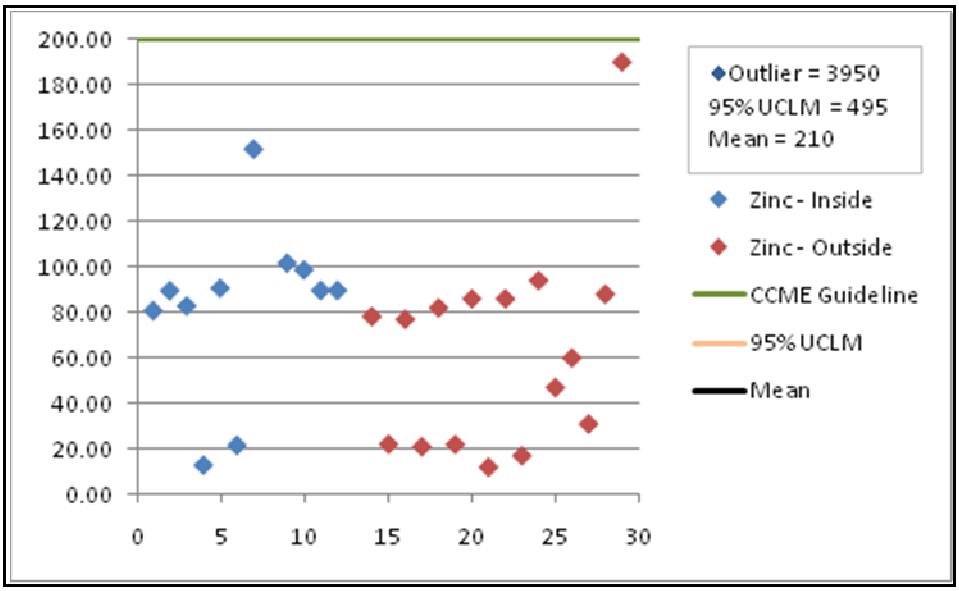
Tin: Exceeded in one surface sample (the outlier, 140 ug/g) collected on the west side of the dump: 2018-10SS-6. Tin is used for corrosion-resistance in steel-plating, and in many alloys, as well as tin cans. This exceedance is likely directly related to the household detritus.

Tin concentrations across the study area (with the exception of the 140 ug/g) were below the CCME guideline (5 ug/g). However, the mean and 95% UCLM are above the CCME guideline due to the presence of extreme values. The waste associated with the dump is likely biasing the data, and Tin should be considered a potential constituent of concern. This will be considered in the Risk Assessment.

Zinc

Zinc - Inside the Old Dump			Zinc - Outside the Old Dump			Zinc across the Study Area	
Mean	405.292		Mean	63.331		Mean	209.886
Standard Error	322.413		Standard Error	11.307		Standard Error	138.749
Median	90		Median	68.5		Median	82.6
Mode	90		Mode	86		Mode	22
Standard Deviation	1116.870		Standard Deviation	45.228		Standard Deviation	734.190
Sample Variance	1247399.666		Sample Variance	2045.540		Sample Variance	539034.5
Kurtosis	11.968		Kurtosis	2.986		Kurtosis	27.797
Skewness	3.458		Skewness	1.336		Skewness	5.264
Range	3936.7		Range	178		Range	3938
Minimum	13.3		Minimum	12		Minimum	12
Maximum	3950		Maximum	190		Maximum	3950
Sum	4863.5		Sum	1013.3		Sum	5876.8
Count	12		Count	16		Count	28
90th Percentile	147		90th Percentile	91		90th Percentile	117
Confidence Level(95.0%)	709.626		Confidence Level(95.0%)	24.100		Confidence Level(95.0%)	284.689

Zinc Concentrations (ug/g) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



Zinc: Exceeded in one surface sample (the outlier, 3950 ug/g) collected on the west side of the dump: 2018-10SS-6. Zinc is still used for corrosion-resistance in steel plating, and is also a component of batteries, as well as other alloys and compounds. This exceedance is likely directly related to the household detritus.

Zinc concentrations across the study area (with the exception of the 3950 ug/g) were below the CCME guideline (200 ug/g). The mean and 95% UCLM are above the CCME guideline due to extreme values. The waste associated with the dump is likely biasing the data, and Zinc should be considered a potential constituent of concern. This will be considered in the Risk Assessment.

Naphthalene and Phenanthrene

Exceedances were observed in Naphthalene and Phenanthrene at a sample collected at 9.0–10.7m bgs at 2018-10BH-6M. This is a background, crossgradient location, 150m east-northeast of the site, and therefore we do not consider the Naphthalene and Phenanthrene exceedances as impacts from the old dump. Nor is it likely to be characteristic of background soils. We suggest that this result is anomalous.

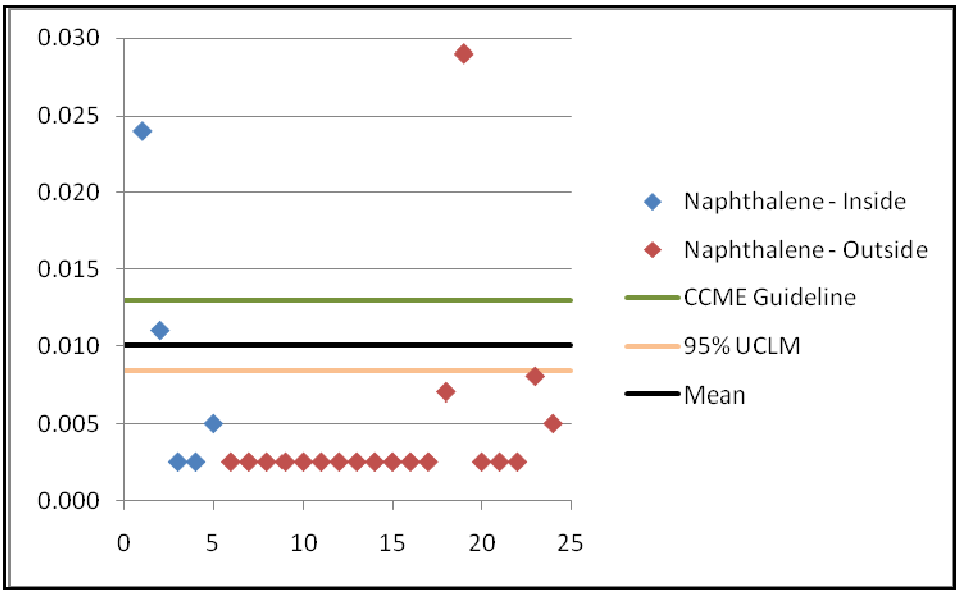
Exceedances were also observed in the shallow sample at 2018-10SS-5 on the west side of the dump. These parameters was not analyzed for in six of the seven 2008 samples, so the site cannot be considered fully characterized with regard to PAHs. The exceedance is likely due to diesel or creosote-coated detritus, and is a potential constituent of concern.

Of the 24 samples analyzed for Phenanthrene, 22 were <DL, and the two exceedances are discussed above. No stats are presented for this parameter. Descriptive statistics for Naphthalene are below.

Naphthalene - Inside the Old Dump			Naphthalene - Outside the Old Dump			Naphthalene across the Study Area	
Mean	0.009		Mean	0.005		Mean	0.005
Standard Error	0.004		Standard Error	0.001		Standard Error	0.001
Median	0.005		Median	0.003		Median	0.003
Mode	0.003		Mode	0.003		Mode	0.003
Standard Deviation	0.009		Standard Deviation	0.006		Standard Deviation	0.007
Sample Variance	0.000		Sample Variance	0.000		Sample Variance	0.000
Kurtosis	2.034		Kurtosis	15.938		Kurtosis	7.340

Naphthalene - Inside the Old Dump			Naphthalene - Outside the Old Dump			Naphthalene across the Study Area	
Skewness	1.544		Skewness	3.897		Skewness	2.790
Range	0.022		Range	0.027		Range	0.027
Minimum	0.003		Minimum	0.003		Minimum	0.003
Maximum	0.024		Maximum	0.029		Maximum	0.029
Sum	0.045		Sum	0.087		Sum	0.132
Count	5		Count	19		Count	24
90th Percentile	0.019		90th Percentile	0.007		90th Percentile	0.010
Confidence Level(95.0%)	0.011		Confidence Level(95.0%)	0.003		Confidence Level(95.0%)	0.003

Naphthalene Concentrations (ug/g) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



The mean and 95% UCLM for Naphthalene is below the CCME guideline. There are some elevated values likely representative of extreme ends of the population. Naphthalene should be considered a potential constituent of concern, as is the case with Phenanthrene. This will be considered in the Risk Assessment.

Other Parameters

All samples collected were compliant for Petroleum Hydrocarbon F1 – F4, and BTEX, as well as Volatile Organic Compounds.

The pH in a saturated paste of deep sample at 08MW06 was 0.05 pH units higher than the ideal range of 6 to 8 units. Across the study area, soil pH is generally > 7; this does not present anomalous data, and is not considered an issue.

We observe elevated Sodium Adsorption Ratio and electrical conductivity at 2018-10SS-6 on the west side of the dump, as well as numerous metals exceedances. The debris in the borehole log is identified as plastic, wire, glass, Styrofoam, and screws, i.e. household detritus, which likely accounts for the overall contamination. The elevated SAR and EC alone do not constitute an issue.

8.3 Groundwater Results

Groundwater analytical results are presented on Figures 9 – 12 and Tables 5 – 8. Historical data from EBA's 2009 report has been included in tables and figures. The 2008 installation at 08MW06B is now destroyed, therefore there is no 2010 sample.

There were no exceedances for Petroleum Hydrocarbon F1 – F4, BTEX, or PAHs in any of the samples collected across the study area.

The groundwater data is assessed with regard to both site characterization and dump leachate. Chloride ion concentration is an indicator of the migration of leachate, as may be the oxidation/reduction potential readings collected as field chemistry. We applied descriptive statistics to these values, which are discussed below.

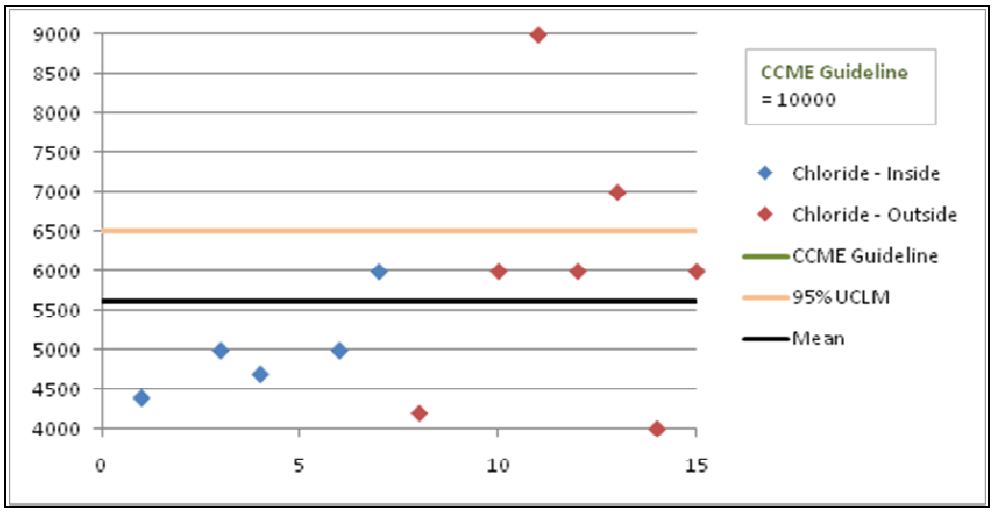
We have also applied descriptive statistics to the other parameters of interest, which are also discussed below. These are predominantly metals. Aluminum, Arsenic, Cadmium, Copper, Iron, Manganese, Mercury, Selenium, and Zinc exceedances are noted in one or more background wells. The charts and graphs show the results inside the old dump site, outside the area, the CCME FCSAP Guideline, and the mean and 95% UCLM of results from across the study area.

Concentrations that are less than detection limit have been assigned a value that is half the detection limit in order to include them in the statistical analysis. Where there are outlier values, they have been removed from the graphs in order to provide more detail to the modal data; however they are presented in text boxes above the legend.

Chloride Ion

Chloride Ion - Inside the Old Dump			**Chloride Ion - Outside the Old Dump**			**Chloride Ion across the Study Area**	
Mean	5020		Mean	6028.571		Mean	5608.333
Standard Error	269.072		Standard Error	640.578		Standard Error	404.98
Median	5000		Median	6000		Median	5500
Mode	5000		Mode	6000		Mode	6000
Standard Deviation	601.664		Standard Deviation	1694.81		Standard Deviation	1402.892
Sample Variance	362000		Sample Variance	2872381		Sample Variance	1968106
Kurtosis	2.308		Kurtosis	0.650		Kurtosis	2.064
Skewness	1.282		Skewness	0.608		Skewness	1.266
Range	1600		Range	5000		Range	5000
Minimum	4400		Minimum	4000		Minimum	4000
Maximum	6000		Maximum	9000		Maximum	9000
Sum	25100		Sum	42200		Sum	67300
Count	5		Count	7		Count	12
90th Percentile	5600		90th Percentile	7800		90th Percentile	6900
Confidence Level(95.0%)	747.065		Confidence Level(95.0%)	1567.438		Confidence Level(95.0%)	891.355

Chloride Ion Concentrations (ug/L) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM

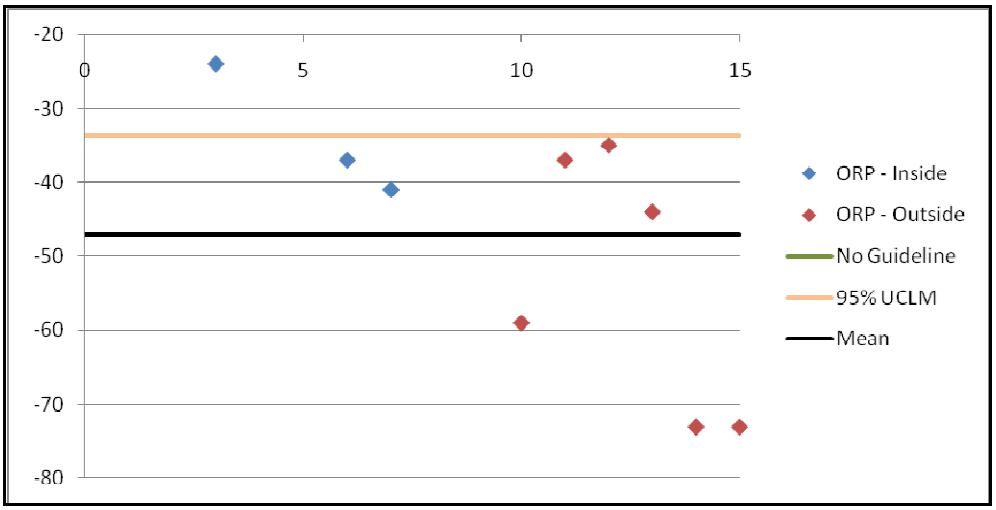


Chloride Ion is an indicator of landfill leachate: All concentrations across the study area are well below the CCME FCSAP Guideline, however the concentrations outside the dump site are greater than the overall mean, with the highest (9000 ug/L) observed at 2018-10BH-3M downgradient of the dump. The next highest concentration (7000 ug/L) is at 2018-10BH-5M, which is down- and crossgradient. The lowest concentrations are all upgradient or within the dump site. However, the means inside and outside the dump are not significantly different, and the highest Chloride ion concentration does not exceed three times the standard deviation plus the mean. If the dump were contributing significant chloride to groundwater we would expect to see the highest concentrations within the groundwater beneath the dump. This is not the case as the highest appear to be downgradient. It is possible that the combination of low waste volume, unlined dump and high groundwater flux does not allow for significant Chloride impacts to be observed. We would recommend monitoring Chloride over time to assess if there are temporal changes that would provide an indication of leachate impact downgradient of the dump.

Oxidation-Reduction Potential

ORP - Inside the Old Dump			ORP - Outside the Old Dump			ORP across the Study Area	
Mean	-34		Mean	-53.5		Mean	-47
Standard Error	5.132		Standard Error	7.060		Standard Error	5.790
Median	-37		Median	-51.5		Median	-41
Mode	-		Mode	-73		Mode	-37
Standard Deviation	8.888		Standard Deviation	17.29		Standard Deviation	17.371
Sample Variance	79		Sample Variance	299.1		Sample Variance	301.75
Kurtosis	-		Kurtosis	-2.420		Kurtosis	-0.875
Skewness	1.346		Skewness	-0.192		Skewness	-0.636
Range	17		Range	38		Range	49
Minimum	-41		Minimum	-73		Minimum	-73
Maximum	-24		Maximum	-35		Maximum	-24
Sum	-102		Sum	-321		Sum	-423
Count	3		Count	6		Count	9
90th Percentile	-27		90th Percentile	-36		90th Percentile	-33
Confidence Level(95.0%)	22.080		Confidence Level(95.0%)	18.149		Confidence Level(95.0%)	13.352

ORP Inside and Outside the Old Dump Site, compared with the Mean and 95% UCLM

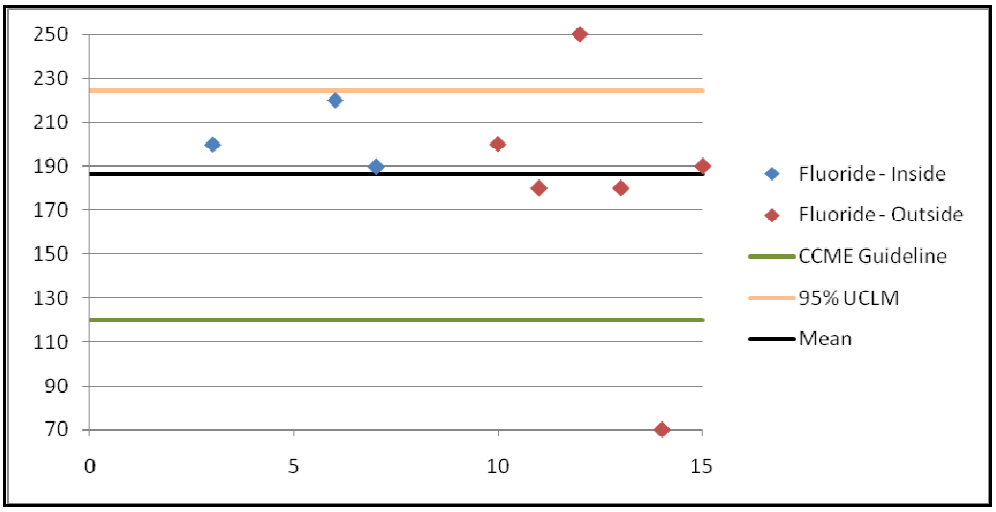


Oxidation-reduction potential: The more positive the ORP value, the greater the potential for reduction, and the greater the likelihood that the environment will support aerobic bacteria. The inverse is also true. Although the sample size is small, the values inside the dump and at 2018-10BH-3M, -4M, and -5M are more positive than outside indicating reduced conditions outside and downgradient of the dump. This parameter should be monitored to assess trends in groundwater quality associated with the dump.

Fluoride

Fluoride - Inside the Old Dump			Fluoride - Outside the Old Dump			Fluoride across the Study Area	
Mean	203.333		Mean	178.333		Mean	186.667
Standard Error	8.819		Standard Error	24.141		Standard Error	16.330
Median	200		Median	185		Median	190
Mode	-		Mode	180		Mode	200
Standard Deviation	15.275		Standard Deviation	59.133		Standard Deviation	48.990
Sample Variance	233.333		Sample Variance	3496.667		Sample Variance	2400
Kurtosis	-		Kurtosis	3.160		Kurtosis	4.853
Skewness	0.935		Skewness	-1.294		Skewness	-1.767
Range	30		Range	180		Range	180
Minimum	190		Minimum	70		Minimum	70
Maximum	220		Maximum	250		Maximum	250
Sum	610		Sum	1070		Sum	1680
Count	3		Count	6		Count	9
90th Percentile	216		90th Percentile	225		90th Percentile	226
Confidence Level(95.0%)	37.946		Confidence Level(95.0%)	62.056		Confidence Level(95.0%)	37.657

Fluoride Concentrations (ug/L) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



Fluoride**:** Fluoride exceeded the CCME FCSAP Guideline across the study area, with a single exception at 2018-10BH-6M offsite to the northeast. The activities associated with the dump itself are not biasing the data, and the data likely represents the variation in the Fluoride population over the area. This identifies it as a background issue, and is not a potential constituent of concern particular to the site. However, this should be considered in the Risk Assessment.

Sulphate (SO_4)

Sulphate exceeding the FCSAP Guideline is seen only in one location (2018-10BH-5M off the southwest corner of the site). It is present in the same order of magnitude in all the samples collected, with a minor suggested trend of higher concentration levels outside the dump site. Sulphate is primarily produced through the oxidation of sulphite ores, the presence of shales, or industrial wastes and also in landfill leachate. Some soils and rocks contain sulphate minerals (e.g. pyrite), which dissolve readily into the groundwater. The exceedance cannot be attributed directly to activities at the dump, and because it is approximately 275m from the river, a ten-fold dilution factor (accounting for groundwater mixing) would be applied to the concentration at the point of discharge. We therefore do not consider this a potential constituent of concern for the site.

Carbon Tetrachloride and **1,2-Dichlorobenzene**

In August 2008, there may have been exceedances of the FCSAP guideline at 08MW04B, 08MW05B, and 08MW06B, however because the detection limit was higher than current applicable guidelines, we cannot comment conclusively. In 2010, the samples were analyzed with a lower DL, and were compliant. There were no concentrations above the detection limit of any VOC in any other location on- or offsite. Therefore we conclude that VOCs are not constituents of concern at the site.

Aluminum

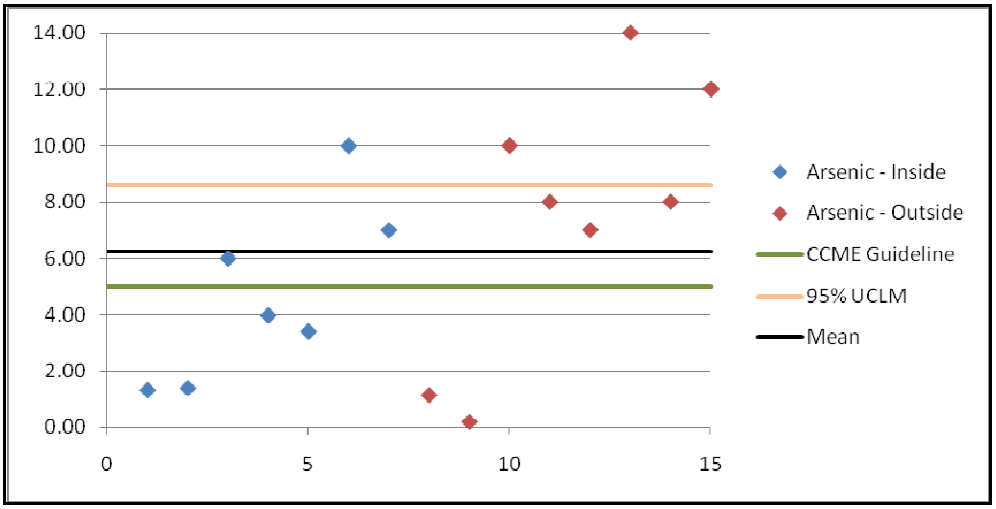
The Health Canada Drinking Water Guideline of 200 ug/L was developed as an operational guidance, applicable only to water treatment plants using aluminum-based coagulants. The FCSAP Tier 1 Interim Guideline (AL) is 5000 ug/L. Because the community water supply is not groundwater sourced, it is appropriate to apply the FCSAP guideline to site groundwater. It is noted that as of June 2010, the BC CSR Schedule 6 Generic Numerical Water Guideline for Aluminum in drinking water was raised from 200 ug/L to 9500 ug/L (protective of adult human health). Two samples (collected at 2018-10BH-1M and -6M) exceeded

the Drinking Water guideline. No downgradient wells, i.e. between -6M and -1M and the river, exceed the Drinking Water guideline. Aluminum is not considered a potential constituent of concern.

Arsenic

Arsenic - Inside the Old Dump			Arsenic - Outside the Old Dump			Arsenic across the Study Area	
Mean	4.73		Mean	7.544		Mean	6.231
Standard Error	1.190		Standard Error	1.707		Standard Error	1.096
Median	3.98		Median	8		Median	7
Mode	-		Mode	8		Mode	10
Standard Deviation	3.150		Standard Deviation	4.827		Standard Deviation	4.244
Sample Variance	9.920		Sample Variance	23.300		Sample Variance	18.012
Kurtosis	-0.371		Kurtosis	-0.638		Kurtosis	-0.932
Skewness	0.606		Skewness	-0.483		Skewness	0.178
Range	8.67		Range	13.8		Range	13.8
Minimum	1.33		Minimum	0.2		Minimum	0.2
Maximum	10		Maximum	14		Maximum	14
Sum	33.11		Sum	60.35		Sum	93.46
Count	7		Count	8		Count	15
90th Percentile	8.2		90th Percentile	12.6		90th Percentile	11.2
Confidence Level(95.0%)	2.913		Confidence Level(95.0%)	4.035		Confidence Level(95.0%)	2.350

Dissolved Arsenic Concentrations (ug/L) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



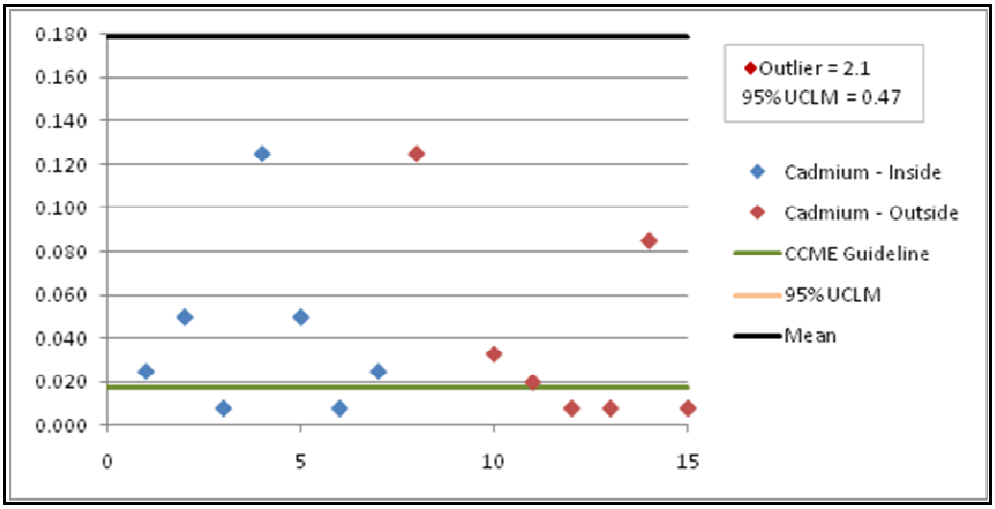
Arsenic: Although 60% (nine) of the fifteen groundwater samples collected during the 2008 and 2010 investigations exceed the guideline, there does not seem to be a significant difference in dissolved Arsenic inside vs. outside the dump. The data likely represents the variation in dissolved Arsenic due to natural mineralization of the groundwater. As some concentrations are over the CCME guideline and the dataset is small, Arsenic will be considered in the Risk Assessment.

Cadmium

Cadmium - Inside the Old Dump			Cadmium - Outside the Old Dump			Cadmium across the Study Area	
Mean	0.042		Mean	0.298		Mean	0.179
Standard Error	0.015		Standard Error	0.258		Standard Error	0.138

Cadmium - Inside the Old Dump			Cadmium - Outside the Old Dump			Cadmium across the Study Area	
Median	0.025		Median	0.027		Median	0.025
Mode	0.025		Mode	0.008		Mode	0.008
Standard Deviation	0.041		Standard Deviation	0.729		Standard Deviation	0.533
Sample Variance	0.002		Sample Variance	0.532		Sample Variance	0.284
Kurtosis	3.357		Kurtosis	7.917		Kurtosis	14.790
Skewness	1.729		Skewness	2.809		Skewness	3.835
Range	0.117		Range	2.092		Range	2.092
Minimum	0.008		Minimum	0.008		Minimum	0.008
Maximum	0.125		Maximum	2.1		Maximum	2.1
Sum	0.291		Sum	2.387		Sum	2.678
Count	7		Count	8		Count	15
90th Percentile	0.08		90th Percentile	0.7175		90th Percentile	0.125
Confidence Level(95.0%)	0.038		Confidence Level(95.0%)	0.610		Confidence Level(95.0%)	0.295

Dissolved Cadmium Concentrations (ug/L) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



Cadmium: Although ten of the fifteen groundwater samples collected during the 2008 and 2010 investigations exceed the guideline, the dissolved Cadmium within the dump is not significantly different than that outside the dump or in the upgradient wells. The data likely represents the variation in dissolved Cadmium due to mineralization of the groundwater. The exceedances may be a background issue, however because the dataset is small, as a measure of conservatism Cadmium will be considered in the Risk Assessment.

Copper

There was an exceedance for Copper at 08MW05B in March 2008, however the next two samples (August 2008 and December 2010) were compliant. Therefore this is not considered a potential constituent of concern.

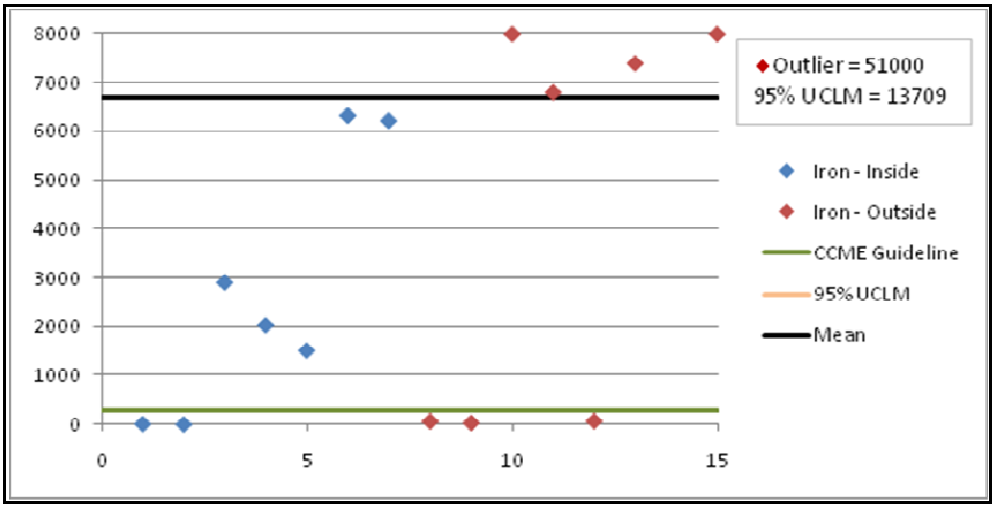
The only other exceedance is at 08MW06B. If we use the hardness data collected from the March 2008 sample (no hardness data available for the August 2008 sample) we observe an exceedance of the FCSAP guideline. This well has since been destroyed, so no sample was collected in 2010. The FCSAP guideline is for the protection of aquatic life. When we look at downgradient wells (08MW05B, 08MW04B, 2018-10BH-

2M, and 2018-10BH-3M), we see that all samples collected between the non-compliant well and the river are compliant for Copper. Therefore we conclude that Copper is not a potential constituent of concern at the site.

Iron

Iron - Inside the Old Dump			Iron - Outside the Old Dump			Iron across the Study Area	
Mean	2708.571		Mean	10163.38		Mean	6684.467
Standard Error	995.068		Standard Error	5981.595		Standard Error	3275.242
Median	2030		Median	7100		Median	2900
Mode	-		Mode	8000		Mode	8000
Standard Deviation	2632.703		Standard Deviation	16918.51		Standard Deviation	12684.96
Sample Variance	6931123		Sample Variance	2.86E+08		Sample Variance	1.61E+08
Kurtosis	-1.288		Kurtosis	6.871		Kurtosis	12.648
Skewness	0.608		Skewness	2.553		Skewness	3.443
Range	6295		Range	50987		Range	50995
Minimum	5		Minimum	13		Minimum	5
Maximum	6300		Maximum	51000		Maximum	51000
Sum	18960		Sum	81307		Sum	100267
Count	7		Count	8		Count	15
90th Percentile	6240		90th Percentile	20900		90th Percentile	8000
Confidence Level(95.0%)	2434.844		Confidence Level(95.0%)	14144.23		Confidence Level(95.0%)	7024.696

Dissolved Iron Concentrations (ug/L) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM

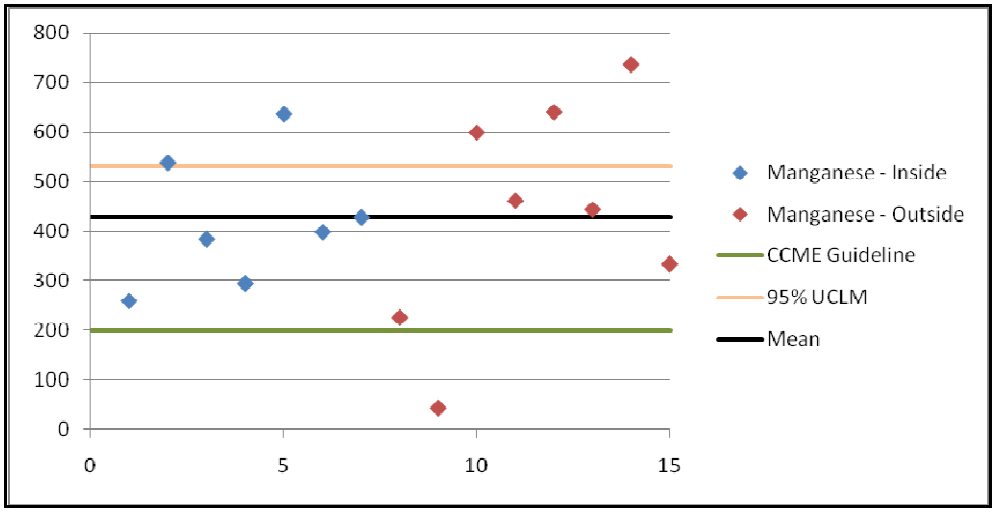


Iron: Of the fifteen groundwater samples collected during the 2008 and 2010 investigations, ten (67%) exceed the guideline of 300 ug/L. The mean outside the dump may be biased high by the outlier value at 2018-10BH-6M, which may be anomalous, however the concentrations inside the dump appear significantly lower than the overall mean. The activities associated with the dump are not obviously biasing the data. The data likely represents the variation in the Iron population over the area. It may be a background issue, and is therefore not a potential constituent of concern particular to the site. Iron will be considered in the Risk Assessment.

Manganese

Manganese - Inside the Old Dump			Manganese - Outside the Old Dump			Manganese across the Study Area	
Mean	419.571		Mean	435.875		Mean	428.267
Standard Error	49.814		Standard Error	81.198		Standard Error	47.531
Median	398		Median	453		Median	428
Mode	-		Mode	-		Mode	-
Standard Deviation	131.795		Standard Deviation	229.663		Standard Deviation	184.086
Sample Variance	17369.95		Sample Variance	52744.98		Sample Variance	33887.64
Kurtosis	-0.286		Kurtosis	-0.391		Kurtosis	-0.042
Skewness	0.573		Skewness	-0.481		Skewness	-0.254
Range	377		Range	694		Range	694
Minimum	259		Minimum	43		Minimum	43
Maximum	636		Maximum	737		Maximum	737
Sum	2937		Sum	3487		Sum	6424
Count	7		Count	8		Count	15
90th Percentile	577.2		90th Percentile	669.8		90th Percentile	639
Confidence Level(95.0%)	121.890		Confidence Level(95.0%)	192.003		Confidence Level(95.0%)	101.943

Dissolved Manganese Concentrations (ug/L) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



Manganese: Of the fifteen groundwater samples collected during the 2008 and 2010 investigations, fourteen (93%) exceed the guideline of 200 ug/L. The onsite and offsite mean concentrations are not significantly different. The activities associated with the dump are not biasing the data. The data likely represents the variation in the Manganese population over the area. It may be a background issue, and is therefore not a potential constituent of concern particular to the site. Manganese will be considered in the Risk Assessment.

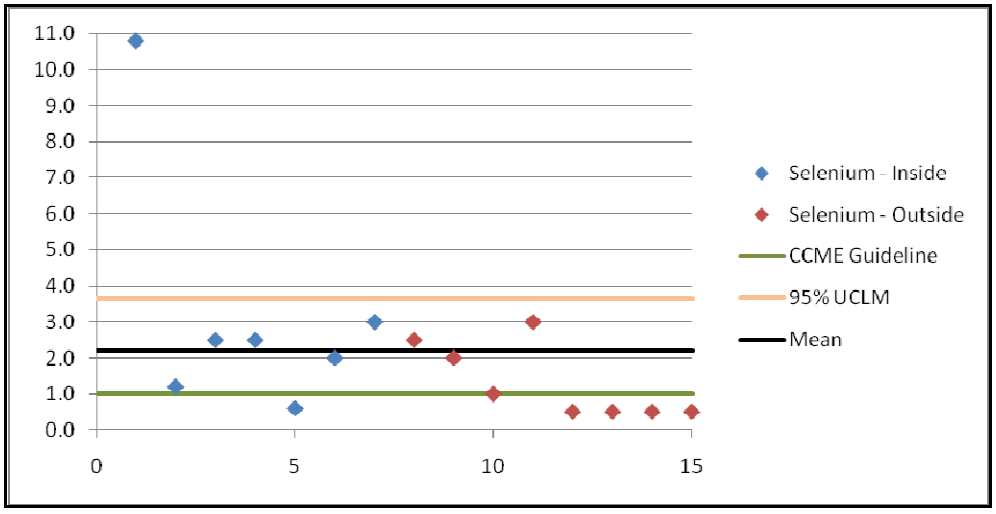
Mercury

The analyses for the 2008 samples collected at 08MW04B, 08MW05B, and 08MW06B had a detection limit for dissolved Mercury that is above both current guidelines. The analyses for samples collected in 2010 had a much lower detection limit (lower than the most stringent of the two guidelines), and were compliant at -04B and -05B. Because -06B had been destroyed, no sample could be collected, however, because the results at the wells were consistent on both earlier sampling events, we have confidence that we would see the same results here. Mercury was <DL at all wells downgradient of -04B, -05B, and -06B. Therefore we conclude that Mercury is not a potential constituent of concern at the site.

Selenium

Selenium - Inside the Old Dump			Selenium - Outside the Old Dump			Selenium across the Study Area	
Mean	3.229		Mean	1.313		Mean	2.207
Standard Error	1.300		Standard Error	0.365		Standard Error	0.662
Median	2.5		Median	0.75		Median	2
Mode	2.5		Mode	0.5		Mode	0.5
Standard Deviation	3.439		Standard Deviation	1.033		Standard Deviation	2.566
Sample Variance	11.829		Sample Variance	1.067		Sample Variance	6.582
Kurtosis	5.785		Kurtosis	-1.264		Kurtosis	10.176
Skewness	2.322		Skewness	0.800		Skewness	2.971
Range	10.2		Range	2.5		Range	10.3
Minimum	0.6		Minimum	0.5		Minimum	0.5
Maximum	10.8		Maximum	3		Maximum	10.8
Sum	22.6		Sum	10.5		Sum	33.1
Count	7		Count	8		Count	15
90th Percentile	6.12		90th Percentile	2.65		90th Percentile	3
Confidence Level(95.0%)	3.181		Confidence Level(95.0%)	0.864		Confidence Level(95.0%)	1.421

Dissolved Selenium Concentrations (ug/L) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



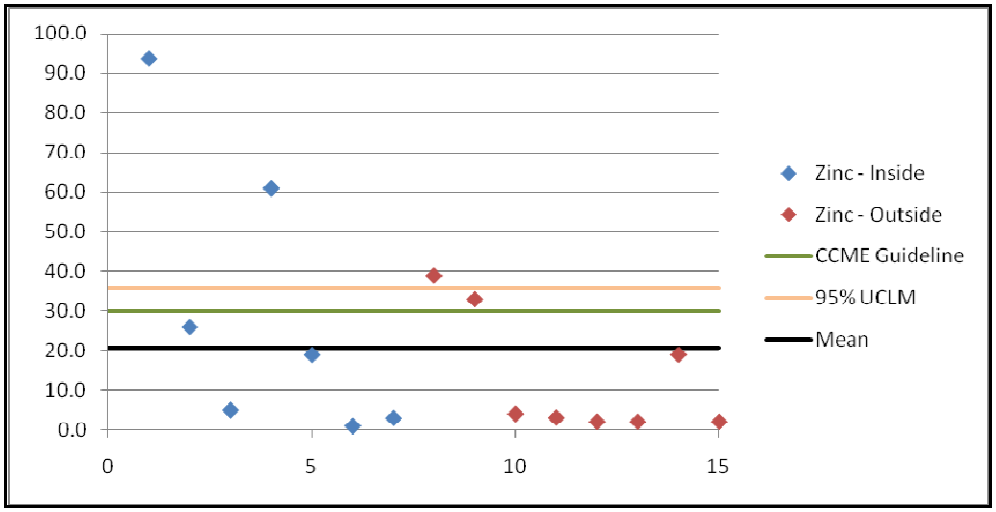
Selenium: The detection limit for Selenium in March 2008 was higher than the current FCSAP guideline, which adds uncertainty to the assessment. However, we observe an elevated concentration (10.8 ug/L) associated with one of the 2008 samples (08MW04B) in the same location where there was an exceedance in the deep soil sample collected during drilling. This borehole is within the dump. This suggests that Selenium is a potential constituent of concern onsite. The remainder of the data supports this, although there may be some natural variation in the Selenium population over the area. This should be considered in the Risk Assessment.

Zinc

Zinc - Inside the Old Dump			Zinc - Outside the Old Dump			Zinc across the Study Area	
Mean	29.829		Mean	13		Mean	20.853
Standard Error	13.241		Standard Error	5.438		Standard Error	6.927

Zinc - Inside the Old Dump			Zinc - Outside the Old Dump			Zinc across the Study Area	
Median	19		Median	3.5		Median	5
Mode	-		Mode	2		Mode	2
Standard Deviation	35.031		Standard Deviation	15.381		Standard Deviation	26.828
Sample Variance	1227.206		Sample Variance	236.571		Sample Variance	719.751
Kurtosis	0.579		Kurtosis	-0.742		Kurtosis	3.003
Skewness	1.260		Skewness	1.051		Skewness	1.761
Range	92.8		Range	37		Range	92.8
Minimum	1		Minimum	2		Minimum	1
Maximum	93.8		Maximum	39		Maximum	93.8
Sum	208.8		Sum	104		Sum	312.8
Count	7		Count	8		Count	15
90th Percentile	74.12		90th Percentile	34.8		90th Percentile	52.2
Confidence Level(95.0%)	32.399		Confidence Level(95.0%)	12.859		Confidence Level(95.0%)	14.857

Dissolved Zinc Concentrations (ug/L) Inside and Outside the Old Dump Site, compared with the CCME Guideline, Mean, and 95% UCLM



Zinc: At 08MW04B (93.8 ug/L) and -05B (61 ug/L), there were exceedances of the FCSAP guideline for Zinc in the March 2008 samples, however the next two samples (August 2008 and December 2010) were compliant. Therefore this is not considered a potential constituent of concern.

The other two exceedances we observe are at 08MW06B, 4m east of the former location of the incinerator, in both the March and August 2008 samples. This well has since been destroyed, so no sample was collected in 2010. The FCSAP guideline is for the protection of aquatic life. When we look at downgradient wells (08MW05B, 08MW04B, 2018-10BH-2M, and 2018-10BH-3M), we see that all samples collected between the non-compliant well and the river are compliant for Zinc. Therefore we conclude that Zinc is not a potential constituent of concern in groundwater at the site.

8.4 Constituents of Concern

In groundwater, the constituents of concern are the elevated levels of Arsenic, Cadmium, Fluoride, Iron, Manganese, and Selenium across the study area. These PCOCs are not specific to the old dump, but to the area, and will be addressed in the Risk Assessment.

In old dump site soils, the potential constituents of concern are Arsenic, Boron, Cadmium, Copper, Lead, Naphthalene, Phenanthrene, Selenium, Tin, and Zinc. These are also addressed in the Risk Assessment.

Because the COCs are specific to the west side of the dump, this area is identified as an Area of Environmental Concern (AEC), however because there may be pockets of waste that were not sampled on the east side, the whole dump area should be considered the AEC, and should be addressed as such in the Risk Assessment.

9.0 ESA CONCLUSIONS

Franz Environmental Inc. (FRANZ) and Columbia Environmental Consulting Ltd. (COLUMBIA) were retained by Parks Canada Agency to complete a Detailed Site Assessment at the Garden River Old Dump in Wood Buffalo National Park, Alberta. This report is presented per the Terms of Reference for Solicitation number: 5P420-10-5048/A, closed on October 14, 2010. The Terms describe the requirements of a work program to complete a closure strategy and long-term risk management plan for the former dump. The site location is presented on Figure 1.

By conducting a geophysical survey, talking to community members, and making visual observations, we have determined the extents of the old dump site. After reviewing the previous report, conducting a data gap analysis and further detailed site investigation, we have analyzed the body of data in order to identify the constituents of concern, which are addressed in the Risk Assessment.

Boreholes logs from both the EBA 2009 report and the current investigation indicate that within the dump, there is evidence of waste/debris at depths no greater than 1.5m bgs. Because drilling may have missed the deepest deposits, we suggest that there may be pockets of debris to 3m.

Per the borehole logs, there is evidence of one unconfined aquifer at approximately 7 – 9m bgs, no evidence of it being under pressure, and no evidence of a higher, perched aquifer. Stratigraphy indicates a dry, silty/sandy formation with discontinuous clay stringers above the water table. Additionally, no seepage was observed on the ravine slope, which was measured to be approximately 3.5 – 5.2m bgs deep. We conclude that the monitoring wells are screened in the aquifer connected to the river, and that based on seasonal data for two wells – 08MW04B and 08MW05B from March and August of 2008, and December of 2010 – there is a water table variation of approximately 1.3m.

In groundwater, the potential constituents of concern are identified as the background levels of Arsenic, Cadmium, Fluoride, Iron, Manganese, and Selenium across the study area. These will be addressed in the Risk Assessment.

In soils, the potential constituents of concern are Arsenic, Boron, Cadmium, Copper, Lead, Naphthalene, Phenanthrene, Selenium, Tin, and Zinc. Exceedances of Naphthalene, Phenanthrene, Boron, Cadmium, Copper, Lead, Selenium, Tin, and Zinc were identified on the west side of the old dump site. There were no exceedances identified on the east side of the site. Exceedances of Arsenic were identified offsite. This will be addressed in the Risk Assessment.

Southwest of the site, at a point west of where the access road meets the river, a 12m seam of groundwater was observed to discharge (daylight) into the river at the toe of the riverbank. This groundwater discharge area contained orange staining; however, no odours or sheens were observed. It was not determined whether this was leachate from the dump site, or whether it was from the area west of the dump, which was formerly occupied by a community septic tile field. No groundwater sample was collected because it was considered unsafe to do so at the time.

No groundwater discharge was observed on the east side of the access road, however full reconnaissance of the riverbank was not possible because it was steep and unsafe to investigate at the time of the site visit.

Elevated levels of Iron in groundwater across the study area were observed, which may explain the orange staining.

Leaching/seepage in the ravine was not evident during the site visit; however, the possibility of this occurring in the warmer and wetter months should not be ruled out.

10.0 RISK ASSESSMENT

10.1 Introduction

The risk assessment report consists of a preliminary human health risk assessment in support of the development of a Landfill Closure Strategy and Risk Management Plan for the site. The work was conducted to assess if environmental conditions at the Old Dump Site present a potential risk to various types of human receptors with access to the site.

10.2 Risk Assessment Objectives

This report presents the methodology and findings of a risk assessment that was conducted to determine if the environmental conditions that exist at the Garden River Old Dump Site present a potential risk to human receptors. The findings of this risk assessment will support the development of a Landfill Closure Strategy and Risk Management Plan for the site. The specific objectives of this assessment were to:

- Complete a review of all previous environmental site assessments and other information pertaining to the environmental conditions and potential risks posed by contamination detected on the site;
- Document the environmental conditions that exist at the site based on historical data, including the 2010 ESA, for use in the risk assessment;
- Undertake a risk assessment to determine the significance of the current environmental conditions on the Garden River Old Dump Site with respect to human receptors, consistent with federal Health Canada and Canadian Council of Ministers of the Environment (CCME) risk assessment methodologies.

10.3 Human Health Risk Assessment – Problem Formulation

The HHRA was conducted in accordance with the Health Canada guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA) guidance documents *Federal (Contaminated Site Risk Assessment in Canada – Parts I, II, III and IV,* September 2004, June 2007, and 2009). These documents were specifically developed for HHRA, and are useful in developing this HHRA as this is the first evaluation of overall risk to human health that has been completed on this site.

10.3.1 Problem Formulation

The problem formulation is the first and most critical step of the risk assessment process to identify substances that potentially have adverse effects to human receptors. The result of the problem formulation is a Conceptual Site Model (CSM) which represents the current understanding of the sources of contamination, release and transport within and among environmental media, and exposure and pathways by which contaminants may contact receptors. This phase involves:

1. Screening and identification of contaminants of potential concern (COPC);
2. Identification and description of potential receptors based on the current and future use of the sites; and
3. Identification of operable exposure pathways.

Consistent with the recommendations of Health Canada (Health Canada, 2007, 2009 draft), this Human Health Risk Assessment assumes the current land use but it also considers that this site may be re-developed for future residential use by the Garden River Community (e.g. Residential area with onsite groundwater used as drinking water).

10.3.2 Screening and Identification of Contaminants of Potential Concern

Overview

The COPC are chemicals in soil, and groundwater that may be a potential hazard to receptors from site activities. This section presents the methodology used to screen the environmental quality data for the Garden River Old Dump Site and from which to identify contaminants of potential concern (COPC) for the human health risk assessment (HHRA). Data retained for this risk assessment was sourced from Columbia/Franz (2011, Detailed Site Assessment of the Garden River Old Dump Site), and the EBA (2009) report "Contaminated Site Assessment Initial and Detailed Testing Programs, Wood Buffalo National Park, Various Locations in the Community of Garden River, Alberta" at the same APEC.

COPC were identified by comparing the maximum concentrations of chemicals detected in soil and groundwater samples obtained through 2009 and 2011 investigations/assessments, with assessment criteria protective of human health.

In some instances, the ESA may have identified potential contaminants of concern (in Section 9.0) which are screened out of the risk assessment. This occurs because the risk assessment uses human health-based assessment criteria (see section below), whereas the ESA screened the data against criteria/guidelines/standards for the protection of human health and the environment.

Assessment Criteria

Assessment criteria were primarily taken from federal guidance which are considered relevant and appropriate since the property is currently managed as part of the Wood Buffalo National Park. Human health-based criteria/guidelines/standards were used when available (Health Canada, 2007). Specific federal guidance used were:

Soil

- CCME 1999 "Canadian Environmental Quality Guidelines" and recent updates (2011) for agricultural (AL) use for fine and coarse grained soil;
- CCME 2008 "Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil" Human Health and Environmental Health Guidelines, agricultural (AL) use;
- CCME 2010 "Soil Quality Guidelines for the Protection of Human Health and the Environment-Polycyclic Aromatic Hydrocarbons Fact Sheet

Groundwater

Health Canada 2010 "Guidelines for Canadian Drinking Water Quality" Summary Table.

Substances for which there are no CCME environmental quality guidelines, were screened against those established by provincial authorities. In cases where applicable provincial guidelines were unavailable, chemical concentrations in soil, and groundwater were compared to USEPA Region IX Soil (Residential Land Use) and Tapwater Regional Screening Level Guidelines (2010) for the protection of human health.

Other considerations made when selecting the assessment criteria were the current and future land uses.

- Agricultural land use has been applied to the site, as the CCME definition of residential/parkland land use is not inclusive of "wildlands such as national or provincial parks". Application of an agricultural land use is also protective of the potential future use of this area for onsite residence by the Garden River Community.
- Protection of future aquifer use is deemed appropriate for the site since onsite groundwater yield is >1.3L/min and calculated natural TDS in groundwater is less than 10,000 mg/L, as determined during

the 2011 site assessment (Health Canada PQRA, 2009 draft). It should be noted that groundwater in the vicinity is currently non-potable and not used as a community water supply. Potable groundwater was considered in a potential future "homestead' use scenario, however given the current nature of the site (uncontrolled dump site), and because the stability of the wastes in the dump is not known, water quality may change over time and use of Site vicinity groundwater as a potable water source is not advised.

COPCs Screened into HHRA

Substances screened into the HHRA, and their respective maximum measured concentrations in surface soil and onsite groundwater are identified in Table 11. Use of the maximum values is a conservative approach and provides a protective estimate of potential risks to human health in this risk assessment.

All parameters recorded as 100% non-detect (ND) in all samples, and for which detection limits were below the applicable screening criteria are not considered COPC and have been omitted from further evaluation.

For the HHRA, if a contaminant exceeded the relevant guidelines/standards in one environmental medium, its corresponding maximum concentration in other media (soil, or groundwater) was also screened in, as appropriate, for detailed exposure calculations.

Soil and groundwater summary screening tables included in Appendix G of this report provide the summary statistics (number of samples, average, standard deviation, minimum, maximum), screening criteria, and sample associated with the maximum concentration for sampled media.

Table 11: COPC screened into the Human Health Risk Assessment

COPC in Soil (ug/g)	COPC in Groundwater (ug/L)
Arsenic (16.0)	**Arsenic (14.0)**
Cadmium (5.0)	*Cadmium (2.1)*

Bold lettering indicates the substance concentration exceeded guidelines in that specific media.

Substances that were screened out of the HHRA, and the rationale for screening them out as COPC for human receptors are included in Appendix J.

10.3.3 Potential Receptors

Characterization of potential human receptors should consider present and future land uses. Characterization, therefore, requires an understanding of the potential receptor exposure scenarios.

Potential human receptors at the sites include:

Scenario A: **Current Scenario** – Local First Nations adults, teens, children, and toddlers (accompanied by adults) with access to the unrestricted old dump Site. Being bordered by trails on the north and west sides of the site, it is expected that members of the general public may occasionally access the site area during recreation and during transit to the river and other parts of the community. For this current scenario, characteristics of a "transient and recreational" site use (where soil exposures via ingestion, inhalation, and dermal contact pathways are incidental), were deemed appropriate and toddlers (for threshold contaminants) and adults (for non-threshold contaminants) were identified as sensitive site receptors for this chronic exposure scenario. Groundwater is considered non-potable in the current scenario, and drinking water is sourced from the Peace River.

Scenario B: **Future Scenario With Drinking Water From Groundwater** – As potential future land uses were also considered in this HHRA, a future "homestead" exposure scenario with onsite residences for the local Garden River Community, and groundwater used for drinking/bathing water sources was identified. For this potential future use scenario, characteristics of a "homestead" site use (where receptors live onsite and

direct exposure to soil and groundwater via inhalation, dermal contact, and ingestion pathways are routine and daily) were deemed appropriate. Toddlers (for threshold contaminants) and adults (for non-threshold contaminants) were identified as most sensitive site receptors for this chronic exposure scenario, however risk calculations for adult, teen, child, and toddler age groups were completed. Groundwater is considered potable in this potential future use scenario.

Scenario C: **Future Scenario With Drinking Water From the Peace River** – A future "homestead" scenario with onsite residences, and drinking/bathing water sourced from the Peace River (current source for the Garden River community) was also considered in this HHRA. For this potential future use scenario, characteristics of a "homestead" exposure scenario (where receptors live onsite and direct exposure to soil via inhalation, dermal contact, and ingestion pathways are routine and daily). Toddlers (for threshold contaminants) and adults (for non-threshold contaminants) were identified as most sensitive site receptors for this chronic exposure scenario, however risk calculations for adult, teen, child, and toddler age groups were completed. Groundwater is considered non-potable in this potential future use scenario, and drinking water is expected to be sourced from the Peace River.

Exposure to community residents and visitors via a remote wildlands exposure scenario as defined in Health Canada PQRA guidance (2009 draft) was considered; however, exposure is expected to be insignificant as:

- Local residents are not likely to choose to camp in areas where habitat quality has been degraded (as Site soils have been disturbed and debris piles are present). People from the local community are likely to choose to camp near the river (approximately 300m south of the site);
- The site is over 50 km from advertised campgrounds, rest stops, and day use areas within Wood Buffalo National Park, it is also over 50 kilometres from the end of the highway accessing the Garden River community. Visitors to Wood Buffalo National Park have limited access to the Garden River community, and those interested in recreational/camping opportunities are unlikely to access the site for remote camping, due to the disturbed habitat, lack of services/utilities onsite, and increased access to recreational opportunities and country food sources closer to the River.

Exposure to the infant age group (0-6 months) as defined by Health Canada was considered, but is expected to be insignificant as:

- Infant exposure to site soil and groundwater is reasonably expected to be negligible in the current scenario A,
- Infant exposure in the potential future use scenarios (B and C) is expected to be mainly indirect via ingestion of contaminated breast milk (an exposure route not assessed in this PQRA) and dermal contact with potable groundwater while bathing (a pathway also assessed in the toddler receptor),
- With their increased soil ingestion rate, risk calculations derived for a toddler exposed to potable groundwater and site soil in a "homestead" exposure scenario (scenario B) are expected to be protective of an infant receptor.

10.3.4 Operable Exposure Pathways

An exposure pathway is a mechanism by which a human receptor is exposed to chemicals from a source. Several possible ways of exposure to contaminants may exist at a site. The following four elements constitute a complete exposure pathway.

- A source and mechanism of chemical release;
- A retention or transport medium;
- A point of potential receptor contact with the affected medium, and

- A means of entry into the body (e.g. ingestion) at the contact point.

Complete pathways therefore, represent situations where there is a potential for receptors to be exposed to the contaminants. Incomplete pathways represent situations where exposure or contact with the contaminant is unlikely to occur resulting in no risk to the receptor.

Groundwater Ingestion

For the current exposure scenario (Scenario A) the site is a non-potable environment. Currently treated drinking water is supplied to the residents of the Garden River Community from the Peace River. In Scenario C, future "homestead" use of the site would continue to depend on treated river waster as a drinking water resource, however, in Scenario B, ingestion of onsite groundwater as drinking water has been considered an operable exposure pathway for all receptors.

Groundwater – Dermal Contact with Water

There are no surface water features on Site for recreational exposure. The potential for dermal contact with contaminated groundwater is considered an incomplete and inactive exposure pathway for all human receptors in the current "recreational/transient" site use scenario (Scenario A) as treated water for bathing is currently sourced for Garden River Community from the Peace River. Dermal contact (full body surface area) with groundwater has been considered as an active exposure pathway for all identified human receptors in the potential future "homestead" use scenario (Scenario B), where residents living onsite could access well-water for bathing (1 event for 1 hr duration as modelled in risk calculations). Risk calculations for dermal contact with groundwater have been completed for all identified receptors in this potential future exposure scenario. A separate "homestead" exposure scenario (Scenario C) where groundwater is not used for bathing has not included risk calculations for this inactive pathway.

Food Sources – Ingestion

Currently there are no known gardens or significant human food sources in this area, particularly associated with the contaminated site soil as compared to the "open range" surrounding the site. Some small shrubs and trees are visible in sections of the site, however, disturbed surface soils, and cleared areas represent degraded habitat for terrestrial organisms (e.g. fox, hares) which may be food sources for hunters and trappers in the community. It is unlikely that small prey items would choose to feed or den in a degraded habitat when undisturbed habitat options are available surrounding the site. The relatively small Site area (3400 sq. meters) is unable to support the wide home ranges of large prey items (hawks, bison, wolves). Time spent by large prey items onsite is expected to be insignificant with respect to exposure of the prey items to contaminated media onsite, and with respect to the availability of these larger prey items to hunters and trappers within the local community. As such, the ingestion of small or large prey items by human receptors were not considered as a significant exposure pathway for receptors in any of the current or future use scenarios.

Ingestion of foraged and gathered potentially contaminated food items (vegetation) from the site has not been considered in any of the risk calculations for any receptors in the current "transient/recreational" exposure scenario (Scenario A),or potential future "homestead" use scenarios (Scenarios B and C) for the site. Based on our current understanding, there are no current gardens onsite and unlikely any foraged foods from the site.

Soil – Dermal Contact, Ingestion and Vapours

Exposure to COPCs in contaminated soil in the current "transient/recreational" use scenario (Scenario A) and the future potential "homestead" use scenarios (Scenario B and C) is possible through incidental ingestion, dermal contact and particulate inhalation. Dermal contact for all receptor age groups is assumed

for hands, legs, and arms in the current use and future use exposure scenarios for the site. Inhalation of soil vapours is not considered an operable exposure pathway for all scenarios given the COPCs (arsenic and cadmium) are non-volatile in the absence of waste incineration.

10.3.5 Conceptual Site Model

The Conceptual Site Model (CSM) represents the current understanding of the sources of contaminants, release and transport within and among environmental media, and exposure and pathways by which they may contact human receptors. The COPC for the operable exposure pathways are: arsenic, and cadmium. The CSM for reach scenario is represented in Figures 14, 15, and 16. As shown, the operable pathways are:

- Incidental Ingestion of Soil;
- Inhalation of Soil Particulates;
- Dermal Contact with Soil; and
- Dermal Contact with Groundwater (Scenario B only - Future ”Homestead, with Potable GW” Scenario)
- Ingestion of Groundwater (Scenario B only - Future “Homestead with Potable GW” Scenario)

10.3.6 Problem Formulation Checklist

The land use, receptors and identified complete exposure pathways in establishing the problem formulation step is summarized as follows.

	Land Uses (check as appropriate)		**Receptor Group(s) (check as appropriate)**		**Critical Receptors (check as appropriate)**		**Exposure Pathways (check as appropriate)**
√	Agricultural (Future Use)	√	General Public		Infant	√	Soil Accidental Ingestion
	Residential/urban parkland		Employees	√	Toddler	√	Soil Dermal Absorption
	Commercial with daycare		Remediation Workers	√	Child	√	Particulate Inhalation
	Commercial without daycare	√	Native Communities	√	Teen		Vapour Inhalation
	Industrial			√	Adult	√	Dermal Contact with water
	Consumption of Traditional Country foods						Country Food Ingestion
√	Recreational (Current Use)					√	Ingestion of Groundwater (Drinking Water) (Future Use)

10.4 Exposure Assessment

An exposure assessment estimates the dose of each COPC for each potential receptor (general public toddler, child, teen, and adult) in each current or future land use scenario. All of the assumptions applied in this HHRA are taken from Health Canada’s Federal Contaminated Site Risk Assessment in Canada, Part 1-Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), (2009-draft).

10.4.1 Characterization of Potential Receptors

The characteristics for the receptors considered in this risk assessment were mainly obtained from Health Canada PQRA Guidance (2009-draft) and are summarized as follows:

Parameters	Toddler	Child	Teen	Adult
Age	7months – 4 years	5-11 years	12-19 years	>20 years
Body Weight (kg)	16.5	32.9	59.7	70.0
Soil Ingestion Rate (g/d)	0.08	0.02	0.02	0.02
Water Ingestion Rate (L/d)	0.6	0.8	1.0	1.5
Inhalation rate (m^3/d)	9.3	14.5	15.6	16.6
Total exposed skin surface area (cm^2)	6130 (Total Body) 3010 (Arms, Legs, and Hands)	10,140 (Total Body) 5140 (Arms, Legs, and Hands)	15,470 (Total Body) 8000 (Arms, Legs, and Hands)	17,640 (Total Body) 9110 (Arms, Legs, and Hands)
Soil loading to exposed skin (g/cm^2/event)	$1X10^{-4}$ (Hands) $1x10^{-5}$ (Other Surfaces)	$1x10^{-4}$ (Hands) $1x10^{-5}$ (Other Surfaces)	$1x10^{-4}$ (Hands) $1x10^{-5}$ (Other Surfaces)	$1x10^{-4}$ (Hands) $1x10^{-5}$ (Other Surfaces)

The exposed skin surface area applied to the current "transient recreational" scenario (Scenario A) was the sum of the skin surface area for hands, arms, and legs for the toddler, child, teen, and adult receptors. These are conservative estimates of exposed skin surface area for receptors given that the property is located within a northern Albertan region and potential receptors onsite would be expected to have extremities covered for at least four months of the year. The exposed surface area applied to the potential future "homestead, potable GW" scenario (Scenario B) was total body surface area for receptor age groups, given that potable groundwater will be used for bathing. These risk calculations also include total body surface area for dermal exposure to soil COPC, this is a conservative estimate of exposed skin as most often only arms, legs and hands may be exposed to surface soil concentrations of COPCs, with some exceptions (e.g. swimsuits in summer months).

10.4.1.1 Exposure Frequency and Duration

Assumptions concerning exposure frequency and duration are from Health Canada (2004, 2007, and 2009-draft updates) for a proposed agricultural future land use and current recreational land use for all receptors. The assumptions for all receptors are considered to be conservative because there are no known or reasonably foreseeable routine activities at this site.

Exposure Frequency and Duration – All Operative Pathways

Scenario	A: Current "Transient Recreational" use (chronic)	A: Current "Transient Recreational" use (acute)	B: Future "Homestead with Potable GW" use (chronic)	B: Future "Homestead with Potable GW" use (acute)	C: Future "Homestead with non-potable GW" use (chronic)	C: Future "Homestead with non-potable GW" use (acute)
Hours per day (indoors)	0	0	22.5	22.5	22.5	22.5
Hours per day (outdoors)	2	2	1.5	1.5	1.5	1.5
Days per week	2	2	7	7	7	7
Weeks per year	35	1	52	1	52	1

Scenario	A: Current "Transient Recreational" use (chronic)	A: Current "Transient Recreational" use (acute)	B: Future "Homestead with Potable GW" use (chronic)	B: Future "Homestead with Potable GW" use (acute)	C: Future "Homestead with non-potable GW" use (chronic)	C: Future "Homestead with non-potable GW" use (acute)
Dermal exposure events per day	1	1	1	1	1	1
Water contact events per day	0	0	1	1	0	0
Duration of water contact event (h)	0	0	1	1	0	0
Days/year of contaminated food ingestion	0	0	0	0	0	0
Exposure Duration (years)	80 (adult) 8 (teen) 7 (child) 4.5 (toddler)	0.019 (toddler – acute)	80 (adult) 8 (teen) 7 (child) 4.5 (toddler)	0.019 (toddler –acute)	80 (adult) 8 (teen) 7 (child) 4.5 (toddler)	0.019 (toddler – acute)
Years for carcinogen amortization	80 (adult)	0	80 (adult)	0	80 (adult)	0

[a] Time outdoors (adult) - Richardson, G.M. (1997) assumed to apply to toddler, child, and teen accompanying adult

These assumptions are considered to be conservative because:

- Ground cover – It is likely that exposure pathways related to incidental contact with soil, or inhalation of fugitive dust particles would be **inoperable** during months when snow is present. Though Garden River is characterized by a northern prairie climate, precipitation usually in the form of snowfall tends to occur from November to April, therefore the ground surface at the site is covered or frozen for approximately 4-6 months of the year.
- With respect to acute toxicity, a short term exposure scenario was also considered in the HHRA. This decision was driven by the fact that the toddler is an active receptor in the current and future use scenarios for this HHRA, and soil ingestion is a major exposure route for this receptor. The decision is also driven by the fact that COPCs in soil and groundwater (arsenic and cadmium) can cause acute skin irritation, lung irritation, GI irritation, redness and swelling, upon exposure at high doses (ATSDR-Cadmium and Arsenic ToxFAQ fact sheets, Captured: February 2011, http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=19&tid=3,http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=47&tid=15) . To assess potential risks from short-term contaminant exposure (24hr/day onsite, 7days/week) under this scenario, doses (mg/kg/day) of threshold response chemicals (non-carcinogens) were compared to chronic toxicity reference values (TRVs) without additionally amortizing the exposure over a yearly period. Derived sub-chronic hazard quotients were then used to quantitatively assess the acute risks from contaminant exposure for each of the current and potential future use scenarios.

10.4.2 Exposure Equations and Models

For this HHRA, the estimates of exposure were based on standard risk assessment equations used by Health Canada (2004 and 2007, 2009 update), and the Health Canada PQRA spreadsheet model (*Federal Contaminated Site Risk Assessment in Canada Part IV, 2009).* Equations used in the model are provided in Appendix I.

10.4.3 Relative Absorption Factors

Bioavailability is the degree to which a chemical or other substance is absorbed or becomes physiologically available to cause an adverse effect. Bioavailability is generally less than 100% of the amount of contaminant to which there is exposure. The amount of absorption will depend on the contaminant's chemical form, the exposure pathway, biological and individual susceptibility, and absorption characteristics. The default Relative Absorption Factors (RAF) from the Health Canada PQRA spreadsheet model: *Federal Contaminated Site Risk Assessment in Canada Part IV* (2009) were applied in this preliminary risk assessment. Bioavailability is assumed to be 100% for the ingestion and inhalation pathways as per Health Canada guidance (2004, 2007, and 2009-draft).

10.5 Toxicity Assessment

The toxicity assessment identifies toxicity reference values (TRV) with which to compare estimated exposure at a site in order to estimate risk. For this HHRA default TRVs from the spreadsheet tool *Federal Contaminated Site Risk Assessment in Canada: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA) Part IV, 2009*) were applied.

10.5.1 Carcinogens and Non-Carcinogens

Of the identified COPC, both arsenic and cadmium are considered carcinogenic substances via ingestion and inhalation pathways. Exposures to these carcinogenic substances were estimated for all potential receptors in each exposure scenario using exposure durations recommended in Health Canada PQRA guidance (Health Canada 2009).

Threshold effects (non-carcinogenic) are also identified for receptor exposures to arsenic and cadmium in this HHRA.

10.5.2 Toxicological Effects

A description of the toxicological effects or health concerns of the contaminants of potential concern are summarized as follows:

Health Concerns and Carcinogen Classification

Health Concern or Target Organ [1,2]												
COPC	**Non Carcinogenic**	**Carcinogenic**	**Brain & Nervous System (neurotoxicity)**	**Liver (hepatic changed)**	**Blood circulation/pressure (haematological changes)**	**Skeletal Changes**	**Kidney (nephrotoxicity)**	**Lung/Respiratory system**	**Bladder**	**Skin (exterior and orifice)**	**Digestive system (stomach & Intestine)**	**Reproductive system**
arsenic	X	X	X	X	X		X	X	X	X		
cadmium	X	X		X		X	X	X			X	

1: Denotes main health concern or target organ, others may exist (sourced from health Canada technical guidance documents and ATSDR Toxicity Fact Sheets for Cadmium and Arsenic.

2: Concerns are related to oral, dermal, and/or inhalation pathways.

10.5.2.1 Dose-Response Assessment

Toxicity reference values (TRVs) should be specific for a particular exposure route, therefore it is necessary to identify multiple TRVs for a single chemical when exposure occurs via multiple routes (i.e., inhalation, ingestion and dermal); however, few, if any, TRVs exist specifically for the dermal exposure pathway. In these instances, dermal exposures were added to the oral dose, following adjustment for relative bioavailability or absorption, for subsequent comparison to the oral TRV. This approach is considered acceptable when multiple exposures are occurring for a single contaminant (Health Canada 2009-draft).

The most scientifically defensible and health protective TRVs established by Health Canada were used for each COPC. If a Health Canada TRV was not available, the applicable TRV developed by the US EPA was used.

TRVs are commonly reported in several different formats, and it is possible to express the same degree of toxicity in different ways. While the different formats may represent equivalent toxicity, they are applied differently during the risk characterization. TRVs used in this assessment include the following.

Tolerable Daily Intake or Reference Dose:

The tolerable daily intake (TDI) or the Reference Dose (RfD) represents the maximum dose of a threshold substance to which an individual could be exposed daily over a lifetime without any expected deleterious effects (Health Canada, 2009-draft). It is expressed as the amount of substance per unit body weight per unit time (e.g., mg/kg body weight/day).

Tolerable Concentration or Reference Concentration:

The tolerable concentration (TC) or reference concentration (RfC) represents the maximum concentration (usually airborne) of a threshold substance to which a person may be continually exposed over a lifetime without any expected deleterious effects (Health Canada, 2009). It is expressed as a concentration (e.g., $\mu g/m^3$).

Slope Factor:

A slope factor relates the exposure dose of a non-threshold substance to the expected probability of developing cancer. It is expressed as the inverse of a dose (e.g., $(mg/kg\ body\ weight/day)^{-1}$) and quantifies the number of predicted cancers per unit dose. The exposure dose multiplied by the slope factor is the expected cancer risk. The slope factor is referred to by some agencies as a cancer potency factor, and denoted as q*.

10.5.2.2 Summary of Toxicological Reference Values (TRVs)

To select the most appropriate TRVs, we considered the environmental conditions at the site and identified values that were representative of the substances at the site. The TRVs used were taken from Health Canada (2004, 2009) and/or US EPA's Integrated Risk Information System (accessed in 2011). Toxicity reference values used in this study are presented in Table 12, below.

Table 12: Toxicity Reference Values

COPC	RfD/TDI (mg/kg-day)	q* $(mg/kg/day)^{-1}$	Inhalation Unit Risk $(mg/m3)^{-1}$	Source
Arsenic	0.0003** (oral)	1.8 (ingestion) 28 (inhalation)	6.4	Health Canada (2009-draft) **Oral RfD for chronic and sub-chronic exposure - (USEPA IRIS 1993)

COPC	RfD/TDI (mg/kg-day)	q* $(mg/kg/day)^{-1}$	Inhalation Unit Risk $(mg/m3)^{-1}$	Source
Cadmium	0.0008 (oral)	42.9 (inhalation)	9.8	Lowest of Health Canada Part II (2007) TRVs and Health Canada Part II (2009-draft) TRVs

10.5.2.3 Evaluation of Potential Toxic Interactions

Typically, criteria, guidelines, and standards developed by provincial and federal regulatory agencies do not account for potential interactions of chemicals. The approach of summing the HQ values is very conservative and may be overly protective, as it assumes that substances interact on the same cellular target and via the same mechanism of action. In reality, interactions (via synergism and/or antagonism) are typically considered to be rare at "environmental concentrations". Currently, two groups of chemicals considered to have the potential to act similarly are: 1) carcinogenic polycyclic aromatic hydrocarbons, and 2) polychlorinated dibenzo-p-dioxins/furans and dioxin-like PCBs. No contaminants from the latter of these two groups of chemicals have been detected at levels exceeding EQGs on the site.

10.6 HHRA Risk Characterization

The risk characterization stage brings together all the previous components of the risk assessment into an overall quantitative assessment of the potential health effects to each human receptor.

For substances presenting risks other than cancer, a Hazard Quotient (HQ) is derived as the ratio of the estimated exposure to an appropriate toxicity reference value (TRV) according to the following equation:

$$\text{Hazard Quotient} = \frac{\text{Estimated Exposure}}{\text{Toxicity Reference Value}}$$

Toxicity risks are evaluated separately for each contaminant and pathway. For purposes of preliminary quantitative risk assessment, exposures associated with HQ ≤ 0.2 will be deemed negligible.

For substances deemed to be carcinogenic, the estimated exposure should be multiplied by the appropriate slope factor or unit risk to derive a conservative estimate of the potential incremental lifetime cancer risk (ILCR). Cancer risks are considered negligible if the estimated ILCR is less than or equal to 1-in-100,000 or 1.00E-05 (Health Canada, 2007).

10.6.1 Summary of Hazard Quotients

Hazard Quotient (HQ) calculations using the Health Canada spreadsheet model are shown in Appendix H. Maximum calculated HQs for each of the current and future exposure scenarios are shown in Table 13, Table 14, and Table 15.

**Table 13: Maximum Hazard Quotients All Operative Pathways –
Scenario A: Current "Transient/Recreational" Use Scenario**

COPC	Pathways	Toddler	Child	Teen	Adult
METALS					
Arsenic	oral/dermal	5.10E-02	7.21E-03	4.22E-03	3.65E-03
	inhalation	3.66E-07	2.86E-07	1.72E-07	1.45E-07
	Total	5.10E-02	7.21E-03	4.22E-03	3.65E-03
Cadmium	oral/dermal	6.53E-03	1.27E-03	8.31E-04	7.47E-04
	inhalation	4.29E-08	3.35E-08	2.01E-08	1.70E-08

COPC	Pathways	Toddler	Child	Teen	Adult
	Total	6.53E-03	1.27E-03	8.31E-04	7.47E-04

**Table 14: Maximum Hazard Quotients All Operative Pathways –
Scenario B: Potential Future "Homestead, Potable GW" Use Scenario**

COPC	Pathways	Toddler	Child	Teen	Adult
METALS					
Arsenic	oral/dermal	**1.98E+00**	**1.19E+00**	**8.16E-01**	**6.91E-01**
	Inhalation	1.43E-06	1.12E-06	6.70E-07	5.37E-08
	Total	**1.98E+00**	**1.19E+00**	**8.16E-01**	**6.91E-01**
Cadmium	oral/dermal	1.30E-01	7.12E-02	4.90E-02	4.17E-02
	Inhalation	1.67E-07	1.31E-07	7.86E-08	6.30E-09
	Total	1.30E-01	7.12E-02	4.90E-02	4.17E-02

**Table 15: Maximum Hazard Quotients All Operative Pathways –
Scenario C: Potential Future "Homestead, Non-Potable GW" Use Scenario**

COPC	Pathways	Toddler	Child	Teen	Adult
METALS					
Arsenic	oral/dermal	**2.65E-01**	3.75E-02	2.19E-02	1.90E-02
	Inhalation	1.43E-06	1.12E-06	6.70E-07	5.66E-07
	Total	**2.65E-01**	3.75E-02	2.19E-02	1.90E-02
Cadmium	oral/dermal	3.40E-02	6.58E-03	4.32E-03	3.89E-03
	Inhalation	1.67E-07	1.31E-07	7.86E-08	6.63E-08
	Total	3.40E-02	6.58E-03	4.32E-03	3.89E-03

The target HQ of 0.2 has been exceeded for oral/dermal exposure to arsenic by the toddler age group in future potential Scenario C: "homestead with non-potable GW" site use. The target HW of 0.2 has been exceeded for oral/dermal exposure to arsenic in soil and groundwater by the toddler, child, teen, and adult receptors in potential future Scenario B: "homestead with potable GW" site use.

The results indicate that unacceptable risks from threshold effects of arsenic exposure are present for both of the potential future land use scenarios, as a function of chronic oral/dermal/inhalation exposures to the receptors. The modeling suggests that the highest potential risk is for oral/dermal exposure of the toddler age group to arsenic and cadmium concentrations in soil and groundwater under the potential future Scenario B: "homestead with potable groundwater" site use. Note that the HHRA calculations are estimates only and do not represent actual risks.

10.6.1.1 Evaluation of Sub-Chronic Risk

The Health Canada PQRA spreadsheet model is primarily developed to evaluate chronic health risks from contaminant exposures. As such, the equations built into the PQRA model averages short term exposures over a yearly period. In the case of receptors (e.g. toddler) which are likely subject to an intense short term exposure to contaminated media (e.g. via the ingestion route), amortizing a short term exposure duration over a yearly period does not account for acutely toxic effects that may result from short term exposure episodes.

Short term exposures (mg/kg-d) through oral, dermal and inhalation of soil particulate pathways were calculated using modifications to the PQRA spreadsheet for the exposure episode (hr/day, days/week, without amortizing the exposure over a monthly or yearly period). A sub-chronic hazard quotient was derived for both arsenic and cadmium based on acute irritant effects that are not linked to these metals' carcinogenicities. Derivation of the sub-chronic HQ is done by comparing total short term exposures (mg/kg-d) to chronic toxicity reference values (mg/kg-d) (Health Canada, 2009) for each COPC. Derivation of these sub-chronic hazard quotients for the toddler receptor in the different site use scenarios is included in Appendix H. Non-carcinogenic COPC with sub-chronic HQ ≤ 1.0 were deemed to be of negligible risk (Wilson Scientific Consulting Inc., 2007).

Derived Sub-chronic Hazard Quotients for Non-Carcinogens

Scenario A: Current "Transient/ Recreational" Site use	HQ- Oral/Dermal /Inhalation pathways	**Scenario C: Future "Homestead, with non-potable GW" Site Use**	HQ- Oral/Dermal /Inhalation pathways	**Scenario B: Future "Homestead, with Potable GW" Site Use**	HQ- Oral/Dermal /Inhalation pathways
Cadmium	1.87E-04	**Cadmium**	6.53E-04	**Cadmium**	3.46E-03
Arsenic	1.46E-03	**Arsenic**	5.10E-03	**Arsenic**	5.51E-02

Bold and Underlined values exceed the acceptable HQ of 1.0.

The results of this modeling suggest that the sub-chronic target HQ of 1.0 has not been exceeded by any soil or groundwater COPC, for the toddler receptor over short term (e.g. week) exposure duration. Note that the sub-chronic HQ calculations are estimates only and do not represent actual risks.

10.6.2 Summary of Carcinogenic Risks

Estimates of ILCR were made using the Health Canada spreadsheet tool and are shown in Appendix H. The maximum calculated ILCRs for each current and potential future use scenario are shown in Table 16.

Table 16: Estimate of Potential Carcinogenic Risks – All Operative Pathways

Receptor/Exposure	**ILCR Risk Estimates**	
	Arsenic	**Cadmium**
Scenario A: Current "Transient/Recreational" Use – Adult		
Cancer Risk from Oral/Dermal Exposure	1.97E-06	NA
Cancer Risk from Inhalation Exposure	1.25E-09	5.97E-10
Cancer Risk – Total	1.97E-06	5.97E-10
Additive Cancer Risk (As+Cd)		*1.97E-06*
Scenario B: Future "Homestead, Potable GW" Use – Adult		
Cancer Risk from Oral/Dermal Exposure	**3.73E-04**	NA
Cancer Risk from Inhalation Exposure	4.86E-09	2.33E-09
Cancer Risk – Total	**3.73E-04**	2.33E-09
Additive Cancer Risk (As+Cd)		***3.73E-04***
Scenario C: Future "Homestead, Non-Potable GW" Use – Adult		
Cancer Risk from Oral/Dermal Exposure	**1.02E-05**	NA
Cancer Risk from Inhalation Exposure	4.86E-09	2.33 E-09
Cancer Risk – Total	**1.02E-05**	2.33E-09
Additive Cancer Risk (As+Cd)		***1.02E-05***

Bold and Underlined values exceed the maximum acceptable ILCR of 1.0E-05.

The Health Canada recommended threshold for ILCR (1.0E-05) has been exceeded for arsenic exposure for adults in the future "homestead, potable GW" exposure scenario (Scenario B) and the future "homestead, non-potable GW" exposure scenario (Scenario C). The modeling suggests that the highest potential risk is from the oral/dermal exposure pathway to arsenic in soil and groundwater. Arsenic and cadmium both have carcinogenic effects on similar target organs (e.g. liver, kidney, lungs), as such their additive cancer risks have been considered and unacceptable cancer risks have been identified in both potential future "homestead, potable GW" and "homestead, non-potable GW" scenarios. Note that the HHRA calculations are estimates only and do not represent actual risks.

10.6.2.1 Summary of Risk Characterization

The risk characterization has shown there are unacceptable risks for toddlers via mainly oral exposure to arsenic in Site surface soil in the potential future "homestead, non-potable GW" exposure scenario (Scenario C). There are also unacceptable risk estimates for toddler, child, teen and adult receptors via mainly oral exposure to arsenic in Site groundwater in the potential future "homestead, potable GW" exposure scenario (Scenario B).

Unacceptable risks (hazard quotients>0.2) from exposure to arsenic and cadmium in site surface soil were not identified for any receptor age group in the current "transient/recreational" exposure scenario, when modelling receptor exposures used maximum arsenic (16 ug/g) and cadmium (5 ug/g) concentrations identified in site soil during the investigation. Given the current receptor models and their stated assumptions, unacceptable risks (HQ>0.2) for the most sensitive age group (toddler) could occur in the current use exposure scenario if identified site soil concentrations of arsenic and cadmium were increased to 65 ug/g (HQ=0.207) and 160 ug/g (HQ=0.209), respectively.

Major Contaminant and Pathway Contributing to Exposure Dose

	Scenario A-adult	**Scenario A**-toddler	**Scenario B**-Adult	**Scenario B**-toddler	**Scenario C**-adult	**Scenario C**-toddler
Major Pathway and Contaminant contributing to Exposure Dose	Arsenic via the soil ingestion pathway	Arsenic via the soil ingestion pathway	Arsenic via the ground-water ingestion pathway	Arsenic via the ground-water ingestion pathway	Arsenic via the soil ingestion pathway	Arsenic via the soil ingestion pathway

Further derivation of sub-chronic hazard quotients to assess acute risks to the toddler receptor from short-term (e.g. week) exposure to threshold effects from arsenic and cadmium suggest that the target HQ of 1.0 has not been exceeded by the identified COPCs in any of the current or potential future exposure scenarios, when modelling receptor exposures used maximum arsenic (16 ug/g) and cadmium (5 ug/g) concentrations identified in site soil during the investigation. Given the current receptor models and their stated assumptions, unacceptable risks from sub-chronic exposures (HQ>1.0) for the most sensitive age group (toddler) could occur in the acute current use exposure scenario if identified site soil concentrations of arsenic and cadmium were increased to 11 000 ug/g (HQ=1.0) and 27000 ug/g (HQ=1.01), respectively.

For non-threshold chemical effects (carcinogenic effects) arsenic exposure via the oral/dermal pathway exceeded the ILCR (1.0E-05) for the adult receptor in both the potential future "homestead" potable groundwater (Scenario B), and non-potable groundwater (Scenario C) use scenarios. Unacceptable cancer risks (ILCR>1.0E-05) were not identified for adults in the current "transient/recreational" exposure scenario, when modelling receptor exposures used maximum arsenic (16 ug/g) and cadmium (5 ug/g) concentrations identified in site soil during the investigation. Given the current receptor models and their stated assumptions, exceedance of the ILCR (1.0E-05) for the most sensitive age group (adult) could occur in the

current use exposure scenario if identified site soil concentrations of arsenic and cadmium were increased to 82 ug/g (ILCR=1.01E-05) and 85,000 ug/g (ILCR=1.01E-05), respectively. Note that all of the risk calculations used in this HHRA are estimates only and do not represent actual risks.

10.6.3 HHRA Uncertainty Evaluation

Sources of uncertainty associated with modeling in risk assessment can include variability in input parameters due to spatial and temporal variation in the parameters, lack of data for key parameters, and the structure of the model due to simplification and assumptions within the PQRA model. The table below describes some of the uncertainties associated with this HHRA.

Uncertainty Analysis

Factor	Uncertainty	Effect on Risk Assessment
Model Assumptions regarding Patterns of Exposure	User Defined Exposure Scenario The user-defined exposure scenarios were based on assumed patterns of access to the sites for specific receptors. These assumptions are believed to reasonably over-estimate exposures at the sites. The actual pattern of exposure at the sites for these specific receptors is not known, however, there are no known routine activities or planned activities at the site.	Overestimation. Estimated pattern of exposure believed to be overestimation. This overestimation of exposure will result in an overestimation of risk.
Model Assumptions regarding Receptor Characteristics	The risk assessment was based on assumed generic receptor characteristics provided in the Health Canada guidance, while actual receptor characteristics may differ from these standard assumptions. Any variance in actual receptor characteristics (e.g. weight, soil and water ingestion, exposed skin, inhalation rates, etc.) to the standard values of the model will be a source of uncertainty.	Unknown effect of Risk Assessment. Over-estimation of risks to user defined receptors based on generic receptor characteristics is likely as there is no known current routine use of the site.
Assumptions regarding Ingestion of Foraged Country Foods	This is an indirect exposure pathway and Determination of contaminant exposure from foraged country foods is beyond the scope of this PQRA, Derivation of dose to receptors through this ingestion pathway remains unknown,	Exposure through the ingestion of contaminated foods has not been assessed in any of the scenarios presented in this risk assessment, Exposure dose to receptors (and therefore risk estimates) may be underestimated without consideration of this pathway in use scenarios. Determination of dose and risk estimates considering this indirect ingestion pathway requires a minimum of information collected from a traditional country foods survey conducted with members of the local community, a site survey of vegetation, and further onsite surface soil, and vegetation sample collection to support a further Site-specific risk assessment.

Factor	Uncertainty	Effect on Risk Assessment
Assumptions regarding Ingestion of Contaminated Vegetation from Gardens	Vegetation can become impacted by root uptake of contaminants from the soil, irrigation with contaminated groundwater and foliar absorption from contaminated particulate matter. Current gardens have not been identified onsite, and future gardens are not expected onsite. However dose to receptors through ingestion of food cultivated onsite has not been evaluated as an operable pathway onsite. If food is expected to be cultivated in gardens onsite, exposure through this pathway is unknown and should be assessed.	Exposure through the ingestion of foods cultivated onsite has not been assessed in any of the scenarios presented in this risk assessment. Exposure dose to receptors (and therefore risk estimates) may be underestimated if cultivation does occur onsite and this pathway is operable in the future. Determination of dose and risk estimates considering this indirect ingestion pathway requires a minimum of information collected from a traditional country foods survey conducted with members of the local community, further onsite surface soil sampling, and background vegetation sample collection to support a further Site-specific risk assessment.
Model Assumptions regarding Contaminant Concentrations and Distributions	<u>Concentration of Contaminants</u> There is always uncertainty associated with the collection and analysis of environmental sampling data. Sources of uncertainty typically include: Which samples are collected and assumed to represent actual site conditions; and Inherent variance in procedures for sample collection, shipment/storage and laboratory analysis.	Unknown; the sampling program was targeted at potential “hotspots” (APECs), and it is reasonable to assume that the data collected may be representative of the highest concentrations at the site (especially considering that for a number of COPCs, concentrations were non-detect (ND) in many samples). The contaminant concentrations across much of the site are likely much lower than those used in the calculations, thus the risk estimates are expected to be conservatively high. The maximum concentration of arsenic in soil was collected within the top 0 – 0.75m bgs at location 2018-10SS-4. This location is approximately 10m east of the site boundary; the sample location was chosen to be near the current location of the incinerator. Wood debris was identified in this borehole, distinct from the plastic, metal, and Styrofoam debris characterizing samples collected from within the dump. Using USEPA Pro UCL software, summary statistics fro concentrations of arsenic in 10 surface (0 – 1.5m bgs) samples collected from within the dump were identified as having a maximum concentration of 10.4 ug/g, and 95% UCLM of 9.73 ug/g. This information suggests that site surface soil likely has arsenic concentrations lower than 16 ug/g. However, metal concentrations can be heterogeneous in soil and given the proximity to the site boundary, it was determined that the maximum soil concentration of 16 ug/g should be input into risk calculations for human receptors accessing the site.

Factor	Uncertainty	Effect on Risk Assessment
Model Assumptions regarding Contaminant Concentrations and Distributions	Concentration of Contaminants There is always uncertainty associated with the collection and analysis of environmental sampling data. Sources of uncertainty can include: Variance in contaminant concentrations in samples due to sample collection techniques (e.g. Turbidity in groundwater samples)	Highly turbid groundwater samples can have suspended material in the water column which can interfere with analysis of dissolved parameter concentrations in water. Highly turbid samples can elevate some parameter concentrations by also accounting for sorbed analyte concentrations on suspended material. Risk estimates based on this data from samples with high turbidity can be overestimated.
Assumptions regarding Contaminant Concentrations in Groundwater	Assessment of groundwater with respect to drinking water quality guidelines and human health toxicity reference values for receptors in the current use scenario and potential future use scenario are derived from current data. Wastes in a landfill can be unstable and onsite groundwater quality may change over time, and under various land use scenarios. Uncertainties remain surrounding future onsite water quality.	Unknown effect on water quality. Human health risks from groundwater quality in the site vicinity should be re-assessed over multiple seasons prior to any future use of groundwater as a drinking water resource.
Model Assumptions regarding Toxicological Mechanisms and Effects	Toxicity reference values used in this assessment are published by regulatory agencies based on animal studies. Toxicity reference values are derived by the extrapolation of the animal study data. Since humans and animals differ in their response to the absorption and distribution of chemicals, the extrapolated toxicity reference values are typically numerically adjusted to add margins of conservatism (safety factors) that are built into the final toxicity reference values.	Unknown. Generally an overestimation of risk will result. Additionally, bioavailability of most COPC in media (e.g. soil) was assumed to be 1 (e.g. the contaminant is assumed to be 100% bioavailable). This assumption would result in a highly conservative calculated dose as not all COPC in soil are 100% bioavailable.

10.6.4 HHRA Summary and Conclusions

Purpose and Methodology

A human health risk assessment was conducted using the Human Health Preliminary Quantitative Risk Assessment (PQRA) guidance documents (Health Canada, 2004, 2007, 2009 updates). The HHRA consists of a Site Characterization, Problem Formulation, Exposure Assessment, Toxicity/Hazard Assessment and Risk Characterization. To quantify risks due to the presence of onsite contaminants, the updated version of the Health Canada PQRA spreadsheet model (2009) was used.

Chemical Screening

An initial chemical screening process identified the following as Chemicals of Potential Concern (COPC) based on their concentrations in environmental media. This information was further used as inputs in the PQRA spreadsheets:

COPC in Soil (ug/g)	COPC in Groundwater (ug/L)
Arsenic (16.0)	Arsenic (14.0)
Cadmium (5.0)	*Cadmium (2.1)*

Potential Receptors and Operable Pathways

Potential human receptors at the site include:

Scenario A: **Current Scenario** – Local First Nations adults, teens, children, and toddlers (accompanied by adults) with access to the unrestricted old dump Site. Being bordered by trails on the north and west sides of the site, it is expected that members of the general public may occasionally access the site area during recreation and during transit to the river and other parts of the community. For this current scenario, characteristics of a "transient and recreational" site use (where soil exposures via ingestion, inhalation, and dermal contact pathways are incidental), were deemed appropriate and toddlers (for threshold contaminants) and adults (for non-threshold contaminants) were identified as sensitive site receptors for this chronic exposure scenario. Groundwater is considered non-potable in the current scenario, and drinking water is sourced from the Peace River.

Scenario B: **Future Scenario With Drinking Water From Groundwater** – As potential future land uses were also considered in this HHRA, a future "homestead" exposure scenario with onsite residences for the local Garden River Community, and groundwater used for drinking/bathing water sources was identified. For this potential future use scenario, characteristics of a "homestead" site use (where receptors live onsite and direct exposure to soil and groundwater via inhalation, dermal contact, and ingestion pathways are routine and daily) were deemed appropriate. Toddlers (for threshold contaminants) and adults (for non-threshold contaminants) were identified as most sensitive site receptors for this chronic exposure scenario, however risk calculations for adult, teen, child, and toddler age groups were completed. Groundwater is considered potable in this potential future use scenario.

Scenario C: **Future Scenario with Drinking Water from the Peace River** – A future "homestead" scenario with onsite residences, and drinking/bathing water sourced from the Peace River (current source for the Garden River community) was also considered in this HHRA. For this potential future use scenario, characteristics of a "homestead" exposure scenario (where receptors live onsite and direct exposure to soil via inhalation, dermal contact, and ingestion pathways are routine and daily). Toddlers (for threshold contaminants) and adults (for non-threshold contaminants) were identified as most sensitive site receptors for this chronic exposure scenario, however risk calculations for adult, teen, child, and toddler age groups were completed. Groundwater is considered non-potable in this potential future use scenario, and drinking water is expected to be sourced from the Peace River.

The operable pathways considered for the HHRA were:

- Incidental Ingestion of Soil;
- Inhalation of Soil Particulates;
- Dermal Contact with Soil; and
- Dermal Contact with Groundwater (Future Use Scenario B: "Homestead, with Potable Groundwater)
- Ingestion of Groundwater (Future Use Scenario B: "Homestead, with Potable Groundwater)

Risk Characterization

The risk characterization has shown there are unacceptable risks for toddlers via oral/dermal exposure to arsenic in Site surface soil in the potential future "homestead, non-potable GW" exposure scenario (Scenario C). There are also unacceptable risk estimates for toddler, child, teen and adult receptors via oral/dermal exposure to arsenic in Site surface soil and groundwater in the potential future "homestead, potable GW" exposure scenario (Scenario B) Unacceptable risks (hazard quotients>0.2) from exposure to arsenic and cadmium in site surface soil were not identified for any receptor age group in the current "transient/recreational" exposure scenario, when modelling receptor exposures used maximum arsenic (16 ug/g) and cadmium (5 ug/g) concentrations identified in site soil during the investigation.

Further derivation of sub-chronic hazard quotients to assess acute risks to the toddler receptor from short-term (e.g. week) exposure to threshold effects from arsenic and cadmium suggest that the target HQ of 1.0

has not been exceeded by the identified COPCs in any of the current or potential future exposure scenarios when modelling receptor exposures used maximum arsenic (16 ug/g) and cadmium (5 ug/g) concentrations identified in site soil during the investigation.

For non-threshold chemical effects (carcinogenic effects) arsenic exposure via the oral/dermal pathway exceeded the ILCR (1.0E-05) for the adult receptor in both the potential future “homestead” potable groundwater (Scenario B), and non-potable groundwater (Scenario C) use scenarios. Unacceptable cancer risks (ILCR>1.0E-05) were not identified for adults in the current “transient/recreational” exposure scenario when modelling receptor exposures used maximum arsenic (16 ug/g) and cadmium (5 ug/g) concentrations identified in site soil during the investigation. Note that all of the risk calculations used in this HHRA are estimates only and do not represent actual risks.

11.0 LANDFILL CLOSURE STRATEGY AND RISK MANAGEMENT

The outcome of the risk assessment indicates that remediation or risk management measures are not required to reduce the human health risks for the current use of the site, however, they are required for future activities.

In the short term or the current scenario, no action is required to manage the concentrations of Arsenic and Cadmium in soil and groundwater onsite. If no action is taken to manage the future risks, then further refinement of the human health risk assessment is warranted. A site specific HHRA will require as a minimum, further investigation and data collection from onsite surface soil and onsite vegetation, in conjunction with a country foods survey conducted with the local community, and a vegetation survey across the site to determine exposure of the general public to contaminants in onsite vegetation.

11.1 Site Closure Requirements

It is recommended that the dump be closed using the Alberta “Environmental Code of Practice for Landfills" as a guideline. The proposed end use is not identified, therefore the objective of closure is to ensure the integrity of the closed landfill. At a minimum, warning signs and fencing/demarcation should be installed to secure the site. The fencing should be chain link, galvanized 2"-mesh, nine-gauge, six-foot high or equivalent. In addition to closure specifications, the local public that may be using the site should be informed about the closure. Signs should be posted directing toward an alternate dump site.

11.2 Final Cover Design, Sloping Requirements, Drainage Restoration and Runoff Control System

Consolidate, regrade and cap the dump. Consolidating the dump materials provides for the waste to be compacted to minimize long term settlement, the installation of firebreaks if required, reduction of the footprint of the dump, and reduction of the landfill cap. During consolidation, all prohibited or oversized wastes can be segregated. The installation of the cap limits infiltration and the generation of leachate. It also eliminates direct exposure pathways for human receptors. The final cover should consist of the following:

1) 0.60m of earthen material with a maximum permeability of 1×10^{-7} metres/second, or alternate material that will achieve equivalent protection. This may include a geosynthetic clay liner if there is not a borrow source nearby.
2) 0.8m of granular subsoil
3) 0.2m topsoil

In order to maintain the integrity of the final cover system, the landfill final slopes should be graded between 5 - 15%. Upgradient and downgradient surface water diversions should be maintained to minimize erosion of the cover.

11.3 Re-vegetation

After installation and contouring of the final cover, it should be re-vegetated using broadcast seeding methods and a native seed mixture. The exact seed mixture and a supplier should be identified to ensure that only native mixes are used.

11.4 Groundwater Monitoring Plan

Groundwater monitoring should be conducted to monitor leachate for the wells upgradient, within and downgradient of the landfill. Compliance should be to FCSAP Interim Guidelines, per the designated land

use (see section 5.0), and/or to the Guidelines for Canadian Drinking Water Quality in order to consider future drinking water use. The required parameters to be tested are:

General and Inorganic Parameters

pH, Total Dissolved Solids, Alkalinity, Ammonia, Total Kjeldahl Nitrogen, Electrical Conductivity, Hardness (CaCO3), Dissolved Organic Carbon (DOC)

Major Ions

Chloride, Calcium, Magnesium, Sodium, Potassium, Sulphate, Nitrate-N, Nitrite-N

Dissolved and Total Metals

Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Iron, Lead, Lithium, Manganese, Molybdenum, Mercury, Nickel, Phosphorus, Silicon, Silver, Strontium, Thallium, Tin, Vanadium, Uranium, Zinc

Volatile Organic Compounds

Benzene, Toluene, Ethylbenzene, Xylene, F1, F2, Phenols, Methylene Chloride, Vinyl Chloride, Trichloroethylene (TCE), Tetrachloroethylene (PCE)

Groundwater monitoring is required once per year. Monitoring should be assessed after four years. After four years groundwater trends should be assessed as well as compliance with guidelines. A contingency plan should be prepared in the event that measured groundwater concentrations exceed target concentrations.

The wells in the first four years should include the following:

2018-10BH-1M, 2018-10BH-2M, 2018-10BH-3M, 2018-10BH-4M, 2018-10BH-5M, 2018-10BH-6M, 2018-10BH-7M, 08MW04B, 08MW05B

The wells should be protected from destruction using barricades. The locations of the wells should be well marked to ensure that they are not lost in the winter months.

11.5 Groundwater Protection Area

Due to the uncontrolled nature of the site, groundwater wells used for drinking water should not be placed within or adjacent to the landfill. As part of the final closure plan, a hydrogeologic study should be undertaken to determine appropriate setbacks for future drinking water wells in the area. At a minimum, no wells should be completed within 200 lateral meters of the boundaries of the landfill or between the landfill and the river until such a study is completed.

11.6 Landfill Gas Monitoring Plan and Protection Area

The dump size is not significant enough to warrant landfill gas collection and control. In addition to groundwater monitoring, identified locations within and adjacent to the landfill should be monitored for the presence of landfill gas. The landfill gas should be monitored at locations adjacent to all existing groundwater wells. A contingency plan should be developed in case measured landfill gas levels exceed target levels. No structure should be placed within 200 lateral meters of the boundaries of the landfill.

11.7 Annual Inspection and Contingency Plan

The landfill should be inspected annually for signs of erosion, settlement and landfill failure. Checklists and written inspection procedures should be conducted on an annual basis. Contingency plans should be revisited each year. One annual report containing the groundwater, landfill gas and inspection data should also be compiled each year.

12.0 LANDFILL CLOSURE COSTS

This section identifies landfill closure costs and post-closure monitoring costs for five years. These costs include:

Engineering Design	$40,000
Construction	
Mobe/demobe	$40,000
Consolidation and regrading	$30,000
Clay or synthetic cover	$90,000
Subsoil (0.8m)	$30,000
Topsoil (0.2m)	$20,000
Vegetation	$5,000
Fencing/barricades	$40,000
Annual monitoring (4 years)/reporting	$300,000
Subtotal	$595,000
Contingency	$65,000
Total	**$660,000**

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14.0 LIMITATIONS

Columbia Environmental Consulting Ltd. and Franz Environmental Inc. (FRANZ/COLUMBIA) prepared this report for Parks Canada Agency. The material presented in this report reflects FRANZ/COLUMBIA's judgment in light of the information available to them at the time of preparation.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibility of such third parties. FRANZ/COLUMBIA accepts no responsibility for damages, if any, suffered by any third party because of decisions made or actions based on this report.

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

There is no warranty expressed or implied that this risk assessment has resolved all potential environmental liabilities associated with the subject property. It is believed however, that the level of detail carried out for this work is appropriate to meet the study objectives. The findings and conclusions are site-specific and were developed in a manner consistent with the level of care and skill normally exercised by environmental professionals currently practicing under similar conditions in the area. The undersigned believe this report to be accurate, however they cannot guarantee the completeness or accuracy of information supplied to them.

Third party information reviewed and used to formulate this report is assumed to be complete and correct. FRANZ/COLUMBIA used this information in good faith and will not accept any responsibility for deficiencies, misinterpretation or incompleteness of the information contained in documents prepared by third parties.

If new information is discovered in the future Columbia Environmental Consulting Ltd. and Franz Environmental Inc. should be requested to re-evaluate the conclusions of this report and provide amendments as required prior to any reliance upon the information provided herein.

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

Other than PCA, copying and distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of Columbia Environmental Consulting Ltd. and Franz Environmental Inc. Nothing in this report is intended to constitute or provide a legal opinion.

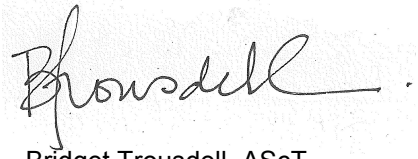
Sincerely,

Columbia Environmental Consulting Ltd./Franz Environmental Inc.

Per:

Graham Martens, R.P.Bio.

Nick Dayal, Eng.L.



Bridget Trousdell, AScT

Meagan Gourley, M.E.T.

Michael Shum, Ph.D, P.Ag., R.P.Bio.

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SITE PHOTOGRAPHS

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 1

Date: December 13 – 20, 2010

Description:

Looking southeast from the northwest corner of site

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 2

Date: December 13 – 20, 2010

Description:

Looking northeast from road at southwest corner of site

Stick-ups at 08MW04 and 08MW04B at left

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SITE PHOTOGRAPHS

Client Name: Parks Canada Agency	Site Location: Garden River Old Dump Site	Project No.: 2018-1001

Photo No. 3

Date: December 13 – 20, 2010

Description:

Looking southwest at incinerator from offsite location of 2018-10SS-4

Client Name: Parks Canada Agency	Site Location: Garden River Old Dump Site	Project No.: 2018-1001

Photo No. 4

Date: December 13 – 20, 2010

Description: Looking west from east side of site

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SITE PHOTOGRAPHS

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 5

Date: December 13 – 20, 2010

Description:

Looking north from north site boundary toward north area of debris

Stick-up at 2018-10BH-1M at right, Garden River Public Works Yard at left

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 6

Date: December 13 – 20, 2010

Description:

Looking west from northwest corner of site, toward 2018-10BH-4M

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SITE PHOTOGRAPHS

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 7

Date: December 13 – 20, 2010

Description:

Looking southwest from the road at southwest corner of site, toward 2018-10BH-5M

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 8

Date: December 13 – 20, 2010

Description:

Looking east from road toward south area of debris and borrow pit south of the site

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SITE PHOTOGRAPHS

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 9

Date: December 13 – 20, 2010

Description:

Looking east toward 2018-10BH-3M

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 10

Date: December 13 – 20, 2010

Description:

Looking southwest down the road toward background well, 2018-10BH-7M

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SITE PHOTOGRAPHS

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 11

Date: December 13 – 20, 2010

Description:

Looking southeast from northeast position onsite toward 2018-10BH-2M

Client Name:	Site Location:	Project No.:
Parks Canada Agency	Garden River Old Dump Site	2018-1001

Photo No. 12

Date: December 13 – 20, 2010

Description:

Well installation in progress

COLUMBIA ENVIRONMENTAL

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SITE SAFETY KICKOFF MEETING

"NOBODY GETS HURT"

PROJECT / LOCATION : Garden River, AB

DATE : Dec. 14 /10

SITE SUPERVISOR : Ryan Fletcher / Elliot Tonasket

COLUMBIA/FRANZ PROJECT MANAGER : Mark Dean

CONTRACTOR : Mobile Riggers

ATTENDEES: *Your signature signifies that you understand and agree with expectations outlined in the discussion below and agree to comply with all the rules and regulations outlined, thus providing a job site that will be safe and injury free.*

Print name	*Company*	*Signature*
Ryan Fletcher	Franz	
Elliott Tonasket	Columbia	Elliott Tonasket
Sean Cerand	MARL	
Adam Duncan	MARL	
Sharon Lwum	Parks Canada	Sharon Lwum

HAWKEYE LINE LOCATORS INC.
GRANDE PRAIRIE OFFICE
Fax (780) 882-2356
Cell (780) 876-4935
EDMONTON OFFICE
Phone (780) 777-2109

STAKE-OUT REPORT / CONFIRMATION

16007

CLIENT

Name Franz Environmental Inc.
Address
City Prov. Postal Code
Location Franz Environmental Inc. @ Garden River Old Dump Site

Date December 14, 2010
Contact Bridget Trousdell
Phone 1-604-603-1658
Fax —

PIPELINE / UTILITY OWNER

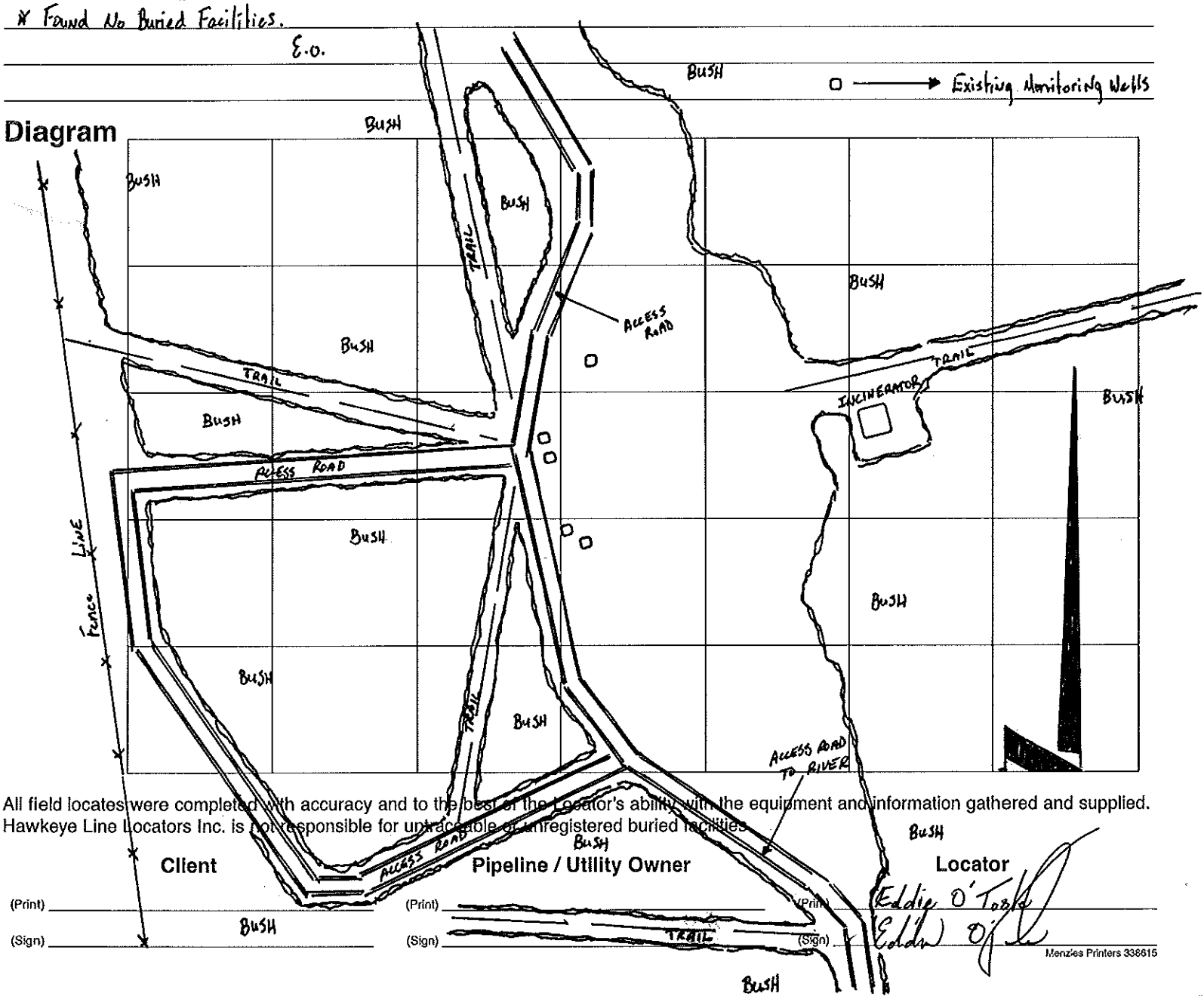
Name Franz Environmental c/o Hawkeye Line Locators
Address Grande Prairie, AB
Program Name / Job No. Monitoring Wells & Bore Holes

Contact Eddie O'Toole
Phone 780-876-1633
Fax —

COMMENTS (please include the legal land description and type of work)

* Found No Buried Facilities.
E.O.

Diagram



All field locates were completed with accuracy and to the best of the Locator's ability with the equipment and information gathered and supplied. Hawkeye Line Locators Inc. is not responsible for unlocatable or unregistered buried facilities.

Client	Pipeline / Utility Owner	Locator
(Print)	(Print)	(Print) Eddie O'Toole
(Sign)	(Sign)	(Sign) Eddie O'Toole

Menzies Printers 338615

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Borehole Log: 2018-10SS-1

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE				SAMPLE					
Depth (ft / m)	Symbol	Description	Depth/Elev.	Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour ppm 100 300 500 700 900	Well Description
0 ft / 0 m		Ground Surface	0.0						No well installed. Shallow borehole for surface sampling only.
		Sand Fine brown sand, trace silt, trace to some gravel Some debris: glass, plastic		-1			100		
			1.5						

Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 17, 2010 ***Sheet:*** 1 of 1

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Borehole Log: 2018-10SS-2

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE				SAMPLE					
Depth (ft / m)	Symbol	Description	Depth/Elev.	Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour ppm 100 300 500 700 900	Well Description
0 ft / 0 m		Ground Surface	0.0						No well installed. Shallow borehole for surface sampling only.
		Silty Sand Fine brown silty sand, some gravel Some debris: plastic at 0 - 0.05m		-2			100		
1 ft / 0.5 m									
2 ft									
3 ft / 1 m									
4 ft									
			1.5						
5 ft / 1.5 m									
6 ft									
2 m									
7 ft									

Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 17, 2010 ***Sheet:*** 1 of 1

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Borehole Log: 2018-10SS-3

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE				SAMPLE					
Depth (ft / m)	Symbol	Description	Depth/Elev.	Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour ppm 100 300 500 700 900	Well Description
0 / 0		Ground Surface	0.0						No well installed. Shallow borehole for surface sampling only.
		Silt Brown silt, some fine sand, some gravel Dark colour, decaying organics		-3			100		
5 / 1			1.5						
10 / 2									
15 / 3									
20 / 4									
25 / 5									
30 / 6									
35 / 7									

Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 17, 2010 ***Sheet:*** 1 of 1

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Borehole Log: 2018-10SS-4

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE				SAMPLE					
Depth (ft / m)	Symbol	Description	Depth/Elev.	Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour ppm 100 300 500 700 900	Well Description
0 ft / 0 m		Ground Surface	0.0						No well installed. Shallow borehole for surface sampling only.
		Silt Dark brown silt, very dark brown organics, decayed wood, wood debris		-4			100		
			1.5						
1 ft / 1 m									
2 ft									
3 ft									
4 ft / 2 m									
5 ft									
6 ft									
7 ft									

Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 17, 2010 ***Sheet:*** 1 of 1

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Borehole Log: 2018-10SS-5

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE				SAMPLE					
Depth (ft / m)	Symbol	Description	Depth/Elev.	Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour ppm 100 300 500 700 900	Well Description
0 / 0		Ground Surface	0.0						No well installed. Shallow borehole for surface sampling only.
		Sand and Gravel Dark brown, fine to coarse sand and gravel, debris at surface and throughout Debris: plastic, wire, glass, styrofoam, screws		-4			100		
1 / 1									
2									
3 / 1									
4									
			1.5						
5									
6 / 2									
7									

Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 17, 2010 ***Sheet:*** 1 of 1

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Borehole Log: 2018-10SS-6

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE				SAMPLE					
Depth (ft / m)	Symbol	Description	Depth/Elev.	Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour ppm 100 300 500 700 900	Well Description
0 / 0		Ground Surface	0.0						No well installed. Shallow borehole for surface sampling only.
		Sand and Gravel Dark brown, fine to coarse sand and gravel, debris at surface and throughout Debris: plastic, wire, glass, styrofoam, screws		-6			100		
1 / 1									
2									
3									
4									
			1.5						
5									
6 / 2									
7									

Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 17, 2010 ***Sheet:*** 1 of 1

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Borehole Log: 2018-10BH-1M

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE

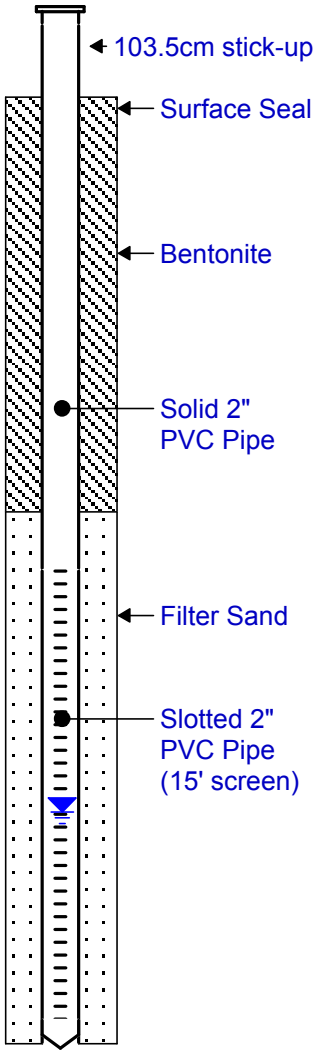
Depth (ft / m)	Symbol	Description	Depth/Elev.
		Ground Surface	0.0
0 – 3.5		***Silty Sand*** Some gravel, brown, dry 0.8 - 1.5m Trace silt 2 - 2.5 Trace clay	2.5
3 – 4		***Fine Sand*** Fine, brown, dry	3.5
4 – 4.5		***Clay*** Trace fine sand, grey clay	4.0
4 – 6		***Fine Sand*** Brown, dry	6.0
6 – 6.5		***Sand and Gravel*** Brown, dry	6.5
6.5 – 7		***Clay*** Trace fine sand, grey clay	7.0
7 – 9.1		***Sand*** Fine to medium, some coarse sand, some gravel, wet	9.1

SAMPLE

Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour (ppm)
-1		G	80	0
-2	***Dup1***	G	90	0
-3		G	100	0
-4		G	100	25
-5		G	100	20
-6		G	80	200
-7		G	100	330

Vapour: ppm 100 300 500 700 900

Well Description



Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 15, 2010 ***Sheet:*** 1 of 1

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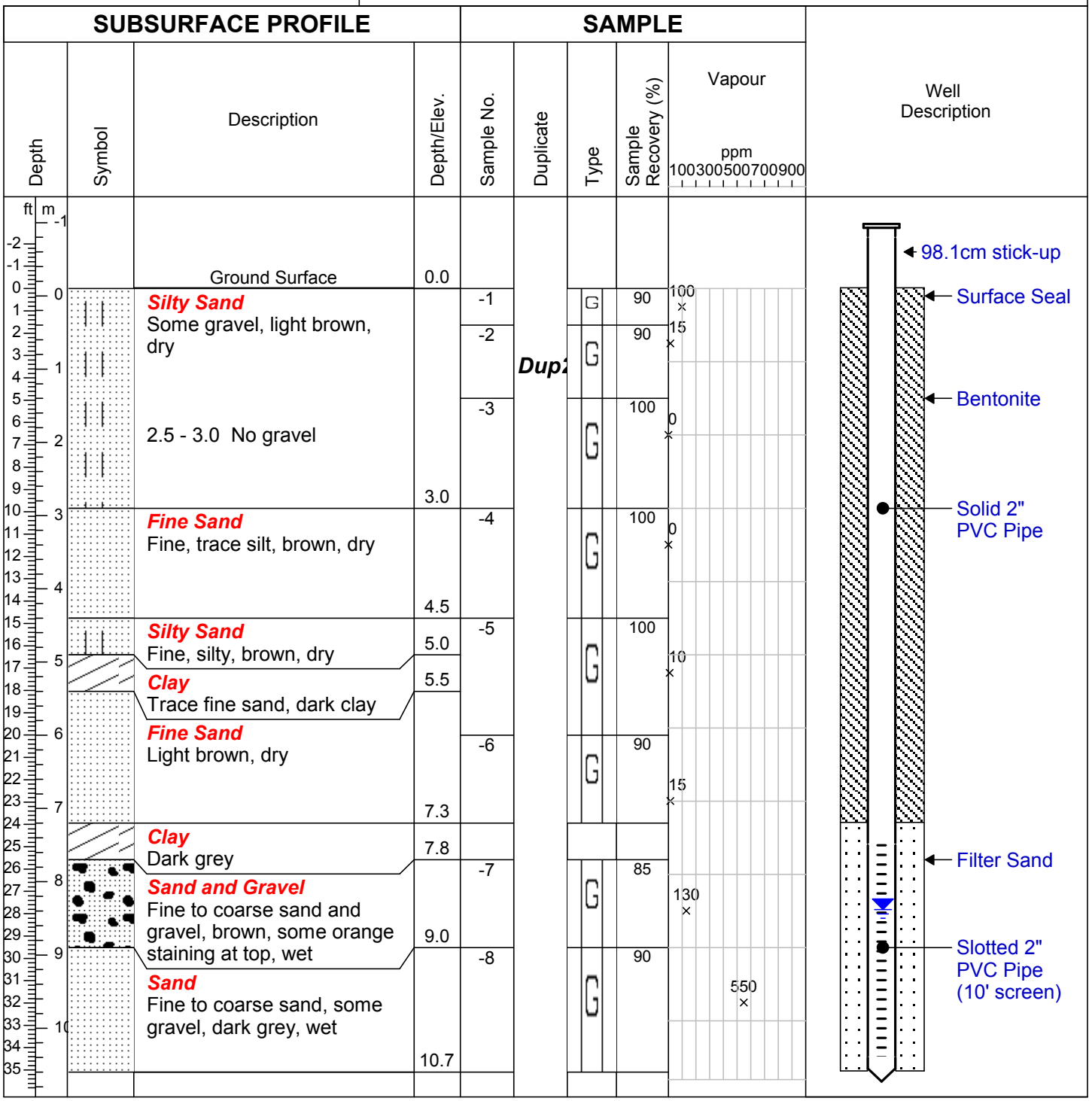
Borehole Log: 2018-10BH-2M

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***



Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 15, 2010 ***Sheet:*** 1 of 1

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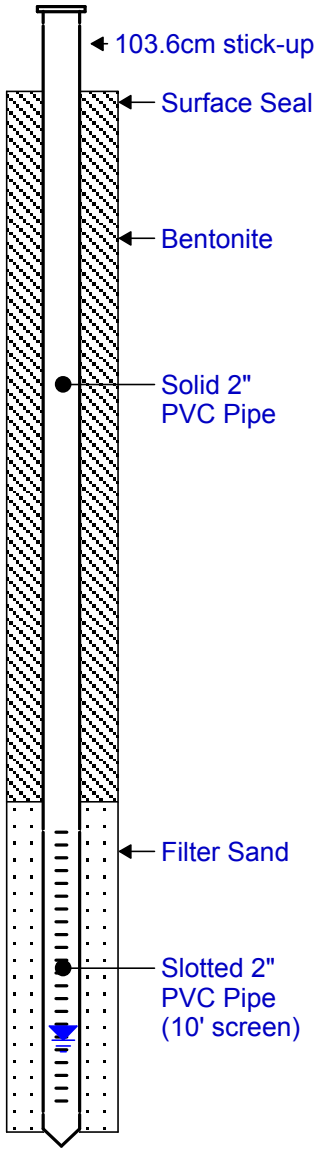
Borehole Log: 2018-10BH-3M

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE				SAMPLE					
Depth (ft / m)	Symbol	Description	Depth/Elev.	Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour (ppm 100 300 500 700 900)	Well Description
		Ground Surface	0.0						
0 – 2.3		***Sand*** Fine, some silt, clay stringers, brown, dry		-1		G	90	140	
0.8 – 1.5		Silt, some sand, dark grey		-2		G	90	25	
2.3 – 3.4		2.9 - 3.1m Clay		-3		G	100	10	
3.4 – 5.2		5.0 - 5.2m Brown clay		-4		G	100	0	
5.2 – 6.4		6.1 - 6.4m Dark grey clay		-5		G	100	0	
6.4 – 7.2		7.0 - 7.2m Dark grey clay	7.2	-6		G	100	50	
7.2 – 9.0		***Sand and Gravel*** Fine to coarse sand and gravel, brown, wet	9.0	-7	Dup1	G	60	0	
9.0 – 10.7		***Sand*** Fine to coarse, some gravel, wet	10.7	-8		G	-	35	



Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 15, 2010 ***Sheet:*** 1 of 1

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Borehole Log: 2018-10BH-4M

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE

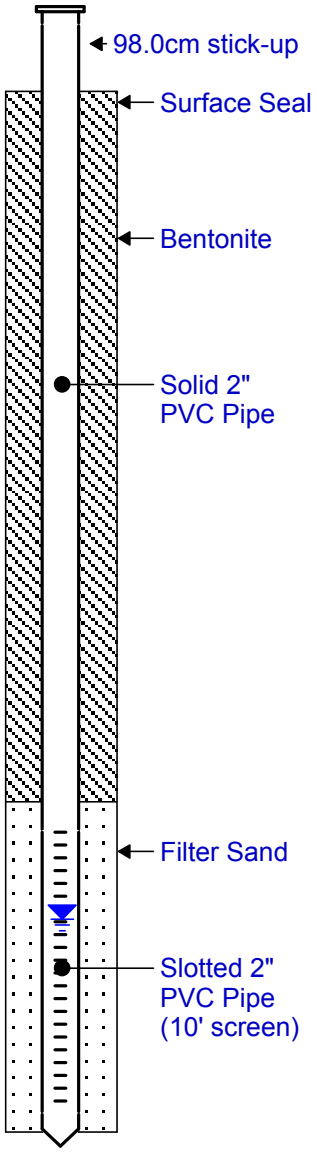
Depth (ft / m)	Symbol	Description	Depth/Elev.
		Ground Surface	0.0
0 – 6		***Silty Sand*** Fine, clay stringers, light brown, dry	
3 – 3.8		3.5 - 3.8m Fine clay, dark brown	
6 – 6.8		***Sandy Silty Clay*** Fine, dark brown	6.8
6.8 – 8		***Sand and Gravel*** Fine to coarse sand, some silt, light brown	8.0
8 – 10		***Sand and Gravel*** Coarse sand and gravel, some silt, dark brown Wet at 9m	10.7

SAMPLE

Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour (ppm)
-1		G	40	100
-2		G	90	0
-3		G	100	5
-4		G	80	0
-5		G	60	10
-6		G	90	10
-7		G	50	100
-8		G	-	140

Vapour ppm scale: 100 300 500 700 900

Well Description



Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 16, 2010 ***Sheet:*** 1 of 1

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Borehole Log: 2018-10BH-5M

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE

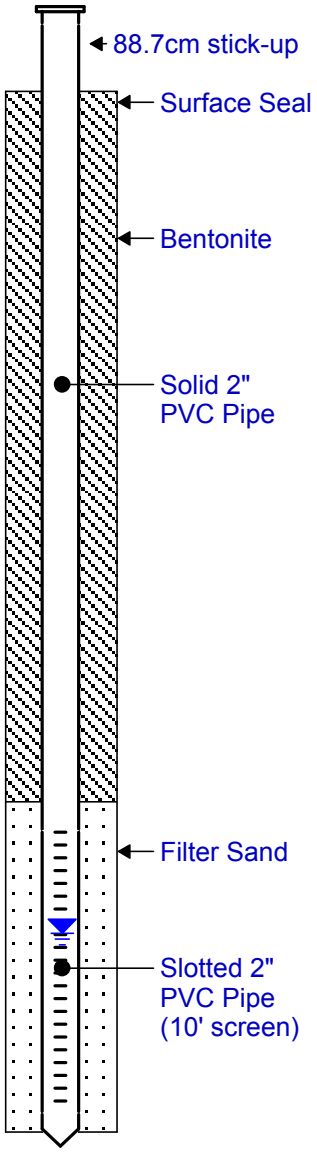
Depth (ft / m)	Symbol	Description	Depth/Elev.
		Ground Surface	0.0
0 – 6		***Silty Sand*** Fine, clay stringers, light brown, dry	6.2
6 – 7		***Silt*** Fine, brown, with grey clay stringer	7.0
7 – 7.7		***Sand*** Fine, brown, dry	7.7
7.7 – 10.7		***Sand and Gravel*** Fine to coarse Fine brown sand, wet at 8m Medium brown-grey sand at 9m	10.7

SAMPLE

Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour (ppm)
-1		G	70	0
-2		G	70	0
-3		G	95	0
-4		G	90	0
-5		G	85	0
-6		G	90	15
-7		G	90	0
-8		G	70	0

Vapour ppm: 100 300 500 700 900

Well Description



Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 17, 2010 ***Sheet:*** 1 of 1

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Borehole Log: 2018-10BH-6M

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE

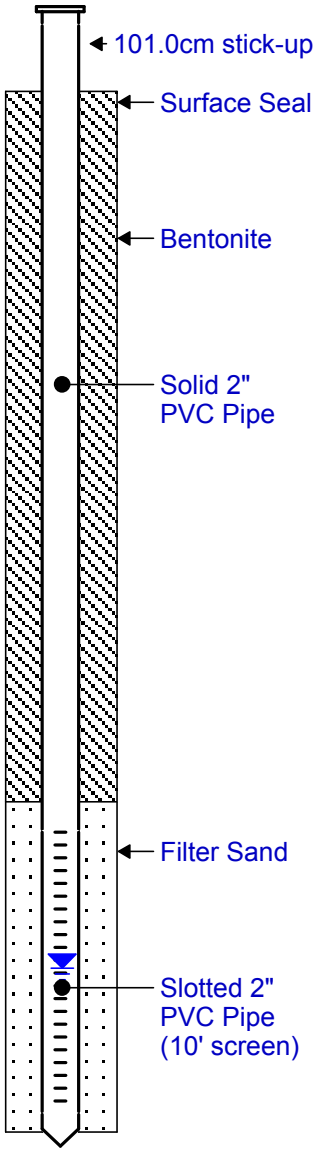
Depth (ft / m)	Symbol	Description	Depth/Elev.
		Ground Surface	0.0
0 – 5		***Silt*** Dark brown to 0.6m, some root litter. After 0.6m, light brown, dense, trace sand. Dark grey clay stringer at 4m. Some sand, orange colour at 5m	5.4
5 – 9		***Silty Clay*** Dark grey clay, light brown fines. Fines grey at 7m. Damp at 8.5m	9.0
9 – 10.7		***Clayey Silt*** Dark grey. Wet at 9.5m. Some sand and gravel	10.7

SAMPLE

Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour (ppm)
-1		G	75	0
-2		G	100	5
-3		G	100	0
-4		G	90	10
-5		G	100	10
-6		G	100	10
-7		G	95	45
-8		G	80	100

Vapour scale: ppm 100 300 500 700 900

Well Description



Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 16, 2010 ***Sheet:*** 1 of 1

FRANZ ENVIRONMENTAL INC.
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Borehole Log: 2018-10BH-7M

Project No.: 2018-1001

Project: Detailed Site Assessment, Garden River Old Dump Site

Client: Parks Canada Agency ***Logged By: RF / ET***

SUBSURFACE PROFILE

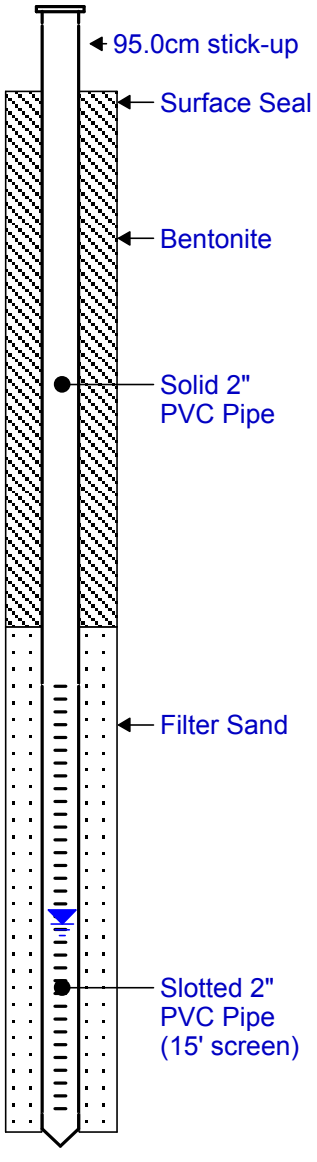
Depth (ft / m)	Symbol	Description	Depth/Elev.
		Ground Surface	0.0
0 – 3		***Silty Sand*** Fine, brown, some grey silty clay stringers	3.0
3 – 6.1		***Sandy Silt*** Fine, brown, some grey clayey silt stringers	6.1
6.1 – 7.5		***Sand*** Fine, brown Some grey clay at 6.5m Some gravel, orange staining, at 7.5m	7.5
7.5 – 10.7		***Sand and Gravel*** Fine to coarse, wet at 8m	10.7

SAMPLE

Sample No.	Duplicate	Type	Sample Recovery (%)	Vapour (ppm)
-1		G	70	0
-2		G	70	0
-3		G	100	0
-4		G	100	0
-5		G	100	0
-6		G	85	5
-7		G	70	15
-8		G	60	0

Vapour ppm: 100 300 500 700 900

Well Description



Drilled By: Mobile Augers & Research ***Hole Dia: 6 in.*** ***Well Dia: 2 in.***

Drill Method: Cassady, truck-mounted rotary (Solid-stem)

Drill Date: December 17, 2010 ***Sheet:*** 1 of 1

Elevation Survey Summary
Garden River Old Dump Study Area, Garden River, AB

08MW05B used as TBM and assigned 100.00 m					
H.I. at station 1 was established at 102.632 m					
Station	HI	F.S.	elevation	Water Levels	Water Elevation
08MW05B	NA	NA	100	9.37	90.63
10BH4M	102.632	2.494	100.138	9.475	90.663
08MW04B	102.632	2.792	99.84	9.326	90.514
10BH5M	102.632	2.62	100.012	9.527	90.485
10BH1M	102.632	3.686	98.946	8.255	90.691
10BH2M	102.632	2.685	99.947	9.46	90.487
1	102.632	2.6	100.032		
2	102.632	2.5	100.132		
3	102.632	3.02	99.612		
4	102.632	4.25	98.382		
5	102.632	2.93	99.702		
6	102.632	4.39	98.242		
7	102.632	3.9	98.732		
8	102.632	4.28	98.352		
9	102.632	3.45	99.182		
10	102.632	3.18	99.452		
11	102.632	2.65	99.982		
12	102.632	2.61	100.022		
13	102.632	2.96	99.672		
14	102.632	2.64	99.992		
15	102.632	2.98	99.652		
16	102.632	2.27	100.362		
17	102.632	1.98	100.652		
18	102.632	1.97	100.662		
19	102.632	2.8	99.832		
20	102.632	2.84	99.792		
21	102.632	1.92	100.712		
22	102.632	2.25	100.382		
23	102.632	2.38	100.252		
24	102.632	2.25	100.382		
25	102.632	3.24	99.392		
26	102.632	3.22	99.412		
27	102.632	3.55	99.082		
28	102.632	2.59	100.042		
29	102.632	1.74	100.892		
Station 2 H.I. was established at 100.794 m					
Station	HI	F.S.	elevation		
10BH7M	100.794	0.971	99.823	9.496	90.327
10BH3M	100.794	0.8	99.994	9.845	90.149
30	100.794	2.9	97.894		
31	100.794	2.17	98.624		
32	100.794	1.68	99.114		
33	100.794	1.71	99.084		
34	100.794	1.85	98.944		
35	100.794	2.02	98.774		
36	100.794	2.39	98.404		
37	100.794	2.83	97.964		
38	100.794	4.57	96.224		
39	100.794	3.68	97.114		
40	100.794	1.78	99.014		

AGAT Laboratories

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CLIENT NAME: FRANZ ENVIRONMENTAL
308-108 MAILAND STREET
VANCOUVER, BC V6B2T4

ATTENTION TO: MEAGAN GOURLEY

PROJECT NO: 2018-1001

AGAT WORK ORDER: 10E461661

SOIL ANALYSIS REVIEWED BY: Irina Gankovsky, Analyst

TRACE ORGANICS REVIEWED BY: Elena Gorobets, Analyst

WATER ANALYSIS REVIEWED BY: Krystyna Krauze, Analyst

DATE REPORTED: Dec 31, 2010

PAGES (INCLUDING COVER): 60

VERSION*: 1

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

*NOTES

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

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

CCME / Alberta Tier 1 Metals + Hg + HWS B + Cr6 (soil)

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-Dup1 2205959	2018-10BH-Dup2 2205960	2018-10BH-Dup3 2205961	2018-10BH-1M-2 2206941	2018-10BH-1M-7 2206954	2018-10BH-2M-2 2206957	2018-10BH-2M-7 2206962	2018-10BH-3M-1 2207012
Antimony	mg/kg	20	0.5	0.7	0.8	<0.5	0.6	<0.5	0.8	<0.5	0.7
Arsenic	mg/kg	17	0.5	7.6	8.7	2.1	7.3	2.9	8.4	3.2	8.3
Barium	mg/kg	500	0.5	243	271	55.7	221	49.4	259	55.1	212
Beryllium	mg/kg	5	0.5	<0.5	0.6	<0.5	<0.5	<0.5	0.6	<0.5	<0.5
Boron (Hot water extraction)	mg/kg	2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	mg/kg	10	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	64	0.5	14.0	18.4	5.7	14.1	5.1	19.1	5.0	14.8
Chromium, Hexavalent	mg/kg	0.4	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Cobalt	mg/kg	20	0.5	6.1	7.9	2.5	5.9	2.5	7.8	2.8	7.1
Copper	mg/kg	63	0.5	15.8	22.4	4.6	15.9	4.4	23.7	4.5	19.9
Lead	mg/kg	140	0.5	7.1	9.2	2.1	7.1	2.0	9.3	2.2	8.1
Mercury	mg/kg	6.6	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Molybdenum	mg/kg	4	0.5	1.3	1.5	0.5	1.3	<0.5	1.4	0.6	1.2
Nickel	mg/kg	50	0.5	19.6	25.3	6.9	19.3	7.7	25.0	7.3	24.4
Selenium	mg/kg	1	0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver	mg/kg	20	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tin	mg/kg	5	0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	mg/kg	23	0.5	1.0	0.9	<0.5	1.0	<0.5	0.9	<0.5	0.8
Vanadium	mg/kg	130	0.5	26.3	33.0	9.1	26.4	9.4	33.5	8.3	28.0
Zinc	mg/kg	200	1	77	97	18	77	21	91	22	82

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

CCME / Alberta Tier 1 Metals + Hg + HWS B + Cr6 (soil)

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-3M-7 2207024	2018-10BH-4M-1 2207027	2018-10BH-4M-8 2207038	2018-10BH-5M-1 2207041	2018-10BH-5M-7 2207051	2018-10BH-6M-1 2207058	2018-10BH-6M-8 2207079	2018-10BH-7M-1 2207080
Antimony	mg/kg	20	0.5	<0.5	0.7	<0.5	0.8	<0.5	0.8	<0.5	0.6
Arsenic	mg/kg	17	0.5	2.3	8.4	1.7	9.4	1.5	9.5	12.6	6.3
Barium	mg/kg	500	0.5	51.0	273	42.5	165	78.5	272	55.7	228
Beryllium	mg/kg	5	0.5	<0.5	0.6	<0.5	0.5	<0.5	0.8	<0.5	<0.5
Boron (Hot water extraction)	mg/kg	2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5
Cadmium	mg/kg	10	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	64	0.5	6.3	17.0	3.4	17.1	4.0	21.7	7.3	12.0
Chromium, Hexavalent	mg/kg	0.4	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Cobalt	mg/kg	20	0.5	2.8	7.3	1.7	7.9	2.1	10.5	6.1	5.7
Copper	mg/kg	63	0.5	5.3	21.3	2.6	23.4	2.9	25.4	6.8	12.3
Lead	mg/kg	140	0.5	2.2	9.1	1.5	9.4	2.0	12.0	4.6	5.7
Mercury	mg/kg	6.6	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Molybdenum	mg/kg	4	0.5	0.5	1.3	<0.5	1.3	<0.5	1.5	0.8	0.9
Nickel	mg/kg	50	0.5	7.5	23.8	5.2	28.1	6.2	31.4	15.2	17.5
Selenium	mg/kg	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5
Silver	mg/kg	20	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tin	mg/kg	5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5
Uranium	mg/kg	23	0.5	<0.5	0.9	<0.5	0.9	<0.5	0.9	0.6	0.8
Vanadium	mg/kg	130	0.5	8.4	29.8	5.4	30.7	7.0	34.6	12.9	22.5
Zinc	mg/kg	200	1	22	86	12	86	17	94	47	60

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

CCME / Alberta Tier 1 Metals + Hg + HWS B + Cr6 (soil)

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-7M-7 2207096	2018-10SS-1 2207098	2018-10SS-2 2207101	2018-10SS-3 2207102	2018-10SS-4 2207103	2018-10SS-5 2207104	2018-10SS-6 2207105
Antimony	mg/kg	20	0.5	<0.5	0.9	1.2	0.7	1.7	1.6	19.0
Arsenic	mg/kg	17	0.5	3.0	8.4	7.9	11.0	16.0	10.0	9.1
Barium	mg/kg	500	0.5	78.8	241	222	204	259	343	154
Beryllium	mg/kg	5	0.5	<0.5	<0.5	<0.5	0.6	0.7	0.7	<0.5
Boron (Hot water extraction)	mg/kg	2	0.5	<0.5	0.9	<0.5	<0.5	**3.2**	**4.3**	**3.7**
Cadmium	mg/kg	10	0.5	<0.5	<0.5	<0.5	<0.5	0.8	0.6	5.0
Chromium	mg/kg	64	0.5	6.7	18.2	28.6	27.4	23.2	24.6	47.2
Chromium, Hexavalent	mg/kg	0.4	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Cobalt	mg/kg	20	0.5	4.2	7.8	7.2	10.1	7.6	9.7	6.4
Copper	mg/kg	63	0.5	5.9	26.0	22.1	19.6	47.9	37.6	**409**
Lead	mg/kg	140	0.5	2.6	14.4	14.8	11.6	14.1	18.4	94.9
Mercury	mg/kg	6.6	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Molybdenum	mg/kg	4	0.5	0.6	1.4	1.3	1.4	1.2	2.0	3.1
Nickel	mg/kg	50	0.5	10.9	24.5	23.9	27.5	22.7	31.7	29.1
Selenium	mg/kg	1	0.5	<0.5	0.6	<0.5	0.7	0.8	<0.5	<0.5
Silver	mg/kg	20	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Thallium	mg/kg	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tin	mg/kg	5	0.5	<0.5	2.2	2.5	0.5	0.9	2.2	**140**
Uranium	mg/kg	23	0.5	<0.5	0.9	0.9	1.1	1.0	1.0	0.7
Vanadium	mg/kg	130	0.5	11.8	29.4	28.6	42.8	31.6	40.2	24.4
Zinc	mg/kg	200	1	31	102	99	88	190	152	**3950**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 Soil (RP, F)

2205959-2207105 Results are based on the dry weight of the sample.

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Particle Size by Sieve

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-1M-7 2206954	2018-10BH-2M-8 2206992	2018-10BH-3M-8 2207026	2018-10BH-4M-8 2207038	2018-10BH-5M-8 2207054	2018-10BH-6M-8 2207079	2018-10BH-7M-8 2207097	2018-10SS-1 2207098
Sieve Analysis - 75 microns (wet)	%		N/A	95.8	98.3	98.0	98.9	98.0	84.9	98.2	20.9
Sieve Texture				Coarse	Coarse	Coarse	Coarse	Coarse	Coarse	Coarse	Fine

Parameter	Unit	G / S	RDL	2018-10SS-2 2207101	2018-10SS-6 2207105
Sieve Analysis - 75 microns (wet)	%		N/A	13.4	29.5
Sieve Texture				Fine	Fine

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

2206954-2207105 Value reported is amount of sample retained on sieve after wash with water and represents proportion by weight particles larger than indicated sieve size.

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Soil Analysis - Salinity (AB Tier 1 - pH Calcium Chloride)

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-Dup1 2205959	2018-10BH-Dup2 2205960	2018-10BH-Dup3 2205961	2018-10BH-1M-2 2206941	2018-10BH-1M-7 2206954	2018-10BH-2M-2 2206957	2018-10BH-2M-7 2206962	2018-10BH-3M-1 2207012
pH (CaCl2 Extraction)		6.0-8.5	N/A	6.9	7.3	7.6	7.4	7.6	7.3	7.4	7.0
Electrical Conductivity (Sat. Paste)	dS/m		0.01	0.57	0.30	0.26	0.50	0.28	0.27	0.23	0.28
Sodium Adsorption Ratio				0.71	0.26	0.21	0.55	0.38	0.16	0.28	0.19
Saturation Percentage	%		N/A	38	54	27	40	30	49	32	43
Chloride, Soluble	mg/L		2	92	7	7	77	9	6	6	9
Calcium, Soluble	mg/L		1	43	40	27	39	33	35	25	37
Potassium, Soluble	mg/L		2	4	2	3	3	4	<2	3	3
Magnesium, Soluble	mg/L		1	22	9	9	20	6	8	6	8
Sodium, Soluble	mg/L		2	23	7	5	17	9	4	6	5
Sulfur (as Sulfate), Soluble	mg/L		2	21	15	20	14	36	12	15	8
Calcium, Soluble (meq/L)	meq/L		0.05	2.15	2.00	1.35	1.95	1.65	1.75	1.25	1.85
Calcium, Soluble (mg/kg)	mg/kg		1	16	22	7	16	10	17	8	16
Chloride, Soluble (meq/L)	meq/L		0.06	2.59	0.20	0.20	2.17	0.25	0.17	0.17	0.25
Chloride, Soluble (mg/kg)	mg/kg		2	35	4	<2	31	3	3	<2	4
Magnesium, Soluble (meq/L)	meq/L		0.08	1.81	0.74	0.74	1.65	0.49	0.66	0.49	0.66
Magnesium, Soluble (mg/kg)	mg/kg		1	8	5	2	8	2	4	2	3
Potassium, Soluble (meq/L)	meq/L		0.05	0.10	0.05	0.08	0.08	0.10	<0.05	0.08	0.08
Potassium, Soluble (mg/kg)	mg/kg		2	<2	<2	<2	<2	<2	<2	<2	<2
Sodium, Soluble (meq/L)	meq/L		0.09	1.00	0.30	0.22	0.74	0.39	0.17	0.26	0.22
Sodium, Soluble (mg/kg)	mg/kg		2	9	4	<2	7	3	2	<2	2
Sulfate (SO4-S), Soluble (meq/L)	meq/L		0.04	0.44	0.31	0.42	0.29	0.75	0.25	0.31	0.17
Sulfate (SO4-S), Soluble (mg/kg)	mg/kg		2	8	8	5	6	11	6	5	3
Theoretical Gypsum Requirement	tonnes/ha			0	0	0	0	0	0	0	0

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Soil Analysis - Salinity (AB Tier 1 - pH Calcium Chloride)

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-3M-7 2207024	2018-10BH-4M-1 2207027	2018-10BH-4M-8 2207038	2018-10BH-5M-1 2207041	2018-10BH-5M-7 2207051	2018-10BH-6M-1 2207058	2018-10BH-6M-8 2207079	2018-10BH-7M-1 2207080
pH (CaCl2 Extraction)		6.0-8.5	N/A	7.3	7.4	7.5	7.3	7.2	7.1	7.5	7.4
Electrical Conductivity (Sat. Paste)	dS/m		0.01	0.26	0.33	0.28	0.43	0.25	0.39	0.50	0.34
Sodium Adsorption Ratio				0.26	0.32	0.34	0.15	0.22	0.18	0.17	0.22
Saturation Percentage	%		N/A	31	48	29	45	27	64	31	37
Chloride, Soluble	mg/L		2	8	7	9	7	6	7	25	8
Calcium, Soluble	mg/L		1	26	33	31	63	27	60	72	47
Potassium, Soluble	mg/L		2	3	3	4	8	4	5	4	6
Magnesium, Soluble	mg/L		1	8	16	7	11	7	12	11	6
Sodium, Soluble	mg/L		2	6	9	8	5	5	6	6	6
Sulfur (as Sulfate), Soluble	mg/L		2	18	12	35	15	20	39	172	22
Calcium, Soluble (meq/L)	meq/L		0.05	1.30	1.65	1.55	3.14	1.35	2.99	3.59	2.35
Calcium, Soluble (mg/kg)	mg/kg		1	8	16	9	28	7	38	22	17
Chloride, Soluble (meq/L)	meq/L		0.06	0.23	0.20	0.25	0.20	0.17	0.20	0.71	0.23
Chloride, Soluble (mg/kg)	mg/kg		2	2	3	3	3	<2	4	8	3
Magnesium, Soluble (meq/L)	meq/L		0.08	0.66	1.32	0.58	0.91	0.58	0.99	0.91	0.49
Magnesium, Soluble (mg/kg)	mg/kg		1	2	8	2	5	2	8	3	2
Potassium, Soluble (meq/L)	meq/L		0.05	0.08	0.08	0.10	0.20	0.10	0.13	0.10	0.15
Potassium, Soluble (mg/kg)	mg/kg		2	<2	<2	<2	4	<2	3	<2	2
Sodium, Soluble (meq/L)	meq/L		0.09	0.26	0.39	0.35	0.22	0.22	0.26	0.26	0.26
Sodium, Soluble (mg/kg)	mg/kg		2	<2	4	2	2	<2	4	<2	2
Sulfate (SO4-S), Soluble (meq/L)	meq/L		0.04	0.37	0.25	0.73	0.31	0.42	0.81	3.58	0.46
Sulfate (SO4-S), Soluble (mg/kg)	mg/kg		2	6	6	10	7	5	25	53	8
Theoretical Gypsum Requirement	tonnes/ha			0	0	0	0	0	0	0	0

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Soil Analysis - Salinity (AB Tier 1 - pH Calcium Chloride)

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-7M-7 2207096	2018-10SS-1 2207098	2018-10SS-2 2207101	2018-10SS-3 2207102	2018-10SS-4 2207103	2018-10SS-5 2207104	2018-10SS-6 2207105
pH (CaCl2 Extraction)		6.0-8.5	N/A	7.3	7.4	7.3	7.1	7.2	7.3	7.4
Electrical Conductivity (Sat. Paste)	dS/m		0.01	0.28	1.99	0.82	1.06	0.48	2.08	5.60
Sodium Adsorption Ratio				0.20	0.58	0.75	0.16	0.42	0.48	2.16
Saturation Percentage	%		N/A	29	46	45	51	70	54	52
Chloride, Soluble	mg/L		2	9	231	60	7	29	49	1000
Calcium, Soluble	mg/L		1	32	295	94	140	66	366	641
Potassium, Soluble	mg/L		2	4	14	4	6	18	53	74
Magnesium, Soluble	mg/L		1	10	63	22	26	12	53	265
Sodium, Soluble	mg/L		2	5	42	31	8	14	37	258
Sulfur (as Sulfate), Soluble	mg/L		2	20	613	186	40	30	960	1780
Calcium, Soluble (meq/L)	meq/L		0.05	1.60	14.7	4.69	6.99	3.29	18.3	32.0
Calcium, Soluble (mg/kg)	mg/kg		1	9	136	42	71	46	198	333
Chloride, Soluble (meq/L)	meq/L		0.06	0.25	6.52	1.69	0.20	0.82	1.38	28.2
Chloride, Soluble (mg/kg)	mg/kg		2	3	106	27	4	20	26	520
Magnesium, Soluble (meq/L)	meq/L		0.08	0.82	5.18	1.81	2.14	0.99	4.36	21.8
Magnesium, Soluble (mg/kg)	mg/kg		1	3	29	10	13	8	29	138
Potassium, Soluble (meq/L)	meq/L		0.05	0.10	0.36	0.10	0.15	0.46	1.36	1.89
Potassium, Soluble (mg/kg)	mg/kg		2	<2	6	<2	3	13	29	38
Sodium, Soluble (meq/L)	meq/L		0.09	0.22	1.83	1.35	0.35	0.61	1.61	11.2
Sodium, Soluble (mg/kg)	mg/kg		2	<2	19	14	4	10	20	134
Sulfate (SO4-S), Soluble (meq/L)	meq/L		0.04	0.42	12.8	3.87	0.83	0.62	20.0	37.1
Sulfate (SO4-S), Soluble (mg/kg)	mg/kg		2	6	282	84	20	21	518	926
Theoretical Gypsum Requirement	tonnes/ha			0	0	0	0	0	0	0

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 Soil (RP, F)

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Glycols Analysis in Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-Dup1 2205959	2018-10BH-Dup2 2205960	2018-10BH-Dup3 2205961	2018-10BH-1M-2 2206941	2018-10BH-1M-7 2206954	2018-10BH-2M-2 2206957	2018-10BH-2M-7 2206962	2018-10BH-3M-1 2207012
Propylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
Monoethylene glycol	mg/kg	60	10	<10	<10	<10	<10	<10	<10	<10	<10
Diethylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
Triethylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
Tetraethylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
Surrogate	**Unit**	**Acceptable Limits**									
Heptanol	%	50-150		130	116	124	119	113	121	114	120

Parameter	Unit	G / S	RDL	2018-10BH-3M-7 2207024	2018-10BH-4M-1 2207027	2018-10BH-4M-8 2207038	2018-10BH-5M-1 2207041	2018-10BH-5M-7 2207051	2018-10BH-6M-1 2207058	2018-10BH-6M-8 2207079	2018-10BH-7M-1 2207080
Propylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
Monoethylene glycol	mg/kg	60	10	<10	<10	<10	<10	<10	<10	<10	<10
Diethylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
Triethylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
Tetraethylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
Surrogate	**Unit**	**Acceptable Limits**									
Heptanol	%	50-150		99	121	110	114	81	120	117	122

Parameter	Unit	G / S	RDL	2018-10BH-7M-7 2207096	2018-10SS-1 2207098	2018-10SS-2 2207101	2018-10SS-3 2207102	2018-10SS-4 2207103	2018-10SS-5 2207104	2018-10SS-6 2207105
Propylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10
Monoethylene glycol	mg/kg	60	10	<10	<10	<10	<10	<10	<10	<10
Diethylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10
Triethylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10
Tetraethylene glycol	mg/kg		10	<10	<10	<10	<10	<10	<10	<10
Surrogate	**Unit**	**Acceptable Limits**								
Heptanol	%	50-150		121	111	124	130	122	100	105

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 Soil (RP, F)

2205959-2207105 Analysis by GC/FID.
Results are based on the dry weight of the sample.

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Glycols Analysis in Water

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-1 2207106	2018-10BH-2 2207116	2018-10BH-3 2207126	2018-10BH-DUP 1 2207128	2018-10BH-4M 2210312	2018-10BH-5M 2210337	2018-10BH-6M 2210342	2018-10BH-7M 2210345
Propylene Glycol	mg/L		10	<10	<10	<10	<10	<10	<10	<10	<10
Monoethylene Glycol	mg/L	31	10	<10	<10	<10	<10	<10	<10	<10	<10
Diethylene Glycol	mg/L		10	<10	<10	<10	<10	<10	<10	<10	<10
Triethylene Glycol	mg/L		10	<10	<10	<10	<10	<10	<10	<10	<10
Tetraethylene Glycol	mg/L		10	<10	<10	<10	<10	<10	<10	<10	<10
Surrogate	**Unit**	**Acceptable Limits**									
Heptanol	%	50-150		100	114	112	121	120	104	111	114

Parameter	Unit	G / S	RDL	018 MW04B 2210349	018 MW05B 2210472
Propylene Glycol	mg/L		10	<10	<10
Monoethylene Glycol	mg/L	31	10	<10	<10
Diethylene Glycol	mg/L		10	<10	<10
Triethylene Glycol	mg/L		10	<10	<10
Tetraethylene Glycol	mg/L		10	<10	<10
Surrogate	**Unit**	**Acceptable Limits**			
Heptanol	%	50-150		100	102

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 GW (RP, F)

2207106-2210472 Identification based on retention time relative to standards.

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

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

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-Dup1 2205959	2018-10BH-Dup2 2205960	2018-10BH-Dup3 2205961	2018-10BH-1M-2 2206941	2018-10BH-1M-6 2206951	2018-10BH-1M-7 2206954	2018-10BH-2M-1 2206955	2018-10BH-2M-2 2206957
Benzene	mg/kg	0.046	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	mg/kg	0.52	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg	0.11	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylenes	mg/kg	15	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
C6 - C10 (F1)	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
C6 - C10 (F1 minus BTEX)	mg/kg	210	10	<10	<10	<10	<10	<10	<10	<10	<10
C10 - C16 (F2)	mg/kg	150	10	<10	<10	<10	<10	<10	<10	<10	<10
C16 - C34 (F3)	mg/kg	1300	10	<10	<10	<10	<10	<10	120	<10	<10
C34 - C50 (F4)	mg/kg	5600	10	<10	<10	<10	<10	<10	<10	<10	<10
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Moisture Content	%		1	11	11	13	8.5	13	18	12	13
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8 (BTEX)	%	50-150		96	94	92	95	94	94	94	94
Ethylbenzene-d10 (BTEX)	%	50-150		95	94	94	90	92	97	93	94
o-Terphenyl (F2-F4)	%	50-150		99	97	97	96	98	99	99	99

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

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

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-2M-7 2206962	2018-10BH-2M-8 2206992	2018-10BH-3M-1 2207012	2018-10BH-3M-7 2207024	2018-10BH-4M-1 2207027	2018-10BH-4M-8 2207038	2018-10BH-5M-1 2207041	2018-10BH-5M-7 2207051
Benzene	mg/kg	0.046	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	mg/kg	0.52	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg	0.11	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylenes	mg/kg	15	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
C6 - C10 (F1)	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
C6 - C10 (F1 minus BTEX)	mg/kg	210	10	<10	<10	<10	<10	<10	<10	<10	<10
C10 - C16 (F2)	mg/kg	150	10	<10	<10	<10	<10	<10	<10	<10	<10
C16 - C34 (F3)	mg/kg	1300	10	29	<10	<10	25	19	<10	<10	<10
C34 - C50 (F4)	mg/kg	5600	10	<10	<10	<10	<10	<10	<10	<10	<10
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Moisture Content	%		1	15	18	28	15	22	17	6.3	9.9
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8 (BTEX)	%	50-150		95	94	95	95	95	96	96	93
Ethylbenzene-d10 (BTEX)	%	50-150		98	91	100	95	98	96	86	90
o-Terphenyl (F2-F4)	%	50-150		101	96	106	97	107	100	99	97

Parameter	Unit	G / S	RDL	2018-10BH-6M-1 2207058	2018-10BH-6M-8 2207079	2018-10BH-7M-1 2207080	2018-10BH-7M-7 2207096	2018-10SS-1 2207098	2018-10SS-2 2207101	2018-10SS-3 2207102	2018-10SS-4 2207103
Benzene	mg/kg	0.046	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	mg/kg	0.52	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg	0.11	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylenes	mg/kg	15	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
C6 - C10 (F1)	mg/kg		10	<10	<10	<10	<10	<10	<10	<10	<10
C6 - C10 (F1 minus BTEX)	mg/kg	210	10	<10	<10	<10	<10	<10	<10	<10	<10
C10 - C16 (F2)	mg/kg	150	10	<10	<10	<10	<10	<10	11	<10	<10
C16 - C34 (F3)	mg/kg	1300	10	<10	87	<10	14	14	18	<10	59
C34 - C50 (F4)	mg/kg	5600	10	<10	24	<10	<10	<10	<10	<10	20
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Moisture Content	%		1	23	18	14	18	11	12	14	15
Surrogate	**Unit**	**Acceptable Limits**		**2207058**	**2207079**	**2207080**	**2207096**	**2207098**	**2207101**	**2207102**	**2207103**
Toluene-d8 (BTEX)	%	50-150		97	94	95	96	96	95	95	106
Ethylbenzene-d10 (BTEX)	%	50-150		97	95	98	95	96	90	101	134
o-Terphenyl (F2-F4)	%	50-150		99	104	89	99	95	107	95	94

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

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

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10SS-5 2207104	2018-10SS-6 2207105
Benzene	mg/kg	0.046	0.005	<0.005	<0.005
Toluene	mg/kg	0.52	0.05	<0.05	<0.05
Ethylbenzene	mg/kg	0.11	0.01	<0.01	<0.01
Xylenes	mg/kg	15	0.05	<0.05	<0.05
C6 - C10 (F1)	mg/kg		10	<10	<10
C6 - C10 (F1 minus BTEX)	mg/kg	210	10	<10	<10
C10 - C16 (F2)	mg/kg	150	10	16	<10
C16 - C34 (F3)	mg/kg	1300	10	83	404
C34 - C50 (F4)	mg/kg	5600	10	29	79
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A	N/A
Moisture Content	%		1	19	19
Surrogate	**Unit**	**Acceptable Limits**			
Toluene-d8 (BTEX)	%	50-150		96	97
Ethylbenzene-d10 (BTEX)	%	50-150		130	112
o-Terphenyl (F2-F4)	%	50-150		101	97

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 Soil (RP, F)

2205959-2207105 Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.

Certified By: Elena Gorobets

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Petroleum Hydrocarbons (BTEX/F1-F4) in Water

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-1 2207106	2018-10BH-2 2207116	2018-10BH-3 2207126	2018-10BH-DUP 1 2207128	2018-10BH-4M 2210312	2018-10BH-5M 2210337	2018-10BH-6M 2210342	2018-10BH-7M 2210345
Benzene	mg/L	0.005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Toluene	mg/L	0.024	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Ethylbenzene	mg/L	0.0024	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Xylenes	mg/L	0.3	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
C6 - C10 (F1)	mg/L	2.2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
C6 - C10 (F1 minus BTEX)	mg/L	2.2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
C>10 - C16	mg/L	1.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
C16 - C34	mg/L		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
C>34 - C50	mg/L		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8 (BTEX)	%	50-150		97	97	99	100	101	101	102	104
o-Terphenyl (F2-F4)	%	50-150		96	97	98	97	97	99	99	98

Parameter	Unit	G / S	RDL	018 MW04B 2210349	018 MW05B 2210472
Benzene	mg/L	0.005	0.0005	<0.0005	<0.0005
Toluene	mg/L	0.024	0.0005	<0.0005	<0.0005
Ethylbenzene	mg/L	0.0024	0.0005	<0.0005	<0.0005
Xylenes	mg/L	0.3	0.0005	<0.0005	<0.0005
C6 - C10 (F1)	mg/L	2.2	0.1	<0.1	<0.1
C6 - C10 (F1 minus BTEX)	mg/L	2.2	0.1	<0.1	<0.1
C>10 - C16	mg/L	1.1	0.1	<0.1	<0.1
C16 - C34	mg/L		0.1	<0.1	<0.1
C>34 - C50	mg/L		0.1	<0.1	<0.1
Surrogate	**Unit**	**Acceptable Limits**			
Toluene-d8 (BTEX)	%	50-150		103	106
o-Terphenyl (F2-F4)	%	50-150		98	98

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 GW (RP, F)

2207106-2210472 The C>6 - C10 fraction is calculated using the toluene response factor.
The C10 - C16 fraction is calculated using the average response factor for nC10, nC16 and nC34.
BTEX has NOT been subtracted from Fraction 1.
Sample is blank corrected.

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Polyaromatic Hydrocarbon Analysis - Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-Dup1 2205959	2018-10BH-Dup2 2205960	2018-10BH-Dup3 2205961	2018-10BH-1M-2 2206941	2018-10BH-1M-6 2206951	2018-10BH-1M-7 2206954	2018-10BH-2M-2 2206957	2018-10BH-2M-7 2206962
Naphthalene	mg/kg	0.016	0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Methylnaphthalene	mg/kg		0.005	<0.005	0.008	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
Acenaphthylene	mg/kg	5.0	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.32	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluorene	mg/kg	0.29	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	mg/kg	0.051	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	mg/kg	0.0046	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoranthene	mg/kg	0.032	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Pyrene	mg/kg	0.034	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Benzo(a)anthracene	mg/kg	0.070	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chrysene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b+j)fluoranthene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene	mg/kg	0.70	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Indeno(1,2,3-cd)pyrene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenzo(ah)anthracene	mg/kg	7.4	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Benzo(ghi)perylene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**									
2-Fluorobiphenyl (PAH)	%	50-150		71	67	68	74	65	63	72	63
p-Terphenyl-d14 (PAH)	%	50-150		80	76	78	100	79	80	86	77

Certified By: Elena Gorobets

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Polyaromatic Hydrocarbon Analysis - Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-2M-8 2206992	2018-10BH-3M-1 2207012	2018-10BH-3M-7 2207024	2018-10BH-4M-1 2207027	2018-10BH-4M-8 2207038	2018-10BH-5M-1 2207041	2018-10BH-5M-7 2207051	2018-10BH-6M-1 2207058
Naphthalene	mg/kg	0.016	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007
2-Methylnaphthalene	mg/kg		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.013
Acenaphthylene	mg/kg	5.0	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.32	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluorene	mg/kg	0.29	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	mg/kg	0.051	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	mg/kg	0.0046	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoranthene	mg/kg	0.032	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Pyrene	mg/kg	0.034	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Benzo(a)anthracene	mg/kg	0.070	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chrysene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b+j)fluoranthene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene	mg/kg	0.70	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Indeno(1,2,3-cd)pyrene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenzo(ah)anthracene	mg/kg	7.4	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Benzo(ghi)perylene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**									
2-Fluorobiphenyl (PAH)	%	50-150		65	73	70	68	72	64	59	70
p-Terphenyl-d14 (PAH)	%	50-150		77	88	88	80	85	72	69	70

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Polyaromatic Hydrocarbon Analysis - Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-6M-8 2207079	2018-10BH-7M-1 2207080	2018-10BH-7M-7 2207096	2018-10SS-1 2207098	2018-10SS-2 2207101	2018-10SS-3 2207102	2018-10SS-4 2207103	2018-10SS-5 2207104
Naphthalene	mg/kg	0.016	0.005	**0.029**	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	**0.024**
2-Methylnaphthalene	mg/kg		0.005	0.066	<0.005	0.006	<0.005	<0.005	<0.005	0.006	0.013
Acenaphthylene	mg/kg	5.0	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.010
Acenaphthene	mg/kg	0.32	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluorene	mg/kg	0.29	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	mg/kg	0.051	0.02	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	**0.09**
Anthracene	mg/kg	0.0046	0.004	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	**0.028**
Fluoranthene	mg/kg	0.032	0.03	**0.04**	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03
Pyrene	mg/kg	0.034	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03
Benzo(a)anthracene	mg/kg	0.070	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03
Chrysene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b+j)fluoranthene	mg/kg		0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene	mg/kg	0.70	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Indeno(1,2,3-cd)pyrene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenzo(ah)anthracene	mg/kg	7.4	0.005	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006
Benzo(ghi)perylene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**									
2-Fluorobiphenyl (PAH)	%	50-150		75	67	66	66	68	62	63	69
p-Terphenyl-d14 (PAH)	%	50-150		73	66	69	68	83	72	61	67

Certified By: Elena Gorobets

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Polyaromatic Hydrocarbon Analysis - Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10SS-6 2207105
Naphthalene	mg/kg	0.016	0.005	0.011
2-Methylnaphthalene	mg/kg		0.005	0.008
Acenaphthylene	mg/kg	5.0	0.005	<0.005
Acenaphthene	mg/kg	0.32	0.005	<0.005
Fluorene	mg/kg	0.29	0.02	<0.02
Phenanthrene	mg/kg	0.051	0.02	<0.02
Anthracene	mg/kg	0.0046	0.004	<0.004
Fluoranthene	mg/kg	0.032	0.03	<0.03
Pyrene	mg/kg	0.034	0.03	<0.03
Benzo(a)anthracene	mg/kg	0.070	0.03	<0.03
Chrysene	mg/kg		0.05	<0.05
Benzo(b+j)fluoranthene	mg/kg		0.05	<0.05
Benzo(k)fluoranthene	mg/kg		0.05	<0.05
Benzo(a)pyrene	mg/kg	0.70	0.03	<0.03
Indeno(1,2,3-cd)pyrene	mg/kg		0.05	<0.05
Dibenzo(ah)anthracene	mg/kg	7.4	0.005	<0.005
Benzo(ghi)perylene	mg/kg		0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**		
2-Fluorobiphenyl (PAH)	%	50-150		70
p-Terphenyl-d14 (PAH)	%	50-150		70

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 Soil (RP, F)

2205959-2207105 Results are based on the dry weight of the sample.
Based on GC/MS target ion analysis.
Isomers Benzo(b)fluoranthene and Benzo(j)fluoranthene have the same GC retention time and are reported as the sum based on the Benzo(b)fluoranthene response.

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Polyaromatic Hydrocarbon Analysis - Water FWAL

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-1 2207106	2018-10BH-2 2207116	2018-10BH-3 2207126	2018-10BH-DUP 1 2207128	2018-10BH-4M 2210312	2018-10BH-5M 2210337	2018-10BH-6M 2210342	2018-10BH-7M 2210345
Acridine	mg/L		0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003
Quinoline	mg/L		0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
2-Methylnaphthalene	mg/L		0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Naphthalene	mg/L	0.0011	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Acenaphthylene	mg/L	0.046	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Acenaphthene	mg/L	0.0058	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Fluorene	mg/L	0.003	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Phenanthrene	mg/L	0.0004	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Anthracene	mg/L	0.000012	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Fluoranthene	mg/L	0.00004	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Pyrene	mg/L	0.000025	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Benzo[a]anthracene	mg/L	0.000018	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Chrysene	mg/L	0.0014	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Benzo[b+j]fluoranthene	mg/L	0.00048	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Benzo[k]fluoranthene	mg/L	0.00048	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Benzo[a]pyrene	mg/L	0.000017	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Indeno[1,2,3-cd]pyrene	mg/L	0.00023	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Benzo[ghi]perylene	mg/L	0.00021	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Dibenzo[ah]anthracene	mg/L	0.00028	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Surrogate	**Unit**	**Acceptable Limits**									
2-Fluorobiphenyl (PAH)	%	50-150		62	61	66	69	111	122	118	118
p-Terphenyl-d14 (PAH)	%	50-150		68	67	78	83	94	104	108	102

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Polyaromatic Hydrocarbon Analysis - Water FWAL

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	018 MW04B 2210349	018 MW05B 2210472
Acridine	mg/L		0.00003	<0.00003	<0.00003
Quinoline	mg/L		0.0001	<0.0001	<0.0001
2-Methylnaphthalene	mg/L		0.00001	<0.00001	<0.00001
Naphthalene	mg/L	0.0011	0.00001	<0.00001	<0.00001
Acenaphthylene	mg/L	0.046	0.00001	<0.00001	<0.00001
Acenaphthene	mg/L	0.0058	0.00001	<0.00001	<0.00001
Fluorene	mg/L	0.003	0.00001	<0.00001	<0.00001
Phenanthrene	mg/L	0.0004	0.00001	<0.00001	<0.00001
Anthracene	mg/L	0.000012	0.00001	<0.00001	<0.00001
Fluoranthene	mg/L	0.00004	0.00001	<0.00001	<0.00001
Pyrene	mg/L	0.000025	0.00001	<0.00001	<0.00001
Benzo[a]anthracene	mg/L	0.000018	0.00001	<0.00001	<0.00001
Chrysene	mg/L	0.0014	0.00001	<0.00001	<0.00001
Benzo[b+j]fluoranthene	mg/L	0.00048	0.00001	<0.00001	<0.00001
Benzo[k]fluoranthene	mg/L	0.00048	0.00001	<0.00001	<0.00001
Benzo[a]pyrene	mg/L	0.000017	0.00001	<0.00001	<0.00001
Indeno[1,2,3-cd]pyrene	mg/L	0.00023	0.00001	<0.00001	<0.00001
Benzo[ghi]perylene	mg/L	0.00021	0.00001	<0.00001	<0.00001
Dibenzo[ah]anthracene	mg/L	0.00028	0.00001	<0.00001	<0.00001
Surrogate	**Unit**	**Acceptable Limits**			
2-Fluorobiphenyl (PAH)	%	50-150		100	121
p-Terphenyl-d14 (PAH)	%	50-150		95	110

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 GW (RP, F)

2207106-2210472 Based on GC/MS target ion analysis.
Isomers Benzo(b)fluoranthene and Benzo(j)fluoranthene have the same GC retention time and are reported as the sum based on the Benzo(b)fluoranthene response.

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-Dup1 2205959	2018-10BH-Dup2 2205960	2018-10BH-Dup3 2205961	2018-10BH-1M-2 2206941	2018-10BH-1M-6 2206951	2018-10BH-1M-7 2206954	2018-10BH-2M-2 2206957	2018-10BH-2M-7 2206962
Chloromethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vinyl Chloride	mg/kg	0.0083	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Bromomethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trichlorofluoromethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acetone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,1-Dichloroethylene	mg/kg	0.15	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene Chloride	mg/kg	0.10	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl tert-butyl ether	mg/kg	0.044	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl Ethyl Ketone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
trans- 1,2-dichloroethylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
cis- 1,2-Dichloroethylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroform	mg/kg	0.0029	0.001	<0.001	<0.001	<0.001	0.001	0.001	0.002	<0.001	<0.001
1,2-Dichloroethane	mg/kg	0.025	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,1-Trichloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	mg/kg	0.013	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Benzene	mg/kg	0.046	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trichloroethylene	mg/kg	0.054	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromodichloromethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
trans-1,3-Dichloropropene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl Isobutyl Ketone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
cis-1,3-Dichloropropene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2-Trichloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	mg/kg	0.52	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2-Hexanone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibromochloromethane	mg/kg	0.91	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylene Dibromide	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tetrachloroethene	mg/kg	0.69	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-Tetrachloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorobenzene	mg/kg	0.39	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-Dup1 2205959	2018-10BH-Dup2 2205960	2018-10BH-Dup3 2205961	2018-10BH-1M-2 2206941	2018-10BH-1M-6 2206951	2018-10BH-1M-7 2206954	2018-10BH-2M-2 2206957	2018-10BH-2M-7 2206962
Ethylbenzene	mg/kg	0.11	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
m & p-Xylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromoform	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Styrene	mg/kg	0.68	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2,2-Tetrachloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o-Xylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	mg/kg	0.051	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	mg/kg	0.097	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,4-Trichlorobenzene	mg/kg	0.78	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Xylenes	mg/kg	13	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8 (BTEX)	%	50-150		103	99	99	103	100	102	100	103

Certified By: Elena Gorobets

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-2M-8 2206992	2018-10BH-3M-1 2207012	2018-10BH-3M-7 2207024	2018-10BH-4M-1 2207027	2018-10BH-4M-8 2207038	2018-10BH-5M-1 2207041	2018-10BH-5M-7 2207051	2018-10BH-6M-1 2207058
Chloromethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vinyl Chloride	mg/kg	0.0083	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Bromomethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trichlorofluoromethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acetone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,1-Dichloroethylene	mg/kg	0.15	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene Chloride	mg/kg	0.10	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl tert-butyl ether	mg/kg	0.044	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl Ethyl Ketone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
trans- 1,2-dichloroethylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
cis- 1,2-Dichloroethylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroform	mg/kg	0.0029	0.001	<0.001	**0.009**	0.001	0.001	0.002	0.001	<0.001	0.001
1,2-Dichloroethane	mg/kg	0.025	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,1-Trichloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	mg/kg	0.013	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Benzene	mg/kg	0.046	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trichloroethylene	mg/kg	0.054	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromodichloromethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
trans-1,3-Dichloropropene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl Isobutyl Ketone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
cis-1,3-Dichloropropene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2-Trichloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	mg/kg	0.52	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2-Hexanone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibromochloromethane	mg/kg	0.91	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylene Dibromide	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tetrachloroethene	mg/kg	0.69	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-Tetrachloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorobenzene	mg/kg	0.39	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	mg/kg	0.11	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-2M-8 2206992	2018-10BH-3M-1 2207012	2018-10BH-3M-7 2207024	2018-10BH-4M-1 2207027	2018-10BH-4M-8 2207038	2018-10BH-5M-1 2207041	2018-10BH-5M-7 2207051	2018-10BH-6M-1 2207058
m & p-Xylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromoform	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Styrene	mg/kg	0.68	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2,2-Tetrachloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o-Xylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	mg/kg	0.051	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	mg/kg	0.097	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,4-Trichlorobenzene	mg/kg	0.78	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Xylenes	mg/kg	13	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8 (BTEX)	%	50-150		102	102	103	102	104	102	101	101

Certified By: Elena Gorobets

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-6M-8 2207079	2018-10BH-7M-1 2207080	2018-10BH-7M-7 2207096	2018-10SS-1 2207098	2018-10SS-2 2207101	2018-10SS-3 2207102	2018-10SS-4 2207103	2018-10SS-5 2207104
Chloromethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vinyl Chloride	mg/kg	0.0083	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Bromomethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trichlorofluoromethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acetone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,1-Dichloroethylene	mg/kg	0.15	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene Chloride	mg/kg	0.10	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl tert-butyl ether	mg/kg	0.044	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl Ethyl Ketone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
trans- 1,2-dichloroethylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
cis- 1,2-Dichloroethylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroform	mg/kg	0.0029	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	**0.004**	0.001
1,2-Dichloroethane	mg/kg	0.025	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1,1-Trichloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	mg/kg	0.013	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Benzene	mg/kg	0.046	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trichloroethylene	mg/kg	0.054	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromodichloromethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
trans-1,3-Dichloropropene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl Isobutyl Ketone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
cis-1,3-Dichloropropene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2-Trichloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	mg/kg	0.52	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
2-Hexanone	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibromochloromethane	mg/kg	0.91	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylene Dibromide	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tetrachloroethene	mg/kg	0.69	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-Tetrachloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorobenzene	mg/kg	0.39	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	mg/kg	0.11	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10BH-6M-8 2207079	2018-10BH-7M-1 2207080	2018-10BH-7M-7 2207096	2018-10SS-1 2207098	2018-10SS-2 2207101	2018-10SS-3 2207102	2018-10SS-4 2207103	2018-10SS-5 2207104
m & p-Xylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromoform	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Styrene	mg/kg	0.68	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2,2-Tetrachloroethane	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o-Xylene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	mg/kg	0.051	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	mg/kg	0.097	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,4-Trichlorobenzene	mg/kg	0.78	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Xylenes	mg/kg	13	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8 (BTEX)	%	50-150		101	103	104	103	103	103	105	102

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PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10SS-6 2207105
Chloromethane	mg/kg		0.01	<0.01
Vinyl Chloride	mg/kg	0.0083	0.0002	<0.0002
Bromomethane	mg/kg		0.01	<0.01
Chloroethane	mg/kg		0.01	<0.01
Trichlorofluoromethane	mg/kg		0.01	<0.01
Acetone	mg/kg		0.1	<0.1
1,1-Dichloroethylene	mg/kg	0.15	0.01	<0.01
Methylene Chloride	mg/kg	0.10	0.01	<0.01
Methyl tert-butyl ether	mg/kg	0.044	0.01	<0.01
Methyl Ethyl Ketone	mg/kg		0.1	<0.1
trans- 1,2-dichloroethylene	mg/kg		0.01	<0.01
1,1-Dichloroethane	mg/kg		0.01	<0.01
cis- 1,2-Dichloroethylene	mg/kg		0.01	<0.01
Chloroform	mg/kg	0.0029	0.001	**0.040**
1,2-Dichloroethane	mg/kg	0.025	0.002	<0.002
1,1,1-Trichloroethane	mg/kg		0.01	<0.01
Carbon Tetrachloride	mg/kg	0.013	0.0005	<0.0005
Benzene	mg/kg	0.046	0.005	<0.005
1,2-Dichloropropane	mg/kg		0.01	<0.01
Trichloroethylene	mg/kg	0.054	0.005	<0.01
Bromodichloromethane	mg/kg		0.01	<0.01
trans-1,3-Dichloropropene	mg/kg		0.01	<0.01
Methyl Isobutyl Ketone	mg/kg		0.1	<0.1
cis-1,3-Dichloropropene	mg/kg		0.01	<0.01
1,1,2-Trichloroethane	mg/kg		0.01	<0.01
Toluene	mg/kg	0.52	0.01	<0.01
2-Hexanone	mg/kg		0.1	<0.1
Dibromochloromethane	mg/kg	0.91	0.01	<0.01
Ethylene Dibromide	mg/kg		0.01	<0.01
Tetrachloroethene	mg/kg	0.69	0.01	<0.01
1,1,1,2-Tetrachloroethane	mg/kg		0.01	<0.01
Chlorobenzene	mg/kg	0.39	0.01	<0.01
Ethylbenzene	mg/kg	0.11	0.01	<0.01

Certified By: Elena Gorobets

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CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Soil

DATE SAMPLED: Dec 15, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	2018-10SS-6 2207105
m & p-Xylene	mg/kg		0.01	<0.01
Bromoform	mg/kg		0.01	<0.01
Styrene	mg/kg	0.68	0.01	<0.01
1,1,2,2-Tetrachloroethane	mg/kg		0.01	<0.01
o-Xylene	mg/kg		0.01	<0.01
1,3-Dichlorobenzene	mg/kg		0.01	<0.01
1,4-Dichlorobenzene	mg/kg	0.051	0.01	<0.01
1,2-Dichlorobenzene	mg/kg	0.097	0.01	<0.01
1,2,4-Trichlorobenzene	mg/kg	0.78	0.01	<0.01
Total Xylenes	mg/kg	13	0.01	<0.01
Surrogate	**Unit**	**Acceptable Limits**		
Toluene-d8 (BTEX)	%	50-150		103

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 Soil (RP, F)

2205959-2207105 Results were obtained based on the dry weight of the sample.

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Water

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-1 2207106	2018-10BH-2 2207116	2018-10BH-3 2207126	2018-10BH-DUP 1 2207128	2018-10BH-4M 2210312	2018-10BH-5M 2210337	2018-10BH-6M 2210342	2018-10BH-7M 2210345
Chloromethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vinyl Chloride	mg/L	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bromomethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloroethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Trichlorofluoromethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Acetone	mg/L		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethylene	mg/L	0.014	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Methylene Chloride	mg/L	0.05	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Methyl tert-butyl ether	mg/L	0.015	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Methyl Ethyl Ketone	mg/L		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
trans- 1,2-dichloroethylene	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-Dichloroethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
cis- 1,2-Dichloroethylene	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloroform	mg/L	0.0018	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-Dichloroethane	mg/L	0.005	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,1-Trichloroethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Carbon Tetrachloride	mg/L	0.005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Benzene	mg/L	0.005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,2-Dichloropropane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Trichloroethylene	mg/L	0.005	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bromodichloromethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
trans-1,3-Dichloropropene	mg/L		0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Methyl Isobutyl Ketone	mg/L		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
cis-1,3-Dichloropropene	mg/L		0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
1,1,2-Trichloroethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	mg/L	0.024	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
2-Hexanone	mg/L		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibromochloromethane	mg/L	0.1	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ethylene Dibromide	mg/L		0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Tetrachloroethene	mg/L	0.03	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,1,2-Tetrachloroethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chlorobenzene	mg/L	0.0013	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Water

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-1 2207106	2018-10BH-2 2207116	2018-10BH-3 2207126	2018-10BH-DUP 1 2207128	2018-10BH-4M 2210312	2018-10BH-5M 2210337	2018-10BH-6M 2210342	2018-10BH-7M 2210345
Ethylbenzene	mg/L	0.0024	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
m & p-Xylene	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bromoform	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Styrene	mg/L	0.072	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2,2-Tetrachloroethane	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
o-Xylene	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,3-Dichlorobenzene	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,4-Dichlorobenzene	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,2-Dichlorobenzene	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,2,4-Trichlorobenzene	mg/L	0.015	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Xylenes	mg/L	0.3	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8 (BTEX)	%	50-150		100	104	101	99	106	110	105	110

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PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Water

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	018 MW04B 2210349	018 MW05B 2210472
Chloromethane	mg/L		0.001	<0.001	<0.001
Vinyl Chloride	mg/L	0.002	0.001	<0.001	<0.001
Bromomethane	mg/L		0.001	<0.001	<0.001
Chloroethane	mg/L		0.001	<0.001	<0.001
Trichlorofluoromethane	mg/L		0.001	<0.001	<0.001
Acetone	mg/L		0.01	<0.01	<0.01
1,1-Dichloroethylene	mg/L	0.014	0.001	<0.001	<0.001
Methylene Chloride	mg/L	0.05	0.001	<0.001	<0.001
Methyl tert-butyl ether	mg/L	0.015	0.001	<0.001	<0.001
Methyl Ethyl Ketone	mg/L		0.01	<0.01	<0.01
trans- 1,2-dichloroethylene	mg/L		0.001	<0.001	<0.001
1,1-Dichloroethane	mg/L		0.001	<0.001	<0.001
cis- 1,2-Dichloroethylene	mg/L		0.001	<0.001	<0.001
Chloroform	mg/L	0.0018	0.001	<0.001	<0.001
1,2-Dichloroethane	mg/L	0.005	0.001	<0.001	<0.001
1,1,1-Trichloroethane	mg/L		0.001	<0.001	<0.001
Carbon Tetrachloride	mg/L	0.005	0.0005	<0.0005	<0.0005
Benzene	mg/L	0.005	0.0005	<0.0005	<0.0005
1,2-Dichloropropane	mg/L		0.001	<0.001	<0.001
Trichloroethylene	mg/L	0.005	0.001	<0.001	<0.001
Bromodichloromethane	mg/L		0.001	<0.001	<0.001
trans-1,3-Dichloropropene	mg/L		0.0003	<0.0003	<0.0003
Methyl Isobutyl Ketone	mg/L		0.01	<0.01	<0.01
cis-1,3-Dichloropropene	mg/L		0.0003	<0.0003	<0.0003
1,1,2-Trichloroethane	mg/L		0.001	<0.001	<0.001
Toluene	mg/L	0.024	0.0005	<0.0005	<0.0005
2-Hexanone	mg/L		0.01	<0.01	<0.01
Dibromochloromethane	mg/L	0.1	0.001	<0.001	<0.001
Ethylene Dibromide	mg/L		0.0003	<0.0003	<0.0003
Tetrachloroethene	mg/L	0.03	0.001	<0.001	<0.001
1,1,1,2-Tetrachloroethane	mg/L		0.001	<0.001	<0.001
Chlorobenzene	mg/L	0.0013	0.001	<0.001	<0.001
Ethylbenzene	mg/L	0.0024	0.0005	<0.0005	<0.0005

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Certificate of Analysis

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

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CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Volatile Organic Compounds in Water

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	018 MW04B 2210349	018 MW05B 2210472
m & p-Xylene	mg/L		0.0005	<0.0005	<0.0005
Bromoform	mg/L		0.001	<0.001	<0.001
Styrene	mg/L	0.072	0.001	<0.001	<0.001
1,1,2,2-Tetrachloroethane	mg/L		0.001	<0.001	<0.001
o-Xylene	mg/L		0.0005	<0.0005	<0.0005
1,3-Dichlorobenzene	mg/L		0.0005	<0.0005	<0.0005
1,4-Dichlorobenzene	mg/L		0.0005	<0.0005	<0.0005
1,2-Dichlorobenzene	mg/L		0.0005	<0.0005	<0.0005
1,2,4-Trichlorobenzene	mg/L	0.015	0.001	<0.001	<0.001
Total Xylenes	mg/L	0.3	0.001	<0.001	<0.001
Surrogate	**Unit**	**Acceptable Limits**			
Toluene-d8 (BTEX)	%	50-150		108	104

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 GW (RP, F)

2207106-2210472 Dilution factor =
The sample was diluted to keep the target compounds in the calibration range of the instrument and to avoid contaminating the purge and trap system. The method detection limit has been corrected for the dilution factor used.

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

CCME / Alberta Tier 1 Metals (Dissolved)

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-1 2207106_	RDL	2018-10BH-2 2207116	2018-10BH-3 2207126	2018-10BH-DUP 1 2207128	2018-10BH-4M 2210312	2018-10BH-5M 2210337
Dissolved Aluminum	mg/L	0.005	0.011	**0.338**	0.002	**0.064**	**0.030**	**0.106**	**0.007**	<0.002
Dissolved Antimony	mg/L	0.006	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Arsenic	mg/L	0.005	0.001	**0.010**	0.001	**0.007**	**0.008**	**0.007**	**0.007**	**0.014**
Dissolved Barium	mg/L	1	0.05	0.33	0.05	0.32	0.41	0.32	0.36	0.41
Dissolved Boron	mg/L	0.5	0.01	0.06	0.01	0.06	0.05	0.06	0.05	0.05
Dissolved Cadmium	mg/L	0.000017	0.000016	**0.000033**	0.000016	**0.000025**	**0.000020**	**0.000028**	<0.000016	<0.000016
Dissolved Chromium	mg/L		0.001	0.003	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Copper	mg/L	0.002	0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Dissolved Iron	mg/L	0.3	0.1	**8.0**	0.1	**6.2**	**6.8**	**6.0**	<0.1	**7.4**
Dissolved Lead	mg/L	0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Manganese	mg/L	0.05	0.005	**0.600**	0.005	**0.428**	**0.462**	**0.420**	**0.641**	**0.444**
Dissolved Molybdenum	mg/L		0.003	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Dissolved Nickel	mg/L	0.025	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dissolved Selenium	mg/L	0.001	0.001	0.001	0.001	**0.003**	**0.003**	**0.002**	<0.001	<0.001
Dissolved Silver	mg/L	0.0001	0.00005	<0.00005	0.00005	<0.00005	<0.00005	0.00009	<0.00005	<0.00005
Dissolved Sodium	mg/L	200	0.6	10.4	0.6	11.3	9.3	10.8	11.5	10.8
Dissolved Thallium	mg/L		0.0005	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Uranium	mg/L	0.01	0.001	0.002	0.001	0.002	0.002	0.002	0.003	0.001
Dissolved Zinc	mg/L	0.03	0.001	0.004	0.001	0.003	0.003	0.005	0.002	0.002

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

CCME / Alberta Tier 1 Metals (Dissolved)

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-6M 2210342	RDL	2018-10BH-7M 2210345	018 MW04B 2210349	018 MW05B 2210472
Dissolved Aluminum	mg/L	0.005	0.011	**0.534**	0.002	**0.032**	<0.002	<0.002
Dissolved Antimony	mg/L	0.006	0.001	<0.001	0.001	<0.001	<0.001	<0.001
Dissolved Arsenic	mg/L	0.005	0.001	**0.008**	0.001	**0.012**	**0.006**	**0.010**
Dissolved Barium	mg/L	1	0.05	0.21	0.05	0.38	0.32	0.38
Dissolved Boron	mg/L	0.5	0.01	0.08	0.01	0.05	0.03	0.04
Dissolved Cadmium	mg/L	0.000017	0.000016	**0.000085**	0.000016	<0.000016	<0.000016	<0.000016
Dissolved Chromium	mg/L		0.001	<0.001	0.001	<0.001	<0.001	<0.001
Dissolved Copper	mg/L	0.002	0.002	<0.002	0.002	<0.002	<0.002	<0.002
Dissolved Iron	mg/L	0.3	0.1	**51.0**	0.1	**8.0**	**2.9**	**6.3**
Dissolved Lead	mg/L	0.001	0.001	**0.002**	0.001	<0.001	<0.001	<0.001
Dissolved Manganese	mg/L	0.05	0.005	**0.737**	0.005	**0.334**	**0.384**	**0.398**
Dissolved Molybdenum	mg/L		0.003	<0.003	0.003	<0.003	<0.003	<0.003
Dissolved Nickel	mg/L	0.025	0.01	0.01	0.01	<0.01	<0.01	<0.01
Dissolved Selenium	mg/L	0.001	0.001	<0.001	0.001	<0.001	**0.003**	**0.002**
Dissolved Silver	mg/L	0.0001	0.00005	<0.00005	0.00005	<0.00005	<0.00005	<0.00005
Dissolved Sodium	mg/L	200	0.6	7.7	0.6	9.7	7.2	8.6
Dissolved Thallium	mg/L		0.0005	<0.0005	0.0005	<0.0005	<0.0005	<0.0005
Dissolved Uranium	mg/L	0.01	0.001	<0.001	0.001	0.001	0.004	0.001
Dissolved Zinc	mg/L	0.03	0.001	0.019	0.001	0.002	0.005	0.001

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 GW (Ag, F)

2207106_-2210472 < - Values refer to Report Detection Limit.

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Metals (Dissolved) - Be, Co, Sn, Ti, V

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-1 2207106_	2018-10BH-2 2207116	2018-10BH-3 2207126	2018-10BH-DUP 1 2207128	2018-10BH-4M 2210312	2018-10BH-5M 2210337	2018-10BH-6M 2210342	2018-10BH-7M 2210345
Dissolved Beryllium	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Cobalt	mg/L		0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.002	0.001
Dissolved Tin	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved Titanium	mg/L		0.001	0.027	0.009	0.003	0.013	0.002	0.001	0.012	0.002
Dissolved Vanadium	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001

Parameter	Unit	G / S	RDL	018 MW04B 2210349	018 MW05B 2210472
Dissolved Beryllium	mg/L		0.001	<0.001	<0.001
Dissolved Cobalt	mg/L		0.001	<0.001	<0.001
Dissolved Tin	mg/L		0.001	<0.001	<0.001
Dissolved Titanium	mg/L		0.001	<0.001	0.001
Dissolved Vanadium	mg/L		0.001	<0.001	<0.001

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 GW (Ag, F)

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Routine Chemistry Water Analysis

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-1 2207106_	2018-10BH-2 2207116	2018-10BH-3 2207126	2018-10BH-4M 2210312	2018-10BH-5M 2210337	2018-10BH-6M 2210342	2018-10BH-7M 2210345	018 MW04B 2210349
pH		6 - 8	NA	8.0	8.0	8.0	7.9	8.1	7.9	8.2	8.2
p - Alkalinity (as CaCO3)	mg/L		5	<5	<5	<5	<5	<5	<5	<5	<5
T - Alkalinity (as CaCO3)	mg/L		5	351	359	355	336	320	737	335	360
Bicarbonate	mg/L		5	428	439	433	409	391	899	409	439
Carbonate	mg/L		5	<5	<5	<5	<5	<5	<5	<5	<5
Hydroxide	mg/L		5	<5	<5	<5	<5	<5	<5	<5	<5
Electrical Conductivity	uS/cm	2	1	**755**	**761**	**786**	**769**	**768**	**1310**	**686**	**727**
Chloride	mg/L		1	6	6	9	6	7	4	6	5
Fluoride	mg/L	NA	0.05	0.20	0.19	0.18	0.25	0.18	0.07	0.19	0.20
Nitrate	mg/L		0.5	<0.5	1.1	1.6	1.7	<0.5	<0.5	<0.5	2.2
Sulfate	mg/L		1	88	79	90	96	111	76	49	53
Dissolved Calcium	mg/L		0.3	102	112	110	116	112	247	101	113
Dissolved Magnesium	mg/L		0.2	27.5	29.4	27.6	27.8	27.6	44.6	24.7	28.5
Dissolved Sodium	mg/L		0.6	10.4	11.3	9.3	11.5	10.8	7.7	9.7	7.2
Dissolved Potassium	mg/L		0.6	2.7	2.7	2.5	3.4	3.0	1.9	2.9	2.9
Dissolved Iron	mg/L		0.1	8.0	6.2	6.8	<0.1	7.4	51.0	8.0	2.9
Dissolved Manganese	mg/L		0.005	0.600	0.428	0.462	0.641	0.444	0.737	0.334	0.384
Calculated TDS	mg/L		1	447	457	463	464	464	823	394	428
Hardness	mg CaCO3/L		1	368	401	388	404	393	800	354	400
Ion Balance	%			91.3	97.9	92.1	98.1	97.8	111	99.9	100
Nitrate + Nitrite-N	mg/L		0.113	<0.113	0.248	0.361	0.384	<0.113	<0.113	<0.113	0.497
Nitrate-N	mg/L		0.113	<0.113	0.248	0.361	0.384	<0.113	<0.113	<0.113	0.497
Nitrite-N	mg/L		0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Routine Chemistry Water Analysis

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	018 MW05B 2210472
pH		6 - 8	NA	8.2
p - Alkalinity (as CaCO3)	mg/L		5	<5
T - Alkalinity (as CaCO3)	mg/L		5	334
Bicarbonate	mg/L		5	407
Carbonate	mg/L		5	<5
Hydroxide	mg/L		5	<5
Electrical Conductivity	uS/cm	2	1	**733**
Chloride	mg/L		1	5
Fluoride	mg/L	NA	0.05	0.22
Nitrate	mg/L		0.5	3.3
Sulfate	mg/L		1	78
Dissolved Calcium	mg/L		0.3	112
Dissolved Magnesium	mg/L		0.2	27.2
Dissolved Sodium	mg/L		0.6	8.6
Dissolved Potassium	mg/L		0.6	2.6
Dissolved Iron	mg/L		0.1	6.3
Dissolved Manganese	mg/L		0.005	0.398
Calculated TDS	mg/L		1	437
Hardness	mg CaCO3/L		1	392
Ion Balance	%			101
Nitrate + Nitrite-N	mg/L		0.113	0.745
Nitrate-N	mg/L		0.113	0.745
Nitrite-N	mg/L		0.015	<0.015

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

2207106_-2210472 < - Values refer to Report Detection Limits.

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Water Analysis - Dissolved Hg

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-3 2207126	2018-10BH-5M 2210337	2018-10BH-6M 2210342	2018-10BH-7M 2210345	018 MW04B 2210349	018 MW05B 2210472
Dissolved Mercury	mg/L	0.000026	0.000022	<0.000022	<0.000022	<0.000022	<0.000022	<0.000022	<0.000022

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ABTier1 GW (RP, F)

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

CLIENT NAME: FRANZ ENVIRONMENTAL

ATTENTION TO: MEAGAN GOURLEY

Water Analysis - TKN, TN

DATE SAMPLED: Dec 17, 2010 | **DATE RECEIVED: Dec 19, 2010** | **DATE REPORTED: Dec 31, 2010** | **SAMPLE TYPE: Water**

Parameter	Unit	G / S	RDL	2018-10BH-1 2207106	2018-10BH-2 2207116	2018-10BH-3 2207126	2018-10BH-4M 2210312	2018-10BH-5M 2210337	2018-10BH-6M 2210342	2018-10BH-7M 2210345	018 MW04B 2210349
Total Kjeldahl Nitrogen	mg/L		0.05	0.59	0.57	0.89	0.63	0.70	2.73	0.68	0.44
Total Nitrogen	mg/L			0.59	0.82	1.25	1.01	0.70	2.73	0.68	0.94

Parameter	Unit	G / S	RDL	018 MW05B 2210472
Total Kjeldahl Nitrogen	mg/L		0.05	0.63
Total Nitrogen	mg/L			1.38

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

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Quality Assurance

CLIENT NAME: FRANZ ENVIRONMENTAL

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Soil Analysis

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Soil Analysis - Salinity (AB Tier 1 - pH Calcium Chloride)															
pH (CaCl2 Extraction)	731	5960	7.3	7.3	0.0%	N/A	100%	90%	110%						
Electrical Conductivity (Sat. Paste)	2363	5960	0.30	0.31	3.3%	< 0.01	100%	90%	110%						
Saturation Percentage	2363	5960	54	50	7.7%	N/A	100%	90%	110%						
Chloride, Soluble	744	601	35	31	12.1%	< 2	98%	90%	110%	97%	90%	110%	99%	90%	110%
Calcium, Soluble	58	5960	40	43	6.7%	< 1	99%	90%	110%				100%	90%	110%
Potassium, Soluble	58	5960	2	2	4.5%	< 2	97%	90%	110%				98%	90%	110%
Magnesium, Soluble	58	5960	9	9	5.7%	< 1	102%	90%	110%				107%	90%	110%
Sodium, Soluble	58	5960	7	6	13.5%	< 2	98%	90%	110%				101%	90%	110%
Sulfur (as Sulfate), Soluble	58	5960	5	6	20.2%	< 2	98%	90%	110%				100%	90%	110%
Comments: N/A: Not applicable															
CCME / Alberta Tier 1 Metals + Hg + HWS B + Cr6 (soil)															
Antimony	1471	2205961	< 0.5	< 0.5	0.0%	< 0.5	93%	70%	130%				113%	75%	125%
Arsenic	1471	2205961	55.9	47.7	15.8%	< 0.5	92%	90%	110%				83%	75%	125%
Barium	1471	2205961	63.5	55.7	13.1%	< 0.5	96%	90%	110%				104%	75%	125%
Beryllium	1471	2205961	< 0.5	< 0.5	0.0%	< 0.5	101%	90%	110%				104%	75%	125%
Boron (Hot water extraction)	1369	5961	<0.5	<0.5	0.0%	< 0.5	95%	90%	110%				106%	75%	125%
Cadmium	1471	2205961	< 0.5	< 0.5	0.0%	< 0.5	96%	90%	110%				108%	75%	125%
Chromium	1471	2205961	4.84	5.66	15.6%	< 0.5	99%	90%	110%				108%	75%	125%
Chromium, Hexavalent	6321	5959	<0.3	<0.3	0.0%	< 0.3	96%	90%	110%	100%	90%	110%	99%	75%	125%
Cobalt	1471	2205961	2.8	2.5	11.3%	< 0.5	96%	90%	110%				104%	75%	125%
Copper	1471	2205961	5.6	4.6	19.6%	< 0.5	98%	90%	110%				104%	75%	125%
Lead	1471	2205961	2.6	2.1	21.3%	< 0.5	93%	90%	110%				102%	75%	125%
Mercury	1471	2205961	< 0.5	< 0.5	0.0%	< 0.5	101%	90%	110%		90%	110%	114%	75%	125%
Molybdenum	1471	2205961	0.6	0.5	18.2%	< 0.5	97%	90%	110%				97%	75%	125%
Nickel	1471	2205961	7.8	6.9	12.2%	< 0.5	100%	90%	110%				105%	75%	125%
Selenium	1471	2205961	< 0.5	< 0.5	0.0%	< 0.5	98%	90%	110%				110%	75%	125%
Silver	1471	2205961	< 0.5	< 0.5	0.0%	< 0.5	92%	90%	110%				106%	75%	125%
Thallium	1471	2205961	< 0.5	< 0.5	0.0%	< 0.5	99%	90%	110%				106%	75%	125%
Tin	1471	2205961	76.4	86.5	12.4%	< 0.5	104%	90%	110%				112%	75%	125%
Uranium	1471	2205961	< 0.5	< 0.5	0.0%	< 0.5	100%	90%	110%				108%	75%	125%
Vanadium	1471	2205961	10.1	9.1	10.4%	< 0.5	86%	80%	120%				106%	75%	125%
Zinc	1471	2205961	133	125	6.2%	< 1	111%	80%	120%				112%	75%	125%
Particle Size by Sieve															
Sieve Analysis - 75 microns (wet)	1315	7938	41.6	42.3	1.7%	N/A	100%	90%	110%						
Particle Size by Sieve															
Sieve Analysis - 75 microns (wet)	1348	7098	20.9	21.7	3.8%	N/A	100%	90%	110%						

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Quality Assurance

CLIENT NAME: FRANZ ENVIRONMENTAL

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Soil Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Certified By:

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Quality Assurance

CLIENT NAME: FRANZ ENVIRONMENTAL

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Trace Organics Analysis

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS)															
Benzene	2601	2205959	<0.005	<0.005	0.0%	< 0.005	95%	80%	120%	92%	80%	120%	123%	60%	140%
Toluene	2601	2205959	<0.05	<0.05	0.0%	< 0.05	94%	80%	120%	95%	80%	120%	124%	60%	140%
Ethylbenzene	2601	2205959	<0.01	<0.01	0.0%	< 0.01	101%	80%	120%	101%	80%	120%	135%	60%	140%
Xylenes	2601	2205959	<0.05	<0.05	0.0%	< 0.05	108%	80%	120%	109%	80%	120%	129%	60%	140%
C6 - C10 (F1)	2601	2205959	<10	<10	0.0%	< 10	93%	80%	120%	103%	80%	120%	104%	60%	140%
C10 - C16 (F2)	722	2205959	<10	<10	NA	< 10	104%	80%	120%	96%	80%	120%	96%	60%	140%
C16 - C34 (F3)	722	2205959	<10	<10	NA	< 10	104%	80%	120%	99%	80%	120%	100%	60%	140%
C34 - C50 (F4)	722	2205959	<10	<10	NA	< 10	104%	80%	120%	92%	80%	120%	96%	60%	140%
Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS)															
C10 - C16 (F2)	722	2207101	11	<10	0.0%	< 10	97%	80%	120%	96%	80%	120%	92%	60%	140%
C16 - C34 (F3)	722	2207101	18	22	20.0%	< 10	97%	80%	120%	96%	80%	120%	95%	60%	140%
C34 - C50 (F4)	722	2207101	<10	12	0.0%	< 10	97%	80%	120%	96%	80%	120%	94%	60%	140%
Petroleum Hydrocarbons (BTEX/F1-F4) in Water															
Benzene	3136	2207233	<0.0005	<0.0005	0.0%	< 0.0005	110%	80%	120%	110%	80%	120%	125%	70%	130%
Toluene	3136	2207233	<0.0005	<0.0005	0.0%	< 0.0005	111%	80%	120%	111%	80%	120%	124%	70%	130%
Ethylbenzene	3136	2207233	<0.0005	<0.0005	0.0%	< 0.0005	110%	80%	120%	108%	80%	120%	120%	70%	130%
Xylenes	3136	2207233	<0.0005	<0.0005	0.0%	< 0.0005	103%	80%	120%	108%	80%	120%	125%	70%	130%
C6 - C10 (F1)	3136	2207233	<0.1	<0.1	0.0%	< 0.1	105%	80%	120%	120%	80%	120%	120%	70%	130%
C>10 - C16	224	2207234	<0.1	<0.1	0.0%	< 0.1	106%	80%	120%	97%	80%	120%	102%	70%	130%
C16 - C34	224	2207234	0.1	0.2	67.0%	< 0.1	106%	80%	120%	98%	80%	120%	101%	70%	120%
C>34 - C50	224	2207234	<0.1	<0.1	0.0%	< 0.1	106%	80%	120%	98%	80%	120%	101%	70%	130%
Volatile Organic Compounds in Water															
Chloromethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	81%	60%	140%	80%	60%	140%	72%	60%	140%
Vinyl Chloride	3136	2205086	<0.001	<0.001	0.0%	< 0.001	74%	60%	140%	79%	60%	140%	73%	60%	140%
Bromomethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	66%	60%	140%	90%	60%	140%	81%	60%	140%
Chloroethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	89%	60%	140%	93%	60%	140%	82%	60%	140%
Trichlorofluoromethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	93%	60%	140%	93%	60%	140%	82%	60%	140%
Acetone	3136	2205086	<0.01	0.01	0.0%	< 0.01	105%	60%	140%	105%	60%	140%	83%	60%	140%
1,1-Dichloroethylene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	96%	60%	140%	94%	60%	140%	81%	60%	140%
Methylene Chloride	3136	2205086	<0.001	<0.001	0.0%	< 0.001	91%	60%	140%	98%	60%	140%	78%	60%	140%
Methyl tert-butyl ether	3136	2205086	<0.001	<0.001	0.0%	< 0.001	99%	60%	140%	99%	60%	140%	95%	60%	140%
Methyl Ethyl Ketone	3136	2205086	<0.01	<0.01	0.0%	< 0.01	114%	60%	140%	114%	60%	140%	72%	60%	140%
trans- 1,2-dichloroethylene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	103%	60%	140%	96%	60%	140%	84%	60%	140%
1,1-Dichloroethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	100%	60%	140%	97%	60%	140%	87%	60%	140%
cis- 1,2-Dichloroethylene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	110%	60%	140%	100%	60%	140%	94%	60%	140%
Chloroform	3136	2205086	0.043	0.042	2.0%	< 0.001	98%	60%	140%	95%	60%	140%	91%	60%	140%
1,2-Dichloroethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	105%	60%	140%	102%	60%	140%	101%	60%	140%
1,1,1-Trichloroethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	98%	60%	140%	99%	60%	140%	87%	60%	140%

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Trace Organics Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Carbon Tetrachloride	3136	2205086	<0.0005	<0.0005	0.0%	< 0.0005	94%	60%	140%	96%	60%	140%	87%	60%	140%
Benzene	3136	2205086	<0.0005	<0.0005	0.0%	< 0.0005	100%	60%	140%	102%	60%	140%	104%	60%	140%
1,2-Dichloropropane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	104%	60%	140%	99%	60%	140%	107%	60%	140%
Trichloroethylene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	113%	60%	140%	116%	60%	140%	69%	60%	140%
Bromodichloromethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	98%	60%	140%	99%	60%	140%	116%	60%	140%
trans-1,3-Dichloropropene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	103%	60%	140%	99%	60%	140%	107%	60%	140%
Methyl Isobutyl Ketone	3136	2205086	<0.01	<0.01	0.0%	< 0.01	109%	60%	140%	109%	60%	140%	99%	60%	140%
cis-1,3-Dichloropropene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	102%	60%	140%	95%	60%	140%	105%	60%	140%
1,1,2-Trichloroethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	97%	60%	140%	95%	60%	140%	108%	60%	140%
Toluene	3136	2205086	<0.0005	<0.0005	0.0%	< 0.0005	103%	60%	140%	102%	60%	140%	101%	60%	140%
2-Hexanone	3136	2205086	<0.01	<0.01	0.0%	< 0.01	110%	60%	140%	110%	60%	140%	108%	60%	140%
Dibromochloromethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	89%	60%	140%	90%	60%	140%	113%	60%	140%
Ethylene Dibromide	3136	2205086	<0.001	<0.001	0.0%	< 0.001	100%	60%	140%	99%	60%	140%	109%	60%	140%
Tetrachloroethene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	99%	60%	140%	101%	60%	140%	100%	60%	140%
1,1,1,2-Tetrachloroethane	3136	2205086	<0.001	<0.001	0.0%	< 0.001	91%	60%	140%	91%	60%	140%	101%	60%	140%
Chlorobenzene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	101%	60%	140%	104%	60%	140%	110%	60%	140%
Ethylbenzene	3136	2205086	<0.0005	<0.0005	0.0%	< 0.0005	102%	60%	140%	101%	60%	140%	102%	60%	140%
m & p-Xylene	3136	2205086	<0.0005	<0.0005	0.0%	< 0.0005	99%	60%	140%	102%	60%	140%	101%	60%	140%
Bromoform	3136	2205086	<0.001	<0.001	0.0%	< 0.001	78%	60%	140%	78%	60%	140%	106%	60%	140%
Styrene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	107%	60%	140%	120%	60%	140%	105%	60%	140%
o-Xylene	3136	2205086	<0.0005	<0.0005	0.0%	< 0.0005	100%	60%	140%	103%	60%	140%	108%	60%	140%
1,3-Dichlorobenzene	3136	2205086	<0.0005	<0.0005	0.0%	< 0.0005	98%	60%	140%	95%	60%	140%	101%	60%	140%
1,4-Dichlorobenzene	3136	2205086	<0.0005	<0.0005	0.0%	< 0.0005	91%	60%	140%	95%	60%	140%	105%	60%	140%
1,2-Dichlorobenzene	3136	2205086	<0.0005	<0.0005	0.0%	< 0.0005	94%	60%	140%	98%	60%	140%	105%	60%	140%
1,2,4-Trichlorobenzene	3136	2205086	<0.001	<0.001	0.0%	< 0.001	96%	60%	140%	90%	60%	140%	102%	60%	140%
Glycols Analysis in Water															
Propylene Glycol	162	2207116	<10	<10	0.0%	< 10	98%	80%	120%	100%	70%	130%	96%	60%	140%
Monoethylene Glycol	162	2207116	<10	<10	0.0%	< 10	95%	80%	120%	98%	70%	130%	92%	50%	150%
Diethylene Glycol	162	2207116	<10	<10	0.0%	< 10	96%	80%	120%	95%	70%	130%	92%	50%	150%
Triethylene Glycol	162	2207116	<10	<10	0.0%	< 10	106%	80%	120%	109%	70%	130%	101%	50%	150%
Tetraethylene Glycol	162	2207116	<10	<10	0.0%	< 10	98%	80%	120%	101%	70%	130%	88%	50%	150%
Heptanol	162	2207116	<10	<10	0.0%	<		0%	0%		0%	0%		0%	0%
Volatile Organic Compounds in Soil															
Chloromethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	95%	60%	140%	97%	60%	140%			
Vinyl Chloride	2607	2205959	< 0.0002	< 0.0002	NA	< 0.0002	87%	60%	140%	98%	60%	140%			
Bromomethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	96%	60%	140%	95%	60%	140%			
Chloroethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	87%	60%	140%	102%	60%	140%			
Trichlorofluoromethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	93%	60%	140%	95%	60%	140%			

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Quality Assurance

CLIENT NAME: FRANZ ENVIRONMENTAL

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Trace Organics Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Acetone	2607	2205959	< 0.1	< 0.1	NA	< 0.1	112%	60%	140%	62%	60%	140%			
1,1-Dichloroethylene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	92%	60%	140%	100%	60%	140%			
Methylene Chloride	2607	2205959	< 0.01	< 0.01	NA	< 0.01	106%	60%	140%	114%	60%	140%			
Methyl tert-butyl ether	2607	2205959	< 0.01	< 0.01	NA	< 0.01	96%	60%	140%	96%	60%	140%			
Methyl Ethyl Ketone	2607	2205959	< 0.1	< 0.1	NA	< 0.1	107%	60%	140%	66%	60%	140%			
trans- 1,2-dichloroethylene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	97%	60%	140%	99%	60%	140%			
1,1-Dichloroethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	94%	60%	140%	95%	60%	140%			
cis- 1,2-Dichloroethylene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	109%	60%	140%	99%	60%	140%			
Chloroform	2607	2205959	< 0.001	< 0.001	NA	< 0.001	94%	60%	140%	105%	60%	140%			
1,2-Dichloroethane	2607	2205959	< 0.002	< 0.002	NA	< 0.002	93%	60%	140%	94%	60%	140%			
1,1,1-Trichloroethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	96%	60%	140%	95%	60%	140%			
Carbon Tetrachloride	2607	2205959	< 0.0005	< 0.0005	NA	< 0.0005	93%	60%	140%	96%	60%	140%			
Benzene	2607	2205959	< 0.005	< 0.005	NA	< 0.005	88%	60%	140%	91%	60%	140%			
1,2-Dichloropropane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	87%	60%	140%	90%	60%	140%			
Trichloroethylene	2607	2205959	< 0.005	< 0.005	NA	< 0.005	87%	60%	140%	89%	60%	140%			
Bromodichloromethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	90%	60%	140%	83%	60%	140%			
trans-1,3-Dichloropropene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	88%	60%	140%	82%	60%	140%			
Methyl Isobutyl Ketone	2607	2205959	< 0.1	< 0.1	NA	< 0.1	85%	60%	140%	85%	60%	140%			
cis-1,3-Dichloropropene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	88%	60%	140%	82%	60%	140%			
1,1,2-Trichloroethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	93%	60%	140%	94%	60%	140%			
Toluene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	87%	60%	140%	90%	60%	140%			
2-Hexanone	2607	2205959	< 0.1	< 0.1	NA	< 0.1	64%	60%	140%	64%	60%	140%			
Dibromochloromethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	90%	60%	140%	85%	60%	140%			
Ethylene Dibromide	2607	2205959	< 0.01	< 0.01	NA	< 0.01	89%	60%	140%	88%	60%	140%			
Tetrachloroethene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	88%	60%	140%	89%	60%	140%			
1,1,1,2-Tetrachloroethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	106%	60%	140%	105%	60%	140%			
Chlorobenzene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	89%	60%	140%	93%	60%	140%			
Ethylbenzene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	88%	60%	140%	89%	60%	140%			
m & p-Xylene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	88%	60%	140%	89%	60%	140%			
Bromoform	2607	2205959	< 0.01	< 0.01	NA	< 0.01	92%	60%	140%	85%	60%	140%			
Styrene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	90%	60%	140%	89%	60%	140%			
1,1,2,2-Tetrachloroethane	2607	2205959	< 0.01	< 0.01	NA	< 0.01	91%	60%	140%	87%	60%	140%			
o-Xylene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	88%	60%	140%	87%	60%	140%			
1,3-Dichlorobenzene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	95%	60%	140%	93%	60%	140%			
1,4-Dichlorobenzene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	93%	70%	130%	90%	90%	110%			
1,2-Dichlorobenzene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	90%	70%	130%	89%	80%	120%			
1,2,4-Trichlorobenzene	2607	2205959	< 0.01	< 0.01	NA	< 0.01	129%	60%	140%	87%	60%	140%			
Total Xylenes	2607	2205959	< 0.01	< 0.01	NA	< 0.01	88%	60%	140%	88%	60%	140%			
Toluene-d8 (BTEX)	2607	2205959	< 1	< 1	NA	< 1	97%	50%	150%	101%	50%	150%			

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Trace Organics Analysis (Continued)

RPT Date: Dec 31, 2010

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Volatile Organic Compounds in Soil															
Chloromethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	95%	60%	140%	97%	60%	140%	98%	60%	140%
Vinyl Chloride	2607	2205959	<0.0002	<0.0002	0.0%	< 0.0002	87%	60%	140%	98%	60%	140%	92%	60%	140%
Bromomethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	96%	60%	140%	95%	60%	140%	81%	60%	140%
Chloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	87%	60%	140%	102%	60%	140%	93%	60%	140%
Trichlorofluoromethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	93%	60%	140%	95%	60%	140%	95%	60%	140%
Acetone	2607	2205959	<0.1	<0.1	0.0%	< 0.1	112%	60%	140%	62%	60%	140%	113%	60%	140%
1,1-Dichloroethylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	92%	60%	140%	100%	60%	140%	96%	60%	140%
Methylene Chloride	2607	2205959	<0.01	<0.01	0.0%	< 0.01	106%	60%	140%	114%	60%	140%	108%	60%	140%
Methyl tert-butyl ether	2607	2205959	<0.01	<0.01	0.0%	< 0.01	96%	60%	140%	96%	60%	140%	96%	60%	140%
Methyl Ethyl Ketone	2607	2205959	<0.1	<0.1	0.0%	< 0.1	107%	60%	140%	66%	60%	140%	106%	60%	140%
trans- 1,2-dichloroethylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	97%	60%	140%	99%	60%	140%	100%	60%	140%
1,1-Dichloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	94%	60%	140%	95%	60%	140%	100%	60%	140%
cis- 1,2-Dichloroethylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	109%	60%	140%	99%	60%	140%	113%	60%	140%
Chloroform	2607	2205959	<0.001	<0.001	0.0%	< 0.001	94%	60%	140%	105%	60%	140%	100%	60%	140%
1,2-Dichloroethane	2607	2205959	<0.002	<0.002	0.0%	< 0.002	93%	60%	140%	94%	60%	140%	95%	60%	140%
1,1,1-Trichloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	96%	60%	140%	95%	60%	140%	99%	60%	140%
Carbon Tetrachloride	2607	2205959	<0.0005	<0.0005	0.0%	< 0.0005	93%	60%	140%	96%	60%	140%	95%	60%	140%
Benzene	2607	2205959	<0.005	<0.005	0.0%	< 0.005	88%	60%	140%	91%	60%	140%	96%	60%	140%
1,2-Dichloropropane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	87%	60%	140%	90%	60%	140%	93%	60%	140%
Trichloroethylene	2607	2205959	<0.01	<0.01	0.0%	< 0.005	87%	60%	140%	89%	60%	140%	95%	60%	140%
Bromodichloromethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	90%	60%	140%	83%	60%	140%	90%	60%	140%
trans-1,3-Dichloropropene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	82%	60%	140%	88%	60%	140%
Methyl Isobutyl Ketone	2607	2205959	<0.1	<0.1	0.0%	< 0.1	85%	60%	140%	85%	60%	140%	84%	60%	140%
cis-1,3-Dichloropropene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	82%	60%	140%	88%	60%	140%
1,1,2-Trichloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	93%	60%	140%	94%	60%	140%	100%	60%	140%
Toluene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	87%	60%	140%	90%	60%	140%	95%	60%	140%
2-Hexanone	2607	2205959	<0.1	<0.1	0.0%	< 0.1	64%	60%	140%	64%	60%	140%	64%	60%	140%
Dibromochloromethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	90%	60%	140%	85%	60%	140%	92%	60%	140%
Ethylene Dibromide	2607	2205959	<0.01	<0.01	0.0%	< 0.01	89%	60%	140%	88%	60%	140%	95%	60%	140%
Tetrachloroethene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	89%	60%	140%	92%	60%	140%
1,1,1,2-Tetrachloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	106%	60%	140%	105%	60%	140%	111%	60%	140%
Chlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	89%	60%	140%	93%	60%	140%	97%	60%	140%
Ethylbenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	89%	60%	140%	94%	60%	140%
m & p-Xylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	89%	60%	140%	93%	60%	140%
Bromoform	2607	2205959	<0.01	<0.01	0.0%	< 0.01	92%	60%	140%	85%	60%	140%	89%	60%	140%
Styrene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	90%	60%	140%	89%	60%	140%	96%	60%	140%
1,1,2,2-Tetrachloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	91%	60%	140%	87%	60%	140%	94%	60%	140%
o-Xylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	87%	60%	140%	93%	60%	140%
1,3-Dichlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	95%	60%	140%	93%	60%	140%	97%	60%	140%

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Quality Assurance

CLIENT NAME: FRANZ ENVIRONMENTAL

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Trace Organics Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
1,4-Dichlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	93%	70%	130%	90%	0%	0%	95%	0%	0%
1,2-Dichlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	90%	70%	130%	89%	0%	0%	93%	0%	0%
1,2,4-Trichlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	129%	60%	140%	87%	60%	140%	95%	60%	140%
Volatile Organic Compounds in Soil															
Chloromethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	95%	60%	140%	97%	60%	140%	98%	60%	140%
Vinyl Chloride	2607	2205959	<0.0002	<0.0002	0.0%	< 0.0002	87%	60%	140%	98%	60%	140%	92%	60%	140%
Bromomethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	96%	60%	140%	95%	60%	140%	81%	60%	140%
Chloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	87%	60%	140%	102%	60%	140%	93%	60%	140%
Trichlorofluoromethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	93%	60%	140%	95%	60%	140%	95%	60%	140%
Acetone	2607	2205959	<0.1	<0.1	0.0%	< 0.1	112%	60%	140%	62%	60%	140%	113%	60%	140%
1,1-Dichloroethylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	92%	60%	140%	100%	60%	140%	96%	60%	140%
Methylene Chloride	2607	2205959	<0.01	<0.01	0.0%	< 0.01	106%	60%	140%	114%	60%	140%	108%	60%	140%
Methyl tert-butyl ether	2607	2205959	<0.01	<0.01	0.0%	< 0.01	96%	60%	140%	96%	60%	140%	96%	60%	140%
Methyl Ethyl Ketone	2607	2205959	<0.1	<0.1	0.0%	< 0.1	107%	60%	140%	66%	60%	140%	106%	60%	140%
trans- 1,2-dichloroethylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	97%	60%	140%	99%	60%	140%	100%	60%	140%
1,1-Dichloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	94%	60%	140%	95%	60%	140%	100%	60%	140%
cis- 1,2-Dichloroethylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	109%	60%	140%	99%	60%	140%	113%	60%	140%
Chloroform	2607	2205959	<0.001	<0.001	0.0%	< 0.001	94%	60%	140%	105%	60%	140%	100%	60%	140%
1,2-Dichloroethane	2607	2205959	<0.002	<0.002	0.0%	< 0.002	93%	60%	140%	94%	60%	140%	95%	60%	140%
1,1,1-Trichloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	96%	60%	140%	95%	60%	140%	99%	60%	140%
Carbon Tetrachloride	2607	2205959	<0.0005	<0.0005	0.0%	< 0.0005	93%	60%	140%	96%	60%	140%	95%	60%	140%
Benzene	2607	2205959	<0.005	<0.005	0.0%	< 0.005	88%	60%	140%	91%	60%	140%	96%	60%	140%
1,2-Dichloropropane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	87%	60%	140%	90%	60%	140%	93%	60%	140%
Trichloroethylene	2607	2205959	<0.01	<0.01	0.0%	< 0.005	87%	60%	140%	89%	60%	140%	95%	60%	140%
Bromodichloromethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	90%	60%	140%	83%	60%	140%	90%	60%	140%
trans-1,3-Dichloropropene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	82%	60%	140%	88%	60%	140%
Methyl Isobutyl Ketone	2607	2205959	<0.1	<0.1	0.0%	< 0.1	85%	60%	140%	85%	60%	140%	84%	60%	140%
cis-1,3-Dichloropropene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	82%	60%	140%	88%	60%	140%
1,1,2-Trichloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	93%	60%	140%	94%	60%	140%	100%	60%	140%
Toluene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	87%	60%	140%	90%	60%	140%	95%	60%	140%
2-Hexanone	2607	2205959	<0.1	<0.1	0.0%	< 0.1	64%	60%	140%	64%	60%	140%	64%	60%	140%
Dibromochloromethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	90%	60%	140%	85%	60%	140%	92%	60%	140%
Ethylene Dibromide	2607	2205959	<0.01	<0.01	0.0%	< 0.01	89%	60%	140%	88%	60%	140%	95%	60%	140%
Tetrachloroethene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	89%	60%	140%	92%	60%	140%
1,1,1,2-Tetrachloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	106%	60%	140%	105%	60%	140%	111%	60%	140%
Chlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	89%	60%	140%	93%	60%	140%	97%	60%	140%
Ethylbenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	89%	60%	140%	94%	60%	140%
m & p-Xylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	89%	60%	140%	93%	60%	140%

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Quality Assurance

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Trace Organics Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Bromoform	2607	2205959	<0.01	<0.01	0.0%	< 0.01	92%	60%	140%	85%	60%	140%	89%	60%	140%
Styrene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	90%	60%	140%	89%	60%	140%	96%	60%	140%
1,1,2,2-Tetrachloroethane	2607	2205959	<0.01	<0.01	0.0%	< 0.01	91%	60%	140%	87%	60%	140%	94%	60%	140%
o-Xylene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	88%	60%	140%	87%	60%	140%	93%	60%	140%
1,3-Dichlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	95%	60%	140%	93%	60%	140%	97%	60%	140%
1,4-Dichlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	93%	70%	130%	90%	0%	0%	95%	0%	0%
1,2-Dichlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	90%	70%	130%	89%	0%	0%	93%	0%	0%
1,2,4-Trichlorobenzene	2607	2205959	<0.01	<0.01	0.0%	< 0.01	129%	60%	140%	87%	60%	140%	95%	60%	140%
Polyaromatic Hydrocarbon Analysis - Soil															
Naphthalene	240	2205959	<0.005	<0.005	0.0%	< 0.005	114%	70%	130%	95%	70%	130%	93%	70%	130%
2-Methylnaphthalene	240	2205959	<0.005	<0.005	0.0%	< 0.005	111%	70%	130%	97%	70%	130%	96%	70%	130%
Acenaphthylene	240	2205959	<0.005	<0.005	0.0%	< 0.005	105%	70%	130%	83%	70%	130%	83%	70%	130%
Acenaphthene	240	2205959	<0.005	<0.005	0.0%	< 0.005	109%	70%	130%	94%	70%	130%	94%	70%	130%
Fluorene	240	2205959	<0.02	<0.02	0.0%	< 0.02	101%	70%	130%	87%	70%	130%	87%	70%	130%
Phenanthrene	240	2205959	<0.02	<0.02	0.0%	< 0.02	110%	70%	130%	94%	70%	130%	93%	70%	130%
Anthracene	240	2205959	<0.004	<0.004	0.0%	< 0.004	127%	70%	130%	89%	70%	130%	89%	70%	130%
Fluoranthene	240	2205959	<0.03	<0.03	0.0%	< 0.03	112%	70%	130%	102%	70%	130%	102%	70%	130%
Pyrene	240	2205959	<0.03	<0.03	0.0%	< 0.03	129%	70%	130%	111%	70%	130%	111%	70%	130%
Benzo(a)anthracene	240	2205959	<0.03	<0.03	0.0%	< 0.03	91%	70%	130%	100%	70%	130%	72%	70%	130%
Chrysene	240	2205959	<0.05	<0.05	0.0%	< 0.05	104%	70%	130%	100%	70%	130%	72%	70%	130%
Benzo(b+j)fluoranthene	240	2205959	<0.05	<0.05	0.0%	< 0.05	113%	70%	130%	103%	70%	130%	71%	70%	130%
Benzo(k)fluoranthene	240	2205959	<0.05	<0.05	0.0%	< 0.05	123%	70%	130%	109%	70%	130%	73%	70%	130%
Benzo(a)pyrene	240	2205959	<0.03	<0.03	0.0%	< 0.03	105%	70%	130%	93%	70%	130%	74%	70%	130%
Indeno(1,2,3-cd)pyrene	240	2205959	<0.05	<0.05	0.0%	< 0.05	129%	70%	130%	94%	70%	130%	74%	70%	130%
Dibenzo(ah)anthracene	240	2205959	<0.005	<0.005	0.0%	< 0.005	125%	70%	130%	93%	70%	130%	77%	70%	130%
Benzo(ghi)perylene	240	2205959	<0.05	<0.05	0.0%	< 0.05	124%	70%	130%	85%	70%	130%	98%	70%	130%
Polyaromatic Hydrocarbon Analysis - Soil															
Naphthalene	240	2207101	<0.005	<0.005	0.0%	< 0.005	114%	70%	130%	94%	70%	130%	88%	70%	130%
2-Methylnaphthalene	240	2207101	<0.005	<0.005	0.0%	< 0.005	111%	70%	130%	94%	70%	130%	94%	70%	130%
Acenaphthylene	240	2207101	<0.005	<0.005	0.0%	< 0.005	105%	70%	130%	91%	70%	130%	88%	70%	130%
Acenaphthene	240	2207101	<0.005	<0.005	0.0%	< 0.005	109%	70%	130%	95%	70%	130%	86%	70%	130%
Fluorene	240	2207101	<0.02	<0.02	0.0%	< 0.02	101%	70%	130%	93%	70%	130%	85%	70%	130%
Phenanthrene	240	2207101	<0.02	<0.02	0.0%	< 0.02	110%	70%	130%	95%	70%	130%	87%	70%	130%
Anthracene	240	2207101	<0.004	<0.004	0.0%	< 0.004	127%	70%	130%	87%	70%	130%	85%	70%	130%
Fluoranthene	240	2207101	<0.03	<0.03	0.0%	< 0.03	112%	70%	130%	99%	70%	130%	92%	70%	130%
Pyrene	240	2207101	<0.03	<0.03	0.0%	< 0.03	129%	70%	130%	96%	70%	130%	78%	70%	130%
Benzo(a)anthracene	240	2207101	<0.03	<0.03	0.0%	< 0.03	91%	70%	130%	91%	70%	130%	95%	70%	130%
Chrysene	240	2207101	<0.05	<0.05	0.0%	< 0.05	104%	70%	130%	78%	70%	130%	83%	70%	130%

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Quality Assurance

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Trace Organics Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Benzo(b+j)fluoranthene	240	2207101	<0.05	<0.05	0.0%	< 0.05	113%	70%	130%	104%	70%	130%	91%	70%	130%
Benzo(k)fluoranthene	240	2207101	<0.05	<0.05	0.0%	< 0.05	123%	70%	130%	102%	70%	130%	81%	70%	130%
Benzo(a)pyrene	240	2207101	<0.03	<0.03	0.0%	< 0.03	105%	70%	130%	85%	70%	130%	97%	70%	130%
Indeno(1,2,3-cd)pyrene	240	2207101	<0.05	<0.05	0.0%	< 0.05	129%	70%	130%	121%	70%	130%	113%	70%	130%
Dibenzo(ah)anthracene	240	2207101	<0.005	<0.005	0.0%	< 0.005	125%	70%	130%	117%	70%	130%	115%	70%	130%
Benzo(ghi)perylene	240	2207101	<0.05	<0.05	0.0%	< 0.05	124%	70%	130%	101%	70%	130%	98%	70%	130%
Glycols Analysis in Soil															
Propylene glycol	163	2205960	<10	<10	0.0%	< 10	101%	70%	130%	104%	70%	130%	102%	60%	140%
Monoethylene glycol	163	2205960	<10	<10	0.0%	< 10	96%	70%	130%	103%	70%	130%	99%	60%	140%
Diethylene glycol	163	2205960	<10	<10	0.0%	< 10	94%	70%	130%	104%	70%	130%	96%	60%	140%
Triethylene glycol	163	2205960	<10	<10	0.0%	< 10	106%	70%	130%	116%	70%	130%	104%	60%	140%
Tetraethylene glycol	163	2205960	<10	<10	0.0%	< 10	92%	70%	130%	108%	70%	130%	86%	60%	140%
Heptanol	163	2205960	<10	<10	0.0%	<		0%	0%		0%	0%		60%	140%
Glycols Analysis in Soil															
Propylene glycol	163				0.0%	< 10	101%	70%	130%	104%	70%	130%	102%	60%	140%
Monoethylene glycol	163				0.0%	< 10	96%	70%	130%	103%	70%	130%	99%	60%	140%
Diethylene glycol	163				0.0%	< 10	94%	70%	130%	104%	70%	130%	96%	60%	140%
Triethylene glycol	163				0.0%	< 10	106%	70%	130%	116%	70%	130%	104%	60%	140%
Tetraethylene glycol	163				0.0%	< 10	92%	70%	130%	108%	70%	130%	86%	60%	140%
Glycols Analysis in Soil															
Propylene glycol	163				0.0%	< 10	101%	70%	130%	104%	70%	130%	102%	60%	140%
Monoethylene glycol	163				0.0%	< 10	96%	70%	130%	103%	70%	130%	99%	60%	140%
Diethylene glycol	163				0.0%	< 10	94%	70%	130%	104%	70%	130%	96%	60%	140%
Triethylene glycol	163				0.0%	< 10	106%	70%	130%	116%	70%	130%	104%	60%	140%
Tetraethylene glycol	163				0.0%	< 10	92%	70%	130%	108%	70%	130%	86%	60%	140%
Polyaromatic Hydrocarbon Analysis - Water FWAL															
Acridine	210	2209567	<0.0001	<0.0001	0.0%	< 0.0001	103%	70%	130%	122%	70%	130%	127%	70%	130%
Quinoline	210	2209567	<0.0001	<0.0001	0.0%	< 0.0001	84%	70%	130%	92%	70%	130%	96%	70%	130%
2-Methylnaphthalene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	105%	70%	130%	92%	70%	130%	107%	70%	130%
Naphthalene	210	2209567	0.00004	0.00004	0.0%	< 0.00001	109%	70%	130%	93%	70%	130%	111%	70%	130%
Acenaphthylene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	120%	70%	130%	95%	70%	130%	112%	70%	130%
Acenaphthene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	105%	70%	130%	91%	70%	130%	111%	70%	130%
Fluorene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	105%	70%	130%	91%	70%	130%	110%	70%	130%
Phenanthrene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	107%	70%	130%	94%	70%	130%	111%	70%	130%
Anthracene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	129%	70%	130%	88%	70%	130%	108%	70%	130%
Fluoranthene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	130%	70%	130%	106%	70%	130%	123%	70%	130%
Pyrene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	125%	70%	130%	83%	70%	130%	99%	70%	130%
Benzo[a]anthracene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	77%	70%	130%	82%	70%	130%	101%	70%	130%
Chrysene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	89%	70%	130%	89%	70%	130%	107%	70%	130%

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Quality Assurance

CLIENT NAME: FRANZ ENVIRONMENTAL

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Trace Organics Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Benzo[b+j]fluoranthene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	114%	70%	130%	108%	70%	130%	116%	70%	130%
Benzo[k]fluoranthene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	128%	70%	130%	112%	70%	130%	123%	70%	130%
Benzo[a]pyrene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	80%	70%	130%	74%	70%	130%	76%	70%	130%
Indeno[1,2,3-cd]pyrene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	79%	70%	130%	72%	70%	130%	70%	70%	130%
Benzo[ghi]perylene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	72%	70%	130%	81%	70%	130%	70%	70%	130%
Dibenzo[ah]anthracene	210	2209567	<0.00001	<0.00001	0.0%	< 0.00001	75%	70%	130%	75%	70%	130%	72%	70%	130%
Petroleum Hydrocarbons (BTEX/F1-F4) in Water															
Benzene	46	2211241	<0.0005	<0.0005	NA	< 0.0005	104%	80%	120%	107%	80%	120%	102%	70%	130%
Toluene	46	2211241	<0.0005	<0.0005	NA	< 0.0005	104%	80%	120%	110%	80%	120%	98%	70%	130%
Ethylbenzene	46	2211241	<0.0005	<0.0005	NA	< 0.0005	106%	80%	120%	116%	80%	120%	99%	70%	130%
Xylenes	46	2211241	<0.0005	<0.0005	NA	< 0.0005	106%	80%	120%	104%	80%	120%	100%	70%	130%
C6 - C10 (F1)	46	2211241	<0.1	<0.1	NA	< 0.1	92%	80%	120%	113%	80%	120%	101%	70%	130%
C>10 - C16	226	2209567	2.7	<0.1	0.0%	< 0.1	100%	80%	120%	95%	80%	120%	81%	70%	130%
C16 - C34	226	2209567	1.6	<0.1	0.0%	< 0.1	100%	80%	120%	93%	80%	120%	83%	70%	120%
C>34 - C50	226	2209567	<0.1	<0.1	0.0%	< 0.1	100%	80%	120%	93%	80%	120%	83%	70%	130%
Petroleum Hydrocarbons (BTEX/F1-F4) in Water															
C16 - C34	226	2209567	<0.1	<0.1	0.0%	< 0.1	100%	80%	120%	93%	80%	120%	83%	70%	120%
C>34 - C50	226	2209567	<0.1	<0.1	0.0%	< 0.1	100%	80%	120%	92%	80%	120%	82%	70%	130%
Polyaromatic Hydrocarbon Analysis - Water FWAL															
Acridine	243	2207128	<0.0001	<0.0001	NA	< 0.0001	96%	70%	130%	120%	70%	130%	108%	70%	130%
Quinoline	243	2207128	<0.0001	<0.0001	NA	< 0.0001	109%	70%	130%	123%	70%	130%	125%	70%	130%
2-Methylnaphthalene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	109%	70%	130%	75%	70%	130%	75%	70%	130%
Naphthalene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	110%	70%	130%	70%	70%	130%	75%	70%	130%
Acenaphthylene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	108%	70%	130%	70%	70%	130%	70%	70%	130%
Acenaphthene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	107%	70%	130%	70%	70%	130%	71%	70%	130%
Fluorene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	106%	70%	130%	70%	70%	130%	70%	70%	130%
Phenanthrene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	108%	70%	130%	70%	70%	130%	71%	70%	130%
Anthracene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	129%	70%	130%	71%	70%	130%	72%	70%	130%
Fluoranthene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	120%	70%	130%	75%	70%	130%	74%	70%	130%
Pyrene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	128%	70%	130%	77%	70%	130%	81%	70%	130%
Benzo[a]anthracene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	105%	70%	130%	74%	70%	130%	73%	70%	130%
Chrysene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	114%	70%	130%	71%	70%	130%	74%	70%	130%
Benzo[b+j]fluoranthene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	112%	70%	130%	83%	70%	130%	73%	70%	130%
Benzo[k]fluoranthene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	106%	70%	130%	76%	70%	130%	81%	70%	130%
Benzo[a]pyrene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	108%	70%	130%	73%	70%	130%	73%	70%	130%
Indeno[1,2,3-cd]pyrene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	124%	70%	130%	85%	70%	130%	81%	70%	130%
Benzo[ghi]perylene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	124%	70%	130%	82%	70%	130%	87%	70%	130%
Dibenzo[ah]anthracene	243	2207128	<0.00001	<0.00001	NA	< 0.00001	116%	70%	130%	78%	70%	130%	77%	70%	130%

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Quality Assurance

CLIENT NAME: FRANZ ENVIRONMENTAL

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Trace Organics Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Certified By: Elena Gorobets

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Quality Assurance

CLIENT NAME: FRANZ ENVIRONMENTAL

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Water Analysis

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Routine Chemistry Water Analysis															
pH	1694	4645	8.2	8.3	1.2%		101%	90%	110%						
T - Alkalinity (as CaCO3)	1694	4645	649	653	0.6%	< 5	99%	90%	110%						
Electrical Conductivity	1694	4645	3330	3320	0.3%	< 1	103%	90%	110%						
Chloride	814	992	4	4	0.0%	< 1	99%	90%	110%				97%	90%	110%
Fluoride	814	992	0.24	0.24	0.0%	< 0.05	93%	90%	110%				99%	90%	110%
Nitrate	814	992	< 0.5	< 0.5	0.0%	< 0.5	100%	90%	110%				98%	90%	110%
Nitrite	814	992	< 0.05	< 0.05	0.0%	< 0.05	98%	90%	110%				98%	90%	110%
Sulfate	814	992	96	96	0.0%	< 1	101%	90%	110%				100%	90%	110%
Comments: N/A - Not Available.															
Routine Chemistry Water Analysis															
Dissolved Calcium	6733	561	138	138	0.3%	< 0.3	99%	90%	110%				102%	75%	125%
Dissolved Magnesium	6733	561	36.3	36.5	0.4%	< 0.2	99%	90%	110%				103%	75%	125%
Dissolved Sodium	6733	561	31.5	31.5	0.2%	< 0.6	96%	90%	110%				102%	75%	125%
Dissolved Potassium	6733	561	3.2	3.2	0.0%	< 0.6	97%	90%	110%				103%	75%	125%
Dissolved Iron	6733	561	0.2	0.2	2.5%	< 0.1	100%	90%	110%				105%	75%	125%
Dissolved Manganese	6733	561	0.022	0.022	0.4%	< 0.005	102%	90%	110%				104%	75%	125%
Comments: N/A - Not Available.															
CCME / Alberta Tier 1 Metals (Dissolved)															
Dissolved Aluminum	1471	2211241	0.00512	0.00484	5.6%	< 0.002	118%	80%	120%				102%	75%	125%
Dissolved Antimony	1471	2211241	0.001	0.001	0.0%	< 0.001	90%	70%	130%				89%	75%	125%
Dissolved Arsenic	1471	2211241	< 0.001	< 0.001	0.0%	< 0.001	92%	90%	110%				97%	75%	125%
Dissolved Barium	1471	2211241	< 0.05	< 0.05	0.0%	< 0.05	96%	90%	110%				93%	75%	125%
Dissolved Boron	1471	2211241	0.306	0.312	1.9%	< 0.01	112%	80%	120%				105%	75%	125%
Dissolved Cadmium	1471	2211241	0.000039	0.000035	10.8%	< 0.000016	96%	90%	110%				100%	75%	125%
Dissolved Chromium	1471	2211241	< 0.001	< 0.001	0.0%	< 0.001	99%	90%	110%				99%	75%	125%
Dissolved Copper	1471	2211241	0.014	0.014	0.0%	< 0.002	98%	90%	110%				99%	75%	125%
Dissolved Lead	1471	2211241	< 0.001	< 0.001	0.0%	< 0.001	93%	90%	110%				94%	75%	125%
Dissolved Molybdenum	1471	2211241	< 0.003	< 0.003	0.0%	< 0.003	97%	90%	110%				97%	75%	125%
Dissolved Nickel	1471	2211241	< 0.003	< 0.003	0.0%	< 0.01	100%	90%	110%				98%	75%	125%
Dissolved Selenium	1471	2211241	< 0.001	< 0.001	0.0%	< 0.001	98%	90%	110%				112%	75%	125%
Dissolved Silver	1471	2211241	< 0.0001	< 0.0001	0.0%	< 0.00005	92%	90%	110%				99%	75%	125%
Dissolved Thallium	1471	2211241	< 0.0001	< 0.0001	0.0%	< 0.0005	99%	90%	110%				99%	75%	125%
Dissolved Uranium	1471	2211241	0.00103	0.00092	11.3%	< 0.001	100%	90%	110%				98%	75%	125%
Dissolved Zinc	1471	2211241	0.037	0.036	2.7%	< 0.001	111%	80%	120%				103%	75%	125%
CCME / Alberta Tier 1 Metals (Dissolved)															
Dissolved Iron	6733	561	0.2	0.2	2.5%	< 0.1	100%	80%	120%				105%	75%	125%
Dissolved Manganese	6733	561	0.022	0.022	0.4%	< 0.005	102%	90%	110%				104%	75%	125%

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Water Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Dissolved Sodium	6733	561	31.5	31.5	0.2%	< 0.6	96%	90%	110%				102%	75%	125%
Routine Chemistry Water Analysis															
Chloride	814	621	4.422	4.444	0.5%	< 1	99%	90%	110%				98%	90%	110%
Fluoride	814	621	0.235	0.244	3.8%	< 0.05	92%	90%	110%				103%	90%	110%
Nitrate	814	621	0.402	0.416	3.4%	< 0.5	101%	90%	110%				97%	90%	110%
Nitrite	814	621	0	0	0.0%	< 0.05	97%	90%	110%				101%	90%	110%
Sulfate	814	621	96	96	0.0%	< 1	102%	90%	110%				101%	90%	110%
Dissolved Calcium	58	561	147	146	0.5%	< 0.3	99%	90%	110%				100%	75%	125%
Dissolved Magnesium	58	561	38.0	37.8	0.6%	< 0.2	102%	90%	110%				107%	75%	125%
Dissolved Sodium	58	561	32.2	32.1	0.2%	< 0.6	98%	90%	110%				101%	75%	125%
Dissolved Potassium	58	561	3.6	3.7	2.6%	< 0.6	97%	90%	110%				98%	75%	125%
Dissolved Iron	58	561	0.2	0.2	0.3%	< 0.1	99%	90%	110%				100%	75%	125%
Dissolved Manganese	58	561	0.023	0.022	1.3%	< 0.005	102%	90%	110%				99%	75%	125%
Comments: N/A - Not Available.															
CCME / Alberta Tier 1 Metals (Dissolved)															
Dissolved Aluminum	1472	2209053	0.0043	0.0048	11.0%	< 0.002	116%	80%	120%				107%	75%	125%
Dissolved Antimony	1472	2209053	< 0.001	< 0.001	0.0%	< 0.001	118%	80%	120%				97%	75%	125%
Dissolved Arsenic	1472	2209053	< 0.001	< 0.001	0.0%	< 0.001	93%	90%	110%				101%	75%	125%
Dissolved Barium	1472	2209053	0.246	0.242	1.6%	< 0.05	105%	90%	110%				104%	75%	125%
Dissolved Boron	1472	2209053	0.065	0.060	8.0%	< 0.01	113%	80%	120%				103%	75%	125%
Dissolved Cadmium	1472	2209053	< 0.00005	< 0.00005	0.0%	< 0.000016	96%	90%	110%				100%	75%	125%
Dissolved Chromium	1472	2209053	< 0.001	< 0.001	0.0%	< 0.001	99%	90%	110%				95%	75%	125%
Dissolved Copper	1472	2209053	< 0.002	< 0.002	0.0%	< 0.002	95%	90%	110%				100%	75%	125%
Dissolved Iron	58	561	0.2	0.2	0.3%	< 0.1	99%	80%	120%				100%	75%	125%
Dissolved Lead	1472	2209053	< 0.001	< 0.001	0.0%	< 0.001	100%	90%	110%				103%	75%	125%
Dissolved Manganese	58	561	0.023	0.022	1.3%	< 0.005	102%	90%	110%				99%	75%	125%
Dissolved Molybdenum	1472	2209053	0.0057	0.0054	5.4%	< 0.003	93%	90%	110%				102%	75%	125%
Dissolved Nickel	1472	2209053	0.0079	0.0074	6.5%	< 0.01	96%	90%	110%				101%	75%	125%
Dissolved Selenium	1472	2209053	0.00097	0.00080	19.2%	< 0.001	95%	90%	110%				98%	75%	125%
Dissolved Silver	1472	2209053	< 0.0001	< 0.0001	0.0%	< 0.00005	83%	80%	120%				98%	75%	125%
Dissolved Sodium	58	561	32.2	32.1	0.2%	< 0.6	98%	90%	110%				101%	75%	125%
Dissolved Thallium	1472	2209053	< 0.0001	< 0.0001	0.0%	< 0.0005	93%	90%	110%				96%	75%	125%
Dissolved Uranium	1472	2209053	0.029	0.029	0.0%	< 0.001	95%	90%	110%				96%	75%	125%
Dissolved Zinc	1472	2209053	0.0035	0.0034	2.9%	< 0.001	109%	90%	110%				100%	75%	125%
Water Analysis - TKN, TN															
Total Kjeldahl Nitrogen	320	788	2.36	2.34	0.9%	< 0.05	95%	90%	110%	94%	90%	110%	107%	90%	110%
Metals (Dissolved) - Be, Co, Sn, Ti, V															

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Quality Assurance

CLIENT NAME: FRANZ ENVIRONMENTAL

AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

ATTENTION TO: MEAGAN GOURLEY

Water Analysis (Continued)

RPT Date: Dec 31, 2010			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Dissolved Beryllium	1471	2211241	< 0.001	< 0.001	0.0%	< 0.001	101%	80%	120%				102%	75%	125%
Dissolved Cobalt	1471	2211241	< 0.001	< 0.001	0.0%	< 0.001	96%	80%	120%				100%	75%	125%
Dissolved Tin	1471	2211241	< 0.001	< 0.001	0.0%	< 0.001	104%	90%	110%				94%	75%	125%
Dissolved Titanium	1471	2211241	0.003	0.003	0.0%	< 0.001	100%	80%	120%				97%	75%	125%
Dissolved Vanadium	1471	2211241	0.001	0.001	0.0%	< 0.001	86%	80%	120%				89%	75%	125%
Metals (Dissolved) - Be, Co, Sn, Ti, V															
Dissolved Beryllium	1472	2210312	<0.001	<0.001	0.0%	< 0.001	101%	80%	120%				104%	75%	125%
Dissolved Cobalt	1472	2210312	0.001	0.001	0.0%	< 0.001	95%	80%	120%				104%	75%	125%
Dissolved Tin	1472	2210312	<0.001	<0.001	0.0%	< 0.001	97%	80%	120%				98%	75%	125%
Dissolved Titanium	1472	2210312	0.002	0.002	0.0%	< 0.001	98%	80%	120%				104%	75%	125%
Dissolved Vanadium	1472	2210312	<0.001	<0.001	0.0%	< 0.001	103%	80%	120%				96%	75%	125%
Water Analysis - Dissolved Hg															
Dissolved Mercury	913	8068	<0.	<0.	0.0%	< 0.000022	100%	90%	110%		90%	110%	102%	75%	125%

Certified By:

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Arsenic	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Barium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Beryllium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Boron (Hot water extraction)	SOIL 0270; SOIL 0110; SOIL 0120; INST 0140	Carter 12.2.4/ EPA 6010; SHEPPARD	ICP/MS
Cadmium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Chromium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Chromium, Hexavalent	SPE 0101; SOIL 0600	ASA 20-4.3; REISENAUER 1982	SPECTROPHOTOMETER
Cobalt	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Copper	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Lead	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Mercury	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Molybdenum	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Nickel	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Selenium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Silver	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Thallium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Tin	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Uranium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Vanadium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Zinc	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050/6010; SHEPPARD	ICP/MS
Sieve Analysis - 75 microns (wet)	SOIL 0540; SOIL 0110	KROETSCH 2007; SHEPPARD 2007	SIEVE
pH (CaCl2 Extraction)	SOIL 0110; SOIL 0120; INST 0103	SHEPPARD 2007; HENDERSHOT 2008	PH METER
Electrical Conductivity (Sat. Paste)	SOIL 0110; SOIL 0120; INST 0121	SHEPPARD 2007; MILLER 2007	CONDUCTIVITY METER
Sodium Adsorption Ratio	SOIL 200	McKeague 3.26	CALCULATION
Saturation Percentage	SOIL 0140; SOIL 0110; SOIL 0120	MILLER 2007; SHEPPARD 2007	GRAVIMETRIC
Chloride, Soluble	SOIL 0110; SOIL 0120; INST 0330	SHEPPARD 2007, EATON 2005	CONTINUOUS FLOW ANALYZER
Calcium, Soluble	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	SHEPPARD 2007; EATON 2005; MILLER 2007, SM 3120B	ICP/OES

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Method Summary

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AGAT WORK ORDER: 10E461661

PROJECT NO: 2018-1001

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Potassium, Soluble	SHEPPARD 2007; EATON 2005; MILLER 2007, SM 3120B	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	ICP/OES
Magnesium, Soluble	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	SHEPPARD 2007; EATON 2005; MILLER 2007, SM 3120B	ICP/OES
Sodium, Soluble	SHEPPARD 2007; EATON 2005; MILLER 2007, SM 3120B	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	ICP/OES
Sulfur (as Sulfate), Soluble	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	SHEPPARD 2007; EATON 2005; MILLER 2007, SM 3120B	ICP/OES

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Propylene glycol	TO 1410	EPA SW - 846 3500A & 8015A	GC/FID
Monoethylene glycol	TO 1410	EPA SW - 846 3500A & 8015A	GC/FID
Diethylene glycol	TO 1410	EPA SW - 846 3500A & 8015A	GC/FID
Triethylene glycol	TO 1410	EPA SW - 846 3500A & 8015A	GC/FID
Tetraethylene glycol	TO 1410	EPA SW - 846 3500A & 8015A	GC/FID
Heptanol	TO 1410	EPA SW - 846 3500A & 8015A	GC/FID
Propylene Glycol	TO 1410	EPA SW-846 3500 & 8015	GC/FID
Monoethylene Glycol	TO 1410	EPA SW-846 3500 & 8015	GC/FID
Diethylene Glycol	TO 1410	EPA SW-846 3500 & 8015	GC/FID
Triethylene Glycol	TO 1410	EPA SW-846 3500 & 8015	GC/FID
Tetraethylene Glycol	TO 1410	EPA SW-846 3500 & 8015	GC/FID
Heptanol	TO 1410	EPA SW-846 3500 & 8015	GC/FID
Benzene	TO 0570	EPA SW-846 8260	GC/MS
Toluene	TO 0570	EPA SW-846 8260	GC/MS
Ethylbenzene	TO 0570	EPA SW-846 8260	GC/MS
Xylenes	TO 0570	EPA SW-846 8260	GC/MS
C6 - C10 (F1)	TO 0570	CCME Tier 1 Method	GC/FID
C6 - C10 (F1 minus BTEX)	TO 0570	CCME Tier 1 Method	GC/FID
C10 - C16 (F2)	TO-0560	CCME Tier 1 Method	GC/FID
C16 - C34 (F3)	TO-0560	CCME Tier 1 Method	GC/FID
C34 - C50 (F4)	TO 0560	CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	TO 0560	CCME Tier 1 Method	GC/FID
Moisture Content	TO 0560	CCME Tier 1 Method	GRAVIMETRIC
Toluene-d8 (BTEX)	TO 0570	EPA SW-846 8260	GC/MS
Ethylbenzene-d10 (BTEX)	TO 0570	EPA SW-846 8260	GC/MS
o-Terphenyl (F2-F4)	TO 0560	CCME Tier 1 Method	GC/FID
Benzene	TO 0540	EPA SW846 8260	GC/MS
Toluene	TO 0540	EPA SW846 8260	GC/MS
Ethylbenzene	TO 0540	EPA SW846 8260	GC/MS
Xylenes	TO 0540	EPA SW846 8260	GC/MS
C6 - C10 (F1)	TO 0540	CCME Tier 1 Method	GC/FID
C6 - C10 (F1 minus BTEX)	TO 0540	CCME Tier 1 Method	GC/FID
C>10 - C16	TO 0511	CCME Tier 1 Method	GC/FID
C16 - C34	TO 0511	CCME Tier 1 Method	GC/FID
C>34 - C50	TO 0511	CCME Tier 1 Method	GC/FID
Toluene-d8 (BTEX)	TO 0340	EPA SW846 8260	GC/FID
o-Terphenyl (F2-F4)	TO 0511	CCME Tier 1 Method	GC/FID
Naphthalene	TO 0500	EPA SW-846 3570/8270	GC/MS
2-Methylnaphthalene	TO 0500	EPA SW-846 3570/8270	GC/MS
Acenaphthylene	TO 0500	EPA SW-846 3570/8270	GC/MS
Acenaphthene	TO 0500	EPA SW-846 3570/8270	GC/MS
Fluorene	TO 0500	EPA SW-846 3570/8270	GC/MS
Phenanthrene	TO 0500	EPA SW-846 3570/8270	GC/MS
Anthracene	TO 0500	EPA SW-846 3570/8270	GC/MS
Fluoranthene	TO 0500	EPA SW-846 3570/8270	GC/MS
Pyrene	TO 0500	EPA SW-846 3570/8270	GC/MS
Benzo(a)anthracene	TO 0500	EPA SW-846 3570/8270	GC/MS
Chrysene	TO 0500	EPA SW-846 3570/8270	GC/MS
Benzo(b+j)fluoranthene	TO 0500	EPA SW-846 3570/8270	GC/MS

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Benzo(k)fluoranthene	TO 0500	EPA SW-846 3570/8270	GC/MS
Benzo(a)pyrene	TO 0500	EPA SW-846 3570/8270	GC/MS
Indeno(1,2,3-cd)pyrene	TO 0500	EPA SW-846 3570/8270	GC/MS
Dibenzo(ah)anthracene	TO 0500	EPA SW-846 3570/8270	GC/MS
Benzo(ghi)perylene	TO 0500	EPA SW-846 3570/8270	GC/MS
2-Fluorobiphenyl (PAH)	TO 0500	EPA SW-846 3570/8270	GC/MS
p-Terphenyl-d14 (PAH)	TO 0500	EPA SW-846 3570/8270	GC/MS
Acridine	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Quinoline	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
2-Methylnaphthalene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Naphthalene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Acenaphthylene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Acenaphthene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Fluorene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Phenanthrene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Anthracene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Fluoranthene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Pyrene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Benzo[a]anthracene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Chrysene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Benzo[b+j]fluoranthene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Benzo[k]fluoranthene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Benzo[a]pyrene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Indeno[1,2,3-cd]pyrene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Benzo[ghi]perylene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Dibenzo[ah]anthracene	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
2-Fluorobiphenyl (PAH)	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
p-Terphenyl-d14 (PAH)	TO 0200	EPA SW-846 3510C & 8270D	GC/MS
Chloromethane	TO 0340	EPA SW-846 8260	GC/MS
Vinyl Chloride	TO 0340	EPA SW-846 8260	GC/MS
Bromomethane	TO 0340	EPA SW-846 8260	GC/MS
Chloroethane	TO 0340	EPA SW-846 8260	GC/MS
Trichlorofluoromethane	TO 0340	EPA SW-846 8260	GC/MS
Acetone	TO 0340	EPA SW-846 8260	GC/MS
1,1-Dichloroethylene	TO 0340	EPA SW-846 8260	GC/MS
Methylene Chloride	TO 0340	EPA SW-846 8260	GC/MS
Methyl tert-butyl ether	T0 0340	EPA SW-846 8260	GC/MS
Methyl Ethyl Ketone	T0 0340	EPA SW-846 8260	GC/MS
trans- 1,2-dichloroethylene	T0 0340	EPA SW-846 8260	GC/MS
1,1-Dichloroethane	T0 0340	EPA SW-846 8260	GC/MS
cis- 1,2-Dichloroethylene	T0 0340	EPA SW-846 8260	GC/MS
Chloroform	T0 0340	EPA SW-846 8260	GC/MS
1,2-Dichloroethane	T0 0340	EPA SW-846 8260	GC/MS
1,1,1-Trichloroethane	T0 0340	EPA SW-846 8260	GC/MS
Carbon Tetrachloride	T0 0340	EPA SW-846 8260	GC/MS
Benzene	T0 0340	EPA SW-846 8260	GC/MS
1,2-Dichloropropane	T0 0340	EPA SW-846 8260	GC/MS
Trichloroethylene	T0 0340	EPA SW-846 8260	GC/MS
Bromodichloromethane	T0 0340	EPA SW-846 8260	GC/MS
trans-1,3-Dichloropropene	T0 0340	EPA SW-846 8260	GC/MS

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PROJECT NO: 2018-1001 **ATTENTION TO: MEAGAN GOURLEY**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Methyl Isobutyl Ketone	T0 0340	EPA SW-846 8260	GC/MS
cis-1,3-Dichloropropene	T0 0340	EPA SW-846 8260	GC/MS
1,1,2-Trichloroethane	T0 0340	EPA SW-846 8260	GC/MS
Toluene	T0 0340	EPA SW-846 8260	GC/MS
2-Hexanone	T0 0340	EPA SW-846 8260	GC/MS
Dibromochloromethane	T0 0340	EPA SW-846 8260	GC/MS
Ethylene Dibromide	T0 0340	EPA SW-846 8260	GC/MS
Tetrachloroethene	T0 0340	EPA SW-846 8260	GC/MS
1,1,1,2-Tetrachloroethane	T0 0340	EPA SW-846 8260	GC/MS
Chlorobenzene	T0 0340	EPA SW-846 8260	GC/MS
Ethylbenzene	T0 0340	EPA SW-846 8260	GC/MS
m & p-Xylene	T0 0340	EPA SW-846 8260	GC/MS
Bromoform	T0 0340	EPA SW-846 8260	GC/MS
Styrene	T0 0340	EPA SW-846 8260	GC/MS
1,1,2,2-Tetrachloroethane	T0 0340	EPA SW-846 8260	GC/MS
o-Xylene	T0 0340	EPA SW-846 8260	GC/MS
1,3-Dichlorobenzene	T0 0340	EPA SW-846 8260	GC/MS
1,4-Dichlorobenzene	TO 0340	EPA SW-846 8260	GC/MS
1,2-Dichlorobenzene	TO 0340	EPA SW-846 8260	GC/MS
1,2,4-Trichlorobenzene	T0 0340	EPA SW-846 8260	GC/MS
Total Xylenes	T0 0340	EPA SW-846 8260	GC/MS
Toluene-d8 (BTEX)	TO 0340	EPA SW-846 8260	GC/FID
Chloromethane	TO 0330	EPA SW-846 8260	GC/MS
Vinyl Chloride	TO 0330	EPA SW-846 8260	GC/MS
Bromomethane	TO 0330	EPA SW-846 8260	GC/MS
Chloroethane	TO 0330	EPA SW-846 8260	GC/MS
Trichlorofluoromethane	TO 0330	EPA SW-846 8260	GC/MS
Acetone	TO 0330	EPA SW-846 8260	GC/MS
1,1-Dichloroethylene	TO 0330	EPA SW-846 8260	GC/MS
Methylene Chloride	TO 0330	EPA SW-846 8260	GC/MS
Methyl tert-butyl ether	TO 0330	EPA SW-846 8260	GC/MS
Methyl Ethyl Ketone	TO 0330	EPA SW-846 8260	GC/MS
trans- 1,2-dichloroethylene	TO 0330	EPA SW-846 8260	GC/MS
1,1-Dichloroethane	TO 0330	EPA SW-846 8260	GC/MS
cis- 1,2-Dichloroethylene	TO 0330	EPA SW-846 8260	GC/MS
Chloroform	TO 0330	EPA SW-846 8260	GC/MS
1,2-Dichloroethane	TO 0330	EPA SW-846 8260	GC/MS
1,1,1-Trichloroethane	TO 0330	EPA SW-846 8260	GC/MS
Carbon Tetrachloride	TO 0330	EPA SW-846 8260	GC/MS
Benzene	TO 0330	EPA SW-846 8260	GC/MS
1,2-Dichloropropane	TO 0330	EPA SW-846 8260	GC/MS
Trichloroethylene	TO 0330	EPA SW-846 8260	GC/MS
Bromodichloromethane	TO 0330	EPA SW-846 8260	GC/MS
trans-1,3-Dichloropropene	TO 0330	EPA SW-846 8260	GC/MS
Methyl Isobutyl Ketone	TO 0330	EPA SW-846 8260	GC/MS
cis-1,3-Dichloropropene	TO 0330	EPA SW-846 8260	GC/MS
1,1,2-Trichloroethane	TO 0330	EPA SW-846 8260	GC/MS
Toluene	TO 0330	EPA SW-846 8260	GC/MS
2-Hexanone	TO 0330	EPA SW-846 8260	GC/MS
Dibromochloromethane	TO 0330	EPA SW-846 8260	GC/MS

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Ethylene Dibromide	TO 0330	EPA SW-846 8260	GC/MS
Tetrachloroethene	TO 0330	EPA SW-846 8260	GC/MS
1,1,1,2-Tetrachloroethane	TO 0330	EPA SW-846 8260	GC/MS
Chlorobenzene	TO 0330	EPA SW-846 8260	GC/MS
Ethylbenzene	TO 0330	EPA SW-846 8260	GC/MS
m & p-Xylene	TO 0330	EPA SW-846 8260	GC/MS
Bromoform	TO 0330	EPA SW-846 8260	GC/MS
Styrene	TO 0330	EPA SW-846 8260	GC/MS
1,1,2,2-Tetrachloroethane	TO 0330	EPA SW-846 8260	GC/MS
o-Xylene	TO 0330	EPA SW-846 8260	GC/MS
1,3-Dichlorobenzene	TO 0330	EPA SW-846 8260	GC/MS
1,4-Dichlorobenzene	TO 0330	EPA SW-846 8260	GC/MS
1,2-Dichlorobenzene	TO 0330	EPA SW-846 8260	GC/MS
1,2,4-Trichlorobenzene	TO 0330	EPA SW-846 8260	GC/MS
Total Xylenes	TO 0330	EPA SW-846 8260	GC/MS
Toluene-d8 (BTEX)	TO 0330	EPA SW-846 8260	GC/FID

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Dissolved Aluminum	INST 0141	SM 3125 B	ICP/MS
Dissolved Antimony	INST 0141	SM 3125 B	ICP/MS
Dissolved Arsenic	INST 0141	SM 3125 B	ICP-MS
Dissolved Barium	INST 0141	SM 3125 B	ICP-MS
Dissolved Boron	INST 0141	SM 3125 B	ICP-MS
Dissolved Cadmium	INST 0141	SM 3125 B	ICP/MS
Dissolved Chromium	INST 0141	SM 3125 B	ICP/MS
Dissolved Copper	INST 0141	SM 3125 B	ICP-MS
Dissolved Iron	INST 0140	SM 3120 B	ICP/OES
Dissolved Lead	INST 0141	SM 3125 B	ICP/MS
Dissolved Manganese	INST 0140	SM 3120 B	ICP/OES
Dissolved Molybdenum	INST 0141	SM 3125 B	ICP/MS
Dissolved Nickel	INST 0141	SM 3125 B	ICP/MS
Dissolved Selenium	INST 0141	SM 3125 B	ICP/MS
Dissolved Silver	INST 0141	SM 3125 B	ICP/MS
Dissolved Sodium	INST 0140	SM 3120 B	ICP/OES
Dissolved Thallium	INST 0141	SM 3125 B	ICP/MS
Dissolved Uranium	INST 0141	SM 3125 B	ICP/MS
Dissolved Zinc	INST 0141	SM 3125 B	ICP-MS
Dissolved Beryllium	INST 0141	SM 3125 B	ICP-MS
Dissolved Cobalt	INST 0141	SM 3125 B	ICP-MS
Dissolved Tin	INST 0141	SM 3125 B	ICP-MS
Dissolved Titanium	INST 0141	SM 3125 B	ICP-MS
Dissolved Vanadium	INST 0141	SM 3125 B	ICP-MS
pH	INST 0101	SM 4500 H+	pH METER
p - Alkalinity (as CaCO3)	INST 0101	SM 2320 B	TITRATION
T - Alkalinity (as CaCO3)	INST 0101	SM 2320 B	TITRATION
Bicarbonate	INST 0101	SM 2320 B	TITRATION
Carbonate	INST 0101	SM 2320 B	TITRATION
Hydroxide	INST 0101	SM 2320 B	TITRATION
Electrical Conductivity	INST 0101	SM 2510 B	CONDUCTIVITY METER
Chloride	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Fluoride	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrate	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Sulfate	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Dissolved Calcium	INST 0140	SM 3120 B	ICP/OES
Dissolved Magnesium	INST 0140	SM 3120 B	ICP/OES
Dissolved Sodium	INST 0140	SM 3120 B	ICP/OES
Dissolved Potassium	INST 0140	SM 3120 B	ICP/OES
Dissolved Iron	INST 0140	SM 3120 B	ICP/OES
Dissolved Manganese	INST 0140	SM 3120 B	ICP/OES
Dissolved Mercury	INST 0160	SM 3112 B	CV/AA
Total Kjeldahl Nitrogen	INST 0430	SM 4500-N org D	AQ-2 DISCRETE ANALYZER
Total Nitrogen			

Parameter	Media	HHRA Screening Criteria	HHRA Screening Criteria Source	MDL	Units	Number of Samples	Average	Standard Deviation	Minimum	Maximum	Location of Max	% ND	Screened into HHRA?	Notes
Soil Salinity														
pH	soil	6 to 8	CCME AL Soil Quality Guidelines,2011			30	7.38	0.25	6.9	8.05	-	0	no	* screened out due to the fact that from this large data set, all samples (n=30) with the exception of one, fall below the pH guideline recommended by CCME for the protection of human health and the environment. Given the number of soil samples analyzed for this parameter, it would be reasonable to consider the 95% UCLM (7.48) or 90th percentile (7.73) as realistic estimates of soil pH. Both of these calculated values fall below the stated CCME Guideline, as such pH is not considered as a soil COPC.
Sodium Adsorption Ratio (SAR)	soil	5	CCME AL Soil Quality Guidelines,2011		SAR	30	0.61	1.01	0.15	5.6	-	0	no	* rationale has been provided in the ESA portion of this report, attributing the maximum value of this parameter (which slightly exceeds the guideline in one of thirty samples) in site soil to local and regional mineral content
Elec. Cond.	soil	2	CCME AL Soil Quality Guidelines,2011	0.01	dS/m	30	0.46	0.46	0.16	2.16	-	0	no	* rationale has been provided in the ESA portion of this report, attributing the maximum value of this parameter (which slightly exceeds the guideline in one of thirty samples) in site soil to local and regional mineral content
Saturation %	soil	NC	NC		%	30	42.65	11.94	27	70	-	0	no	
Calcium, Soluble	soil	NC	NC	1	ug/g	30	40.53	68.55	7.0	333.0	-	0	no	* see rationale detailed in report for not including calcium as a soil COPC.
Chloride , Soluble (calc.)	soil	>1000 000 (HH-soil intake)	BC CSR Schedule 5 (AL Land Use, Human Health)	2 to 10	ug/g	30	29.20	94.82	2.0	520.0	-	53.33	no	*screened out as the factor "protection of groundwater for drinking water" in BC CSR Schedule 5 is not used as a soil guideline since groundwater has been analyzed for this parameter and screened against DWQ Guidelines in a seperate table. (Rationale supported by SAB Risk Forum- April 2009, White Paper for Discussion-COPC Screening, Applicable Standards).
Magnesium, Soluble (calc.)	soil	NC	NC	1	ug/g	30	10.81	24.96	1.9	138	-	0	no	* see rationale detailed in report for not including calcium as a soil COPC.
Potassium, Soluble (calc.)	soil	NC	NC	0.9 to 2	ug/g	30	4.64	8.23	<0.9	38	-	56.67	no	
Sodium, Soluble (calc.)	soil	>1000 000 (HH-soil intake)	BC CSR Schedule 5 (AL Land Use, Human Health)	2	ug/g	30	9.58	23.99	<2	134.0	-	16.67	no	*screened out as the factor "protection of groundwater for drinking water" in BC CSR Schedule 5 is not used as a soil guideline since groundwater has been analyzed for this parameter and screened against DWQ Guidelines in a seperate table. (Rationale supported by SAB Risk Forum- April 2009, White Paper for Discussion-COPC Screening, Applicable Standards).
Sulfate (S04-S), Soluble (calc.)	soil	NC	NC	2	ug/g	30	70.00	192.21	3.0	926.0	-	0	no	*The risk of adverse effects from exposure to soil concentrations of sulfate is considered to be negligible and this parameter has not been included as a soil COPC The concentration range of this parameter in site soil can be attributed to local and regional mineral content in soils. Furthermore sulfate concentrations in groundwater at background wells, onsite wells, and wells at the site boundary are compliant with the federal drinking water standard for sulfate.
Glycols											-			
Diethylene glycol	soil	10(Fine) 15 (Coarse) (DUA)	AENV,2010. Table 2.	10	ug/g	23	10.00	0.00	<10	<10	-	100	no (ND)	
Ethylene glycol	soil	960	CCME AL Soil Quality Guidelines,2011	10	ug/g	23	10.00	0.00	<10	<10	-	100	no (ND)	
Propylene glycol	soil	NC	NC	10	ug/g	23	10.00	0.00	<10	<10	-	100	no (ND)	* Propylene Gylcol is less toxic than ethylene glycol (ATSDR-Case Study in Environmental Medicine, Ethylene and Propylene Glycol Toxicity, WB1103), as all samples are non-detect, with a detection limit below the guideline for ethylene glycol, it is expected that the human health risk from propylene glycol is negligible and this parameter has not been included as a soil COPC.
Tetraethylene glycol	soil	NC	NC	10	ug/g	23	10.00	0.00	<10	<10	-	100	no (ND)	* All sample concentrations for this parameter are non-detect, and below soil guidelines stated for related glycols. Tetraethylene glycol concentrations in soil are expected to have negligible human health risks, as such it has not been included as a soil COPC.
Triethylene glycol	soil	100 (Fine), 150 (Coarse) (DUA)	AENV,2010. Table 2.	10	ug/g	23	10.00	0.00	<10	<10	-	100	no (ND)	
Monocyclic Aromatic Hydrocarbons											-			
Benzene	soil	0.030 (coarse), 0.0068 (fine)	CCME AL Soil Quality Guidelines,2011	0.005	ug/g	37	0.01	1.759E-18	<0.005	<0.005	-	100	no (ND)	
Ethyl benzene	soil	0.082 (coarse), 0.018 (fine)	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	37	0.01	3.517E-18	<0.01	<0.01	-	100	no (ND)	
Styrene	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.01	1.768E-18	<0.01	<0.01	-	100	no (ND)	
Toluene	soil	0.37 (coarse), 0.08 (fine)	CCME AL Soil Quality Guidelines,2011	0.001 to 0.05	ug/g	37	0.04	0.019	<0.01	<0.05	-	100	no (ND)	
m+p-Xylene	soil	25 (fine), 3.1 (coarse)	CL, Table 3, OMOE 2009	0.01	ug/g	25	0.01	1.770E-18	<0.01	<0.01	-	100	no (ND)	
o-Xylene	soil	25 (fine), 3.1 (coarse)	CL, Table 3, OMOE 2009	0.01	ug/g	25	0.01	1.770E-18	0.01	<0.01	-	100	no (ND)	
Xylenes (total)	soil	11 (coarse), 2.4 (fine)	CCME AL Soil Quality Guidelines,2011	0.001 to 0.05	ug/g	37	0.04	0.017	<0.01	<0.05	-	100	no (ND)	
Metals											-			
Antimony	soil	20	CCME AL Soil Quality Guidelines,2011	0.2 to 1	ug/g	31	1.20	3.32	0.2	19	-	48.39	no	
Arsenic	soil	12 (HH)	CCME AL Soil Quality Guidelines,2011	0.50	ug/g	31	7.22	3.67	1.5	**16**	**2018-10SS-4**	0	**YES**	* The maximum concentration is soil is greater than the guideline derived for the limiting pathway of soil ingestion (CCME, As Fact Sheet, 2001 Update)
Barium	soil	750	CCME AL Soil Quality Guidelines,2011	0.50	ug/g	31	181.03	95.92	37.8	343	-	0	no	
Boron (Hot water extraction)	soil	2	CCME AL Soil Quality Guidelines,2011	0.5 to 1	ug/g	23	0.94	1.12	<0.5	4.3	-	73.91	no	*See report rationale for screening boron out as a soil and groundwater COPC.
Beryllium	soil	4	CCME AL Soil Quality Guidelines,2011	0.5 to 1	ug/g	31	0.66	0.21	<0.5	1	-	64.52	no	
Cadmium	soil	1.4 (HH)	CCME AL Soil Quality Guidelines,2011	0.5 to 1	ug/g	31	0.66	0.81	<0.5	**5**	**2018-10SS-6**	87.10	**YES**	* The maximum concentration is soil is greater than the guideline derived for the limiting pathway of soil ingestion (CCME, Cd Fact Sheet, 2001 Update)
Chromium	soil	64	CCME AL Soil Quality Guidelines,2011	0.5	ug/g	31	15.20	9.42	3.4	47.2	-	0	no	
Chromium (VI)	soil	0.4	CCME AL Soil Quality Guidelines,2011	0.3	ug/g	23	0.30	0.00	<0.3	<0.3	-	100	no	
Cobalt	soil	40	CCME AL Soil Quality Guidelines,2011	0.5	ug/g	31	6.31	2.73	1.7	10.8	-	0	no	

Parameter	Media	HHRA Screening Criteria	HHRA Screening Criteria Source	MDL	Units	Number of Samples	Average	Standard Deviation	Minimum	Maximum	Location of Max	% ND	Screened into HHRA?	Notes
Copper	soil	1100 (HH)	CCME AL Soil Quality Guidelines,2011, CCME Cu Fact Sheet,1999 Update, Human Health Guideline (soil ingestion/inhalation/dermal pathway)	0.5	ug/g	31	29.79	71.24	2.6	409	-	0	no	
Lead	soil	140 (HH)	CCME AL Soil Quality Guidelines,2011, Pb Fact Sheet, 1999 Update, Human Health Guideline (soil ingestion/inhalation/dermal pathway)	5	ug/g	33	10.76	15.70	1.5	94.9	-	0	no	
Mercury	soil	6.6	CCME AL Soil Quality Guidelines,2011	0.05 to 0.5	ug/g	31	0.39	0.20	<0.05	0.5	-	87.10	no	
Molybdenum	soil	5	CCME AL Soil Quality Guidelines,2011	0.5 to 1	ug/g	31	1.12	0.52	<0.5	3.1	-	32.26	no	
Nickel	soil	50	CCME AL Soil Quality Guidelines,2011	0.5	ug/g	31	19.76	9.28	4.8	33.3	-	0	no	
Selenium	soil	80 (HH)	CCME AL Soil Quality Guidelines,2011, Se Fact Sheet, 2010 Update, Human Health Guideline (soil ingestion/inhalation/dermal pathway)	0.5	ug/g	31	0.57	0.21	0.4	1.58	-	74.19	no	
Silver	soil	20	CCME AL Soil Quality Guidelines,2011	0.5	ug/g	31	0.48	0.18	0.2	1	-	90.32	no	
Thallium	soil	1	CCME AL Soil Quality Guidelines,2011	0.5	ug/g	31	0.53	0.12	<0.5	<1	-	100	no	
Tin	soil	5	CCME AL Soil Quality Guidelines,2011	0.5	ug/g	31	6.35	24.88	<0.5	140	-	74.19	no	*see report rationale for screening tin out as a soil COPC.
Uranium	soil	23	CCME AL Soil Quality Guidelines,2011	0.5	ug/g	31	1.09	0.57	<0.5	2	-	48.39	no	
Vanadium	soil	130	CCME AL Soil Quality Guidelines,2011	0.5	ug/g	31	23.65	11.45	5.4	42.8	-	0	no	
Zinc	soil	200	CCME AL Soil Quality Guidelines,2011	1	ug/g	31	195.77	697.97	12	3950	-	0	no	* see report rationale for screening out zinc as a soil COPC for this HHRA
Polycyclic Aromatic Hydrocarbons											-			
Acenaphthene	soil	3900 (VI)	AENV,2010. Table 2.	0.01	ug/g	25	0.01	8.85E-19	<0.005	<0.005	-	100	no (ND)	
Acenaphthylene	soil	0.17 (fine), 0.15 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	25	0.01	0.001	<0.005	<0.01	-	100	no(ND)	
Anthracene	soil	5.3 B[a]P TPE, IACR<1.0*, and 2400 (DC)	CCME AL SoQG for PAH, CCME 2010, and AENV,2010. Table 2.	0.004	ug/g	25	0.00	0.0048	<0.004	0.028	-	92	no	
Benzo[a]anthracene	soil	5.3 B[a]P TPE, IACR<1.0*	CCME AL SoQG for PAH, CCME 2010	0.01 to 0.03	ug/g	27	0.03	0.01	<0.01	0.03	-	96.30	no	
Benzo[a]pyrene	soil	5.3 B[a]P TPE, IACR<1.0*	CCME AL SoQG for PAH, CCME 2010	0.01 to 0.03	ug/g	27	0.03	0.01	<0.01	<0.03	-	100	no(ND)	
Benzo[b+j]fluoranthene	soil	5.3 B[a]P TPE, IACR<1.0*	CCME AL SoQG for PAH, CCME 2010	0.01 to 0.05	ug/g	27	0.05	0.01	<0.01	0.06	-	96.30	no	
Benzo[ghi]perylene	soil	5.3 B[a]P TPE, IACR<1.0*	CCME AL SoQG for PAH, CCME 2010	0.05	ug/g	25	0.05	1.42E-17	<0.05	<0.05	-	100	no(ND)	
Benzo[k]fluoranthene	soil	5.3 B[a]P TPE, IACR<1.0*	CCME AL SoQG for PAH, CCME 2010	0.05	ug/g	27	0.05	0.01	<0.01	<0.05	-	100	no(ND)	
Chrysene	soil	5.3 B[a]P TPE, IACR<1.0*	CCME AL SoQG for PAH, CCME 2010	0.05	ug/g	25	0.05	1.42E-17	<0.05	<0.05	-	100	no (ND)	
Dibenzo[a,h]anthracene	soil	5.3 B[a]P TPE, IACR<1.0*	CCME AL SoQG for PAH, CCME 2010	0.005	ug/g	27	0.01	0.001	<0.005	0.01	-	92.59	no	
Fluoranthene	soil	5.3 B[a]P TPE, IACR<1.0*, and 3500 (DC)	CCME AL SoQG for PAH, CCME 2010, and AENV,2010. Table 2.	0.03	ug/g	25	0.03	0.002	<0.03	0.04	-	92	no	
Fluorene	soil	5.3 B[a]P TPE, IACR<1.0*, and 2700 (DC)	CCME AL SoQG for PAH, CCME 2010, and AENV,2010. Table 2.	0.02	ug/g	25	0.02	3.54E-18	<0.02	<0.02	-	100	no (ND)	
Indeno[1,2,3-cd]pyrene	soil	5.3 B[a]P TPE, IACR<1.0*	CCME AL SoQG for PAH, CCME 2010	0.05	ug/g	27	0.05	0.01	<0.01	<0.05	-	100	no (ND)	
2-Methylnaphthalene	soil	3.4(fine), 0.99 (coarse)	0MOE, AL Land Use, 2009. Table 2.	0.005	ug/g	25	0.01	0.01	0.005	0.066	-	68	no	
Naphthalene	soil	5.3 B[a]P TPE, IACR<1.0*, and 2.2 (VI)	CCME AL SoQG for PAH, CCME 2010, and AENV,2010. Table 2.	0.01	ug/g	27	0.01	0.01	0.005	0.029	-	77.78	no	
Phenanthrene	soil	5.3 B[a]P TPE, IACR<1.0*	CCME AL SoQG for PAH, CCME 2010	0.01 to 0.02	ug/g	27	0.02	0.01	<0.01	0.09	-	92.59	no	
Pyrene	soil	5.3 B[a]P TPE, IACR<1.0*, and 2100 (DC)	CCME AL SoQG for PAH, CCME 2010, and AENV, 2010. Table 2.	0.01 to 0.03	ug/g	27	0.03	0.01	<0.01	0.03	-	96.30	no	
Petroleum Hydrocarbons											-			
F1 (C6-C10)	soil	30 (coarse), 170 (fine)	CWS PHC AL Use , 2008	5 to 10	ug/g	37	8.51	2.32	<5	<10	-	100	no(ND)	
F1 (C6-C10) minus BTEX	soil	30 (coarse), 170 (fine)	CWS PHC AL Use , 2008	5 to 10	ug/g	36	8.61	2.27	<5	<10	-	100	no(ND)	
F2 (C10-C16)	soil	150	CWS PHC AL Use , 2008	5 to 10	ug/g	37	10.73	4.31	<5	20	-	94.59	no	
F3 (C16-C34)	soil	300 (coarse), 1300 (fine)	CWS PHC AL Use , 2008	5 to 20	ug/g	37	31.46	67.76	<5	404	-	56.76	no	
F4 (C34-C50)	soil	2800 (coarse), 5600 (fine)	CWS PHC AL Use , 2008	5 to 20	ug/g	37	13.57	12.47	<5	79	-	89.19	no	
Volatile Organic Compounds											-			
Acetone	soil	28 (fine), 16 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.1	ug/g	25	0.10	2.83E-17	<0.1	<0.1	-	100	no (ND)	
Bromodichloromethane	soil	1.9 (fine), 1.5 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.010	ug/g	25	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
Bromoform	soil	0.26 (fine), 0.27 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	25	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
Bromomethane	soil	0.05	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	25	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
Carbon tetrachloride	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.0005	ug/g	27	0.00	0.003	<0.0005	<0.01	-	100	no (ND)	
Chlorobenzene	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
Chlorodibromomethane	soil	0.27 (Coarse) VI, 0.91 (Fine) DUA	AENV,2010. Table 2.	0.01	ug/g	25	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
Chloroethane	soil	NC	NC	0.01	ug/g	25	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	* all sample concentrations are non-detect, as such this parameter has not been included as a soil COPC.
Chloroform	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.00	0.01	<0.001	<0.04	-	48.15	no (ND)	
Chloromethane	soil	NC	NC	0.01	ug/g	25	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	* all sample concentrations are non-detect, as such this parameter has not been included as a soil COPC.
1,2-Dichlorobenzene	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
1,3-Dichlorobenzene	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
1,4-Dichlorobenzene	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	

Parameter	Media	HHRA Screening Criteria	HHRA Screening Criteria Source	MDL	Units	Number of Samples	Average	Standard Deviation	Minimum	Maximum	Location of Max	% ND	Screened into HHRA?	Notes
1,1-Dichloroethane	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
1,2-Dichloroethane	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.002	ug/g	27	0.00	0.002	<0.002	<0.01	-	100	no (ND)	
1,1-Dichloroethene	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
cis-1,2-Dichloroethene	soil	2.5 (fine), 1.9 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	25	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
trans-1,2-Dichloroethene	soil	0.75 (fine), 0.084 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	27	0.01	1.77E-18	<0.01	<0.01	-	100	no (ND)	
Dichloromethane	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
1,2-Dichloropropane	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
cis-1,3-Dichloropropene	soil	0.081 (fine), 0.05 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	27	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
trans-1,3-Dichloropropene	soil	0.081 (fine), 0.05 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	27	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
Ethylene dibromide	soil	0.05	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	25	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
2-Hexanone	soil	NC	NC	0.1	ug/g	25	0.100	2.83E-17	<0.1	<0.1	-	100	no (ND)	* all sample concentrations are non-detect, as such this parameter has not been included as a soil COPC.
Methyl ethyl ketone	soil	44 (fine), 16 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.1	ug/g	25	0.100	2.83E-17	<0.1	<0.1	-	100	no (ND)	
Methyl isobutyl ketone	soil	4.3 (fine), 1.7 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.1	ug/g	25	0.100	2.83E-17	<0.1	<0.1	-	100	no (ND)	
Methyl tert-butyl ether	soil	0.044 (Fine) DUA	AENV,2010. Table 2.	0.01	ug/g	25	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
1,1,1,2-Tetrachloroethane	soil	0.05 (fine), 0.058 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	25	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
1,1,2,2-Tetrachloroethane	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.011	0.003	<0.01	<0.02	-	100	no (ND)	
Tetrachloroethene	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	26	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
1,2,4-Trichlorobenzene	soil	0.05	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	25	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
1,1,1-Trichloroethane	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
1,1,2-Trichloroethane	soil	0.1	CCME AL Soil Quality Guidelines,2011	0.01	ug/g	27	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
Trichloroethene	soil	0.01	CCME AL Soil Quality Guidelines,2011	0.005	ug/g	27	0.005	0.001	<0.005	<0.01	-	100	no (ND)	
Trichlorofluoromethane	soil	5.8 (fine), 4 (coarse)	OMOE, AL Land Use, 2009. Table 2.	0.01	ug/g	25	0.010	1.77E-18	<0.01	<0.01	-	100	no (ND)	
Vinyl chloride	soil	0.00034 (Coarse), 0.0083 (Fine) (VI)	AENV,2010. Table 2.	0.0002	ug/g	25	0.0002	2.77E-20	<0.0002	<0.0002	-	100	no (ND)	

NC-No Criteria Available for this parameter
CCME AL Soil Quality Guidelines, 2011= CCME Soil Quality Guidelines for the Protection of Human Health and the Environment (Agricultural Land Use, Coarse and Fine Soils), January 2011 Update
CCME AL SoQG for PAH, CCME 2010= CCME Soil Quality Guidelines for the Protection of Human Health and the Environment (2010) Update Fact Sheet
TPE=B[a]P Total Potency Equivalent for the protection of humans from direct contact with contaminated soil (carcinogenic effects)
IACR= Index of Additive cancer Risk (IACR) to ensure that potable water resources are protected from carcinogenic effects
AENV, 2010. Table 2.-Alberta Environment, 2010 Update. Table 2. Surface Soil Remediation Guidelines for Agricultural Land Use-All Exposure Pathways (Guideline chosen is the lowest of Human Health Direct Contact(DC), Slab and Basement Vapour Inhalation (VI), and Domestic Use Aquifer Guidelines (DUA))
CWS PHC AL Use , 2008= CCME Canada Wide Standards for Petroleum Hydrocarbons in Soil, Technical Supplement, January 2008 Update. Tables 2 (Fine soil) and 3(Coarse Soil). for Agricultural Land Use. The lowest guideline of all pathways included in land use was chosen.
OMOE, 2009. Table 2.= Ontario Ministry of Environment, Soil, Groundwater, and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. July 2009 Update. Table 2. Full Depth Generic Site Condition Soil Standards (Agricultural Land Use), in a Potable Groundwater Condition.
BC CSR Schedule 5 (AL Land Use, Human Health)= British Columbia Contaminated Sites Regulation Schedule 5. Matrix Numerical Soil Standards (AL Land Use, Human Health Protection, lowest of Intake of Contaminated Soil and Groundwater used for Drinking Water Factors, includes amendment 343/2008.

Human Health (PQRA) Summary Screening Table for Groundwater

Parameter	Media	HHRA Screening Criteria	HHRA Screening Criteria Source	MDL	Units	Number of Samples	Average	Standard Deviation	Minimum	Maximum	Location of Max	% ND	Screened into HHRA?	Notes
Conventionals														
Hardness (CaCO3)	groundwater	NC	NC	1000	ug/L	12	389916.67	125180.89	354000	800000	-		no	* Hardness component concentrations in groundwater (Mg, Ca,) are evaluated individually.
pH	groundwater	6.5-8.5	Health Canada DWQ Guidelines, 2010	NA		12	7.97	0.18	7.71	8.2	-	0	no	
Conductivity	groundwater	NC	NC	1	uS/cm	12	797.67	163.71	686	1310	-	0	no	*not chemical parameters under evaluation as a groundwater COPC
Ion balance	groundwater	NC	NC	NA	%	12	98.49	5.05	91.3	111	-	0	no	*not chemical parameters under evaluation as a groundwater COPC
Alkalinitys														
Bicarbonate	groundwater	NC	NC	5000	ug/L	12	464500.00	137940.37	391000	899000	-	0	no	* See report rationale for screening alkalinity and related parameters out as groundwater COPC
Carbonate	groundwater	NC	NC	5000	ug/L	12	5000.00	0.00	<5000	<5000	-	100	no (ND)	* all samples are nondetect for this parameter. As such the parameter has not been included as a groundwater COPC
Hydroxide	groundwater	NC	NC	5000	ug/L	12	5000.00	0.00	<5000	<5000	-	100	no (ND)	* all samples are nondetect for this parameter. As such the parameter has not been included as a groundwater COPC
Alkalinity, Carbonate	groundwater	NC	NC	5000	ug/L	12	383090.91	118315.22	320000.0	737000.0	-	0	no	* See report rationale for screening alkalinity and related parameters out as groundwater COPC.
Anions														
Chloride ion	groundwater	250000	Health Canada DWQ Guidelines, 2010	1000	ug/L	12	5608.33	1402.89	4000.0	9000.0	-	0	no	
Fluoride	groundwater	1500	Health Canada DWQ Guidelines, 2010	50	ug/L	9	186.67	48.99	70.0	250.0	-	0	no	
Sulphate (SO4)	groundwater	500 000	Health Canada DWQ Guidelines, 2010	1000	ug/L	12	74108.33	20163.22	48000.0	111000	-	0	no	
Glycols														
Diethylene glycol	groundwater	370	BC CSR, Schedule 10, DW	10000	ug/L	10	10000.00	0.00	<10000	<10000	-	100	no (ND)	
Ethylene glycol	groundwater	15000 to 18000	BC CSR, Schedule 10, DW	10000	ug/L	10	10000.00	0.00	<10000	<10000	-	100	no (ND)	
Propylene glycol	groundwater	18000	BC CSR, Schedule 10, DW	10000	ug/L	10	10000.00	0.00	<10000	<10000	-	100	no (ND)	
Tetraethylene glycol	groundwater	NC	NC	10000	ug/L	10	10000.00	0.00	<10000	<10000	-	100	no (ND)	*all sample concentrations are non-detect for this parameter and related glycol parameters which do have screening values. As such this parameter has not been included as a groundwater COPC.
Triethylene glycol	groundwater	60000	AENV, December 2010, Table 2. (AL Land Use)	10000	ug/L	10	10000.00	0.00	<10000	<10000	-	100	no (ND)	
Monocyclic Aromatic Hydrocarbons											-			
Benzene	groundwater	5	Health Canada DWQ Guidelines, 2010	0.5	ug/L	16	0.50	0.00	<0.5	<0.5	-	100	no (ND)	
Ethylbenzene	groundwater	2.4	Health Canada DWQ Guidelines, 2010	0.5	ug/L	16	0.50	0.00	<0.5	<0.5	-	100	no (ND)	
Styrene	groundwater	5.4	OMOE, 2009, Table 2.	1	ug/L	13	1.00	0.00	<1	<1	-	100	no (ND)	
Toluene	groundwater	24	Health Canada DWQ Guidelines, 2010	0.5	ug/L	16	0.50	0.00	<0.5	<0.5	-	100	no (ND)	
m+p-Xylene	groundwater	300	Health Canada DWQ Guidelines, 2010	0.5	ug/L	13	0.50	0.00	<0.5	<0.5	-	100	no (ND)	
o-Xylene	groundwater	300	Health Canada DWQ Guidelines, 2010	0.5	ug/L	13	0.50	0.00	<0.5	<0.5	-	100	no (ND)	
Xylenes (total)	groundwater	300	Health Canada DWQ Guidelines, 2010	0.5	ug/L	13	0.50	0.000	<0.5	<0.5	-	100	no (ND)	
Metals														
Dissolved Aluminum	groundwater	200 (OG/AO)	Health Canada DWQ Guidelines, 2010	2 to 11	ug/L	16	18.5	147.87196	2	534	-	56.25	no	* See report rationale for screening dissolved aluminum out as a groundwater COPC.
Dissolved Antimony	groundwater	6	Health Canada DWQ Guidelines, 2010	0.1 to 4	ug/L	16	0.55	0.85	<0.1	<4	-	100	no (ND)	
Dissolved Arsenic	groundwater	10	Health Canada DWQ Guidelines, 2010	0.4 to 1	ug/L	16	6.67	4.09	<0.4	**14**	**2018-10BH-5M**	6.25	**YES**	
Dissolved Barium	groundwater	1000	Health Canada DWQ Guidelines, 2010	50	ug/L	16	354.50	88.45	61	420	-	0	no	
Dissolved Beryllium	groundwater	4	OMOE, 2009, Table 2.	0.5	ug/L	16	0.75	0.54	<0.5	2.5	-	93.75	no	
Dissolved Boron	groundwater	5000	Health Canada DWQ Guidelines, 2010	10	ug/L	16	33.00	13.80	16	80	-	31.25	no	
Dissolved Cadmium	groundwater	5	Health Canada DWQ Guidelines, 2010	0.016	ug/L	16	0.03	0.51	<0.016	2.1	-	62.50	no	
Dissolved Calcium	groundwater	NC	NC	300	ug/L	15	106000.00	37050.14	78200	247000	-	0	no	* See report rationale for screening dissolved calcium out as a groundwater COPC.
Dissolved Chromium (Total)	groundwater	50	Health Canada DWQ Guidelines, 2010	0.5 to 1	ug/L	16	0.75	1.63	<0.5	5	-	87.50	no	
Dissolved Cobalt	groundwater	3.8	OMOE, 2009, Table 2.	1	ug/L	16	1.22	0.48	<1	2	-	18.75	no	
Dissolved Copper	groundwater	1000	Health Canada DWQ Guidelines, 2010	2	ug/L	16	2.64	4.21	<2	17.7	-	62.50	no	
Dissolved Iron	groundwater	300	Health Canada DWQ Guidelines, 2010	5-100	ug/L	16	4015.00	12253.70	<5	51000	-	12.50	no	* See report rationale for screening out dissolved iron as a groundwater COPC.
Dissolved Lead	groundwater	10	Health Canada DWQ Guidelines, 2010	1	ug/L	16	0.55	0.50	0.1	2	-	81.25	no	
Dissolved Magnesium	groundwater	100000	BC CSR, Schedule 6, DW	200	ug/L	15	26550.00	4645.40	24500	44600	-	0	no	
Dissolved Manganese	groundwater	50	Health Canada DWQ Guidelines, 2010	5	ug/L	16	296.50	177.86	43	737	-	0	no	* See report rationale for screening out dissolved iron as a groundwater COPC.
Dissolved Mercury	groundwater	1	Health Canada DWQ Guidelines, 2010	0.022 to 0.1	ug/L	10	0.030	0.02467	<0.022	0.1	-	100	no	
Dissolved Molybdenum	groundwater	70	OMOE, 2009, Table 2.	3	ug/L	16	1.93	3.27	0.76	15	-	81.25	no	
Dissolved Nickel	groundwater	100	OMOE, 2009, Table 2.	10	ug/L	16	5.92	3.28	1.83	10	-	56.25	no	
Dissolved Selenium	groundwater	10	Health Canada DWQ Guidelines, 2010	0.6 to 1	ug/L	16	5.90	2.58	<0.6	10.8	-	43.75	no	* The well location for this exceeding Se concentration was sampled three times. Groundwater concentrations exceeded the guideline for selenium once in 2008, and was subsequently sampled and compliant twice (2008 and 2010 thereafter. Based on this information dissolved selenium has not been included as a groundwater COPC in the risk assessment.
Dissolved Silver	groundwater	1.5	OMOE, 2009, Table 2.	0.01 to 0.05	ug/L	16	0.03	0.02	<0.01	0.1	-	93.75	no	
Dissolved Sodium	groundwater	200 000	Health Canada DWQ Guidelines, 2010	600	ug/L	15	9150.00	11895.13	7200	55700	-	0	no	
Dissolved Thallium	groundwater	2	OMOE, 2009, Table 2.	0.1 to 0.5	ug/L	16	0.30	0.18	<0.1	<0.5	-	100	no (ND)	
Dissolved Tin	groundwater	22000	BC CSR, Schedule 10, DW	0.1 to 50	ug/L	16	0.55	19.8131848	<0.1	<50	-	100	no (ND)	
Dissolved Titanium	groundwater	NC	NC	1	ug/L	16	1.55	7.05	1	27	-	37.50	no	* See report rationale for screening out dissolved titanium as a groundwater COPC.
Dissolved Uranium	groundwater	20	Health Canada DWQ Guidelines, 2010	1	ug/L	16	2.42	2.244	1	9.7	-	6.25	no	
Dissolved Vanadium	groundwater	6.2	OMOE, 2009, Table 2.	1	ug/L	16	1.00	1.3663	<1	<5	-	100	no (ND)	
Dissolved Zinc	groundwater	5000	Health Canada DWQ Guidelines, 2010	1	ug/L	16	47.90	26.22	1	93.8	-	0	no	

Human Health (PQRA) Summary Screening Table for Groundwater

Parameter	Media	HHRA Screening Criteria	HHRA Screening Criteria Source	MDL	Units	Number of Samples	Average	Standard Deviation	Minimum	Maximum	Location of Max	% ND	Screened into HHRA?	Notes
Nutrients					ug/L									
Nitrate (as N)	groundwater	10 000	Health Canada DWQ Guidelines, 2010	113	ug/L	12	525.00	876.45	500	3300	-	33.33	no	
Nitrate plus Nitrite (as N)	groundwater	10 000	Health Canada DWQ Guidelines, 2010	113	ug/L	12	331.50	289.45	113	900	-	33.33	no	
Nitrite (as N)	groundwater	3200	Health Canada DWQ Guidelines, 2010	15	ug/L	12	32.50	15.83	<15	<50	-	100	no (ND)	
Dissolved Potassium	groundwater	NC	NC	600	ug/L	15	3315.00	872.68	1300	5100	-	0	no	* See report rationale for screening out dissolved potassium as a groundwater COPC.
Total Nitrogen	groundwater	NC	NC	50	ug/L	9	680.00	657.833	590	2730	-	0	no	* Nitrogen is a component of all living things, total nitrogen content is mainly used to support descriptions of water quality affecting aquatic life. Toxicity to humans from exposure to related parameter groups (nitrates and nitrites) are evaluated against separate guidelines. Total nitrogen is not included as a groundwater COPC.
Polycyclic Aromatic Hydrocarbons														
Acenaphthene	groundwater	4.1	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Acenaphthylene	groundwater	1	OMOE, 2009, Table 2.	0.01	ug/L	10	0.01	1.83E-18	<0.01	<0.01	-	100	no (ND)	
Acridine	groundwater	NC	NC	0.01 to 0.05	ug/L	13	0.05	1.75E-02	<0.01	<0.05	-	100	no (ND)	*all samples are non-detect for this parameter and related MAH/PAH parameters which do have guideline screening values. As such this parameter has not been included as a groundwater COPC.
Anthracene	groundwater	2.4	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Benzo[a]anthracene	groundwater	1	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Benzo[a]pyrene	groundwater	0.01	Health Canada DWQ Guidelines, 2010	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Benzo[b+j]fluoranthene	groundwater	0.1	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Benzo[ghi]perylene	groundwater	0.2	OMOE, 2009, Table 2.	0.01	ug/L	10	0.01	1.83E-18	<0.01	<0.01	-	100	no (ND)	
Benzo[k]fluoranthene	groundwater	0.1	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Chrysene	groundwater	0.1	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Dibenzo[a,h]anthracene	groundwater	0.2	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Fluoranthene	groundwater	0.41	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.8056E-18	<0.01	<0.01	-	100	no (ND)	
Fluorene	groundwater	120	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Indeno[1,2,3-cd]pyrene	groundwater	0.2	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
2-Methylnaphthalene	groundwater	3.2	OMOE, 2009, Table 2.	0.01	ug/L	10	0.01	1.83E-18	<0.01	<0.01	-	100	no (ND)	
Naphthalene	groundwater	11	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.81E-18	<0.01	<0.01	-	100	no (ND)	
Phenanthrene	groundwater	1	OMOE, 2009, Table 2.	0.01	ug/L	13	0.01	1.806E-18	<0.01	<0.01	-	100	no (ND)	
Pyrene	groundwater	4.1	OMOE, 2009, Table 2.	0.01 to 0.02	ug/L	13	0.01	2.77E-03	<0.01	<0.02	-	100	no (ND)	
Quinoline	groundwater	0.022	USEPA Region 9, November 2010, Tapwater.	0.01	ug/L	13	0.10	3.95E-02	<0.01	<0.01	-	100	no (ND)	*all samples are non-detect for this parameter and related MAH/PAH parameters which do have guideline screening values. As such this parameter has not been included as a groundwater COPC.
Petroleum Hydrocarbons														
F1 (C6-C10)	groundwater	750	OMOE, 2009, Table 2.	100	ug/L	13	100.00	0.00	<100	<100	-	100	no (ND)	
F1 (C6-C10) minus BTEX	groundwater	750	OMOE, 2009, Table 2.	100	ug/L	13	100.00	0.00	<100	<100	-	100	no (ND)	
F2 (C10-C16)	groundwater	150	OMOE, 2009, Table 2.	100	ug/L	13	75.00	21.93	<100	<100	-	100	no (ND)	
F3 (C16-C34)	groundwater	500	OMOE, 2009, Table 2.	100	ug/L	10	100.00	0.00	<100	<100	-	100	no (ND)	
F4 (C34-C50)	groundwater	500	OMOE, 2009, Table 2.	100	ug/L	10	100.00	0.00	<100	<100	-	100	no (ND)	
Volatile Organic Compounds														
Bromodichloromethane	groundwater	16	Health Canada DWQ Guidelines, 2010	1	ug/L	10	1.00	0.00	<1	<1	-	100	no (ND)	
Bromoform	groundwater	100	Health Canada DWQ Guidelines, 2010	1	ug/L	10	1.00	0.00	<1	<1	-	100	no (ND)	
Bromomethane	groundwater	51	BC CSR, Schedule 10, DW	1	ug/L	10	1.00	0.00	<1	<1	-	100	no (ND)	
Carbon tetrachloride	groundwater	5	Health Canada DWQ Guidelines, 2010	0.5 t o1	ug/L	13	0.50	0.22	<0.5	1	-	100	no (ND)	
Chlorobenzene	groundwater	30	Health Canada DWQ Guidelines, 2010	1	ug/L	13	1.000	0.00	<1	<1	-	76.92	no (ND)	
Chlorodibromomethane	groundwater	100	Health Canada DWQ Guidelines, 2010	1	ug/L	10	1.000	0.00	<1	<1	-	100	no (ND)	
Chloroethane	groundwater	46	BC CSR, Schedule 10, DW	1	ug/L	10	1.000	0.00	<1	<1	-	100	no (ND)	
Chloroform	groundwater	2.4	OMOE, 2009, Table 2.	1	ug/L	13	1.000	0.00	<1	<1	-	100	no (ND)	
Chloromethane	groundwater	950	BC CSR, Schedule 10, DW	1	ug/L	10	1.000	0.00	<1	<1	-	100	no (ND)	
1,2-Dichlorobenzene	groundwater	200	Health Canada DWQ Guidelines, 2010	0.5 to 1	ug/L	13	0.500	0.22	<0.5	<1	-	100	no (ND)	
1,3-Dichlorobenzene	groundwater	59	OMOE, 2009, Table 2.	0.5 to 1	ug/L	13	0.500	0.22	<0.5	<1	-	100	no (ND)	
1,4-Dichlorobenzene	groundwater	5	Health Canada DWQ Guidelines, 2010	0.5 t o1	ug/L	13	0.500	0.22	<0.5	<1	-	100	no (ND)	
1,1-Dichloroethane	groundwater	5	OMOE, 2009, Table 2.	1	ug/L	12	1.000	0.00	<1	<1	-	100	no (ND)	
1,2-Dichloroethane	groundwater	5	Health Canada DWQ Guidelines, 2010	1	ug/L	13	1.000	0.00	<1	<1	-	100	no (ND)	
1,1-Dichloroethene	groundwater	14	Health Canada DWQ Guidelines, 2010	1	ug/L	13	1.000	0.00	<1	<1	-	100	no (ND)	
cis-1,2-Dichloroethene	groundwater	1.6	OMOE, 2009, Table 2.	1	ug/L	10	1.000	0.00	<1	<1	-	100	no (ND)	
trans-1,2-Dichloroethene	groundwater	1.6	OMOE, 2009, Table 2.	1	ug/L	13	1.000	0.00	<1	<1	-	100	no (ND)	
Dichloromethane	groundwater	50	Health Canada DWQ Guidelines, 2010	1	ug/L	13	1.000	0.00	<1	<1	-	100	no (ND)	
1,2-Dichloropropane	groundwater	9.9	BC CSR, Schedule 10, DW	1	ug/L	13	1.000	0.00	<1	<1	-	100	no (ND)	

Parameter	Media	HHRA Screening Criteria	HHRA Screening Criteria Source	MDL	Units	Number of Samples	Average	Standard Deviation	Minimum	Maximum	Location of Max	% ND	Screened into HHRA?	Notes
cis-1,3-Dichloropropene	groundwater	0.5	OMOE, 2009, Table 2.	1	ug/L	13	0.300	0.31	<0.3	<1	-	100	no (ND)	*all sample concentrations are non-detect for this parameter, only 3 of 13 samples have detection limits above the guideline, all wells sampled with detection limits above the guideline were subsequently resampled with lowered detection limits, all other analysis for VOC parameters in groundwater were non-detect for all samples. Based on the abovementioned rationale this parameter has not been included as a groundwater COPC in th HHRA.
trans-1,3-Dichloropropene	groundwater	0.5	OMOE, 2009, Table 2.	1	ug/L	13	0.300	0.31	<0.3	<1	-	100	no (ND)	*all sample concentrations are non-detect for this parameter, only 3 of 13 samples have detection limits above the guideline, all wells sampled with detection limits above the guideline were subsequently resampled with lowered detection limits, all other analysis for VOC parameters in groundwater were non-detect for all samples. Based on the abovementioned rationale this parameter has not been included as a groundwater COPC in th HHRA.
Ethylene dibromide	groundwater	0.34	BC CSR, Schedule 10, DW	1	ug/L	10	0.3000	0.31	<0.3	<1	-	100	no (ND)	*all sample concentrations are non-detect for this parameter, only 3 of 13 samples have detection limits above the guideline, all wells sampled with detection limits above the guideline were subsequently resampled with lowered detection limits, all other analysis for VOC parameters in groundwater were non-detect for all samples. Based on the abovementioned rationale this parameter has not been included as a groundwater COPC in th HHRA.
Methyl tert-butyl ether	groundwater	15	Health Canada DWQ Guidelines, 2010	1	ug/L	10	1.00	0.00	<1	<1	-	100	no (ND)	
1,1,1,2-Tetrachloroethane	groundwater	26	BC CSR, Schedule 10, DW	1	ug/L	10	1.00	0.00	<1	<1	-	100	no (ND)	
1,1,2,2-Tetrachloroethane	groundwater	3.4	BC CSR, Schedule 10, DW	1 to 2	ug/L	13	1.00	0.44	<1	<2	-	100	no (ND)	
Tetrachloroethene	groundwater	30	Health Canada DWQ Guidelines, 2010	1	ug/L	13	1.00	0.00	<1	<1	-	100	no (ND)	
1,1,1-Trichloroethane	groundwater	200	OMOE, 2009, Table 2.	1	ug/L	13	1.00	0.00	<1	<1	-	100	no (ND)	
1,1,2-Trichloroethane	groundwater	4.7	OMOE, 2009, Table 2.	1	ug/L	13	1.00	0.00	<1	<1	-	100	no (ND)	
Trichloroethene	groundwater	5	Health Canada DWQ Guidelines, 2010	1	ug/L	13	1.00	0.00	<1	<1	-	100	no (ND)	
Trichlorofluoromethane	groundwater	150	OMOE, 2009, Table 2.	1	ug/L	10	1.00	0.00	<1	<1	-	100	no (ND)	
Vinyl chloride	groundwater	2	Health Canada DWQ Guidelines, 2010	1	ug/L	10	1.00	0.00	<1	<1	-	100	no (ND)	
Other														
Acetone	groundwater	33000	BC CSR, Schedule 10, DW	10	ug/L	10	10.00	0.00	<10	<10	-	100	no (ND)	
Calculated TDS	groundwater	500000	Health Canada DWQ Guidelines, 2010	1000	ug/L	12	407000.00	112276.31	394000	823000	-	0	no	* see report rationale for screening this parameter out as a groundwater COPC.
2-Hexanone	groundwater	47	USEPA Region 9, November 2010, Tapwater.	10	ug/L	10	10.00	0.00	<10	<10	-	100	no (ND)	
Methyl ethyl ketone	groundwater	22000	BC CSR, Schedule 10, DW	10	ug/L	10	10.00	0.00	<10	<10	-	100	no (ND)	
Methyl isobutyl ketone	groundwater	2900	BC CSR, Schedule 10, DW	10	ug/L	10	10.00	0.00	<10	<10	-	100	no (ND)	
1,2,4-Trichlorobenzene	groundwater	70	OMOE, 2009, Table 2.	10	ug/L	10	1.00	0.00	<1	<1	-	100	no (ND)	

Health Canada, DWQ, 2010= Health Canada Guidelines for Canadian Drinking Water Quality, December 2010 Update
BC CSR Schedule 10, DW- BC CSR Contaminated Sites Regulation, Schedule 10, Drinking Water Standard amendments up to B.C. Reg. 286/2010, October 4, 2010.
USEPA Region 9, November 2010- USEPA Regional Screening Level (RSL) Master Summary Table, Tapwater Standards, November 2010 Update
OMOE, 2009 , Table 2.= Ontario Ministry of the Environment, Soil, Groundwater, and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, July 27, 2009. Table 2: Full Depth Generic Site Condition Standards in a Potable Groundwater Condition, for All types of Property Use
Environmental Canada, Compendium of Environmental Quality Benchmarks, 1999-Appendix 2-1 Available Water Quality Criteria and Guidelines for the Protection of Human Health (Water Supplies)
AENV, December 2010, Table 2. (AL Land Use)- Alberta Environment, Soil and Groundwater Remediation Guidelines, December 2010 Update. Table 2.Alberta Tier 1 Groundwater Remediation Guidelines (Agricultural Land Use).
BC CSR Schedule 10, DW- BC CSR Contaminated Sites Regulation, Schedule 6, Drinking Water Standard amendments up to B.C. Reg. 286/2010, October 4, 2010.

Scenario A:
Current
“Transient and Recreational”
Exposure Scenario

Toddler (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	File #:	2018-1001
Date:		Comment:	Rec_toddler (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	Yes	Yes
Other	Yes	No
specify:	Recreational _toddler	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Recreational _toddler

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type		Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Toddler	Toddler
Body weight (kg)	16.5	16.5
Soil ingestion rate (g/d)	0.08	0.08
Inhalation rate (m^3/d)	9.3	9.3
Water ingestion rate (L/d)	0.6	0.6
Skin surface area (cm^2)		
- hands	430	430
- arms	890	890
- legs	1690	1690
- total	3010	6130
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	0	105
- other vegetables	0	67
- fish	0	95
- wild game	0	85
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Recreational _toddler	Defaults
Hours per day (indoors)	0	22.5
Hours per day (outdoors)	2	1.5
Days per week	2	7
Weeks per year	35	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	4.5	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_toddler (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		5.10E-02	6.53E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		3.66E-07	4.29E-08	NA	NA	NA	NA
Hazard Index - Total		5.10E-02	6.53E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		8.81E-08	NA	NA	NA	NA	NA
Cancer Risk - Dermal		2.26E-08	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.11E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		7.02E-11	3.36E-11	NA	NA	NA	NA
Cancer Risk - Total		1.11E-07	3.36E-11	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Toddler**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_toddler (chronic)
Exposure Scenario:	**Recreational _t**		
Native population considered			
Cancer Risks Calculated?	**No**		

User-Defined Receptor Characteristics		
Body weight (kg): 16.5	Skin surface area (cm2) - hands: 430	
Soil ingestion rate (g/d): 0.08	- arms: 890	Food ingestion rates (g/d)
Inhalation rate (m3/d): 9.3	- legs: 1690	Root vegetables: 0
Water ingestion rate (L/d): 0.6	- total: 3010	Other vegetables: 0
	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 0
	- other: 0.00001	Wild game: 0

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	1.94872E-10	6.08974E-11	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil	1.49E-05	4.66E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	1.10E-10	3.43E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	3.85E-07	5.61E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	1.49E-05	4.66E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	3.85E-07	5.61E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	1.53E-05	5.22E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	1.10E-10	3.43E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	1.53E-05	5.22E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		5.10E-02	6.53E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		3.66E-07	4.29E-08	NA	NA	NA	NA
Hazard Index - Total		5.10E-02	6.53E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario A:
Current
“Transient and Recreational”
Exposure Scenario

Toddler (acute)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Current "Transient/Recreational" Land Use	File #:	2018-1001
Date:		Comment:	Rec_toddler (acute)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	Yes	Yes
Other	Yes	No
specify:	Recreational _toddler	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	Yes	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Recreational _toddler

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type		Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Toddler	Toddler
Body weight (kg)	16.5	16.5
Soil ingestion rate (g/d)	0.08	0.08
Inhalation rate (m^3/d)	9.3	9.3
Water ingestion rate (L/d)	0.6	0.6
Skin surface area (cm^2)		
- hands	430	430
- arms	890	890
- legs	1690	1690
- total	3010	6130
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	0	105
- other vegetables	0	67
- fish	0	95
- wild game	0	85
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Recreational _toddler	Defaults
Hours per day (indoors)	0	22.5
Hours per day (outdoors)	2	1.5
Days per week	2	7
Weeks per year	1	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	0.019	60
Years for carcinogen amortization	0.019	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient/Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_toddler (acute)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		1.46E-03	1.87E-04	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.05E-08	1.23E-09	NA	NA	NA	NA
Hazard Index - Total		1.46E-03	1.87E-04	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		4.48E-08	NA	NA	NA	NA	NA
Cancer Risk - Dermal		1.15E-08	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		5.63E-08	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		3.56E-11	1.71E-11	NA	NA	NA	NA
Cancer Risk - Total		5.63E-08	1.71E-11	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Toddler**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient/Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_toddler (acute)

Exposure Scenario:	**Recreational _t**	**User-Defined Receptor Characteristics**	Skin surface area (cm2) - hands: 430	
Native population considered		Body weight (kg): 16.5	- arms: 890	Food ingestion rates (g/d)
Cancer Risks Calculated?	**No**	Soil ingestion rate (g/d): 0.08	- legs: 1690	Root vegetables: 0
		Inhalation rate (m3/d): 9.3	- total: 3010	Other vegetables: 0
		Water ingestion rate (L/d): 0.6	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 0
			- other: 0.00001	Wild game: 0

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	5.56777E-12	1.73993E-12	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil	4.26E-07	1.33E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	3.14E-12	9.81E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	1.10E-08	1.60E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	4.26E-07	1.33E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	1.10E-08	1.60E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	4.37E-07	1.49E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	3.14E-12	9.81E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	4.37E-07	1.49E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		1.46E-03	1.87E-04	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.05E-08	1.23E-09	NA	NA	NA	NA
Hazard Index - Total		1.46E-03	1.87E-04	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario A:
Current
“Transient and Recreational”
Exposure Scenario

Child (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	File #:	2018-1001
Date:		Comment:	Rec_child (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	Yes	Yes
Other	Yes	No
specify:	Recreational _child	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Recreational _child

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type		Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Child	Toddler
Body weight (kg)	32.9	32.9
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	14.5	14.5
Water ingestion rate (L/d)	0.8	0.8
Skin surface area (cm^2)		
- hands	590	590
- arms	1480	1480
- legs	3070	3070
- total	5140	10140
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	161	161
- other vegetables	98	98
- fish	170	170
- wild game	125	125
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Recreational _child	Defaults
Hours per day (indoors)	0	22.5
Hours per day (outdoors)	2	1.5
Days per week	2	7
Weeks per year	35	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	7	60
Years for carcinogen amortization	80	60

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Child**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_child (chronic)

Exposure Scenario:	**Recreational _c**	**User-Defined Receptor Characteristics**	Skin surface area (cm2) - hands: 590	
Native population considered		Body weight (kg): 32.9	- arms: 1480	Food ingestion rates (g/d)
Cancer Risks Calculated?	**No**	Soil ingestion rate (g/d): 0.02	- legs: 3070	Root vegetables: 161
		Inhalation rate (m3/d): 14.5	- total: 5140	Other vegetables: 98
		Water ingestion rate (L/d): 0.8	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 170
			- other: 0.00001	Wild game: 125

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	1.94872E-10	6.08974E-11	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil	1.87E-06	5.85E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	8.59E-11	2.68E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	2.93E-07	4.28E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	1.87E-06	5.85E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	2.93E-07	4.28E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	2.16E-06	1.01E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	8.59E-11	2.68E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	2.16E-06	1.01E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		7.21E-03	1.27E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		2.86E-07	3.35E-08	NA	NA	NA	NA
Hazard Index - Total		7.21E-03	1.27E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_child (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		5.10E-02	6.53E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		3.66E-07	4.29E-08	NA	NA	NA	NA
Hazard Index - Total		5.10E-02	6.53E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		1.37E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		3.52E-08	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.72E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		1.09E-10	5.22E-11	NA	NA	NA	NA
Cancer Risk - Total		1.72E-07	5.22E-11	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

Scenario A:
Current
“Transient and Recreational”
Exposure Scenario

Teen (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	File #:	2018-1001
Date:		Comment:	Rec_teen (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	Yes	Yes
Other	Yes	No
specify:	Recreational _teen	

Exposure Scenario		Recreational _teen

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Active Critical Receptors (Yes/No)		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type		Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Teen	Toddler
Body weight (kg)	59.7	59.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	15.8	15.8
Water ingestion rate (L/d)	1	1
Skin surface area (cm^2)		
- hands	800	800
- arms	2230	2230
- legs	4970	4970
- total	8000	15470
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	227	227
- other vegetables	120	120
- fish	200	200
- wild game	175	175
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Recreational _teen	Defaults
Hours per day (indoors)	0	22.5
Hours per day (outdoors)	2	1.5
Days per week	2	7
Weeks per year	35	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	8	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_teen (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		5.10E-02	6.53E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		3.66E-07	4.29E-08	NA	NA	NA	NA
Hazard Index - Total		5.10E-02	6.53E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		1.57E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		4.02E-08	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.97E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		1.25E-10	5.97E-11	NA	NA	NA	NA
Cancer Risk - Total		1.97E-07	5.97E-11	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Teen**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_teen (chronic)
Exposure Scenario:	**Recreational _t**		
Native population considered			
Cancer Risks Calculated?	**No**		

User-Defined Receptor Characteristics

Body weight (kg): 59.7	Skin surface area (cm2) - hands: 800	
Soil ingestion rate (g/d): 0.02	- arms: 2230	Food ingestion rates (g/d)
Inhalation rate (m3/d): 15.8	- legs: 4970	Root vegetables: 227
Water ingestion rate (L/d): 1	- total: 8000	Other vegetables: 120
	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 200
	- other: 0.00001	Wild game: 175

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	1.94872E-10	6.08974E-11	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil	1.03E-06	3.22E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	5.16E-11	1.61E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	2.35E-07	3.43E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	1.03E-06	3.22E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	2.35E-07	3.43E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	1.27E-06	6.65E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	5.16E-11	1.61E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	1.27E-06	6.65E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		4.22E-03	8.31E-04	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.72E-07	2.01E-08	NA	NA	NA	NA
Hazard Index - Total		4.22E-03	8.31E-04	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario A:
Current
“Transient and Recreational”
Exposure Scenario

Adult (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	File #:	2018-1001
Date:		Comment:	Rec_adult (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	No	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	Yes	Yes
Other	Yes	No
specify:	Recreational _adult	

Exposure Scenario		Recreational _adult

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Active Critical Receptors (Yes/No)		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type		Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	15.8	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	9110	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	188	188
- other vegetables	137	137
- fish	220	220
- wild game	270	270
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	Recreational _adult	Defaults
Hours per day (indoors)	0	22.5
Hours per day (outdoors)	2	1.5
Days per week	2	7
Weeks per year	35	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	80	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_adult (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		5.10E-02	6.53E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		3.66E-07	4.29E-08	NA	NA	NA	NA
Hazard Index - Total		5.10E-02	6.53E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		1.57E-06	NA	NA	NA	NA	NA
Cancer Risk - Dermal		4.02E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.97E-06	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		1.25E-09	5.97E-10	NA	NA	NA	NA
Cancer Risk - Total		1.97E-06	5.97E-10	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Current "Transient Recreational" Land Use	**File #:**	2018-1001
Date:		**Comment:**	Rec_adult (chronic)

Exposure Scenario:	**Recreational _a**	**User-Defined Receptor Characteristics**	Skin surface area (cm2) - hands: 890	
Native population considered		Body weight (kg): 70.7	- arms: 2500	Food ingestion rates (g/d)
Cancer Risks Calculated?	**Yes**	Soil ingestion rate (g/d): 0.02	- legs: 5720	Root vegetables: 188
		Inhalation rate (m3/d): 15.8	- total: 9110	Other vegetables: 137
		Water ingestion rate (L/d): 1.5	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 220
			- other: 0.00001	Wild game: 270

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	42.9	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	9.8	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		unit risk	unit risk	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	1.94872E-10	6.08974E-11	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil	8.70E-07	2.72E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	4.35E-11	1.36E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	2.24E-07	3.26E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	8.70E-07	2.72E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	2.24E-07	3.26E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	1.09E-06	5.98E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	4.35E-11	1.36E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	1.09E-06	5.98E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		3.65E-03	7.47E-04	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.45E-07	1.70E-08	NA	NA	NA	NA
Hazard Index - Total		3.65E-03	7.47E-04	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		1.57E-06	NA	NA	NA	NA	NA
Cancer Risk - Dermal		4.02E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.97E-06	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		1.25E-09	5.97E-10	NA	NA	NA	NA
Cancer Risk - Total		1.97E-06	5.97E-10	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario B:
Potential Future
"Homestead with Potable GW"
Exposure Scenario

Toddler (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW" site use	File #:	2018-1001
Date:		Comment:	Ag_toddler (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Agricultural _Toddler	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	Yes	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	Yes	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Agricultural _Toddler

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	Yes	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Toddler	Toddler
Body weight (kg)	16.5	16.5
Soil ingestion rate (g/d)	0.08	0.08
Inhalation rate (m^3/d)	9.3	9.3
Water ingestion rate (L/d)	0.6	0.6
Skin surface area (cm^2)		
- hands	430	430
- arms	890	890
- legs	1690	1690
- total	6130	6130
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	105	105
- other vegetables	67	67
- fish	95	95
- wild game	85	85
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Agricultural _Toddler	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	52	52
Dermal exposure events/day	1	1
Water contact events per day	1	1
Duration of water contact event (h)	1	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	4.5	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW" site use	**File #:**	2018-1001
Date:		**Comment:**	Ag_toddler (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		1.98E+00	1.30E-01	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		1.98E+00	1.30E-01	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		3.05E-05	NA	NA	NA	NA	NA
Cancer Risk - Dermal		6.41E-06	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		3.69E-05	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		2.74E-10	1.31E-10	NA	NA	NA	NA
Cancer Risk - Total		3.69E-05	1.31E-10	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05	**Target Cancer Risk Exceeded**					

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	1.00E+00	1.00E+00	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Toddler**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW"	**File #:**	2018-1001
Date:		**Comment:**	Ag_toddler (chronic)
Exposure Scenario:	**Agricultural _T**	**User-Defined Receptor Characteristics**	Skin surface area (cm2) - hands: 430
Native population considered		Body weight (kg): 16.5	- arms: 890
Cancer Risks Calculated?	**No**	Soil ingestion rate (g/d): 0.08	- legs: 1690
		Inhalation rate (m3/d): 9.3	- total: 6130
		Water ingestion rate (L/d): 0.6	Soil loading (g/cm2-event) - hands: 0.0001
			- other: 0.00001

Food ingestion rates (g/d)
Root vegetables: 105
Other vegetables: 67
Fish: 95
Wild game: 85

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bathing/swimming water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	7.6E-10	2.375E-10	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

				Exposure (mg/kg/d)			
		Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil		7.76E-05	2.42E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles		4.28E-10	1.34E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water		5.09E-04	7.64E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil		2.00E-06	2.92E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water		5.20E-06	7.80E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure		5.87E-04	1.01E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure		7.20E-06	3.70E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure		5.94E-04	1.04E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure		4.28E-10	1.34E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)		5.94E-04	1.04E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00

				Hazard/Risk Estimates			
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		1.98E+00	1.30E-01	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		1.98E+00	1.30E-01	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario B:
Potential Future
"Homestead with Potable GW"
Exposure Scenario

Toddler (acute)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW"	File #:	2018-1001
Date:		Comment:	Ag_toddler (acute)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Agricultural _Toddler	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	Yes	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	Yes	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Agricultural _Toddler

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	Yes	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Toddler	Toddler
Body weight (kg)	16.5	16.5
Soil ingestion rate (g/d)	0.08	0.08
Inhalation rate (m^3/d)	9.3	9.3
Water ingestion rate (L/d)	0.6	0.6
Skin surface area (cm^2)		
- hands	430	430
- arms	890	890
- legs	1690	1690
- total	6130	6130
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	105	105
- other vegetables	67	67
- fish	95	95
- wild game	85	85
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Agricultural _Toddler	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	1	52
Dermal exposure events/day	1	1
Water contact events per day	1	1
Duration of water contact event (h)	1	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	0.019	60
Years for carcinogen amortization	0.019	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW"	**File #:**	2018-1001
Date:		**Comment:**	Ag_toddler (acute)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		5.51E-02	3.46E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		2.75E-08	3.22E-09	NA	NA	NA	NA
Hazard Index - Total		5.51E-02	3.46E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		1.04E-05	NA	NA	NA	NA	NA
Cancer Risk - Dermal		6.33E-06	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.68E-05	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		9.35E-11	4.48E-11	NA	NA	NA	NA
Cancer Risk - Total		1.68E-05	4.48E-11	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05	**Target Cancer Risk Exceeded**					

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	1.00E+00	1.00E+00	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Toddler**

User Name: Franz Environmental Inc. **Site:** Garden River Old Dump Site
Proponent: Potential Future "Homestead with Potable GW" **File #:** 2018-1001
Date: **Comment:** Ag_toddler (acute)

Exposure Scenario: **Agricultural _T**
Native population considered
Cancer Risks Calculated? **No**

User-Defined Receptor Characteristics

Body weight (kg): 16.5	Skin surface area (cm2) - hands: 430	
Soil ingestion rate (g/d): 0.08	- arms: 890	Food ingestion rates (g/d)
Inhalation rate (m3/d): 9.3	- legs: 1690	Root vegetables: 105
Water ingestion rate (L/d): 0.6	- total: 6130	Other vegetables: 67
	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 95
	- other: 0.00001	Wild game: 85

Chemical Properties	Units	Arsenic	Cadmium				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	Units	Arsenic	Cadmium				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bathing/swimming water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	1.46154E-11	4.56731E-12	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	Cadmium				
Inadvertent ingestion of contaminated soil	1.49E-06	4.66E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	8.24E-12	2.57E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	9.79E-06	1.47E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	3.85E-08	5.61E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	5.20E-06	7.80E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	1.13E-05	1.93E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	5.24E-06	8.36E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	1.65E-05	2.77E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	8.24E-12	2.57E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	1.65E-05	2.77E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	Cadmium				
Hazard Quotient - Oral/Dermal		5.51E-02	3.46E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		2.75E-08	3.22E-09	NA	NA	NA	NA
Hazard Index - Total		5.51E-02	3.46E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario B:
Potential Future
"Homestead with Potable GW"
Exposure Scenario

Child (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW" site use	File #:	2018-1001
Date:		Comment:	Ag_Child (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Agricultural _Child	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	Yes	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	Yes	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Agricultural _Child

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	Yes	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Child	Toddler
Body weight (kg)	32.9	32.9
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	14.5	14.5
Water ingestion rate (L/d)	0.8	0.8
Skin surface area (cm^2)		
- hands	590	590
- arms	1480	1480
- legs	3070	3070
- total	10140	10140
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	161	161
- other vegetables	98	98
- fish	170	170
- wild game	125	125
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Agricultural_Child	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	52	52
Dermal exposure events/day	1	1
Water contact events per day	1	1
Duration of water contact event (h)	1	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	7	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW" site use	**File #:**	2018-1001
Date:		**Comment:**	Ag_Child (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		1.98E+00	1.30E-01	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		1.98E+00	1.30E-01	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		4.75E-05	NA	NA	NA	NA	NA
Cancer Risk - Dermal		6.47E-06	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		5.40E-05	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		4.26E-10	2.04E-10	NA	NA	NA	NA
Cancer Risk - Total		5.40E-05	2.04E-10	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05	**Target Cancer Risk Exceeded**					

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	1.00E+00	1.00E+00	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Child**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW"	**File #:**	2018-1001
Date:		**Comment:**	Ag_Child (chronic)

Exposure Scenario:	**Agricultural _C**	**User-Defined Receptor Characteristics**	Skin surface area (cm2) - hands: 590	
Native population considered		Body weight (kg): 32.9	- arms: 1480	Food ingestion rates (g/d)
Cancer Risks Calculated?	**No**	Soil ingestion rate (g/d): 0.02	- legs: 3070	Root vegetables: 161
		Inhalation rate (m3/d): 14.5	- total: 10140	Other vegetables: 98
		Water ingestion rate (L/d): 0.8	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 170
			- other: 0.00001	Wild game: 125

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bathing/swimming water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	7.6E-10	2.375E-10	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

				Exposure (mg/kg/d)			
		Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil		9.73E-06	3.04E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles		3.35E-10	1.05E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water		3.40E-04	5.11E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil		1.52E-06	2.22E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water		4.31E-06	6.47E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure		3.50E-04	5.41E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure		5.84E-06	2.87E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure		3.56E-04	5.70E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure		3.35E-10	1.05E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)		3.56E-04	5.70E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

				Hazard/Risk Estimates			
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		1.19E+00	7.12E-02	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.12E-06	1.31E-07	NA	NA	NA	NA
Hazard Index - Total		1.19E+00	7.12E-02	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario B:
Potential Future
"Homestead with Potable GW"
Exposure Scenario

Teen (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW" Site use	File #:	2018-1001
Date:		Comment:	Ag_Teen (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Agricultural _Teen	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	Yes	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	Yes	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Agricultural _Teen

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	Yes	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Teen	Toddler
Body weight (kg)	59.7	59.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	15.8	15.8
Water ingestion rate (L/d)	1	1
Skin surface area (cm^2)		
- hands	800	800
- arms	2230	2230
- legs	4970	4970
- total	15470	15470
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	227	227
- other vegetables	120	120
- fish	200	200
- wild game	175	175
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Agricultural _Teen	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	52	52
Dermal exposure events/day	1	1
Water contact events per day	1	1
Duration of water contact event (h)	1	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	8	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name: Franz Environmental Inc. **Site:** Garden River Old Dump Site
Proponent: Potential Future "Homestead with Potable GW" Site use **File #:** 2018-1001
Date: **Comment:** Ag_Teen (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		1.98E+00	1.30E-01	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		1.98E+00	1.30E-01	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		5.43E-05	NA	NA	NA	NA	NA
Cancer Risk - Dermal		6.50E-06	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		6.08E-05	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		4.86E-10	2.33E-10	NA	NA	NA	NA
Cancer Risk - Total		6.08E-05	2.33E-10	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05	**Target Cancer Risk Exceeded**					

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	1.00E+00	1.00E+00	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions
All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report
Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Teen**

User Name: Franz Environmental Inc. **Site:** Garden River Old Dump Site
Proponent: Potential Future "Homestead with Potable GW" **File #:** 2018-1001
Date: **Comment:** Ag_Teen (chronic)

Exposure Scenario: **Agricultural _Te**
Native population considered
Cancer Risks Calculated? **No**

User-Defined Receptor Characteristics
Body weight (kg): 59.7
Soil ingestion rate (g/d): 0.02
Inhalation rate (m3/d): 15.8
Water ingestion rate (L/d): 1
Skin surface area (cm2) - hands: 800
- arms: 2230
- legs: 4970
- total: 15470
Soil loading (g/cm2-event) - hands: 0.0001
- other: 0.00001
Food ingestion rates (g/d)
Root vegetables: 227
Other vegetables: 120
Fish: 200
Wild game: 175

Chemical Properties	Units	Arsenic	Cadmium				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	Units	Arsenic	Cadmium				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bathing/swimming water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	7.6E-10	2.375E-10	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	Cadmium				
Inadvertent ingestion of contaminated soil	5.36E-06	1.68E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	2.01E-10	6.29E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	2.35E-04	3.52E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	1.22E-06	1.78E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	3.63E-06	5.44E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	2.40E-04	3.69E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	4.85E-06	2.33E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	2.45E-04	3.92E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	2.01E-10	6.29E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	2.45E-04	3.92E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	Cadmium				
Hazard Quotient - Oral/Dermal		8.16E-01	4.90E-02	NA	NA	NA	NA
Hazard Quotient - Inhalation		6.70E-07	7.86E-08	NA	NA	NA	NA
Hazard Index - Total		8.16E-01	4.90E-02	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario B:
Potential Future
“Homestead with Potable GW”
Exposure Scenario

Adult (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW" Use	File #:	2018-1001
Date:		Comment:	Ag_Adult (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Agricultural _Adult	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	Yes	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	Yes	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Agricultural _Adult

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	Yes	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	1.5	15.8
Water ingestion rate (L/d)	1	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	17640	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	188	188
- other vegetables	137	137
- fish	220	220
- wild game	270	270
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	Agricultural _Adult	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	52	52
Dermal exposure events/day	1	1
Water contact events per day	1	1
Duration of water contact event (h)	1	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	80	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Potential Future "Homestead with Potable GW" Use	**File #:**	2018-1001
Date:		**Comment:**	Ag_Adult (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		1.98E+00	1.30E-01	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		1.98E+00	1.30E-01	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		5.43E-04	NA	NA	NA	NA	NA
Cancer Risk - Dermal		8.38E-06	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		5.51E-04	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		4.86E-09	2.33E-09	NA	NA	NA	NA
Cancer Risk - Total		5.51E-04	2.33E-09	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05	**Target Cancer Risk Exceeded**					

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	1.00E+00	1.00E+00	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name: Franz Environmental Inc. **Site:** Garden River Old Dump Site
Proponent: Potential Future "Homestead with Potable GW" **File #:** 2018-1001
Date: **Comment:** Ag_Adult (chronic)

Exposure Scenario: **Agricultural _A**
Native population considered
Cancer Risks Calculated? **Yes**

User-Defined Receptor Characteristics
Body weight (kg): 70.7
Soil ingestion rate (g/d): 0.02
Inhalation rate (m3/d): 1.5
Water ingestion rate (L/d): 1
Skin surface area (cm2) - hands: 890
- arms: 2500
- legs: 5720
- total: 17640
Soil loading (g/cm2-event) - hands: 0.0001
- other: 0.00001
Food ingestion rates (g/d)
Root vegetables: 188
Other vegetables: 137
Fish: 220
Wild game: 270

Chemical Properties	Units	Arsenic	Cadmium				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	42.9	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	9.8	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		unit risk	unit risk	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	Units	Arsenic	Cadmium				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bathing/swimming water	mg/L	1.40E-02	2.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	7.6E-10	2.375E-10	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	Cadmium				
Inadvertent ingestion of contaminated soil	4.53E-06	1.41E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	1.61E-11	5.04E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	1.98E-04	2.97E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	1.16E-06	1.70E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	3.49E-06	5.24E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	2.03E-04	3.11E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	4.66E-06	2.22E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	2.07E-04	3.33E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	1.61E-11	5.04E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	2.07E-04	3.33E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	Cadmium				
Hazard Quotient - Oral/Dermal		6.91E-01	4.17E-02	NA	NA	NA	NA
Hazard Quotient - Inhalation		5.37E-08	6.30E-09	NA	NA	NA	NA
Hazard Index - Total		6.91E-01	4.17E-02	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		3.65E-04	NA	NA	NA	NA	NA
Cancer Risk - Dermal		8.38E-06	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		3.73E-04	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		4.86E-09	2.33E-09	NA	NA	NA	NA
Cancer Risk - Total		3.73E-04	2.33E-09	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05	**Target Cancer Risk Exceeded**					

Scenario C:
Potential Future
"Homestead with Non-Potable GW"
Exposure Scenario

Toddler (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Future "Homestead with non-potable GW" site use	File #:	2018-1001
Date:		Comment:	Ag_no DW_toddler (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Ag_noDW_toddler	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Ag_noDW_toddler

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Toddler	Toddler
Body weight (kg)	16.5	16.5
Soil ingestion rate (g/d)	0.08	0.08
Inhalation rate (m^3/d)	9.3	9.3
Water ingestion rate (L/d)	0.6	0.6
Skin surface area (cm^2)		
- hands	430	430
- arms	890	890
- legs	1690	1690
- total	3010	6130
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	105	105
- other vegetables	67	67
- fish	95	95
- wild game	85	85
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Ag_noDW_toddler	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	52	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	4.5	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Future "Homestead with non-potable GW" site use	**File #:**	2018-1001
Date:		**Comment:**	Ag_no DW_toddler (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		2.65E-01	3.40E-02	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		2.65E-01	3.40E-02	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		4.58E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		1.18E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		5.76E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		2.74E-10	1.31E-10	NA	NA	NA	NA
Cancer Risk - Total		5.76E-07	1.31E-10	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Toddler**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Future "Homestead with non-potable GW" site u	**File #:**	2018-1001
Date:		**Comment:**	Ag_no DW_toddler (chronic)
Exposure Scenario:	**Ag_noDW_todd**	**User-Defined Receptor Characteristics**	Skin surface area (cm2) - hands: 430
Native population considered		Body weight (kg): 16.5	- arms: 890
Cancer Risks Calculated?	**No**	Soil ingestion rate (g/d): 0.08	- legs: 1690
		Inhalation rate (m3/d): 9.3	- total: 3010
		Water ingestion rate (L/d): 0.6	Soil loading (g/cm2-event) - hands: 0.0001
			- other: 0.00001

Food ingestion rates (g/d)
Root vegetables: 105
Other vegetables: 67
Fish: 95
Wild game: 85

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	7.6E-10	2.375E-10	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

		Exposure (mg/kg/d)					
		Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil		7.76E-05	2.42E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles		4.28E-10	1.34E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil		2.00E-06	2.92E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure		7.76E-05	2.42E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure		2.00E-06	2.92E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure		7.96E-05	2.72E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure		4.28E-10	1.34E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)		7.96E-05	2.72E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		2.65E-01	3.40E-02	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		2.65E-01	3.40E-02	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario C:
Potential Future
"Homestead with Non-Potable GW"
Exposure Scenario

Toddler (acute)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Future Use "Homestead with non-potable GW" site use	File #:	2018-1001
Date:		Comment:	Ag_no DW_toddler (acute)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)

		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Ag_noDW_toddler	

Operative Pathways (Yes/No)

		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario Ag_noDW_toddler

Vapour Transport Modelling
Vapour source for exposure calculations: Most Conservative

Receptor Groups (Yes/No)

		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)

		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints

		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Toddler	Toddler
Body weight (kg)	16.5	16.5
Soil ingestion rate (g/d)	0.08	0.08
Inhalation rate (m^3/d)	9.3	9.3
Water ingestion rate (L/d)	0.6	0.6
Skin surface area (cm^2)		
- hands	430	430
- arms	890	890
- legs	1690	1690
- total	3010	6130
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	105	105
- other vegetables	67	67
- fish	95	95
- wild game	85	85
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Ag_noDW_toddler	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	1	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	0.019	60
Years for carcinogen amortization	0.019	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Future Use "Homestead with non-potable GW" site use	**File #:**	2018-1001
Date:		**Comment:**	Ag_no DW_toddler (acute)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		5.10E-03	6.53E-04	NA	NA	NA	NA
Hazard Quotient - Inhalation		2.75E-08	3.22E-09	NA	NA	NA	NA
Hazard Index - Total		5.10E-03	6.53E-04	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		1.57E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		4.02E-08	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.97E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		9.35E-11	4.48E-11	NA	NA	NA	NA
Cancer Risk - Total		1.97E-07	4.48E-11	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Toddler**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Future Use "Homestead with non-potable GW"	**File #:**	2018-1001
Date:		**Comment:**	Ag_no DW_toddler (acute)
Exposure Scenario:	**Ag_noDW_todd**	**User-Defined Receptor Characteristics**	Skin surface area (cm2) - hands: 430
Native population considered		Body weight (kg): 16.5	- arms: 890
Cancer Risks Calculated?	**No**	Soil ingestion rate (g/d): 0.08	- legs: 1690
		Inhalation rate (m3/d): 9.3	- total: 3010
		Water ingestion rate (L/d): 0.6	Soil loading (g/cm2-event) - hands: 0.0001
			- other: 0.00001

Food ingestion rates (g/d)
Root vegetables: 105
Other vegetables: 67
Fish: 95
Wild game: 85

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	1.46154E-11	4.56731E-12	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil	1.49E-06	4.66E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	8.24E-12	2.57E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	3.85E-08	5.61E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	1.49E-06	4.66E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	3.85E-08	5.61E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	1.53E-06	5.22E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	8.24E-12	2.57E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	1.53E-06	5.22E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		5.10E-03	6.53E-04	NA	NA	NA	NA
Hazard Quotient - Inhalation		2.75E-08	3.22E-09	NA	NA	NA	NA
Hazard Index - Total		5.10E-03	6.53E-04	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario C:
Potential Future
"Homestead with Non-Potable GW"
Exposure Scenario

Child (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Future "Homestead with non-potable GW" site use	File #:	2018-1001
Date:		Comment:	Ag_no DW_child (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Ag_noDW_child	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Ag_noDW_child

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*	0.0003		
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Child	Toddler
Body weight (kg)	32.9	32.9
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	14.5	14.5
Water ingestion rate (L/d)	0.8	0.8
Skin surface area (cm^2)		
- hands	590	590
- arms	1480	1480
- legs	3070	3070
- total	5140	10140
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	161	161
- other vegetables	98	98
- fish	170	170
- wild game	125	125
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Ag_noDW_child	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	52	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	7	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Future "Homestead with non-potable GW" site use	**File #:**	2018-1001
Date:		**Comment:**	Ag_no DW_child (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		2.65E-01	3.40E-02	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		2.65E-01	3.40E-02	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		7.13E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		1.83E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		8.96E-07	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		4.26E-10	2.04E-10	NA	NA	NA	NA
Cancer Risk - Total		8.96E-07	2.04E-10	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Child**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Future "Homestead with non-potable GW" site u	**File #:**	2018-1001
Date:		**Comment:**	Ag_no DW_child (chronic)
Exposure Scenario:	**Ag_noDW_child**	**User-Defined Receptor Characteristics**	Skin surface area (cm2) - hands: 590
Native population considered		Body weight (kg): 32.9	- arms: 1480
Cancer Risks Calculated?	**No**	Soil ingestion rate (g/d): 0.02	- legs: 3070
		Inhalation rate (m3/d): 14.5	- total: 5140
		Water ingestion rate (L/d): 0.8	Soil loading (g/cm2-event) - hands: 0.0001
			- other: 0.00001

Food ingestion rates (g/d)
Root vegetables: 161
Other vegetables: 98
Fish: 170
Wild game: 125

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	7.6E-10	2.375E-10	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil	9.73E-06	3.04E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	3.35E-10	1.05E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	1.52E-06	2.22E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	9.73E-06	3.04E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	1.52E-06	2.22E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	1.13E-05	5.26E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	3.35E-10	1.05E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	1.13E-05	5.26E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		3.75E-02	6.58E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.12E-06	1.31E-07	NA	NA	NA	NA
Hazard Index - Total		3.75E-02	6.58E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario C:
Potential Future
"Homestead with Non-Potable GW"
Exposure Scenario

Teen (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Future Use " Homestead with non-potable GW"	File #:	2018-1001
Date:		Comment:	Ag_no DW_teen (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Ag_noDW_teen	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Ag_noDW_teen

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Teen	Toddler
Body weight (kg)	59.7	59.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	15.8	15.8
Water ingestion rate (L/d)	1	1
Skin surface area (cm^2)		
- hands	800	800
- arms	2230	2230
- legs	4970	4970
- total	8000	15470
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	227	227
- other vegetables	120	120
- fish	200	200
- wild game	175	175
Evaluate Cancer Risks (Yes/No)?	No	No

User-defined Land-Use / Exposure Scenario

Scenario name	Ag_noDW_teen	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	52	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	8	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Future Use " Homestead with non-potable GW"	**File #:**	2018-1001
Date:		**Comment:**	Ag_no DW_teen (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		2.65E-01	3.40E-02	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		2.65E-01	3.40E-02	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		8.15E-07	NA	NA	NA	NA	NA
Cancer Risk - Dermal		2.09E-07	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.02E-06	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		4.86E-10	2.33E-10	NA	NA	NA	NA
Cancer Risk - Total		1.02E-06	2.33E-10	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Teen**

User Name: Franz Environmental Inc. **Site:** Garden River Old Dump Site
Proponent: Future Use " Homestead with non-potable GW" **File #:** 2018-1001
Date: **Comment:** Ag_no DW_teen (chronic)

Exposure Scenario: **Ag_noDW_teen**
Native population considered
Cancer Risks Calculated? **No**

User-Defined Receptor Characteristics

Body weight (kg): 59.7	Skin surface area (cm2) - hands: 800	
Soil ingestion rate (g/d): 0.02	- arms: 2230	Food ingestion rates (g/d)
Inhalation rate (m3/d): 15.8	- legs: 4970	Root vegetables: 227
Water ingestion rate (L/d): 1	- total: 8000	Other vegetables: 120
	Soil loading (g/cm2-event) - hands: 0.0001	Fish: 200
	- other: 0.00001	Wild game: 175

Chemical Properties	Units	Arsenic	Cadmium				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	NA	NA	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		TDI	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		NA	NA	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	Units	Arsenic	Cadmium				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	7.6E-10	2.375E-10	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	Cadmium				
Inadvertent ingestion of contaminated soil	5.36E-06	1.68E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	2.01E-10	6.29E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	1.22E-06	1.78E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	5.36E-06	1.68E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	1.22E-06	1.78E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	6.58E-06	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	2.01E-10	6.29E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	6.58E-06	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	Cadmium				
Hazard Quotient - Oral/Dermal		2.19E-02	4.32E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		6.70E-07	7.86E-08	NA	NA	NA	NA
Hazard Index - Total		2.19E-02	4.32E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		NA	NA	NA	NA	NA	NA
Cancer Risk - Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		NA	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		NA	NA	NA	NA	NA	NA
Cancer Risk - Total		NA	NA	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05						

Scenario C:
Potential Future
"Homestead with Non-Potable GW"
Exposure Scenario

Adult (chronic)

HEALTH CANADA PQRA SPREADSHEET
USER INPUT SHEET

User Name:	Franz Environmental Inc.	Site:	Garden River Old Dump Site
Proponent:	Future "Homestead with non-potable GW" site use	File #:	2018-1001
Date:		Comment:	Ag_no DW_adult (chronic)

PROBLEM FORMULATION

Potential Land Uses (Yes/No)		Default
Agricultural	Yes	Yes
Residential/urban parkland	No	Yes
Commercial	No	Yes
Industrial	No	Yes
Occupational - outdoors	No	Yes
Recreational	No	Yes
Other	Yes	No
specify:	Ag_noDW_adult	

Operative Pathways (Yes/No)		Default
Inadvertent ingestion of soil	Yes	Yes
Inhalation of soil particles	Yes	Yes
Inhalation of indoor contaminant vapours	No	Yes
Inhalation of outdoor contaminant vapours	No	Yes
Ingestion of drinking water	No	Yes
Dermal contact with soil	Yes	Yes
Dermal contact with water	No	Yes
Ingestion of contaminated food	No	No

Exposure Scenario		Ag_noDW_adult

Vapour Transport Modelling		
Vapour source for exposure calculations		Most Conservative

Receptor Groups (Yes/No)		Default
General public or residents	Yes	Yes
Employees	No	Yes
Canadian native communities	Yes	No
Other		No
specify:		

Active Critical Receptors (Yes/No)		Default
Infant	No	Yes
Toddler	Yes	Yes
Child	Yes	Yes
Teen	Yes	Yes
Adult	Yes	Yes
Other	Yes	No
specify:		

Contaminant Concentrations

Chemical Name	required	Arsenic	Cadmium				
Soil (mg/kg)	required	16	5				
Groundwater - source (mg/L)	optional	0.014	0.0021				
Drinking water (mg/L)	optional	0.014	0.0021				
Bathing/swimming water (mg/L)	optional						
Indoor air - vapours (mg/m^3)	optional						
Outdoor air - vapours (mg/m^3)	optional						
Outdoor air - particulate (mg/m^3)	optional						
Root vegetables (mg/kg wet weight)	optional						
Other vegetables (mg/kg wet weight)	optional						
Fish (mg/kg wet weight)	optional						
Wild game (mg/kg wet weight)	optional						

Risk Assessment Endpoints		Default
Acceptable hazard index:	0.2	0.2
Acceptable cancer risk:		1.00E-05

Precluding Conditions for Fate and Transport Models

Are non-aqueous phase liquids (NAPL) present?	No
Is groundwater contamination present in fractured bedrock?	No
Is groundwater contamination migrating through a confined aquifer?	No
Is there active pumping or drawdown of groundwater at the site?	No
Is contamination present within 1 m of building foundation?	No
Do any buildings within 5 m of contamination have earthen foundations?	No
Are any buildings constructed on very high permeability media?	No
Are there preferential vapour flow pathways connecting contamination to a building?	No

Fate and Transport Model Input

	Value	Default	Models Affected
Soil Type	fine-grained	coarse-grained	PS, V-I, V-O, GW
Significant vehicle traffic on unpaved roads?	no	No	P-O
Site Characteristics			
Depth to Groundwater (m)	6	3	GW, V-O
Depth from Surface to Contamination (m)	0	0	GW, V-O
Distance - Contaminated Soil to Building (m)	1	1	V-I
Distance - Contaminated GW to Building (m)	1	1	V-I
Distance to potable water user (m)	0	0	GW
Distance to Bathing/Swimming Water (m)	0	0	GW
Particulate Concentration in Air (ug/m^3)	0.76	0.76	P-O
Building Type	Residential	Residential	V-I

Optional Sections

User-defined Chemicals

Note: user-defined chemicals should be named in this section before being selected in the 'Contaminant Concentrations' table above

		Chemical 1	Chemical 2	Chemical 3
Name		Arsenic		
CAS Number				
Chemical class (organic/inorganic)		inorganic		
Tolerable daily intake (mg/kg/d) - infant	*Enter all applicable and appropriate toxicity benchmarks; values must be referenced and justified in the PQRA report.*			
Tolerable daily intake (mg/kg/d) - toddler		0.0003		
Tolerable daily intake (mg/kg/d) - child		0.0003		
Tolerable daily intake (mg/kg/d) - teen		0.0003		
Tolerable daily intake (mg/kg/d) - adult		0.0003		
Tolerable concentration (mg/m^3)				
Oral slope factor $(mg/kg/d)^{-1}$		1.8		
Inhalation slope factor $(mg/kg/d)^{-1}$		28		
Inhalation unit risk $(mg/m^3)^{-1}$		6.4		
Relative dermal absorption factor		0.03		
Organic carbon partitioning coefficient (mL/g) - Koc				
Log Kow (unitless)				
Henry's Law constant at 25°C (unitless) - H'				
Henry's Law constant at 25°C (atm-m3/mol) - H				
Water Solubility at 25°C (mg/L)				
Molecular Weight (g/mol)		78		
Vapour Pressure at 25°C (atm)		0		

Note: values in grayed cells will not be used; Health Canada default values are applied.

User-defined Receptor

Name		Defaults
Age group	Adult	Toddler
Body weight (kg)	70.7	70.7
Soil ingestion rate (g/d)	0.02	0.02
Inhalation rate (m^3/d)	15.8	15.8
Water ingestion rate (L/d)	1.5	1.5
Skin surface area (cm^2)		
- hands	890	890
- arms	2500	2500
- legs	5720	5720
- total	9110	17640
Soil loading to exposed skin (g/cm^2/event)		
- hands	1.00E-04	0.0001
- surfaces other than hands	1.00E-05	0.00001
Food ingestion (g/d)		
- root vegetables	188	188
- other vegetables	137	137
- fish	220	220
- wild game	270	270
Evaluate Cancer Risks (Yes/No)?	Yes	Yes

User-defined Land-Use / Exposure Scenario

Scenario name	Ag_noDW_adult	Defaults
Hours per day (indoors)	22.5	22.5
Hours per day (outdoors)	1.5	1.5
Days per week	7	7
Weeks per year	52	52
Dermal exposure events/day	1	1
Water contact events per day	0	1
Duration of water contact event (h)	0	1
Days/year contaminated food ingestion	0	365
Exposure duration (years)	80	60
Years for carcinogen amortization	80	60

SUMMARY OF PQRA RESULTS Version: October 31, 2008

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Future "Homestead with non-potable GW" site use	**File #:**	2018-1001
Date:		**Comment:**	Ag_no DW_adult (chronic)

		Maximum Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		2.65E-01	3.40E-02	NA	NA	NA	NA
Hazard Quotient - Inhalation		1.43E-06	1.67E-07	NA	NA	NA	NA
Hazard Index - Total		2.65E-01	3.40E-02	NA	NA	NA	NA
Target Hazard Index:	0.2	**Target Hazard Index Exceeded**					
Cancer Risk - Oral		8.15E-06	NA	NA	NA	NA	NA
Cancer Risk - Dermal		2.09E-06	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.02E-05	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		4.86E-09	2.33E-09	NA	NA	NA	NA
Cancer Risk - Total		1.02E-05	2.33E-09	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05	**Target Cancer Risk Exceeded**					

	Critical Receptors					
	Arsenic	**Cadmium**				
Oral/Dermal - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Inhalation - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Total - non-cancer effects	Toddler	Toddler	NA	NA	NA	NA
Oral - cancer effects	Adult	NA	NA	NA	NA	NA
Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Oral + Dermal - cancer effects	Adult	NA	NA	NA	NA	NA
Inhalation - cancer effects	Adult	Adult	NA	NA	NA	NA
Total - cancer effects	Adult	Adult	NA	NA	NA	NA
Source of indoor air vapours	NA	NA	NA	NA	NA	NA
Model used for vapour transport	NA	NA	NA	NA	NA	NA

Key Calculated Model Parameters						
Vapour Intrusion Model Parameters	Note: parameters show as "NA" if relevant exposure pathways are inoperative or if user-input concentration is used instead of modelled value					
Qsoil/Qbuilding	NA	NA	NA	NA	NA	NA
Soil alpha	NA	NA	NA	NA	NA	NA
Groundwater alpha	NA	NA	NA	NA	NA	NA
Groundwater model dilution factors						
DF1 (soil to leachate)	NA	NA	NA	NA	NA	NA
DF2 (leachate at source to water table):	NA	NA	NA	NA	NA	NA
DF3 (leachate at water table to groundwater):	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - drinking water:	NA	NA	NA	NA	NA	NA
DF4 (source to receptor) - bathing/swimming water:	NA	NA	NA	NA	NA	NA

Notes/Comments

Vapour Intrusion Model

Chemical Interactions

All chemicals of concern present at the site should be evaluated for potential additive effects based on target organs and mechanisms of effect.

Concentration Checks

Precluding Conditions

Other Notes

Provide justification for all non-default model parameters in PQRA report

Error functions in groundwater model could not be calculated; installation of Analysis ToolPak is required

HEALTH CANADA PQRA SPREADSHEET Version: October 31, 2008
OUTPUT SHEET - USER-DEFINED RECEPTOR **Adult**

User Name:	Franz Environmental Inc.	**Site:**	Garden River Old Dump Site
Proponent:	Future "Homestead with non-potable GW" site u	**File #:**	2018-1001
Date:		**Comment:**	Ag_no DW_adult (chronic)
Exposure Scenario:	**Ag_noDW_adul**	**User-Defined Receptor Characteristics**	Skin surface area (cm2) - hands: 890
Native population considered		Body weight (kg): 70.7	- arms: 2500
Cancer Risks Calculated?	**Yes**	Soil ingestion rate (g/d): 0.02	- legs: 5720
		Inhalation rate (m3/d): 15.8	- total: 9110
		Water ingestion rate (L/d): 1.5	Soil loading (g/cm2-event) - hands: 0.0001
			- other: 0.00001

Food ingestion rates (g/d)
Root vegetables: 188
Other vegetables: 137
Fish: 220
Wild game: 270

Chemical Properties	**Units**	**Arsenic**	**Cadmium**				
Tolerable daily intake	mg/kg/d	0.0003	0.0008	NA	NA	NA	NA
Tolerable concentration	mg/m^3	NA	NA	NA	NA	NA	NA
Oral slope factor	$(mg/kg/d)^{-1}$	1.8	NA	NA	NA	NA	NA
Inhalation slope factor	$(mg/kg/d)^{-1}$	28	42.9	NA	NA	NA	NA
Inhalation unit risk	$(mg/m^3)^{-1}$	6.4	9.8	NA	NA	NA	NA
Dermal slope factor	$(mg/kg/d)^{-1}$	NA	NA	NA	NA	NA	NA
Critical oral exposure benchmark		slope factor	TDI	NA	NA	NA	NA
Critical inhalation exposure benchmark		unit risk	unit risk	NA	NA	NA	NA
Relative dermal absorption factor	unitless	0.03	0.14	1	1	1	1

Chemical Concentrations	**Units**	**Arsenic**	**Cadmium**				
Soil	mg/kg	1.60E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking water	mg/L	1.40E-02	2.10E-03	NA	NA	NA	NA
Bathing/swimming water	mg/L	NA	NA	NA	NA	NA	NA
Indoor air vapours	mg/m^3	NA	NA	NA	NA	NA	NA
Outdoor air vapours	mg/m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Outdoor air particulate	mg/m^3	1.22E-08	3.80E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Amortized total air concentration	mg/m^3	7.6E-10	2.375E-10	0	0	0	0
Root vegetables	mg/kg wet wt	0	0	0	0	0	0
Other vegetables	mg/kg wet wt	0	0	0	0	0	0
Fish	mg/kg wet wt	0	0	0	0	0	0
Wild game	mg/kg wet wt	0	0	0	0	0	0

RESULTS

	Exposure (mg/kg/d)					
	Arsenic	**Cadmium**				
Inadvertent ingestion of contaminated soil	4.53E-06	1.41E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminated soil particles	1.70E-10	5.31E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - indoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of contaminant vapours - outdoor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated drinking water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with contaminated soil	1.16E-06	1.70E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dermal contact with water	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of contaminated food	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ingestion exposure	4.53E-06	1.41E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total dermal exposure	1.16E-06	1.70E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion + dermal exposure	5.69E-06	3.11E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total inhalation exposure	1.70E-10	5.31E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Exposure (all pathways)	5.69E-06	3.11E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

		Hazard/Risk Estimates					
		Arsenic	**Cadmium**				
Hazard Quotient - Oral/Dermal		1.90E-02	3.89E-03	NA	NA	NA	NA
Hazard Quotient - Inhalation		5.66E-07	6.63E-08	NA	NA	NA	NA
Hazard Index - Total		1.90E-02	3.89E-03	NA	NA	NA	NA
Target Hazard Index:	0.2						
Cancer Risk - Oral		8.15E-06	NA	NA	NA	NA	NA
Cancer Risk - Dermal		2.09E-06	NA	NA	NA	NA	NA
Cancer Risk - Oral + Dermal		1.02E-05	NA	NA	NA	NA	NA
Cancer Risk - Inhalation		4.86E-09	2.33E-09	NA	NA	NA	NA
Cancer Risk - Total		1.02E-05	2.33E-09	NA	NA	NA	NA
Target Cancer Risk:	1.00E-05	**Target Cancer Risk Exceeded**					

TABLE 7. Recommended General Equations for Dose Estimation

Note: Presented below are generalized equations; actual equations presented by individual contractors may vary according to the manner in which different variables are presented, the units used, and the precise presentation of exposure frequency, exposure duration and averaging times. Abbreviations denoting variables have been harmonized through all equations; variables are not necessarily represented in every equation.

Inadvertent Ingestion of Contaminated Soil

The predicted intake of each contaminant via ingestion of contaminated soil is calculated as:

$$Dose\ (mg/kg/day) = \frac{C_S \times IR_S \times RAF_{Oral} \times D_2 \times D_3 \times D_4}{BW \times LE}$$

Where:

C_S = concentration of contaminant in soil (mg/kg)
IR_S = receptor soil ingestion rate (kg/d)
RAF_{Oral} = relative absorption factor from the GI tract (unitless)
D_2 = days per week exposed/7 days
D_3 = weeks per year exposed/52 weeks
D_4 = total years exposed to site (to be employed for assessment of carcinogens only)
BW = body weight (kg)
LE = life expectancy (yr) (to be employed for assessment of carcinogens only)

NOTE: the terms D_3 and D_4 should be omitted when considering exposures posed by chemicals with developmental (foetal) effects.

Inhalation of Contaminated Soil Particles

The predicted intake of each contaminant via inhalation of dust entrained into the air is calculated as:

$$Dose\ (mg/kg/day) = \frac{C_S \times P_{Air} \times IR_A \times RAF_{Inh} \times D_1 \times D_2 \times D_3 \times D_4}{BW \times LE}$$

Where:

C_S = concentration of contaminant in soil (mg/kg)
P_{Air} = particulate concentration in air (kg/m^3)
IR_A = receptor air intake (inhalation) rate (m^3/day)
RAF_{Inh} = relative absorption factor by inhalation (unitless)
D_1 = hours per day exposed/24 hours
D_2 = days per week exposed/7 days
D_3 = weeks per year exposed/52 weeks
D_4 = total years exposed to site (to be employed for assessment of carcinogens only)
BW = body weight (kg)
LE = life expectancy (yr) (to be employed for assessment of carcinogens only)

Notes: P_{Air} may be directly measured or may be estimated using methods discussed in the text. Alternately, C_A (air-borne concentration; mg/m^3) may be

directly measured, negating the prediction of air-borne concentration using C_S and P_{Air}. The terms D_3 and D_4 should be omitted when considering exposures posed by chemicals with developmental (foetal) effects.

TABLE 7 (continued)
Recommended General Equations for Dose Estimation

Inhalation of Contaminant Vapours

The predicted intake of each contaminant via inhalation of vapours is calculated as:

$$Dose\ (mg/kg/day) = \frac{C_A \times IR_A \times RAF_{Inh} \times D_1 \times D_2 \times D_3 \times D_4}{BW \times LE}$$

Where:
C_A = concentration of contaminant in air (mg/m^3)
IR_A = receptor air intake (inhalation) rate (m^3/day)
RAF_{Inh} = relative absorption factor for inhalation (unitless)
D_1 = hours per day exposed/24 hours
D_2 = days per week exposed/7 days
D_3 = weeks per year exposed/52 weeks
D_4 = total years exposed to site (to be employed for assessment of carcinogens only)
BW = body weight (kg)
LE = life expectancy (yr) (to be employed for assessment of carcinogens only)

Notes: C_A may be directly measured or may be estimated from soil-borne or groundwater-borne concentrations of volatile COPCs using methods discussed in the text. The terms D_3 and D_4 should be omitted when considering exposures posed by chemicals with developmental (foetal) effects.

Ingestion of Contaminated Drinking Water

The predicted intake of each contaminant via ingestion of contaminated drinking water is calculated as:

$$Dose\ (mg/kg/day) = \frac{C_w \times IR_w \times RAF_{Oral} \times D_2 \times D_3 \times D_4}{BW \times LE}$$

Where:
C_w = concentration of contaminant in drinking water (mg/L)
IR_w = receptor water intake rate (L/d)
RAF_{Oral} = relative absorption factor from the GI tract (unitless)
D_3 = weeks per year exposed/52 weeks
D_4 = total years exposed to site (to be employed for assessment of carcinogens only)
BW = body weight (kg)

D_2 = days per week exposed/7 days

LE = life expectancy (yr) (to be employed for assessment of carcinogens only)

Notes: C_w may be directly measured or may be estimated from soil-borne or groundwater-borne concentrations of COPCs using methods discussed in the text. The terms D_3 and D_4 should be omitted when considering exposures posed by chemicals with developmental (foetal) effects.

TABLE 7 (continued)
Recommended General Equations for Dose Estimation

Dermal Absorption from Contaminated Soil

The predicted intake of each contaminant via dermal contact with contaminated soil is calculated as:

$$Dose\ (mg/kg/day) = \frac{[(C_S \times SA_H \times SL_H) + (C_S \times SA_O \times SL_O)] \times RAF_{Derm} \times D_2 \times D_3 \times D_4}{BW \times LE}$$

Where:

C_S = concentration of contaminant in soil (mg/kg)
SA_H = surface area of hands exposed for soil loading (cm^2)
SA_O = surface area exposed other than hands (cm^2)
SL_H = soil loading rate to exposed skin of hands (kg/cm^2-event)
SL_O = soil loading rate to exposed skin other than hands (kg/cm^2-event)
D_2 = days per week exposed/7 days
D_3 = weeks per year exposed/52 weeks
D_4 = total years exposed to site (for assessment of carcinogens only)
RAF_{Derm} = relative dermal absorption factor (unitless)
BW = body weight (kg)
LE = life expectancy (yr) (for assessment of carcinogens only)

NOTE: the terms D_3 and D_4 should be omitted when considering exposures posed by chemicals with developmental (foetal) effects.

Ingestion of Contaminated Foods (Produce, Fish, Game, etc.)

The predicted intake of each contaminant via ingestion of contaminated food is calculated as:

$$Dose\ (mg/kg\ day) = \frac{[\sum [C_{Food\ i} \times IR_{Foodi} \times RAF_{Orali} \times D_i]] \times D_4}{BW \times 365 \times LE}$$

Where:

C_{Foodi} = concentration of contaminant in food *i* (mg/kg)
IR_{Foodi} = receptor ingestion rate for food *i* (kg/d)
RAF_{Orali} = relative absorption factor from the GI tract for contaminant *i* (unitless)
D_i = days per year during which consumption of food *i* will occur (d/yr)
D_4 = total years exposed to site (for assessment of carcinogens only)
BW = body weight (kg)
LE = life expectancy (for assessment of carcinogens only)
365 = total days per year (constant) (d/yr)

Notes: Concentrations of contaminants in foods can be measured directly, or can be predicted using methods discussed in the text. The terms D_3 and D_4 should be omitted when considering exposures posed by chemicals with developmental (foetal) effects.

COPC	Rationale for exclusion from the HHRA
Calcium (*Excluded from HHRA)*	Calcium concentrations observed at the site are unlikely from anthropogenic sources (ie are naturally occurring). Calcium is the fifth most abundant element, and its presence in freshwater systems can be attributed to the weathering of rocks (e.g. limestone) and soil seepage, leaching and runoff. The national average concentration of calcium in soil is about 13700 ug/g. Bedrock geology for this particular Site is characterized by mostly sedimentary rocks inclusive of calcareous shales (2011, Alberta Geological Survery), suggesting that elevated calcium concentrations may be identified in onsite soil and groundwater . Measured calcium concentrations in onsite soils (mean 40.53 ug/g, range:7-333 ug/g) are below this national average. Calcium concentrations in water are dependant of the residence time of water in calcium rich geological formations (Health Canada- Technical Document 1987). Calcium concentrations in waters are variable, measured drinking water in Canada is 1100 to 112 800 µg/L (Health Canada- Technical Document 1987). Surface waters generally contain lower concentrations of calcium than groundwater, and the highest concentration recorded in Canadian surface waters (1 370 000 ug/L) was in Bench Mark Creek, Alberta. Given the geology onsite, it is not surprising that the mean measured calcium concentrations in groundwater onsite (mean: 106 000 ug/L, range:78200-247000 ug/L) falls within the upper range of recorded concentrations in drinking water. Indeed the mean measured concentration of calcium (174000ug/L) in groundwater from two background wells (6M and 7M) located northeast and southwest of the Site, respectively, is above the range normally seen in Canadian drinking water. Efforts to reduce calcium in drinking water are mainly due to aesthetic reasons (e.g. reducing water hardness) and there is no evidence of adverse health effects that can specifically be attributed to calcium in drinking waters (Health Canada- Technical Document 1987). Although no human health guideline has been derived for calcium concentrations in soil or groundwater, based on the abovementioned information it is determined that calcium concentrations in Site groundwater are above national averages for drinking water but within background concentrations determined onsite, and supported by regional geology. Based on the above information adverse human health effects are not expected to occur within the soil and groundwater concentration range observed onsite, as such calcium is not retained as a soil or groundwater COPC.
Magnesium (*Excluded from HHRA*)	Magnesium is the eighth most abundant natural element, it is present in all natural waters and is a major contributor to water hardness. Magnesium carbonates in sedimentary rocks are generally considered to be the principal sources of magnesium in natural waters. Magnesium concentrations in soil onsite are variable (range: 1.9 ug/g to 138 ug/g), with a mean concentration (10.81 ug/g) above that in shallow (5 ug/g) and deep (3 ug/g) soils from background locations (6M and 7M). Water in areas of magnesium containing rock may have concentrations in the range of 10-50 mg/L. However, if the rock contains sulphates and chlorides of magnesium, which are very soluble, the water may contain several hundred milligrams of magnesium per litre. Groundwater collected in onsite wells and wells surrounding the Site have a mean magnesium concentration of 26.5 mg/L (range: 24.5-44.6 mg/L) and fall within the range described for Canadian groundwater. Mean background concentrations of magnesium (34.65 mg/L) in groundwater from two offsite wells (6M and 7M) also fall within this range (Health Canada- Technical Document 1978). Magnesium is an essential element in human metabolism and is the fourth most common mineral constituent in the body. The most observable effect of excess magnesium in the drinking water is a laxative effect, particularly with magnesium sulphate at concentration above 700 mg/L. Magnesium concentrations between 100-500 mg/L in drinking water can affect taste and palatability. Measured onsite groundwater concentrations of magnesium are below these benchmark concentrations and below BC CSR Schedule 6 drinking water standards. According to Health Canada guidance, the average daily intake of magnesium for children and adults ranges between 200-300 mg/day. Even considering the maximum magnesium concentrations in onsite soil (138 ug/g) and groundwater(44 600 ug/L), onsite human receptors would not be expected to consume more than approximately 26 mg/d (toddler) and 67 mg/d(adult) through soil ingestion and drinking water (groundwater) pathways (based on exposure assumption outlined in the report text). Predicted daily intake from these pathways is well below the national average. (Health Canada- Technical Document 1978).

	There is no evidence of adverse health effects specifically attributable to magnesium in soil or drinking water. A health based guideline for magnesium has therefore not been specified in either media. Based on the abovementioned information the likelihood of negative health effects associated with ingestion exposure to magnesium in either media is considered negligible and magnesium is not assessed further as a soil or groundwater COPC.
Manganese (*Excluded from HHRA*)	As summarized in Health Canada guidance documents (Health Canada, Technical Document-Manganese, 1987) manganese is generally present in natural surface waters as dissolved or suspended matter at concentrations below 50 µg/L. A survey of Canadian surface waters undertaken in 1980–1981 showed that the usual range of manganese in freely flowing river water was 10–400 µg/L with maximum concentrations of dissolved manganese being 1,700 µg/L. Manganese is more prevalent in groundwater supplies than in surface water supplies owing to the reducing conditions that exist underground (Health Canada, Technical Document-Manganese, 1987). Manganese concentrations of groundwater samples collected from all onsite and background wells at the Garden River Old Dump Site (mean 296 µg/L, range 43-737 µg/L) are only slightly above reported values for lakes and rivers across Canada, and not entirely unexpected for groundwater conditions. The mean concentration of manganese in two background wells (6M and 7M), northeast and southwest of the Site is 536 µg/L; whereas the mean manganese concentration in groundwater collected from onsite wells and those at the boundary of the Old Dump Site is 412 µg/L. Manganese is an essential element functioning both as an enzyme co-factor and as a constituent of metalloenzymes. The Recommended Daily Intake (RDI) of manganese for Canadians has yet to be established. A federal health based guideline for manganese in drinking water has also not yet been established. The main routes of absorption for manganese are the respiratory and gastrointestinal tracts whereas cutaneous absorption of inorganic manganese is negligible.The federal aesthetic objective for manganese in drinking water is set at ≤0.05 mg/L based on the potential for concentrations to affect water palatability, staining laundry and plumbing fixtures and potential accumulation of microbial growths in distribution systems. Manganese at this recommended limit is not considered to represent a threat to human health, and drinking water with much higher concentrations has been safely consumed. A health based interim guideline for manganese (550 µg/L) in groundwater has been developed by the Director of the BC MOE, effective June 1, 2010 to May 31, 2011 (Director's Interim Standards for Contaminated Site-Generic Numerical Drinking Water Standards for Aluminum, Iron, and Manganese, October 12, 2010.) Neither groundwater concentrations in background or onsite wells exceed this health based guidelines. Groundwater onsite is not currently used as a potable water resource, however it's potential as a future resource requires the application of drinking water standards as a measure of conservatism in this risk assessment. Based on the abovementioned information the human health risk of exposure to manganese in groundwater is negligible, as such dissolved manganese is not carried further as a groundwater COPC in the HHRA.
Potassium (*Excluded from HHRA)*	Potassium is a naturally occurring element in the earth's crust, most commonly found in the form of potassium chloride (Health Canada, Guidance on Potassium from Water Softeners, May 2008) which easily dissolves in water. Generally potassium levels in Canadian lakes and rivers are <10,000 µg/L, and the average potassium concentration for potable surface water and groundwater ranges from <1,000 to 8,000 µg/L. Potassium levels in deep bedrock aquifers of the prairies tend to be higher and are generally a function of depth below surface and the distance from the outcrop area containing the potassium minerals. Average potassium concentration in drinking water in Alberta (1990-2004) is 3900 µg/L (Health Canada 2008). Groundwater samples collected in the Garden River area (background wells, onsite wells, and site boundary wells) indicate the presence of this element at a mean concentration of 3315 µg//L (range: 1300-5100 µg//L) well within the range of national and regional potable surface water and groundwater. In terms of human health potassium is an essential element and normally does not cause adverse effects to human health. However, a disruption in the body's potassium homeostasis may result in adverse affects when potassium concentrations exceed (hyperkalemia) or fall below (hypokalemia) the normal range in the blood. The adequate intake for adults (19-70+ years of age) is 4.7 g/day (67 mg/kg bw/day for a 70 kg adult) and a total average intake of potassium from all sources for Canadians approximates 44 mg/kg bw per day (3.1 g/day for a 70 kg adult). An **acute** exposure of 78 mg/kg bw (5.5 g for a 70 kg adult) would be required to precipitate hyperkalemia in individuals with normal renal function (Health Canada 2008). Based on exposure calculations for a 70 kg adult exposed to maximum measured concentrations in soil (38 ug/g, accidental ingestion, 0.02g/day) and groundwater(5100 ug/g, drinking water, 1.5L/day) through the ingestion pathway, the combined soil and water intake of 7.65 mg (0.00765g) potassium/day is well below the total intake average and the threshold cited for adverse health effects in a healthy population There are no available water criteria for the protection of human health or the environment for potassium. Potassium levels generally found in drinking water are not a health concern to the general population, and a

	health based drinking water guideline is not proposed for potassium. Groundwater onsite is not currently used as a potable water resource, however it's potential as a future resource requires the application of drinking water standards as a measure of conservatism in this risk assessment. Based on the abovementioned information the likelihood of negative health effects associated with exposure to potassium concentrations in site soil and groundwater is considered negligible, and this parameter is not assessed further as a soil or groundwater COPC in this risk assessment.
Titanium *(Excluded from HHRA)*	Titanium, the ninth most abundant element in the earth's crust, is widely distributed and occurs in multiple valence states as well as in both a cationic state (e.g., titanium chlorides, phosphates, and sulfates) and an anionic state (e.g., calcium, iron, and sodium titanates). Titanium dioxide is extensively used as a white pigment in paints, enamels, plastics, and cosmetics as well as a colouring agent in food. The main sources of contamination of the general environment with titanium are the combustion of fossil fuels and the incineration of titanium-containing wastes. Titanium can be found in soils in the form of stable minerals, from the weathering and accumulation of rutile, ilmenite, brookite, and other common titanium minerals in sedimentary rocks. It is widely distributed and occurs at an average concentration of 4400 mg/kg (Titanium Guidance Document, World Health Organization, Geneva, 1982). The titanium concentration in drinking-water supplies is generally low, having an approximate range of 0.5-15 µg/litre (WHO, 1982). Groundwater concentrations of titanium in the Garden River area are variable (mean 1.55 ug/L, range:1-27 ug/L); with a mean concentration in background wells (6M and 7M) of 7.0 ug/L and a mean concentration in onsite and site boundary wells of 5.08 ug/L, well within the range described by the WHO for drinking water supplies. Furthermore, titanium has been detected in samples from 15 rivers in the USA and Canada in concentrations ranging from 2 to 107 µg/litre. Results of historical long-term toxicity studies indicate that titanium, administered in doses as a soluable salt in drinking water (dose:5 mg/L) and in food (0.6-9g/day) did not cause any adverse effects in the animals. In humans, titanium compounds are poorly absorbed from the gastro-intestinal tract, which is the main route of exposure for the general population. The WHO technical document (1982) indicates that titanium is capable of crossing the blood-brain barrier and placental barrier, and when inhaled can accumulate in lungs but not in other organs. Excretion of ingested titanium is majority through the faeces, and to a lesser extent the urine at a rate of approximately 10ug/L. Available data on the occurrence of titanium and titanium compounds in the environment, as well as data on toxicity, indicate that the current level of exposure of the general population does not present a health risk. Background and onsite groundwater concentrations of titanium are in accordance with reported concentrations in global drinking water resources. According to available data presented in the WHO guidance document (1982) on the toxicity of titanium and titanium compounds and their presence in various environmental media, health risks to the general population from exposure to titanium in groundwater are believed to be negligible. As such titanium is not considered further as a groundwater COPC.
Iron (*Excluded from HHRA*)	Iron is the fourth most abundant element in the earth's crust and its presence in waters can be attributed to the weathering of rocks and minerals, acidic mine drainage, landfill leachate, sewage effluents, and iron-related industries. Iron is generally found in surface waters as salts containing Fe(III) when the pH >7. Most of the salts are insoluble in water and settle out or are adsorbed into surfaces (Health Canada Supporting Documentation 1978). Concentrations of iron in Canadian surface waters are generally below 10 000 µg/L, but based on data collected from National Water Quality Database (NAQUADA) stations range between 1.0 – 90 000 µg/L in lakes and rivers across Canada (Health Canada Supporting Documentation 1978). Mean iron concentrations onsite/site boundary wells (3380 µg/L) fall within the national range for surface waters. Mean dissolved iron concentrations from two background wells (29500 µg/L) northeast and southeast of the Site, are well above concentrations identified in onsite groundwater, but also fall within the range for national surface waters (Health Canada Supporting Documentation 1978). Iron is an essential element for human health, integral to the functioning of cytochromes, porphyrins, and metalloenzymes. Its absorption occurs mainly through the intestines upon dietary intake. Iron toxicity is mainly due to underlying disease etiologies, and dietary over-ingestion. Total daily intake of iron from food, air, and water for an average adult is approximately 18000 µg/L /day (Health Canada Supporting Documentation 1978). The Health Canada 2008 Drinking Water Quality Guideline for iron (300 µg/L) is currently not health based but an aesthetic objective. The iron aesthetic objective of 300 µg/L is related to its tendency to cause rust coloured silt in water supplies, stains on clothing, and promote the growth of iron bacteria in water systems at higher concentrations (Health Canada Supporting Documentation 1978). A health based interim guideline for

	iron (6500 ug/L) in groundwater has been developed by the Director of the BC MOE, effective June 1, 2010 to May 31, 2011. (Director's Interim Standards for Contaminated Site-Generic Numerical Drinking Water Standards for Aluminum, Iron, and Manganese, October 12, 2010.) Groundwater concentrations in onsite/site boundary wells do not exceed background well concentrations describing regional groundwater quality, or the health based BC MOE Standard. Groundwater onsite is not currently used as a potable water resource, however it's potential as a future resource requires the application of drinking water standards to Site groundwater as a measure of conservatism in this risk assessment. Based on the abovementioned information the human health risk of exposure to dissolved iron in onsite groundwater is negligible, as such dissolved iron is not carried further as a groundwater COPC in the HHRA.
Alkalinity/ Bicarbonate/ Carbonate (*Excluded from HHRA*)	Alkalinity is the measure of bicarbonate, carbonate and hydroxide constituents in water. Per technical documents distributed by the the Illinois Health Department, Highly alkaline water (>500 mg/L) is associated with higher pH values, high hardness and TDS (Illinois Department of Public Health, Commonly found substances in drinking water and available treatment). Alkalinity is closely related to water hardness and though hardness and TDS have aesthetic objectives established by Health Canada to minimize staining and scale in electrical appliances, there are no federal Canadian health based standards developed for alkalinity or its parameter constituents in drinking water. Drinking water alkalinity in the form of carbonates, bicarbonates, hydroxides stabilizes and buffers the pH of water and reduces its corrosivity (WHO, 2005). Alkalinity in natural waters is variable with mineral content and in the presence of limestone and calcareous soils (Nutrients in Drinking Water, WHO, 2005). A review of available health and organoleptic data suggests a WHO recommended minimum of 30 mg/L bicarbonate in drinking water. A further WHO review of epidemiological studies suggests that drinking waters high in minerals (bicarbonate content of 243.7 mg/L) were linked to a lower incidence of cardiovascular adverse effects. Additionally epidemiological studies indicated that the populations associated with the lowest morbidity in adults and infants were exposed to high mineral content waters with bicarbonate water contents of 400 mg/L. Given the regional geology of the Site, it is not unexpected that groundwater hardness and alkalinity are elevated. Local background wells northeast and southwest of the Site have mean alkalinity and bicarbonate concentrations of 536 mg/L, and 654 mg/L, respectively. Onsite wells have slightly lower concentrations of both parameters (mean bicarbonate 426.6 mg/L, mean alkalinity (349.1 mg/L). Given that mean onsite concentrations of these parameters are less than local background concentrations and within the range discussed by the WHO guidance document. It is judged that the human health risk of exposure to moderately high alkalinity in onsite groundwater is negligible; as such alkalinity and related parameters are not carried further as groundwater COPC in the HHRA.
Aluminum (*Excluded from HHRA*)	Aluminum is a naturally occurring element, present in all the water bodies in Canada. It can be found in a variety of minerals. Varying amounts of aluminum are present naturally in groundwater and surface water, including those used as sources of drinking water. The amount of aluminum in surface water varies, ranging from 12 to 2250 ug/L in North American rivers. Aluminum concentrations in Canadian drinking water also vary over a wide range. The highest concentrations in Canada have been recorded in Alberta, where, during 1987, the mean concentration in 10 major urban centres was 0.384 mg/L; one water sample was 6.08 mg/L. Groundwater aluminum concentrations at the Site (mean 18.5 ug/L, range 2-534 ug/L) are well within reported values for North American surface waters and within the range of aluminum concentrations in drinking water historically found in Alberta. Aluminum has no known beneficial effect in humans. However per Health Canada Guidance "there is no consistent, convincing evidence that aluminum in drinking water causes adverse health effects in humans, and aluminum does not affect the acceptance of drinking water by consumers or interfere with practices for supplying good water." The same conclusions are drawn from WHO guidance documents (Aluminum in Drinking Water- Background Document for development of WHO Guidelines for Drinking Water Quality, WHO, 2003). Furthermore a health based interim guideline for aluminum (9500 ug/L) in groundwater has been developed by the Director of the BC MOE, effective June 1, 2010 to May 31, 2011 (Director's Interim Standards for Contaminated Site-Generic Numerical Drinking Water Standards for Aluminum, Iron, and Manganese, October 12, 2010.) Neither groundwater concentrations in background or onsite wells exceed this health based Standard. No federal health based guideline has been developed for dissolved aluminum, but an aesthetic objective/operational guideline for aluminum (200ug/L for other treatment systems, 100ug/L for conventional treatment plants) has been developed for treated drinking water, in which aluminum salts are added as flocculents during the treatment process.

	The mean concentration of dissolved aluminum (mean:283 ug/L, range: 32-534 ug/L) in groundwater samples collected from two background wells (6M and 7M) northeast and southwest of the Site are below the health based guideline developed for groundwater in the province of BC. With the exclusion of groundwater from background wells, the mean concentration of aluminum in groundwater collected from wells (1M, 2M, 3M, 4M, 5M, 04B, 05B and 06B) within the dump site and delineating the boundary of the dump Site) is approximately 45 ug/L (range: <2ug/L to 338 ug/L) which is below BC MOE Director's Interim Drinking Water Standards for Aluminum in Groundwater. Groundwater onsite is not currently used as a potable water resource, however it's potential as a future resource requires the application of drinking water standards to onsite groundwater as a measure of conservatism in this risk assessment. Based on the abovementioned information dissolved aluminum is not carried further as a groundwater COPC in the HHRA.
Tin (*Excluded from HHRA*)	Tin is used extensively to solder alloys for electronic equipment and as a protective coating for other metals, especially for food containers. Point sources which can introduce tin into the environment include the breakdown of used cans/food containers/tin containing wastes in landfills, waste incineration and the burning of fossil fuels (Tin and Inorganic Tin Compounds-Concise International Chemical Assessment Document 65, WHO, 2005). Some forms of tin are soluble, however most inorganic tin tends to partition into soil and sediment. Tin concentrations in the Earths crust are approximately 2-3 ug/g. Tin concentrations in soil range from <1 to 200 ug/g but can be higher in areas of high tin deposits. Given that background concentrations of tin in shallow and deep soils in areas northeast and southwest of the Site are at approximately 0.5 ug/g, tin deposits are not expected in the area. Tin concentrations in Site soil are variable (range: 0.5-140 ug/g) with a mean concentration of 6.35 ug/g. Tin concentrations are no higher than 5.0 ug/g in any of the other soil samples collected onsite. At the location where the maximum concentration in soil was identified (2018-10SS-6, inside the Old Dump extents) wire and screws were identified. It's possible that fragments of metal from this debris were included in the soil sample, potentially elevating the concentration of metals (in this case tin) identified in this sample. As per a WHO technical document regarding tin the general population is mainly exposed to inorganic tin through the diet, from which the average intake of tin can range from <1 to 60 mg/day. Less than 5% of inorganic tin tends to be absorbed from the GI tract, where it distributes to organs, and eventually excreted via the urine. Adverse effects from tin overexposure can include GI disturbances, disturbed mineral balance in the body, benign pneumoconiosis from occupational inhalation of tin dusts. A USEPA Health Effects Assessment Summary Table (1997) suggests a human health oral reference dose of 6 x10E-1 mg/kg/day based on the formation of organ lesions in a chronic rat study, the USEPA Region IX calculated a residential soil screening level of 47000 ug/g soil, protective of the soil ingestion pathway based on this HEAST derived value. As a further level of conservatism, only 20% of this residential soil screening value (9400 ug/g soil) is used to screen onsite soil concentrations as USEPA risk calculations are based on a hazard quotient of <1.0 whereas Health Canada guidance is derived using a hazard quotient <0.2. As the potentially anomalous maximum tin concentration found in onsite soil (140 ug/g soil) is well below this value we suspect that the risk of adverse effects from exposure to tin compounds in soil is negligible. Tin is not screened into this HHRA as a soil COPC.
Zinc (*Excluded from HHRA*)	The CCME federal guideline for soil (200 ug/g) is derived from soil contact data from toxicity studies on plants and invertebrates as well as soil and food ingestion toxicity data for mammals and avian species (CCME Zinc Fact Sheet, 1999). The average soil concentration of zinc in Canada is 90 mg/kg (Health Canada, Zinc Technical Document, 1979). Soil samples from the top 1.5 m collected at 5 boreholes on the boundary of the Old Dump Site at Garden River (ranged in zinc concentration from 77-91 ug/g). Furthermore zinc concentrations in soil (0-0.5 mbgs) at background locations NE and SW of the dump Site, ranged between 60-94 ug/g soil, of the 11 surface soil samples collected from within the old Dump Site (0-0.5 mbgs) only one sample (2018-10SS-6) had zinc concentrations(3950 ug/g soil in soil above the range of 78-190 ug/g soil. Given this information, it can be concluded that aside from an anomalous sample the majority of onsite surface soil at the dump site is expected to have zinc concentrations in line with local background concentrations and the stated national average. The BC CSR Schedule 5 Matrix soil standard derived for the protection of human health exposure though the soil ingestion pathway is 10 000 ug/g. The maximum soil concentration (3950 ug/g) identified in surface soil onsite is well below the BC CSR human health standard for agricultural land use. Furthermore evidence from borehole logs at the sample location where this maximum concentration was collected, indicated that debris inclusive of wires and screws were present throughout the top half-meter of soil, suggesting that metals concentrations in soil at this location may have elevated by debris particulates in this soil sample. Zinc is a common element in the earth's crust and an essential element to human health. Zinc can also be released in environmental media from paints, wood preservatives, mining, and burning waste(Zinc Fact Sheet,

	ToxFAQs, ATSDR. August 2005.) According to Health Canada guidance (1979) the daily dietary requirement for zinc ranges between 4-10 mg/day based on sex and age. Ingested zinc is mainly absorbed by the small intestine, transported to the liver and redistributed to various organs via the circulatory system bound to proteins, red blood cells and as a free ion. Long-term ingestion of quantities considerably in excess of these amounts has not resulted in adverse effects. Furthermore, because of efficient homeostatic control mechanisms, the occurrence of chronic zinc toxicity is extremely unlikely (Health Canada, Zinc- Technical Document, 1979). To further verify that exposure to zinc at maximum soil concentrations will not have adverse effects on human health. Health Canada spreadsheet models were used to preliminarily model dose exposures for the most sensitive receptor (toddler) via the soil ingestion, inhalation of soil particles, and dermal contact using the maximum soil (3950 ug/g) and groundwater (93.8 ug/L) encountered in the Garden River area, based on exposure assumptions detailed in the report. The calculated dose (2.29 x10E-2 mg/kg/day) was compared to the Health Canada derived zinc TDI of 0.478 mg/kg/day. Based on the abovementioned information, concentrations of zinc in soil and groundwater are deemed to have negligible adverse effects on humans exposed via ingestion of soil and groundwater, inadvertent inhalation of soil particles and dermal contact with soil and groundwater. As such zinc has not been screened in as a soil COPC for the HHRA.
Calculated TDS (*Excluded from HHRA*)	Total dissolved solids (TDS) comprise inorganic salts and small amounts of organic matter that are dissolved in water. The principal constituents are usually the cations calcium, magnesium, sodium and potassium and the anions carbonate, bicarbonate, chloride, sulphate and, particularly in groundwater, nitrate (from agricultural use). Total dissolved solids in water supplies originate from natural sources, sewage, urban and agricultural runoff and industrial wastewater. In Canada, salts used for road deicing can contribute significantly to the TDS loading of water supplies. Concentrations of TDS in water vary owing to different mineral solubilities in different geological regions. In areas of Precambrian rock, TDS concentrations in water are generally less than 65 mg/L. Levels are higher in regions of Paleozoic and Mesozoic sedimentary rock, ranging from 195 to 1100 mg/L because of the presence of carbonates, chlorides, calcium, magnesium and sulphates. Given the types of sedimentary rock that comprise the Ireton Formation (Paleozoic era) characterizing bedrock geology in the Garden River area, it is not surprising that mean TDS concentrations in two offsite background wells (608 mg/L), and mean TDS concentration in onsite/site boundary wells (445.7 mg/L) falls within the upper TDS range for this regional geology. Concentrations of TDS in drinking water in Canada are generally below 500 mg/L but can be considerably higher, particularly in the arid western regions. Concentrations of TDS in 54% of 1042 communities surveyed in Alberta in October 1989 were below 500 mg/L , but ranged considerably (<100 to 1000 mg/L). Recent data on health effects associated with the ingestion of TDS in drinking water have not been identified. The presence of dissolved solids in water may affect its taste. The palatability of drinking water has been rated, by panels of tasters, according to TDS level as follows: excellent, less than 300 mg/L; good, between 300 and 600 mg/L; fair, between 600 and 900 mg/L; poor, between 900 and 1200 mg/L; and unacceptable, greater than 1200 mg/L. Given this scale, measured TDS concentrations suggest that groundwater from offsite background wells and onsite wells is of fair to good taste, respectively (Health Canada- Total Dissolved Solids Technical Document, Chemical/ Physical Parameters, January 1991 Update). No federal health based guideline has been established for TDS in Drinking Water. Health Canada has established an aesthetic objective of ≤500 mg/L for total dissolved solids (TDS) in drinking water. At higher levels, excessive hardness, lack of palatability, mineral deposition and corrosion may occur in water distribution systems. At low levels, however, TDS contributes to the palatability of water. Offsite background wells (6M and 7M) exhibit mean TDS concentrations above this aesthetic objective, whereas onsite groundwater characterized from boundary and onsite wells has a mean TDS concentration below local background concentrations and below the aesthetic objective identified by health Canada. (Health Canada, TDS Technical Document, January 1991 Update). Groundwater onsite is not currently used as a potable water resource, however it's potential as a future resource requires the application of drinking water standards to Site groundwater as a measure of conservatism in this risk assessment. Based on the abovementioned information the human health risk of exposure to TDS in onsite groundwater is negligible, as such Calculated TDS is not carried further as a groundwater COPC in the HHRA.
Boron (*Excluded from HHRA*)	Boron is a naturally occurring element which occurs in the earths crust at an average concentration of 10 ppm (10ug/g) (IRIS, Toxicological Review of Boron and Compounds, June 2004). Boron compounds, most notably boric acid and sodium borate (borax, $Na_2B_4O_7.10H_2O$), are used in the preparation of disinfectants and drugs, in the manufacture of borosilicate glass, as components of enamels, as antioxidants for soldering, and in the cosmetics, leather, textile, paint and wood-processing industries. Boron concentrations in surface and subsurface soil at background locations (6M and 7M) is approximately 0.5 ug/g, and slightly lower than the mean concentrations of boron in site soil (mean: 0.94 ug/g, range: 0.5- 4.3 ug/g) but both site soil and background soil concentrations of boron fall within the stated average.

	The predominant form of boron in water is boric acid. Average boron concentrations in 3842 samples of treated and distributed water in 51 Ontario communities surveyed from 1987 to early 1989 ranged from 0.042 to 235 µg/L. Based on a daily water consumption of 1.5 L and the maximum boron content of 0.57 mg/L measured in drinking water in the Ontario survey, the maximum daily intake of boron in Canadian drinking water is estimated to be 0.86 mg. (Health Canada-Boron Technical Document 1990). Mean groundwater concentration of boron in the Garden River area is approximately 3.3 ug/L; well under the federal drinking water standards and within the noted range for drinking water in Ontario communities. The greatest route of human exposure to boron is via ingestion of fruits and vegetables (IRIS, Toxicological Review of Boron and Compounds, June 2004). Boron can be absorbed by the GIT, via the lung epithelium, and via absorption through damaged skin, it can circulate in the body as boric acid and borates, and accumulate in bone. Boric acid is not metabolized and is primarily excreted via the urine. Health Canada and USPEA review of toxicity studies carried out with boron dosing suggest that fetal development and testicular development are sensitive endpoints for multiple species exposed to this element (IRIS, Toxicological Review of Boron and Compounds, June 2004, and Health Canada-Boron Technical Document 1990). At present data is inadequate to determine if boron has potential to be a human carcinogen, in Canada it is identified as a Group IVC (probably not a carcinogen) chemical. Using the Health Canada TDI (0.0175 mg/kg/day) for boron as a reference, maximum concentrations in soil (0.0043mg/g) and groundwater (0.08 mg/L) were modeled using Health Canada Guidance (Part IV) to calculate potential daily doses (mg/kg/day) via inhalation, soil ingestion, and dermal routes for a 70 kg adult receptor and a 16.5kg toddler receptor onsite, based on assumed exposure scenarios detailed in the report text. Predicted daily doses of boron for both the adult (1.7x10E-3) and toddler (2.9x10E-3) were below the tolerable daily intake value suggested by Health Canada guidance. Based on this information, soil and groundwater concentrations of boron are considered to cause negligible adverse effects to human receptors and justify having boron screened out as a groundwater or soil COPC in the HHRA.