HUMAN HEALTH RISK ASSESSMENT

RED MOUNTAIN UNDERGROUND GOLD PROJECT

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April 2018
Project No.: 00265-03

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Acronyms and Abbreviations

AAQOs	Ambient Air Quality Objectives
AIR	Application Information Requirements
AQO	Air Quality Objectives
ATSDR	United States Agency for Toxic Substances and Disease Registry
BC CSR	British Columbia Contaminated Sites Regulation
BCEAO	British Columbia Environmental Assessment Office
BCF	Bioconcentration Factor
BCMOE	British Columbia Ministry of Environment
BTF	Biotransfer Factor
CAAQS	Canadian Ambient Air Quality Standards
CAPMoN	Canadian Air and Precipitation Monitoring Network
CCME	Canadian Council of Ministers of the Environment
CEQ	Commission on Environmental Quality
CEQG	Canadian Environmental Quality Guidelines
CIL	Carbon-In-Leach
CO	Carbon Monoxide
COPC	Constituent of Potential Concern
Core6	Core6 Environmental Ltd
CWH	Coastal Western Hemlock
DMA	Dimethylarsenic acid
DQRA	Detailed Quantitative Risk Assessment
EA	Environmental Assessment
EEC	Estimated Environmental Concentration
EMF	Electromagnetic Field
HEA	Health Effects Assessment
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IDM	IDM Mining Ltd

ILCR	Incremental Lifetime Cancer Risk
IRIS	Integrated Risk Information System
LSA	Local Study Area
MAC	Maximum Acceptable Concentration
MH	Mountain Hemlock
ML/ARD	Metal Leaching/Acid Rock Drainage
MMA	Monomethyl arsenic acid
MMBC	Métis Nation BC
MOE	Ministry of Environment
NFA	Nisga'a Final Agreement
NLG	Nisga'a Lisims Government
NO_2	Nitrous Oxide
O_3	Ozone
P90	90^{th} Percentile
PFSA	Project Footprint Study Area
$PM_{2.5}$	Particulate Matter Less than 2.5 microns in diameter
PM_{10}	Particulate Matter Less than 10 microns in diameter
Project	Red Mountain Underground Gold Project
PQRA	Preliminary Quantitative Risk Assessment
QA	Quality Assurance
QC	Quality Control
RDKS	Regional District of Kitimat-Stikine
RfC	Reference Concentration
RfD	Reference Dose
RIVM	Netherlands National Institute of Public Health and the Environment
RME	Reasonable Maximum Exposure
ROC	Receptor of Concern
RSD	Risk-specific Dose
RSA	Regional Study Area
SARA	Species at Risk Act (2002)
SO_2	Sulphur Dioxide
TC	Tolerable Concentration

TDI	Tolerable Daily Intake
TMF	Tailings Management Facility
TPM	Total Particulate Matter
TRV	Toxicity Reference Value
TSKLH	Traditional Territory of Tsetsaut Skii km Lax Ha
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
VC	Valued Component
VOC	Volatile Organic Compounds
WHO	World Health Organization

Statement of Limitations

This report was prepared by Core6 Environmental Ltd (Core6) for IDM Mining Ltd (IDM) who has been part of the development of the scope-of-work and objectives for this project and understand its limitations. This report is intended to provide information to IDM to support project permitting efforts through the British Columbia Ministry of Environment. Core6 is not a party to the various considerations underlying IDM's business decisions and does not make recommendations regarding such decisions. Core6 accepts no responsibility for any business decisions relating to the Project. Any use, reliance on, or decision made by a third-party based on this report, is the sole responsibility of the third-party. Core6 accepts no liability or responsibility for any damages that may be suffered or incurred by any third-party as a result of decisions made or actions taken based on this report.

This report has been developed in a manner consistent with the level or skill normally exercised by environmental professionals practicing under similar conditions. In preparing this report, Core6 has relied on information provided by others and has assumed that the information provided is factual and accurate. Core6 accepts no responsibility for any deficiency, misstatement, or inaccuracy in this report resulting from information provided by others. If the assumed facts or accuracy of the information relied upon are shown to be incorrect, or if new information is discovered, then modifications to this report may be necessary.

1 INTRODUCTION

This Human Health Risk Assessment (HHRA) was completed by Core6 Environmental Ltd. (Core6) to support the assessment of Human Health Effects, as part of the Environmental Assessment (EA) initiated by IDM Mining Ltd. (IDM) for the Red Mountain Underground Gold Project (the Project), located near the town of Stewart, in northwestern British Columbia (BC; Figure 1).

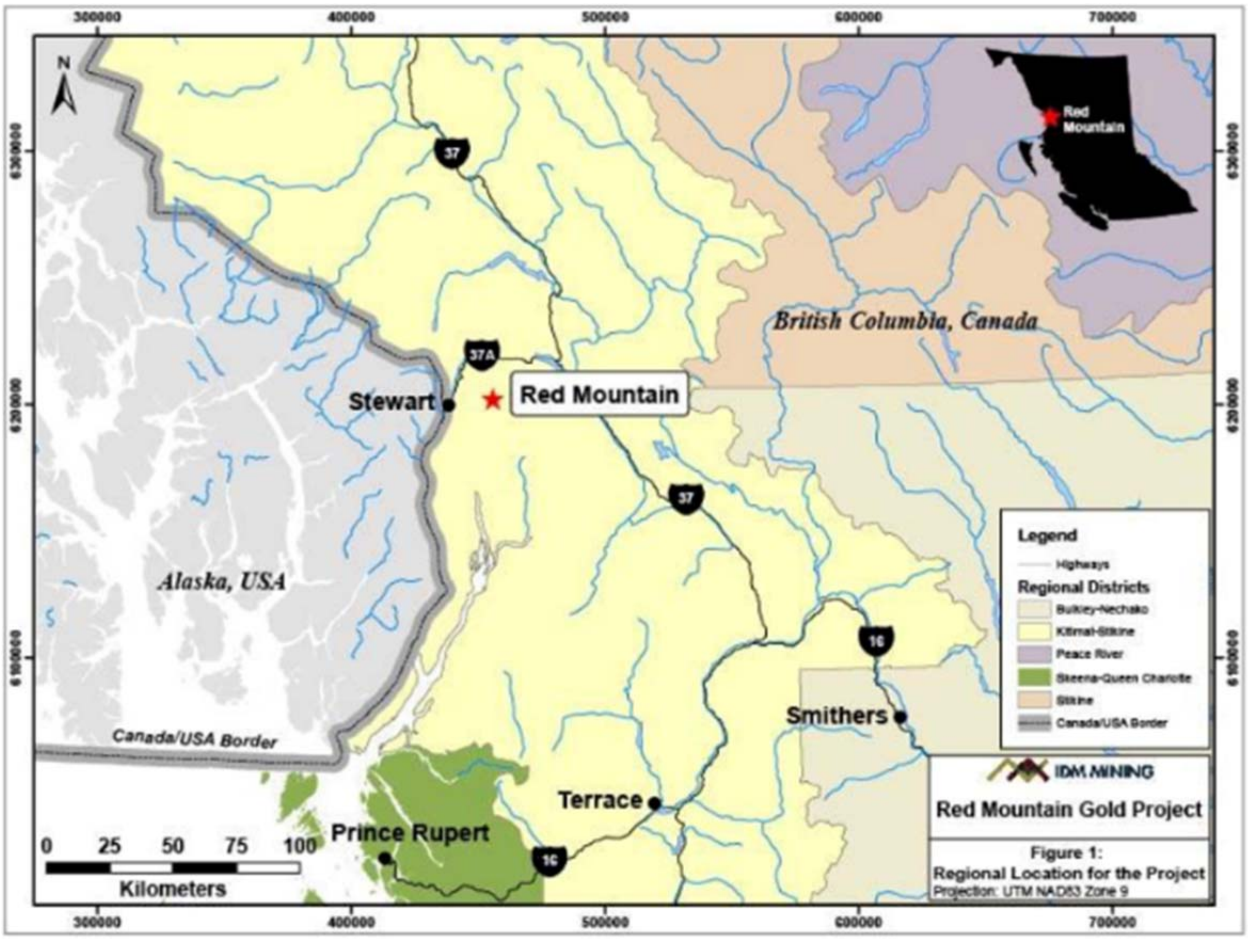


Figure 1 Project Location Plan

The development and operation of the Project have the potential to alter existing (baseline) conditions with respect to the concentrations of chemical parameters in the vicinity of the Project. Consequently, there is a potential for adverse effects in human receptors, above baseline conditions (i.e., concentrations), as a result of exposure to chemicals associated with Project activities. To evaluate potential, the practice of HHRA has evolved to provide an improved understanding of the potential for unacceptable adverse effects to human receptors.

Three key factors are considered in an HHRA:

- Sources of potential risk;
- Receptors of concern (ROCs); and
- Exposure pathways.

Depending on the jurisdiction, sources of potential risk may sometimes be referred to as hazards or stressors. This HHRA specifically focuses on exposure to chemicals as sources of potential risk. ROCs refer to the different user groups and their activities or behaviors that may result in exposure to identified sources of potential risk (e.g., hunters, hikers, residents). Exposure pathways refer to the means by which ROCs are exposed to the sources. For example, hunters may be exposed to chemicals directly through contact with soil while hunting or through dietary uptake (i.e., purposeful ingestion) of their catch. Perhaps the most important principle of risk assessment is that there can only be risk when all three of these factors coincide. If any one of these factors is not present, there is no risk (Figure 2).

here all three factors coincide, further consideration is required to characterize the risk through a more thorough understanding of the characteristics and activity patterns of the ROCs, the spatial and temporal nature of the source(s) and associated chemical stressors, and the exposure pathways by which ROCs are exposed to the source(s). A graphical illustration of the relationships between sources, exposure pathways, and receptors - a Human Health Conceptual Site Exposure Model - is provided at the end of the Problem Formulation section.

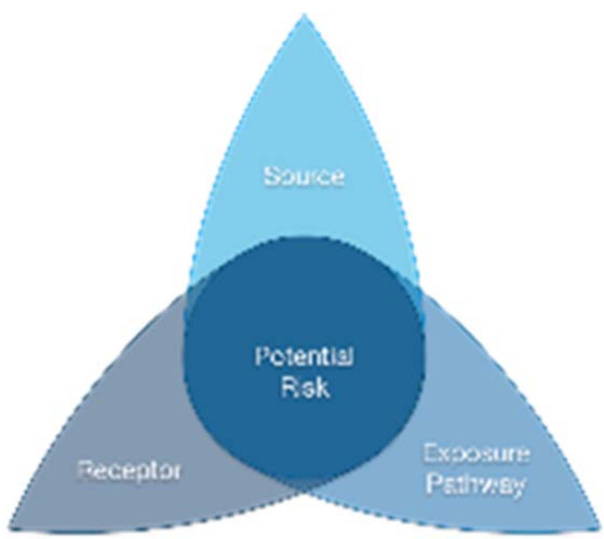


Figure 2 Risk Factor Overlap Principle

2 PROJECT DESCRIPTION

IDM proposes to develop and operate the Project (Figure 3) as a 1,000 tonne per day (tpd) underground gold mine. The development area is approximately 163 hectares and is located at approximately 55.896° to 56.054° north latitude, and 129.665° to 129.802° west longitude. The Project is in the Bitter Creek watershed, within the Cambria Mountain Range, which is part of the Boundary Range (Alaska Boundary Range) that extends along the border of Alaska and British Columbia. The elevation ranges from 1,500 to 2,100 masl, with an average of approximately 1,800 masl. The Project falls within the Nass Wildlife Area as set out in Nisga'a Final Agreement (NFA), and is within the Kitimat-Stikine Regional District.

The Project has four main phases: Construction Phase, Operation Phase, Closure and Reclamation Phase, and Post-Closure Phase. Reclamation will be on-going during operations. The life of the Project is anticipated to be approximately 23 years. It is expected that the Construction Phase could begin as early as Spring 2018, and will last approximately 18 months. The Operation Phase will continue for 6 years, based on the Project plan. The Closure and Reclamation Phase will last 5 years, and the Post-Closure Phase, an additional 10 years.

Activity will be primarily contained within two main areas with interconnecting access roads:

1. Mine Site – located in the Goldslide Creek watershed, a sub-watershed of the larger Bitter Creek watershed, and is the location of the underground mine and dual portal access at the upper elevations of Red Mountain (1950 masl) (Figure 4); and
2. Bromley Humps – also situated in the Bitter Creek watershed (1500 masl), and is the location of the proposed Process Plant and Tailings Management Facility (TMF) (Figure 5).

The Process Plant will consist of the following:

- 3-stage crushing and fine ore storage;
- Primary and secondary grinding;
- Carbon-in-Leach (CIL);
- Acid Wash and Elution;
- Carbon Regeneration;
- Cyanide destruction;
- Recovery and refining; and
- Tailings disposal at the TMF.

The crushing circuit will operate at an availability of 70% while the plant will operate 24 hours per day, 365 days per year, at an availability of 92%. The tailings will undergo cyanide destruction before being delivered to the TMF. Tailings slurry from the processing plant will be discharged from the delivery pipelines into the TMF. Only water meeting effluent limits will be discharged to Bitter Creek. Water released from the TMF will be treated as necessary prior to discharge to Bitter Creek.

The material to be mined by IDM includes: mineralized zones of crudely tabular, northwesterly trending and moderately to steeply southwesterly dipping gold and silver-bearing iron sulphide stockworks. The deposit will initially be accessed from an existing portal and exploration ramp. In the first year of operation, a lower access, to be used for haulage, will be added. Access ramps will be driven at a maximum grade of 15% at a 4.5 m x 4.5 m profile to accommodate 30-tonne haul trucks. Ore material will be hauled to the Processing Plant on a road yet to be constructed.

An existing access road from Highway 37 extends for approximately 13 km along the Bitter Creek valley, close to the location of the proposed Processing Plant, but stops short of the proposed mine site. An additional 13-km extension of the existing road is planned. Roads will not be accessible to the public. Locally-developed, geochemically-suitable borrows/rock quarries, adjacent to the proposed access road alignment, will provide the bulk of crushed rock and aggregate to build roads, lay-down areas, provide concrete aggregate and support other construction and maintenance activities.

Electrical power will be supplied to the Project through a connection to the BC Hydro electrical transmission system near Stewart, BC. Power will be delivered to both the Process Plant and the mine site by a 25 KV transmission line.

A camp will not be constructed at the mine site. Workers will likely reside in Stewart and will be transported as necessary to the Project area.

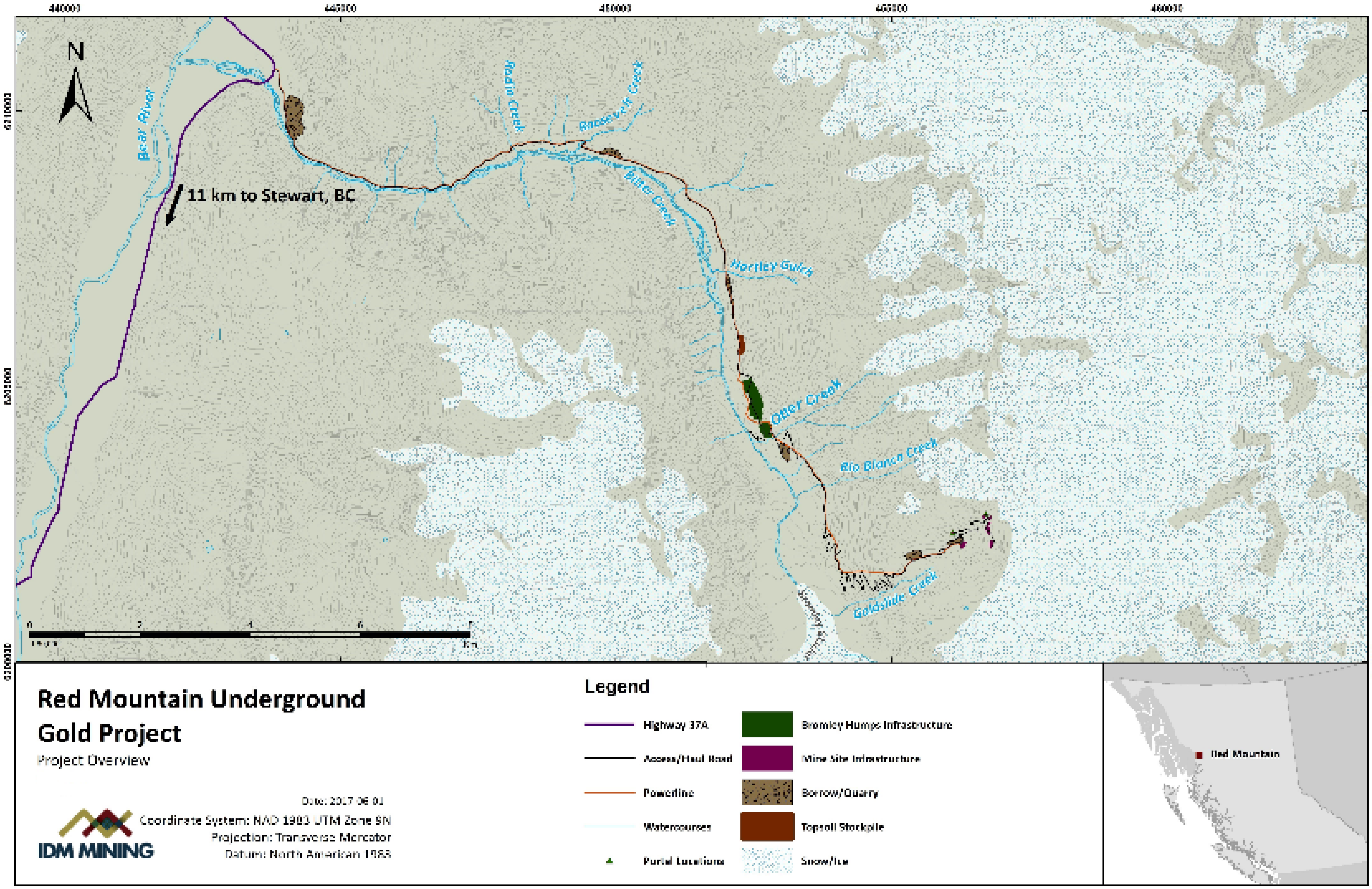


Figure 3 Project Overview

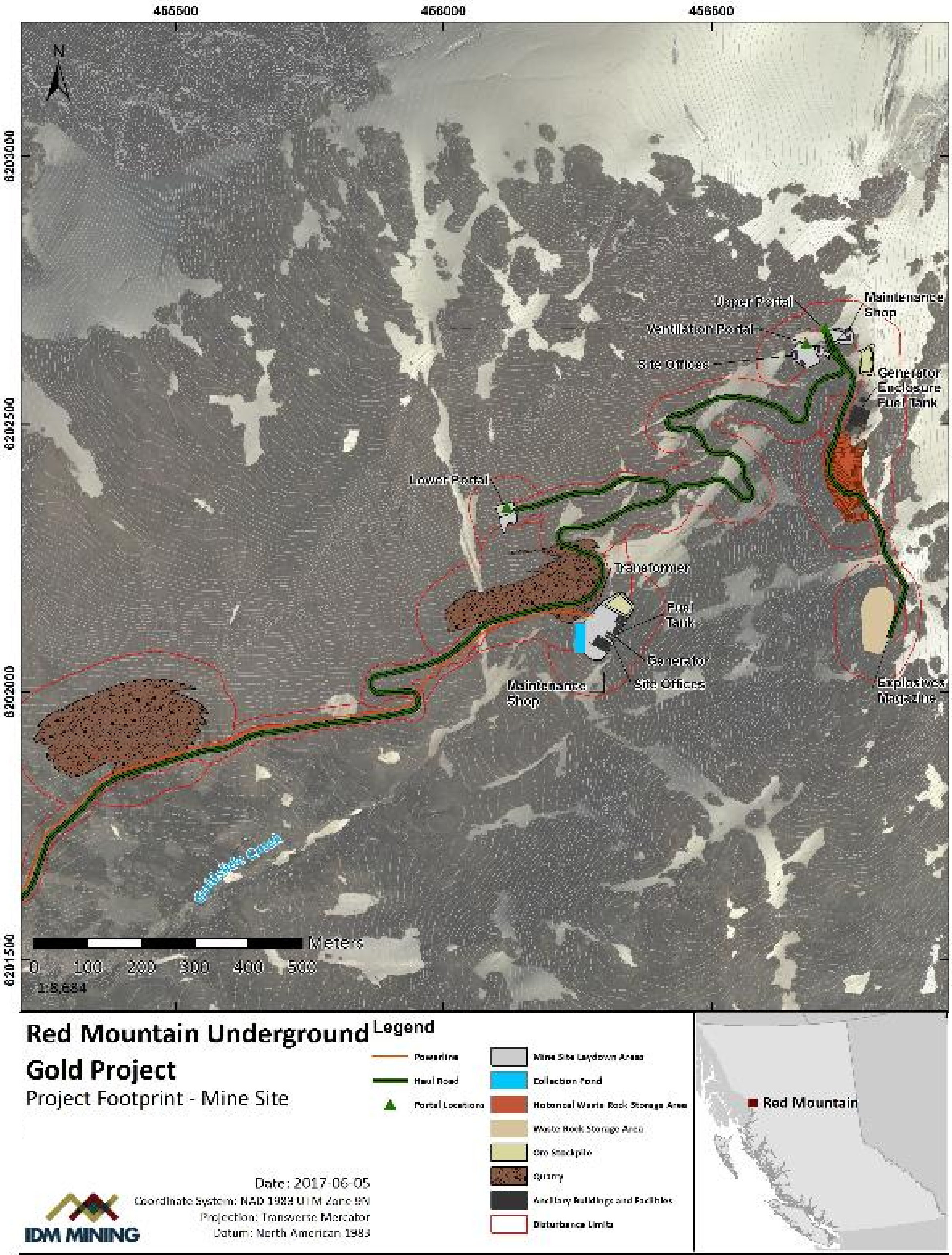


Figure 4 Project Footprint - Mine Site

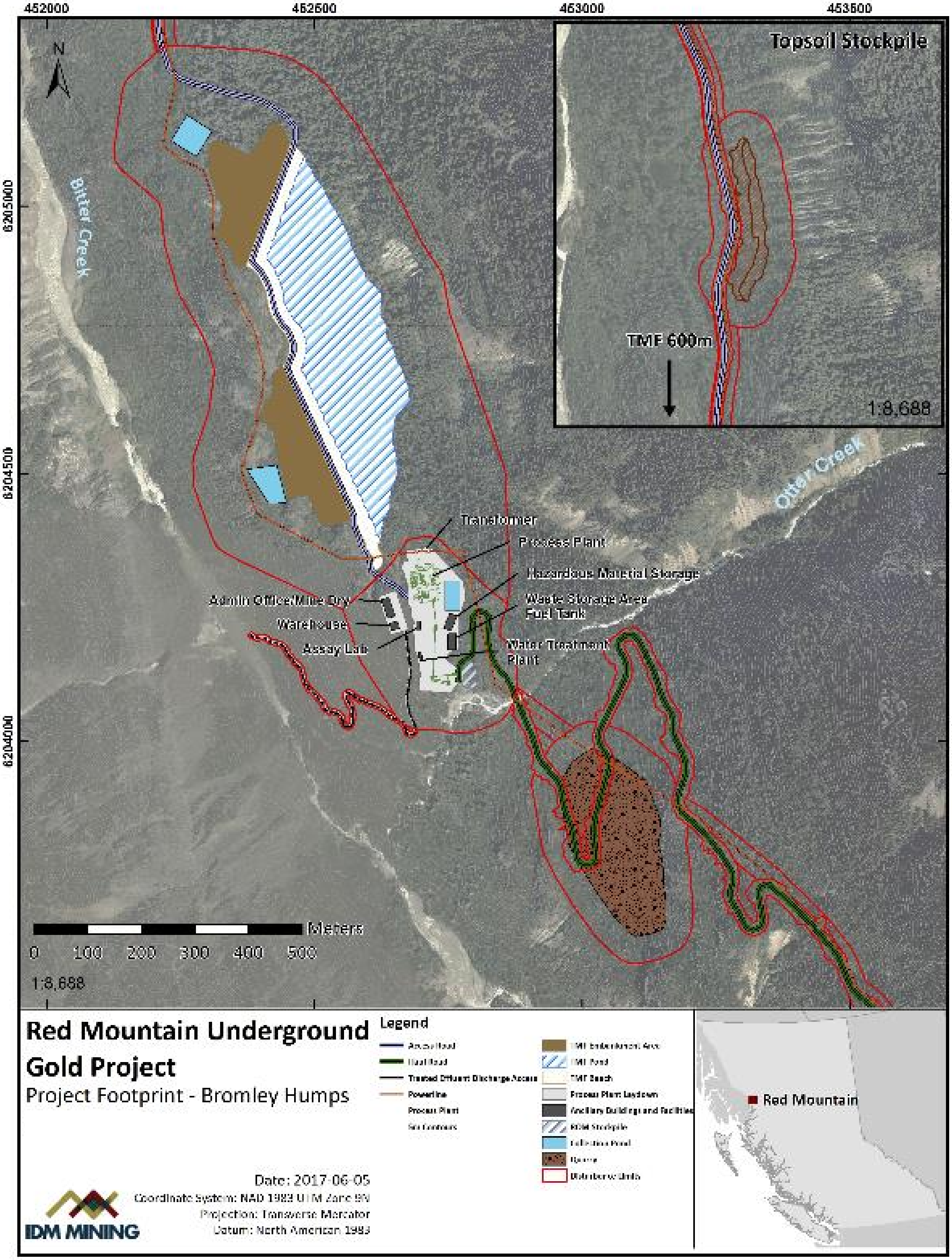


Figure 5 Project Footprint - Bromley Humps

3 STUDY AREA

3.1 Local Study Area

The Local Study Area (LSA) for the HHRA was established as an area with a radius of 50 km, which includes the following communities:

- District of Stewart;
- Village of Gitlaxt'aamiks (formerly New Aiyansh);
- Village of Gitwinksihlkw (Canyon City);
- Village of Laxgalts'ap (Greenville);
- Village of Gingolx (Kincolith);
- Meziadin Junction; and
- Bell II.

The Project is also within the Nass Area and the Nass Wildlife Area, as set out in the Nisga'a Final Agreement (NFA). Pursuant to the NFA, Nisga'a Nation, as represented by Nisga'a Lisims Government (NLG), has Treaty rights to the management and harvesting of fish, wildlife, and migratory birds within the Nass Wildlife Area and the larger Nass Area. The Project is also within the asserted traditional territory of Tsetsaut Skii km Lax Ha (TSKLH) and is within an area where Métis Nation BC (MNBC) claims Aboriginal rights.

The LSA for the HHRA (Figure 6) incorporates the zone of influence of the Project on Human Health, and considered measurement indicators that are considered to potentially interact with the Project. These include air contaminants, noise, EMFs, and constituents in surface water, sediment, fish, groundwater, soil, plants, and wildlife. LSA spatial boundary figures for the Air Quality VC (Figure 7), Surface Water Quality VC (Figure 8), Fish and Fish Habitat VC (Figure 9), and the Wildlife and Wildlife Habitat VC (Figure 10) have been included in this chapter to put the Human Health LSA into the context of the measurement indicators supporting the assessment of the Health VC.

The LSA boundary for Noise is encompassed within the Air Quality LSA boundary. Spatial boundaries for Sediment Quality, Groundwater Quality, and Hydrogeology are encompassed within the Surface Water Quality LSA boundary. Spatial boundaries for Vegetation and Ecosystems and Landforms and Natural Landscapes (including soil quality) are encompassed within the Wildlife and Wildlife Habitat LSA boundary.

All direct and indirect exposures to future Project activities will occur within the Bitter Creek watershed portion of the LSA, with the exception of ingestion of country food by person living outside the watershed. For example, someone from Village of Gitlaxt'aamiks or Stewart may be given or purchase moose caught in the Bitter Creek Watershed.

3.2 Regional Study Area

The Regional District of Kitimat-Stikine (RDKS) will serve as the Regional Study Area (RSA) that will be used a baseline comparison for predicting, measuring, and monitoring the potential effects of the proposed Project on health effects (Figure 6). The RSA boundary takes into consideration the predicted habitat of select wildlife during hunting/ trapping season, such as moose, hare and grouse, and fishing areas in lower Bitter Creek. It also considers nearby communities as people from these communities are more likely to hunt, fish and recreate in the LSA (Figure 6).

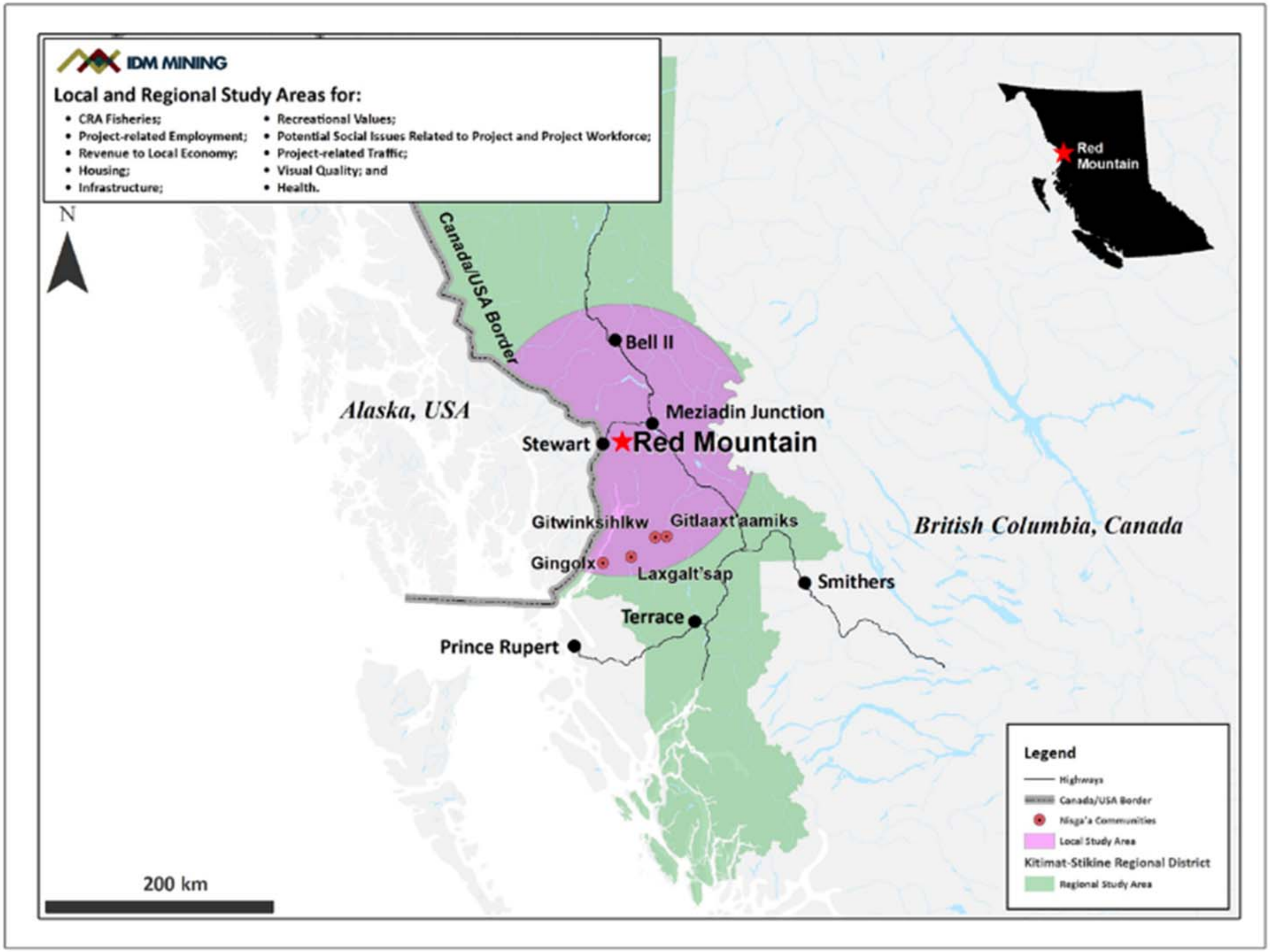


Figure 6 Local and Regional Study Areas for Health Effects

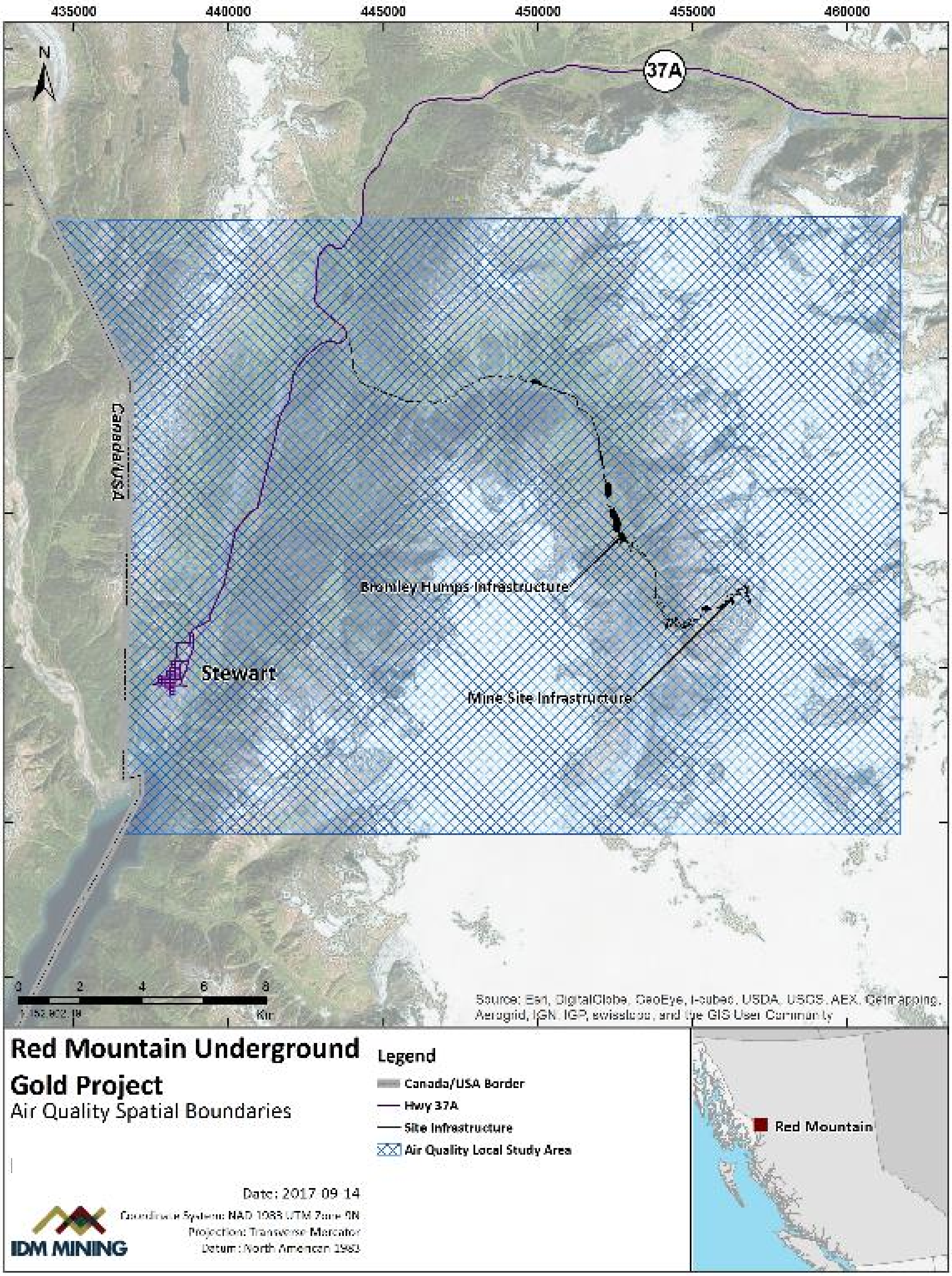


Figure 7 Air Quality Spatial Boundaries

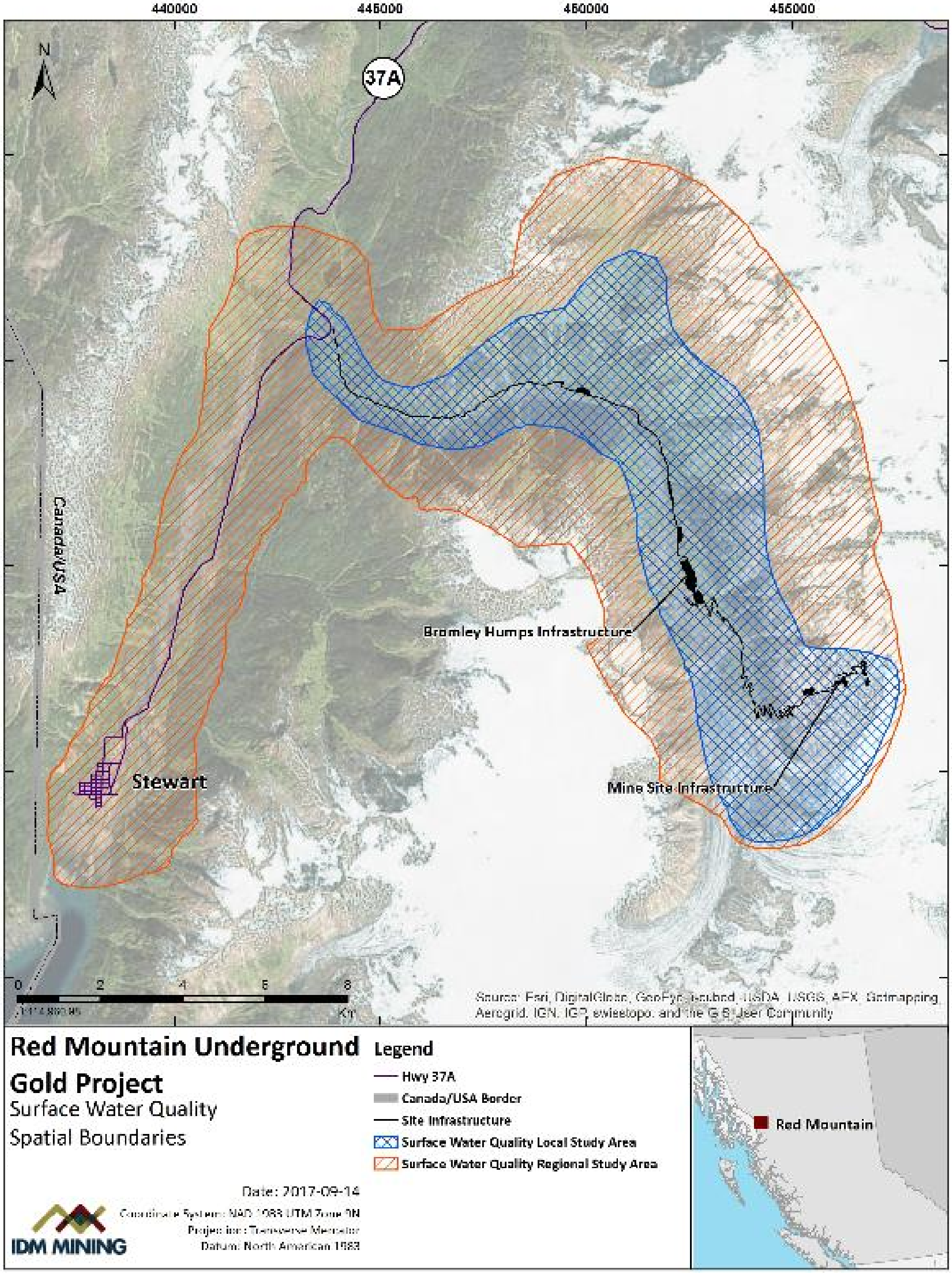


Figure 8 Surface Water Quality Spatial Boundaries

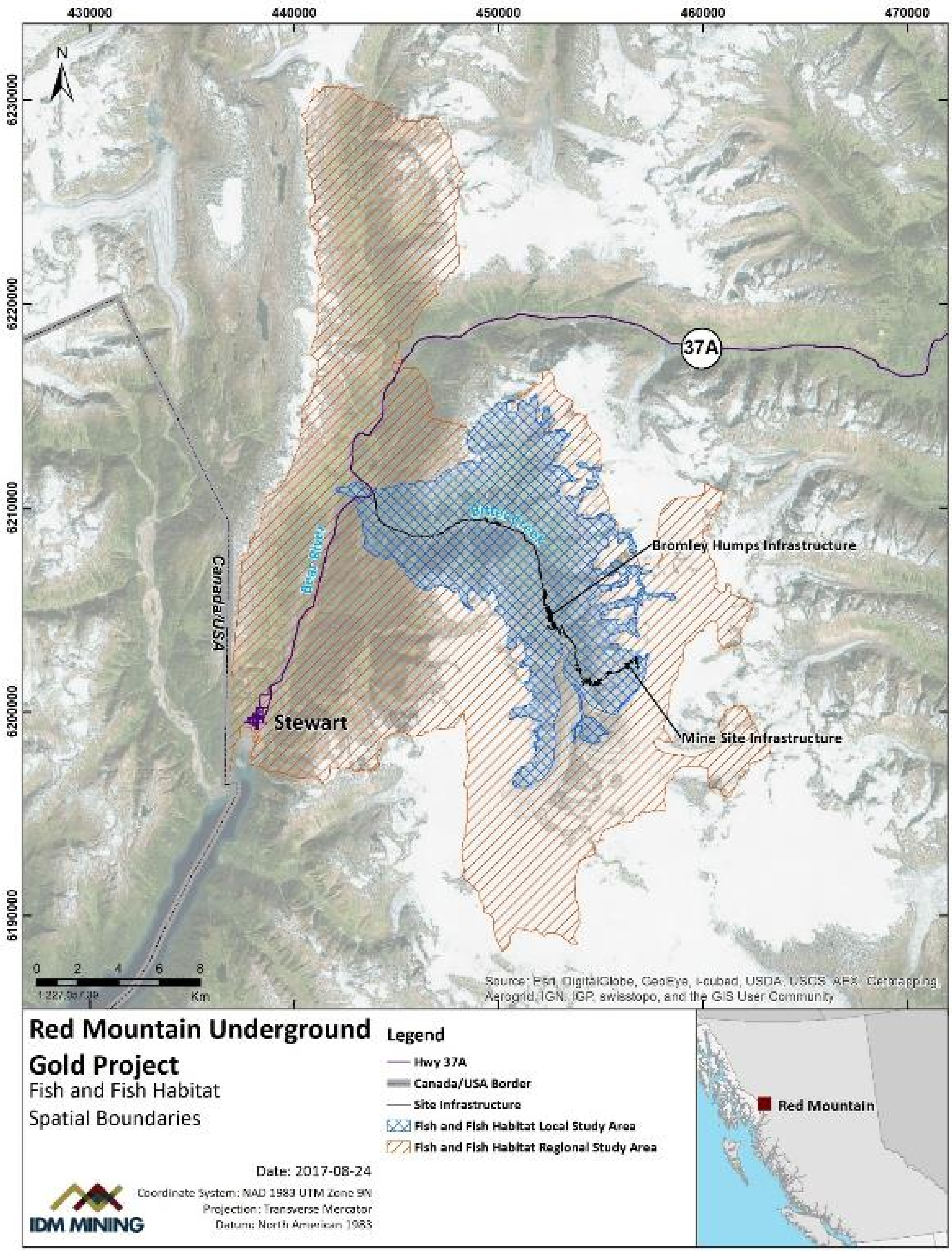


Figure 9 Fish and Fish Habitat Spatial Boundaries

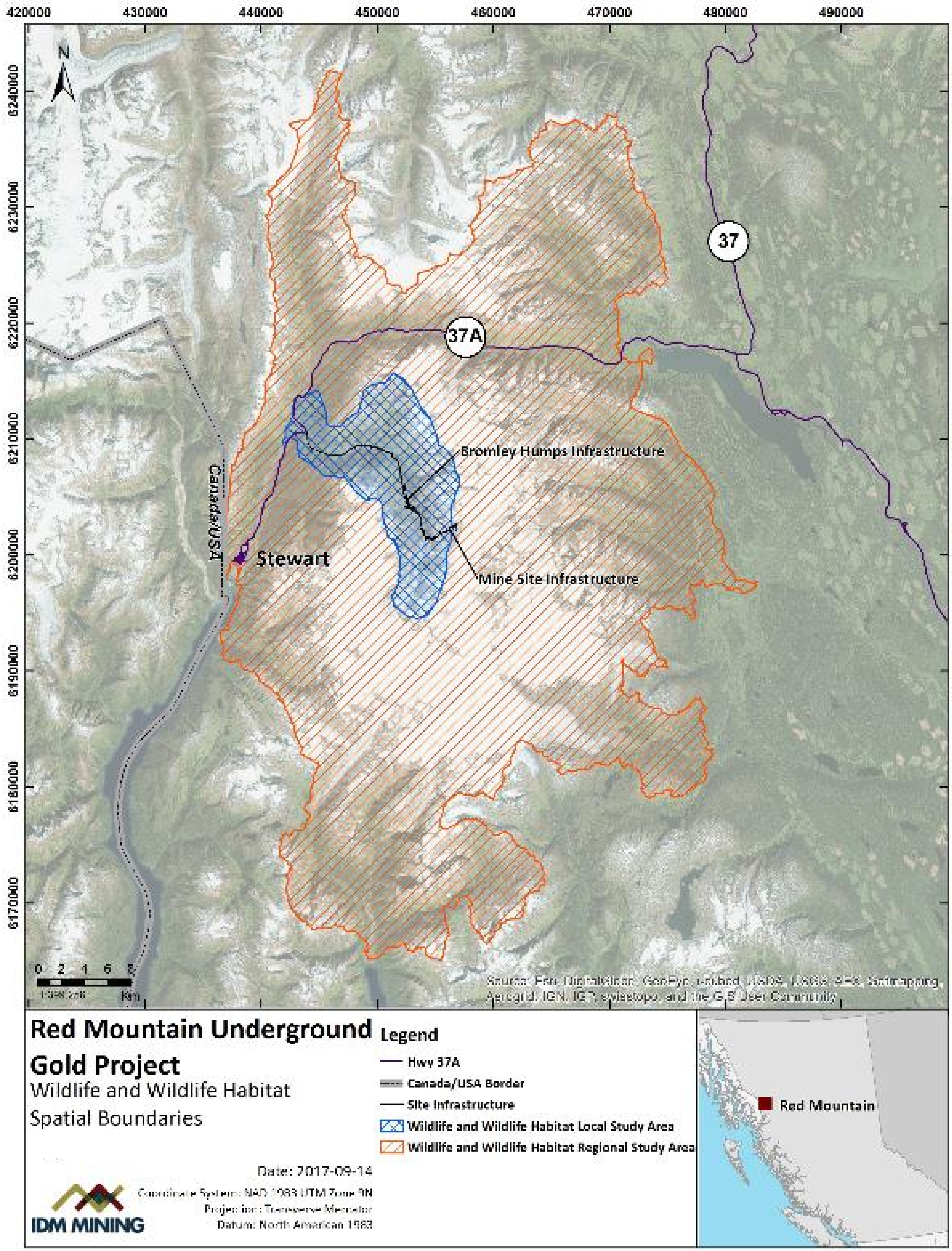


Figure 10 Wildlife and Wildlife Habitat Spatial Boundaries

4 BACKGROUND

4.1 Location Description

The Project is located within the Bitter Creek watershed, which is within the Southern Boundary Range. The watershed is a largely north-south valley that drains Bromley Glacier into the Bear River. Roosevelt Creek is also a significant drainage occupying a hanging valley in the northeast portion of the watershed, while smaller watercourses occur in deep gullies on the steep mountain slopes. The area is characterized by steep, wet slopes that contain frequent avalanche tracks. The north end of Bitter Creek Valley contains Coastal Western Hemlock (CWH) forests along the lower- and mid-slopes, including large areas of mid-slope mature and old forests. The mouth of Bitter Creek, as it drains into Bear River, is characterized by flat floodplain forests, dominated by deciduous stands adjacent to the rivers and grading into mixed forests on higher, less active floodplains. Narrow fringes of floodplain forest extend up Bitter Creek, with most of the active creek floodplain area being highly scoured rock and gravel, and occasional sparsely-vegetated areas. Mountain Hemlock (MH) forests occupy a narrow, steep band above the CWH (around 700 masl), and replace the CWH at the valley bottom as elevation increases to the southeast of Roosevelt Creek. Parkland MH forests start around 900 masl, and often contain old to very old forested stands before giving way to stunted Krummholz around 1,200 masl as the alpine zone begins.

As Bitter Creek climbs in elevation towards Bromley Glacier, lower slope forests begin to be replaced by early seral shrub communities where the soil development is limited and vegetation communities are in early stages of post-glaciation establishment. At the southern end of the valley the MH transitions into sparse parkland communities, with the majority of the area dominated by recently de-glaciated morainal deposits, along with colluvial slopes and barren alpine communities. Alpine communities are varied in the Bitter Creek Watershed, where transitional areas above the parkland forests are often diverse and contain rich herb meadow slopes, subalpine fir (*Abies lasiocarpa*) Krummholz, and expanses of alpine heath intermixed with dwarf shrub tundra-like communities. Exposed higher elevations contain extensive sparsely vegetated communities and barren rock outcrops before giving way to glaciers and icefields.

Avalanche tracks are abundant in the watershed, due to steep slopes and high snowfall. Avalanche communities are typically wet and rich and dominated by alder (*Alnus viridis* ssp. *crispa*), with lesser components of Devil's club (*Oplopanax horridus*) and various willows (*Salix* spp.). At the upper elevations, the avalanche slopes contain lush herb meadows. The edge of avalanche tracks, as they pass through forested areas, often contain slide-maintained forested communities that are irregular and fragmented in extent, and contain a high percent of dead or damaged trees.

The Bitter Creek watershed has a history of mine operation and exploration. Highway 37A and a BC Hydro powerline cross the creek near the confluence with Bear River. Much of the area near Highway 37A has been or is being, cleared or logged for various purposes. Small quarries and borrow pits associated with the highway or powerline construction occur along Highway 37A, and basic amenities have been developed for a recreation area at Clements Lake.

An old, overgrown road runs parallel to much of Bitter Creek along the northern side on old floodplains and the toe of the slope. Several smaller old roads branch off up the slopes, and there are numerous old logged areas adjacent to the road. Additional roads occur around the vicinity of the old mine portal on Red Mountain. Current exploration activities include new roads in the alpine near the old portal, along with the exploration camp, helicopter pad, and numerous temporary drill pads.

4.2 Information Sources

The following documents represent the sources from which information and data that was provided to Core6, originated:

- Project Overview: (Volume 2, Chapter 1);
- Geochemical Characterization of Waste Rock, Ore, and Talus (Volume 8, Appendix 1-B);
- Air Quality Modelling Report (Volume 8, Appendix 7-A);
- Ecosystems, Vegetation, Terrain and Soils Baseline Report (Volume 8, Appendix 9-A);
- Mine Area Hydrogeology Report (Volume 8, Appendix 10-A);
- Bromley Humps Baseline Hydrogeology Report (Volume 8, Appendix 10-B);
- Baseline Surface Water and Groundwater Quality Report (Volume 8, Appendix 14-A);
- Water Quality Assessment of the Reasonable Upper Limit Case (Volume 8, Appendix 14-B);
- Water and Load Balance Model Report (Volume 8, Appendix 14-C);
- Baseline Wildlife Resources Report (Volume 8, Appendix 16-A); and
- Baseline Fisheries and Aquatic Resources (Volume 8, Appendix 18-A).

4.3 Regulatory Environment

The British Columbia Environmental Assessment Office (BCEAO) issued a Section 10 Order to IDM confirming that the proposed Project requires an EA Certificate. As the proposed Project exceeds the minimum daily ore production threshold of 600 tpd, the Project will also require a decision pursuant to *Canadian Environmental Assessment Act 2012.*

As the Project is required to meet both provincial and federal requirements, the HHRA was completed consistent with accepted technical guidance prepared by provincial and federal regulatory bodies, as described below:

- Health Canada. 2012a. *Federal Contaminated Site Risk Assessment in Canada*, *Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0;*
- Health Canada. 2010a. *Federal Contaminated Site Risk Assessment in Canada Part II: Health Canada Toxicological Reference Values;*
- Health Canada. 2012b. *Federal Contaminated Site Risk Assessment in Canada Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals (DQRA);*
- Health Canada. 2010b. *Federal Contaminated Site Risk Assessment in Canada Supplemental Guidance on Human Health Risk Assessment for Country Foods;*
- BCMOE. 2015. *Technical Guidance on Contaminated Sites 7 - Supplemental Guidance for Risk Assessments;* and
- Northern Health. 2015. *Guidance on Human Health Risk Assessment.*

The main components of the HHRA, consistent with Canadian provincial and federal risk assessment guidance (along with that of numerous other regulatory jurisdictions worldwide), are as follows:

- Problem Formulation;
- Exposure Assessment;
- Toxicity Assessment;
- Risk Characterization;
- Uncertainty Assessment; and
- Discussion and Conclusions.

5 OBJECTIVES

The primary objective of this HHRA are to quantitatively evaluate human health risks associated with the Project. This objective is met through an evaluation of exposure to chemicals under baseline and predicted future conditions (i.e., Construction Phase, Operation Phase, Closure and Reclamation Phase, and Post-Closure Phase). Incremental differences between the baseline and predicted future conditions is considered to capture the potential changes attributable to the Project. The HHRA was limited to non-occupational chemical exposures (with respect to the Project). Occupational health and safety is addressed elsewhere in the Environmental Assessment.

6 PROBLEM FORMULATION

The problem formulation is the planning stage of the HHRA. The intent of the problem formulation is to identify sources, constituents of potential concern (COPCs), ROCs, and the pathways through which the ROCs may be exposed to COPCs. When the pathways are considered complete, further quantitative evaluation is needed in the HHRA.

The HHRA evaluated baseline and the worst-case predicted future conditions when identifying COPCs and calculating risk. All future activity phases (i.e., Construction Phase, Operation Phase, Closure and Reclamation Phase, and Post-Closure Phase) were considered, and the highest predicted concentrations of COPCs were evaluated in the HHRA. Typically, the highest predicted COPC concentrations were in the Operations Phase. Evaluating the worst-case scenario is a conservative approach for evaluating future conditions since the concentrations and calculated risks in the other phases are expected to be lower.

The following information is provided in this section, as per the Project Application Information Requirements (AIR):

- Identification of potential sources and release mechanisms of COPCs (Section 6.1);
- Identification of receptors that may be exposed to COPCs, including consideration of exposure to sensitive groups (Section 6.4);
- Fate and transport assessment for each COPC (Section 6.2 and Attachment E);
- Identification of exposure pathways for all COPCs and receptors (Section 6.5); and
- Development of a conceptual site model that summarizes the above information into a diagram and flow chart (Section 6.6).

Following the problem formulation, the results of the exposure assessment (Section 7), toxicity assessment (Section 8), and risk characterization (Section 9) are presented. Uncertainties within the study are presented in Section 10.

6.1 Identification of COPC Sources

Three primary sources of COPCs occur within the LSA:

- Construction and operation of the mine site, which includes the following activities:
  - Construction of buildings offices, explosives storage, hazardous waste storage and fuel storage (contaminants of interest included nitrate, nitrite ammonia (nitrogen species), diesel, VOCs, dust, metals); and
  - Excavation of tunnels, shafts, and portals, exposing ore deposits and producing waste rock and stockpiles (contaminants of interest included nitrogen species, diesel, VOCs, dust, metals).
- Construction and operation of the Plant and TMF, which includes the following activities:
  - Including clearing construction of the processing plant, and construction of TMF (contaminants of interest included, dust, metals);

  - Ore processing produces waste materials as a result of physical and chemical processes, including: crushing and grinding of ore material (producing dust), thickening, pre-oxidation, cyanide leaching, electrowinning, cyanide destruction and tailings disposal (reagents include sodium cyanide, hydrochloric acid, caustic acid, copper sulphate, and sodium metabisulphate) (contaminants of interest included, VOCs, dust, metals, sodium, cyanide, copper, sulphate, chloride, NO_2, O_3, SO_2, CO); and
  - Tailings stored in lined TMF with leak capture system (contaminants of interest included, metals, sodium, cyanide, copper, sulphate, chloride).
- Construction and use of the access and haul road, which includes the following activities:
  - Clearing and grading of the road, and excavation of material from local borrow pits and quarries for road base (contaminants of interest included, dust, metals, VOCs); and
  - Operation of vehicles on the access and haul roads (contaminants of interest included, dust, metals).

6.2 Release Mechanisms, Transport Pathways

Several primary mechanisms can release and transport COPCs within the LSA:

- Leaching into groundwater from the primary source mine works, ore and waste rock stockpiles;
- Migration of water through bedrock fractures;
- Migration and free water movement and discharge to the ground surface via mine portals;
- TMF release to groundwater; and
- Fugitive dust emissions from roads, waste rock and ROM stockpiles, above ground blasting during construction, and plant emissions.

Secondary and tertiary sources of groundwater and surface water contamination are anticipated to be the result of the following:

- Weathering (physical and chemical) and leaching of exposed wall rock (i.e., intact bedrock surface) and waste rock (e.g., excavated and crushed rock as boulders, cobbles); and
- Interaction of water (i.e., groundwater and surface water) and oxygen (i.e., atmospheric air) with iron sulfide ore minerals in the waste rock and bedrock.

The anticipated drainage of these secondary sources carries concentrations of elements and base metals with the potential to impact downstream groundwater and surface waters.

Secondary and tertiary sources of air contamination are anticipated to be the result of the following:

- Wind erosion of dust from roads (fugitive dust precipitated by the driving of haul trucks on the roads);
- Natural weathering of the wildlands area;
- Stockpiles of waste rock and ore material (due to the movement of materials to and from stockpiles); and
- Plant emissions, which includes a combination of particulate and non-particulate.

Secondary and tertiary sources of soil contamination are anticipated to be a result of deposition of air particulate containing fugitive dust from the Project roadways, ore material and waste rock.
Sources of sediment contamination are anticipated to be the result of soil erosion, deposition of air particulate, and precipitation of contamination in surface water.

The source of contamination in plants (tertiary source and exposure medium) is the soil impacted by the deposition of air particulate. The source of contamination in moose, hare and grouse (exposure media) is plants and, to a lesser degree, soil and surface water ingestion. The source of contamination in fish (exposure medium) is surface water.

6.3 Identification of Constituents of Potential Concern

The COPCs evaluated in the HHRA were those constituents released from the mine as a result of mine activities, not including released during spills or other unplanned events. As mentioned in the objectives, this HHRA does not evaluate occupational exposures.
The following multi-step process was used to identify COPCs:

1. Compilation of data in each environmental media, for baseline and predicted future conditions;
2. Identification of appropriate media-specific screening levels such as the Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (CCME 2017) and the British Columbia Contaminated Sites Regulation (BC CSR) Standards (BC 2017);
3. Identification of regional background concentrations (i.e., 95% of the baseline) in each environmental media, if available;
4. Comparison of constituent concentrations to screening levels. If the constituent concentrations were less than or equal to screening levels, the constituent was not carried forward as a COPC;
5. Comparison of constituent concentrations to regional background concentrations for those constituents exceeding guidelines. If the constituent concentration were less than or equal to regional background concentrations, the constituent was not carried forward as COPC; and
6. Identification of final COPCs.

If screening levels or background concentrations were not available, then the constituent was also considered a COPC.

The identification of COPCs in each potential exposure media, air**,** soil, surface water (for drinking water), groundwater (for drinking water), sediment, and country foods is described in the subsections below.

6.3.1 Air

6.3.1.1 Baseline Conditions

Air quality and dustfall data have not been collected in the LSA. Ambient air quality has previously been monitored at other locations in BC and the Northwest Territories, however, including the Saturna station of the Canadian Air and Precipitation Monitoring Network (CAPMoN), located 1,000 km south-southeast of the Project, the Diavik Diamond Mine located 300 km northeast of Yellowknife (the Project is 920 km to the NE of Yellowknife), the Galore Creek Copper-Gold-Silver Mine Project located 280 km west of the Project, and the Kitsault Mine Project located 250 km southwest of the Project. The most representative baseline concentrations of NO_2, SO_2, CO, PM_{10}, $PM_{2.5}$, TPM, dustfall, and deposition were selected as baseline values for the Project. Since there were no annual $PM_{2.5}$ concentrations available from other locations, a 24-hour $PM_{2.5}$ concentration of 1.3 µg/m^3 from the Galore Creek Project was also adopted for the annual $PM_{2.5}$ baseline concentration for the Project. Source contribution, and background and predicted particulate matter concentrations are presented in Attachment C, Tables C1 and C2.

Since screening levels for metals are based on concentrations bound to PM10 (particulate matter less than 10 µm in diameter) baseline data were calculated by multiplying soil concentrations of metals by the representative 24-hour PM10 (3.4 µg/m3, from the Galore Creek Copper-Gold-Silver Mine Project). The methods for acquiring baseline air data are presented in Volume 3, Chapter 7, Section 7.4.4.

VOCs including diesel vapours, and process plant reagents were not carried forward from the air quality assessment because their releases were deemed to be negligible. No dispersion modelling was completed for these chemicals in the Air Quality modelling report (Volume 8, Appendix 7-A, Section 3, Table 3-2 and Table 3-3). Potential VOC emissions will be primarily a concern for workers on site during the construction and operation of the project. As such, the potential effects will be managed and mitigated in accordance with the Occupational Health and Safety Plan (Volume 5, Chapter 29, Section 29.17).

6.3.1.2 Predicted Future Conditions

Air quality modelling data for the Operations Phase, was determined to be the worst-case among the future Project phases. The air quality modelling completed for the Project included emissions sources located within the Project footprint.

Following the worst-case scenario approach, Operations Phase concentrations were used to represent the exposure in all other phases. The maximum predicted concentrations were estimated for priority pollutants (Volume 8, Appendix 7-A) and were used to compare to screening levels. For metals in particulate a weighted average of PM_{10} sources (background areas, road dust, ore, and waste rock) was used to estimate the concentration of chemicals in air particulate. PM_{10} was used to be consistent with Health Canada Guidance (Health Canada 2011). Metals concentration in air were estimated at three locations (downstream of the Tailings Management Facility, the road between Lower Portal and the Plant site, and between Lower Portal and Bitter Creek) (Figure C1, Attachment C). Metals concentrations in each source were then multiplied by the location-specific composition of source PM_{10}, and the location-specific PM_{10}, to calculate a 24-hour PM_{10} concentration for each metal at each of the three locations. Refer to Attachment C, Section 1.3 for example calculations of the predicted air and soil concentrations. As annual PM10 data was not available it was estimated for each metal by dividing the PM2.5 concentrations by 0.4. The World Health Organization (WHO) (2014) estimated annual mean PM10, when these data were not available, on the basis of PM2.5 with a conversion factor of 0.6 for the ratio PM2.5/PM10 for the United States of America and Australia, and around 0.3-0.4 for Canada (based on stations where both PM2.5 and PM10 were available) (WHO 2014).

6.3.1.3 Air Screening Levels

The air quality criteria considered in the evaluation were the BC Ambient Air Quality Objectives (AAQOs), which are a suite of ambient air quality criteria, including Provincial Air Quality Objectives (AQOs), National Ambient Air Quality Objectives (NAAQOs) and Canadian Ambient Air Quality Standards (CAAQS), with the strictest selected (Attachment A, Table A1).

Since the most recent development of NAAQOs and CAAQSs for $PM_{2.5}$ and NO_2, a body of research has been increasing that indicates that the current guidelines may not be protective of human health. Elliott and Copes (2017) estimated the burden of mortality attributable to long-term exposure to ambient fine particulate matter ($PM_{2.5}$) among adults in the Interior and Northern region of British Columbia. A threshold concentration of 5 $\mu g/m^3$ was assumed based on this study, below which no mortality effects occur. The $PM_{2.5}$ of 5 $\mu g/m^3$ was considered when screening annual $PM_{2.5}$ levels. The annual maximum $PM_{2.5}$ estimated for the Project was 4.4 $\mu g/m^3$. A review of Figure D-8 from Volume 8, Appendix 7-A illustrates isopleths of $PM_{2.5}$ air concentrations. Two areas had $PM_{2.5}$ greater than 2 $\mu g/m^3$. These two areas represent less than 1% of the Bitter Creek watershed. One of the two areas was at the Mine Site and the other was near Bromley Humps between Bromley Humps and the Mine Site. Non-mine worker use of these areas is not anticipated during mine construction and operation. Therefore, non-occupational exposure to $PM_{2.5}$ in the Bitter Creek watershed is likely to be less than 2 $\mu g/m^3$.

Health Canada (2016) and the USEPA (2016) have recently reviewed their air quality guidelines for NO_2 to assess whether they are still considered protective of human health. Both studies determined that "There is likely to be a causal relationship between long-term NO_2 exposure and respiratory effects. Evidence is suggestive of, but not sufficient to infer, a causal relationship for short-term NO_2 exposure with cardiovascular effects and total mortality and for long-term NO_2 exposure with cardiovascular effects and diabetes, poorer birth outcomes, and cancer." USEPA (2016) indicted that while there is continued or new supporting epidemiologic evidence, a large uncertainty remains, particularly whether NO_2 exposure has an effect independent of traffic-related copollutants. Epidemiologic studies have not adequately accounted for confounding effects, and there is a paucity of support from experimental studies. Some recent experimental studies have shown NO_2-induced increases in systemic inflammation or oxidative stress, but such changes are not consistently observed or necessarily linked to any health effect, unlike the mode of action information available for asthma (USEPA 2016). Health Canada (2016) acknowledges issues of confounding copollutants ($PM_{2.5}$, SO_2, and CO), but feels that evidence suggests that the NO_2 guideline should be updated. For this HHRA, however, the current interim guidelines, established by the province to accommodate a stepwise approach to management of SO_2 and NO_2 in anticipation of new Canadian Standards coming out for these parameters, were considered to be acceptable. There is some uncertainty with regards to how the new Canadian Standards (coming into effect in 2020) will ultimately be used and applied (e.g., between various jurisdictions, by the regulatory authorities, at a project versus airshed level).

For metals, the Texas Commission on Environmental Quality Effects Screening Levels (1-hour and annual averaging period PM_{10}; Texas CEQ 2014) and the Ontario Ministry of the Environment Ambient Air Quality Criteria (24-hour averaging period; Ontario MOE 2012). The lowest screening level was used when more than one screening value was available for a given averaging period. The annual averaging period screening values were compared to the annual modelled air concentrations. The 24-hour averaging period screening values were compared the 24-hour modelled air concentrations. The Texas CEQ 1-hour PM_{10} values are presented for comparison only.

A diesel particulate matter (DPM) analysis was completed using data presented in the Air Quality Modelling Report (Volume 8 Appendix 7-A) and Health Canada (2016). The proportion of PM2.5 that was DPM was first estimated using data in Tables 3.2 and 3.3 of Volume 8Appendix 7-A, as shown in Table 1 below. DPM accounted for 84% and 2% of the PM2.5 during the Construction Phase and Operation Phase annual emissions, respectively.

Table 1 Percent DPM

Air Contaminant	Construction Scenario Total (tonnes/year)	Operation Scenario Total (tonnes/year)
$PM_{2.5}$	2.5	17.2
DPM	2.1	0.41
%DPM	84%	2%

The 24-hour and annual DPM air concentrations were then estimated by applying the %DPM to the predicted $PM_{2.5}$ concentrations for both scenarios, as shown in Table 2 below. The maximum estimated DPM concentration was 3.5 µg/m^3 for the 24-hour Construction Scenario.

Table 2 Estimated DPM Concentrations

Calculation Basis & Averaging Time	Construction Scenario		Operation Scenario	
	Maximum $PM_{2.5}$ Concentration + Background Total (µg/m^3)	Estimated DPM Concentration (µg/m^3)	Maximum $PM_{2.5}$ Concentration + Background Total (µg/m^3)	Estimated DPM Concentration (µg/m^3)
98th Percentile of 24-hour Block Averages	4.1	3.5	18.6	0.44
Annual Maximum	1.7	1.4	4.4	0.10

The DPM concentrations were then compared to the DPM risk/guidance values from Health Canada (2016), which is provided in Table 3 below.

Table 3 Health Canada DPM Critical Effect Values

Health Outcome	Risk/ guidance Value	Critical Effect
Cancer	N/A	N/A
Non-cancer – chronic exposure	5 µg/m^3	Respiratory – inflammation, histopathological and/or functional changes
Non-cancer – short-term exposure	10 µg/m^3	Respiratory – increased airway resistance and inflammation

The maximum estimated DPM concentrations do not exceed the non-cancer chronic and short-term exposure risk/guidance values from Health Canada. Based on this analysis, project-related risks from DPM are considered negligible.

6.3.1.4 Air COPCs

Air COPCs were identified based on the steps listed at the beginning of Section 6.3. A comparison of the baseline and predicted future concentrations to screening levels is presented in Attachment A, Tables A1 and A2. No air COPCs were carried forward for quantitative evaluation in the HHRA as all constituent concentrations in air were less than screening levels.

Predicted PM and NO_2 concentrations were compared to provincial and federal existing guidelines, and as a result were not screened into the HHRA. IDM acknowledges that even though NO_2 and PM exposure concentrations related to the project are low they are within the range where there is some uncertainty regarding effects. Toxicity profiles for PM and NO_2 have been developed and are presented Attachment E. The Air Quality and Dust Management Plan (Volume 5, Chapter 29) will include monitoring programs that will allow for real-time verification of the air quality modelling results and the effectiveness of applied mitigation measures.

6.3.2 Soil

6.3.2.1 Baseline Conditions

Soil data for baseline conditions included surface soil collected to support geochemical studies (Volume 7, Appendix 1-B, Section 3) and from more recent soil samples collected specifically to characterize the chemistry of soils in the LSA watershed (Volume 8, Appendix 9-A, Section 5.6) (Figure 11). Summary statistics for baseline soils are presented in Attachment B, Table B1.

6.3.2.2 Predicted Future Conditions

Project activities will result in the release of fugitive dust and Processing Plant emissions to air, some of which will have elevated concentrations of metals when compared to baseline soil concentrations. This dust (air particulate), will settle out of the air onto soil, plants, and surface water, and therefore has the potential to elevate the concentrations of metals in those media. Predicted future soil concentrations were estimated by modelling dust fall associated with fugitive dust and plant emissions during the construction and operational phases of the Project, considered to be the worst-case conditions. A more detailed explanation about how predicted future concentrations were calculated is documented in Attachment C. Tables in Attachment C present predicted dustfall, dust deposition, and soil concentrations at ten locations (Table C3). The three locations with the highest predicted soil concentrations (downstream of the Tailings Management Facility, the road between Lower Portal and the Plant site, and between Lower Portal and Bitter Creek) are tabulated in Attachment C, Table C10. Refer to Attachment C, Section 1.3 for example calculations of the predicted air and soils concentrations.

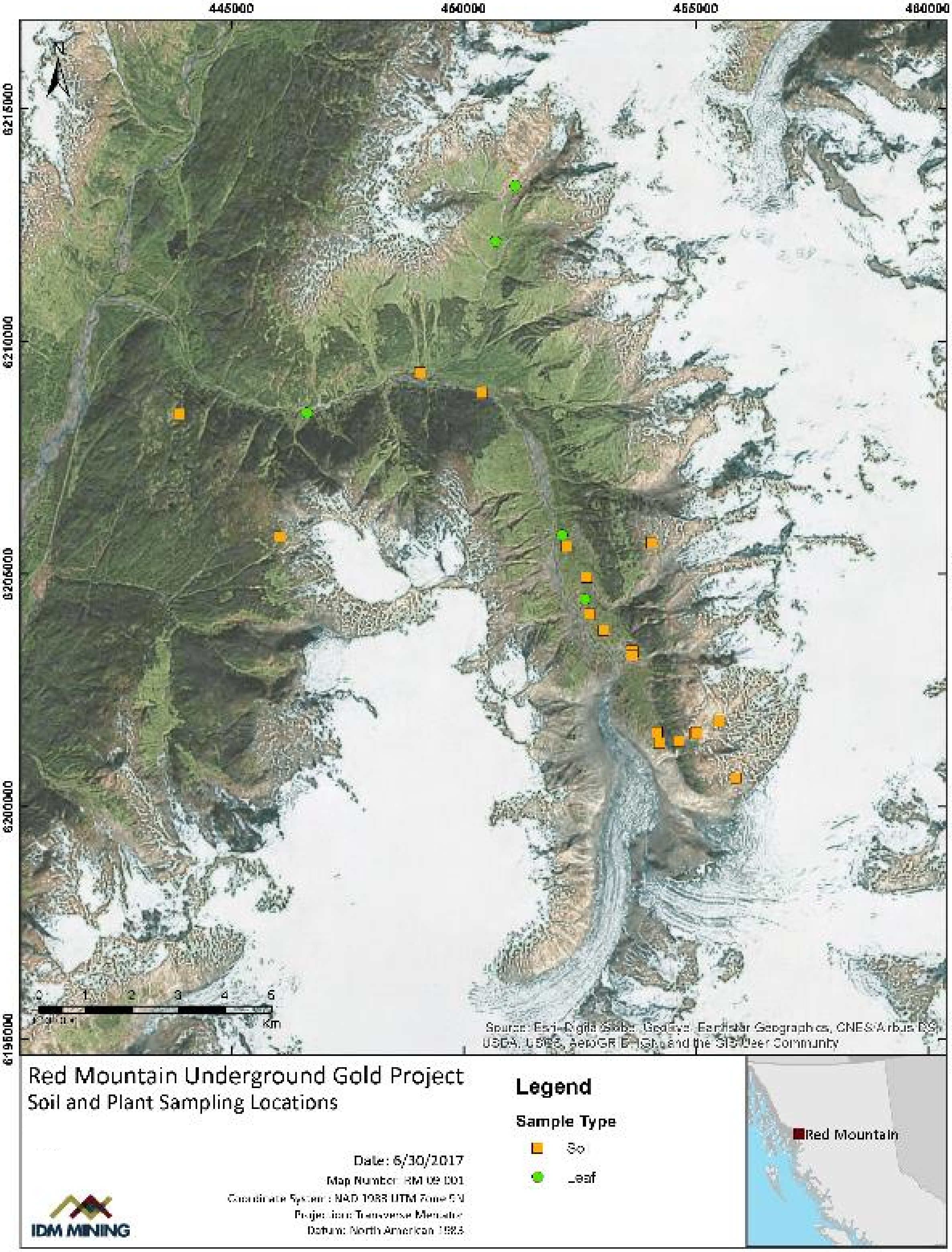


Figure 11 Soil and Plant Sampling Locations

6.3.2.3 Soil Screening Levels

To identify soil COPCs for quantitative evaluation in the HHRA, soil screening levels were selected from Canadian federal and BC guidelines and standards and considered published BC background concentrations (BCMOE 2017). If one of the federal or provincial guidelines were generic, that is, can serve as a screening threshold for human and ecological receptors, and the other contained specific guidelines for human receptors, then the human receptor specific guideline was used even should it be higher than the generic guideline. Should no federal or provincial guideline or standard be available for a given metal, a guideline or standard from another jurisdiction was considered for use as the screening value. If no screening value was available for a chemical, then it was carried forward as a COPC.

Guidelines, criteria, and standards considered in the development of soil screening levels included:

- Canadian Environmental Quality Guidelines (CEQGs) (CCME 2017);
- British Columbia Contaminated Sites Regulation (BC CSR 2017) – Schedule 3.1 Part 2 Generic Numerical Soil Standards to protect human health-wildlands natural, and Schedule 3.1 Part 1 Matrix Numerical Soil Standards for human health protection-wildlands natural;
- Protocol 4 for Contaminated Sites, Determining Background Soil Quality (BCMOE 2017);
- If no guideline or background concentration was available for a given chemical in soil then one could consider average the crustal abundance for a given chemical for use as a background concentration; or
- Guideline or standards from other jurisdictions including USEPA Regional Screening Levels (RSL) or (USEPA 2017a).

The soil screening level to be carried forward was selected using the following tiered approach:

- If federal (Canadian) and provincial (British Columbia) guidelines were available, the lowest of the two was selected as the soil screening level, with the overriding condition that human health specific guidelines were selected over generic guidelines;
- If only one regulatory criterion (federal or provincial) was available, then this value (provisional screening value) was selected; and
- If no federal or provincial criteria were available, then a value from another jurisdiction was selected as the soil screening level.

The selected soil screening levels are presented in Attachment A, Table A4. COPCs screened in for risk assessment are tabulated in Attachment A, Table A5.

6.3.2.4 Soil COPCs

Soil COPCs were identified based on the steps outlined in Section 6.1. Baseline and future predicted soil concentrations are compared to screening levels and regional background levels in Table A5.

Arsenic and iron had baseline and predicted future concentrations that exceeded screening levels. Screening levels were not available for bismuth, calcium gallium, gold, lanthanum, magnesium, phosphorous, potassium, scandium, sulfur, tellurium, thorium, titanium, and ytrium. Essential nutrients (calcium, magnesium, phosphorus, potassium and sodium) were not carried forward as COPCs because they are generally only toxic at extremely high concentrations. The rare earth elements gallium, lanthanum, scandium, thorium and ytrium were not carried forward as COPCs because the average concentrations in the earth's crust are considerably greater than the highest predicted future concentrations (Attachment A, Table A5). Cadmium, mercury and selenium were carried forward as COPCs because of their potential to biomagnify in the food chain.

6.3.3 Surface Water

6.3.3.1 Baseline Conditions

Baseline surface water samples were collected from sample locations in the upper, middle, and lower Bitter Creek (4 locations), Goldslide Creek (2 locations), Rio Blanco Creek (1 location), Otter Creek (1 location), the Bear River upstream and downstream of the confluence with Bitter Creek and at Stewart (3 locations), and in American Creek (1 location) (Figure 12). Summary statistics for total and dissolved surface water for each of the 14 sample locations (AC02, BR08, BR06, BR03, BC02, BC04, BC06, BC08, GSC02, GSC09, GSC07, OC06, RBC02, and RC02) are reported in Attachment B, Tables B2 –B15. Overall summary statistics for total and dissolved surface water are presented in Tables B16 – B19. Methods for baseline surface water quality monitoring and QA/QC is presented in Volume 8, Appendix 14-A, Section 3.

6.3.3.2 Predicted Future Conditions

Predictive modelling of metal surface water concentrations (50^{th} percentile and 90^{th} percentile) for unfiltered (total) water data from six sample stations (BR06, BC02, BC06, BC08, RBC02, and GSC02) was completed for the Operations Phase and for Post-Closure, to 150 years into the future (Volume 8, Appendix 14-B) and considered metal leaching and acid mine drainage. The most recent water load balance study data was used to represent future soil concentrations.

6.3.3.3 Drinking Water Screening Levels

To identify surface water COPCs for the HHRA, surface water screening levels used for drinking water were developed from Federal and BC guidelines and standards. When no guideline or standard was available from these sources guidelines and standards from other jurisdictions were considered. The criteria considered in the development of surface water screening levels used for drinking water included the following, in order of preference:

- Health Canada Guidelines for Canadian Drinking Water Quality (Health Canada 2017) – Maximum Acceptable Concentrations (MAC);
- British Columbia Contaminated Sites Regulation (BC CSR) – Schedule 3.2 Generic Numerical Water Standards for Drinking Water;
- Canadian Environmental Quality Guidelines (CEQGs) (CCME 2017); and
- USEPA Regional Screening Levels (USEPA RSL; USEPA 2017a).

The selected surface water screening levels used for drinking water are presented in Attachment A, Table A6.

6.3.3.4 Surface Water Drinking Water COPCs

The maximum baseline unfiltered surface water concentrations across 14 nodes, and the maximum of the modelled monthly 90th percentile (P90) unfiltered surface water concentrations were compared to surface water screening levels used for drinking water.

The surface water COPCs carried forward for further consideration in the HHRA (Attachment A, Table A12) included constituents that exceeded screening levels (aluminum, antimony, arsenic, cadmium, chromium, cobalt, iron, lead, manganese, mercury, selenium, thallium, and vanadium), and those that did not have screening levels (i.e., bismuth). Calcium and silicon did not have screening levels but are considered non-toxic in surface water except at very high concentrations and were therefore not retained as COPCs. The phosphorus upper limit of dietary intake ranges from 65 grams for a one year old to 350 grams for an adult (WHO 2005). As the maximum concentration of phosphorus in surface water is 1.55 mg/L the phorporus from Bitter Creek contributes less than one percent of the upper limit of dietary intake phosphorus was not considered to be a COPC in surface water (WHO 2005)**.** Mercury was also carried forward as a COPC due to its potential to biomagnify in the food chain. The potential for biomagnification is identified in each chemical-specific toxicity profile (Attachment E).

6.3.4 Groundwater

6.3.4.1 Baseline Conditions

Data from groundwater monitoring completed at eleven locations by SRK (Volume 8, Appendix 14-A) are tabulated in Attachment A, Table A8. Summary statistics for baseline groundwater quality data are provided in Attachment B, Table B20. The 95th percentile concentration for each chemical analyzed for the baseline groundwater sampling program was used to represent the baseline condition in the HHRA. The complete groundwater quality data set is in provided in the SRK report (Volume 8, Appendix 14-A). Methods for baseline groundwater quality monitoring and QA/QC is presented in Volume 8, Appendix 14-A, Section 3.

6.3.4.2 Predicted Future Conditions

The groundwater source term use for underground operations in the surface water model (Volume 8, Appendix 14-C) was used as the predicted future groundwater concentrations.

6.3.4.3 Drinking Water Screening Levels

To identify groundwater COPCs for the HHRA, drinking water screening levels were developed from Federal and BC guidelines and standards. The screening process was completed in the same manner as surface water. The selected surface water screening levels used for drinking water are presented in Attachment A, Table A6.

6.3.4.4 Groundwater COPCs

The maximum baseline groundwater concentrations for each constituent, and the modelled groundwater source for the predictive load balance study was compared to surface water screening levels used for drinking water. The groundwater COPCs carried forward for further consideration in the HHRA are presented in Attachment A, Table A9. Constituents whose concentrations were greater than their respective screening levels were considered to be drinking water COPCs in groundwater (nitrate, antimony, arsenic, cadmium, cobalt, and manganese). Calcium is only toxic at extremely high concentrations and thus was not carried forward as a COPC. Bismuth, silicon, titanium, and vanadium were not detected in groundwater and, therefore, were not carried forward as a COPC. Mercury and selenium were carried forward as COPCs due to their potential to biomagnify in the food chain. The potential for biomagnification is identified in each chemical-specific toxicity profile (Attachment E).
There are currently no drinking water wells in the LSA.

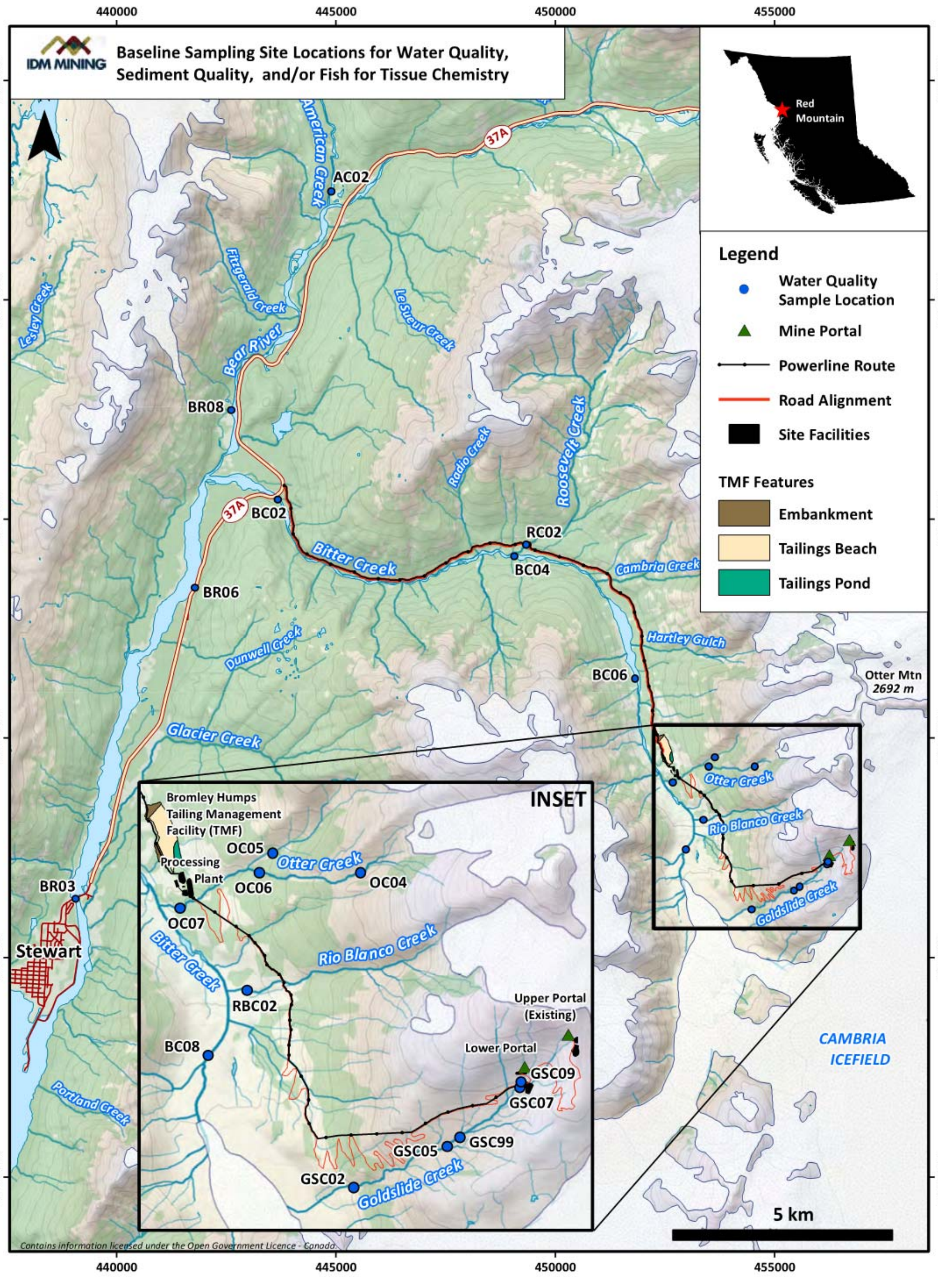


Figure 12 Surface Water, Sediment, and Fish Tissue Sample Locations

6.3.5 Sediment

6.3.5.1 Baseline Conditions

Sediment sample data were available for eight locations: AC02 in American Creek; BR06, BR08, in the Bear River; BC02, BC04, BC08, in Bitter Creek; and GCS05 and GCS02 in Goldslide Creek (Figure 12). At each location, multiple replicate samples were collected (Volume 8, Appendix 18-A). During the 2014 sampling period, completed by SNC-Lavalin, three samples were collected at each site, while for the 2016 sampling period, five replicates were collected at each location (Volume 8, Appendix 18-A). Summary statistics for sediment data are provided in Attachment B, Table B21. It should be noted that the sediment sampling program was purposely biased to depositional areas where fine sediments are present. This is because heavy metals are more likely to be present at these locations, and to be in the finer sediments. Methods for baseline sediment quality monitoring and QA/QC is presented in Volume 8, Appendix 18-A, Section 2.

6.3.5.2 Predicted Future Conditions

Predictive modelling of sediment concentrations was completed in two steps and followed the approach in Volume 3, Chapter 14. The first step determined the extent of change in surface water concentration from baseline conditions to the Operations Phase, and Reclamation and Closure/ Post-Closure phases. The second step involved applying that relative change to baseline sediment conditions to predict future sediment concentrations. The maximum predicted sediment concentrations from three sediment sample locations (BR06, BC02, and BC06) were used to screen sediment (Attachment A, Table A10).

6.3.5.3 Sediment Screening Levels

As there are no sediment screening levels for direct contact with humans, soil screening levels were used as surrogates for sediment screening levels. The soil screening levels are presented in Attachment A, Table A4.

6.3.5.4 Identification of Sediment COPCs

Sediment COPCs were identified by comparing the 95th percentile baseline concentrations and the maximum predicted future sediment concentrations to sediment screening levels. The essential nutrients calcium and potassium were not carried forward as COPCs since they are generally only toxic at extremely high concentrations. The concentrations of magnesium and titanium in sediment were also not carried forward as COPCs as the concentrations were much lower than the average concentrations in the earth's crust (23,300 mg/kg for magnesium and 5,650 mg/kg for titanium, respectively; Wedepohl 1995). These constituents are also known to have low toxicity. Although mercury and cadmium did not exceed their screening levels, they were included as COPCs because of their potential for biomagnification in the food chain.

The sediment COPCs carried forward for further consideration in the HHRA are presented in Attachment A, Table A10. Eleven COPCs were identified in sediment: arsenic, barium, bismuth, cadmium, cobalt, copper, iron, lead, manganese, mercury, and selenium.

6.3.6 Country Foods

Country foods include a wide range of animal, plant, and fungi species harvested for medicinal or nutritional use. The primary objective when assessing risk from ingestion of country foods is identifying the most relevant country foods to evaluate. Key considerations when selecting country foods included:

- Which country foods are currently hunted/harvested in the Human Health RSA;
- Whether representative country food species are co-located within areas predicted to be affected by potential Project-induced releases;
- How are the country foods used (i.e., food, medicine, or both);
- What part(s) of the country foods are consumed (i.e., specific organs, plant leaves or roots);
- What quantities of country foods are consumed; and
- What the consumption frequencies are for each country food.

The *Food Nutrition & Environment Study* by Chan *et al.* (2011) lists over 200 traditional foods that are consumed by Aboriginal Groups in British Columbia. The Human Health spatial boundaries (LSA/RSA) overlap with Ecozones 4 and 6 (Figure 13). Ecozone 4 information was used as the basis for the selection of species consumed by Aboriginal and non-Aboriginal persons. Table 4 presents a list of foods that IDM understands to be consumed by Aboriginal persons in Ecozone 4, Ecozone 6, and BC in general.

Table 4 Seasonal frequency of top ten consumed traditional food items for consumers and non-consumers combined, based on average days per year

BC FN living on-reserve			Ecozone 4 BC FN living on-reserve			Ecozone 6 BC FN living on-reserve		
Traditional Food	Percent consumers	Average days per year	Traditional Food	Percent consumers	Average days per year	Traditional Food	Percent Consumers	Average days per year
Salmon (any type)	92	47	Moose meat	94	86	Salmon (any type)	98	63
Moose meat	60	28	Soapberries	57	14	Salmon, Sockeye	88	33
Salmon, Sockeye	79	27	Blue huckleberry	80	14	Eulachon grease	57	21
Deer meat	52	19	Salmon (any type)	64	11	Halibut	82	16
Eulachon grease	35	12	Trout (any type)	61	9	Laver seaweed	57	15
Halibut	55	10	Balsam pitch	8	9	Moose meat	48	13
Salmon, Chinook (King/Spring)	43	9	Red willow root	7	8	Salmon, Chinook (King/Spring)	45	11
Laver seaweed	34	9	Poplar (cottonwood) inner bark	4	7	Blackberry, large (Himalayan)	51	10
Blueberries (Alaska, oval leaved, bog)	36	7	Salmon, Sockeye	32	6	Prawn	53	9
Soapberries	34	6	Black bear fat	21	6	Clams (any type)	73	8

The top ten traditional food items consumed by Aboriginal Groups living in Ecozone 4 (Project area) as reported in the *Food Nutrition & Environment Study* by Chan *et al.* (2011) include mammals, fish, and vegetation:

1. Moose meat
2. Soapberries
3. Blue huckleberry
4. Salmon (any type)
5. Trout (any type)
6. Balsam pitch
7. Red willow root
8. Poplar (cottonwood) inner bark
9. Salmon (Sockeye)
10. Black bear fat

As it is rarely possible to assess all potential country foods, one representative species is usually selected as a surrogate from each of the following groups of foods: large mammals, small mammals, birds, fish, and vegetation. If representative foods are determined to be safe for consumption, then all other foods within the group would also be considered safe for consumption.

Moose, hare, and grouse, respectively, were the large mammal, small mammal, and bird country foods consumed in the greatest amount by Aboriginal Groups in Ecozone 4 (Chan *et al.*, 2011). Salmon (any type) was the fish consumed in the greatest amount by Aboriginal Groups in the RSA. Berries were the type of vegetation consumed in the greatest amount by Aboriginal Groups. All of these country foods are present in the Bitter Creek watershed portion of the LSA and it is assumed they will be exposed to COPCs released by the Project.

Based on the information presented above, moose, hare, grouse, Dolly Varden, and Sitka willow, were the surrogate country foods selected to represent food consumption by Aboriginal and non-Aboriginal receptors for the large mammal, small mammal, bird, fish, and vegetation food groups, respectively. Sitka willow was selected based on its importance to moose as a food source and its tendency to bioaccumulate metals at higher concentrations than berries; willow and berry metal concentration data from two projects in the same geographic region (Brucejack - Rescan 2013a; KSM – Rescan 2013b) indicate that most metal concentrations in leaves tend to be at least 100% higher than concentrations in berries. Therefore, the use of willow is a more conservative estimate of human health risk than the analysis of berries.

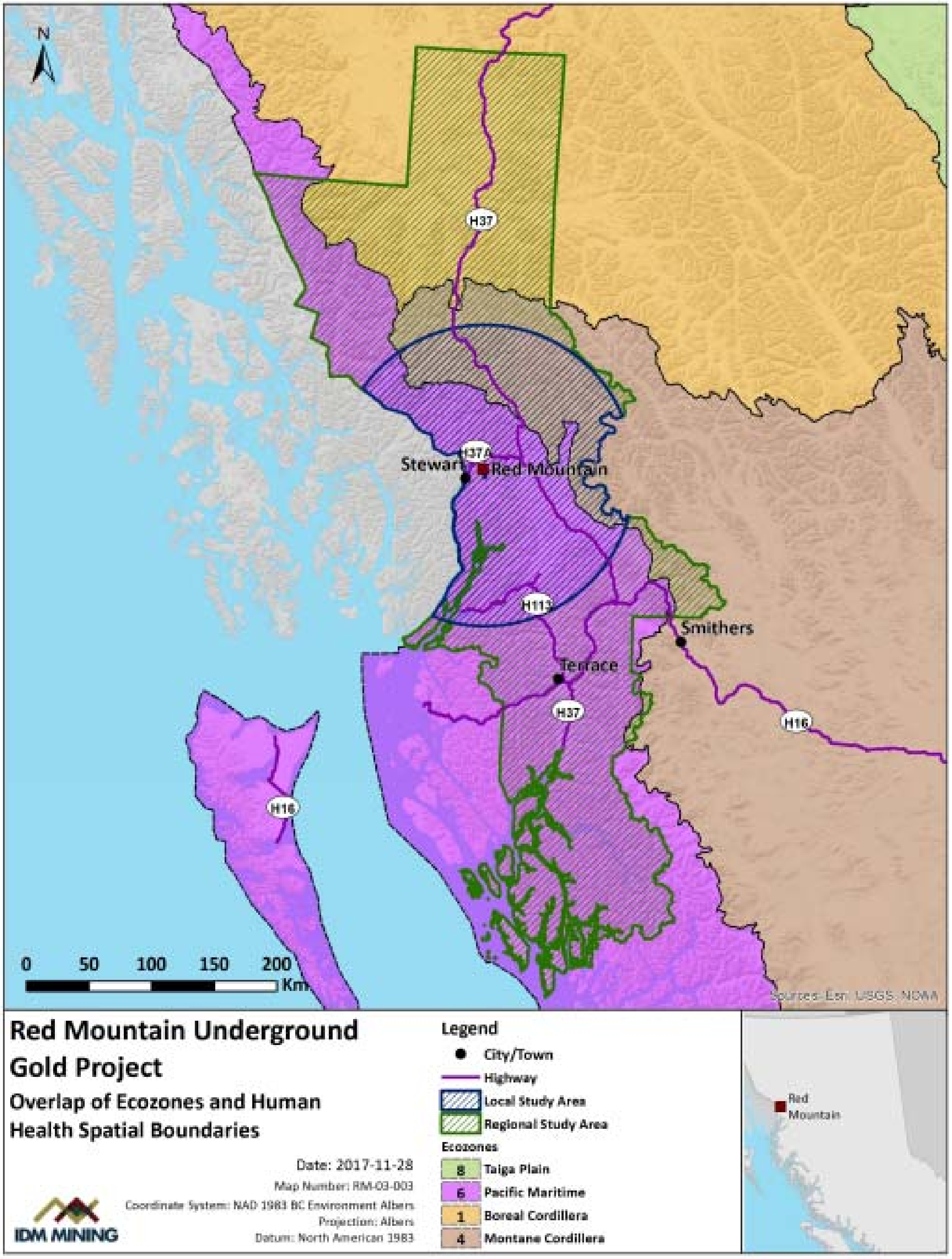


Figure 13 Overlap of Ecozones and Human Health Spatial Boundaries.

6.3.6.1 Baseline Conditions

To support food chain modelling of wildlife species, plant leaves (Sitka willow) and fish (Dolly Varden) samples were collected from the LSA (Volume 8, Appendices 9-A, Section 5.7 and 18-A, Section 3.6.2). Metal concentration data from 7 plant tissue samples (Figure 11) and 56 fish tissue samples (Figure 12) formed the basis for assessing exposure to COPCs via country foods, under baseline conditions. Plant tissue, surface water, and soil sample data were used for inputs to the food chain model to estimate concentrations of metals in moose, hare, and grouse under baseline conditions. A detailed description of the modeling used to estimate country foods is provided in Section 7.1.6.

Methods for baseline plant tissue monitoring is presented in Volume 8, Appendix 9-A, Section 7.1.6. Methods for baseline fish tissue monitoring and QA/QC is presented in Volume 8, Appendix 18-A, Section 2. Whole body fish tissue analysis was completed for fish (personal communication May Mason 2017); fork lengths of sampled fish ranged from 87 to 260mm, the upper end of which are potentially consumed.

6.3.6.2 Predicted Future Conditions

Concentrations of plants and fish, under future conditions, were estimated from bioconcentration factors based on baseline sample data for plants and fish; whereas, concentrations of moose, hare, and grouse, under future conditions, were estimated using biotransfer factors in the food-chain model. A summary of the bioconcentration and biotransfer factors is provided in Sections 7.1.4 to 7.1.6

6.3.6.3 Country Foods Screening Levels

Country foods screening levels were derived using an approach developed for deriving action levels for fish advisories (OHA 2016). Separate country foods screening levels were derived for fish and plants, given the differences in consumption rates for these two food sources. The following equation was used for determining tissue screening levels for non-carcinogenic toxicological endpoint for humans:

$$SL = 0.2 \times \frac{(TDI \times BW)}{IR}$$

Where:

- SL = Screening Level (mg/kg)
- TDI = Tolerable Daily Intake (mg/kg-day) (chemical-specific)
- BW = Body Weight (kg) = 70.7kg for adults and 16.5kg for toddlers
- IR = Fish/ Plant Ingestion Rate (kg/day) = 0.29 kg/day for adults and 0.091 kg/day for toddlers

The following equation was used for determining country foods screening levels for carcinogenic effects:

$$SL = \frac{\left(\frac{ARL}{CSF} \times BW\right)}{IR} \times ADAF$$

Where:

SL = Screening Level (mg/kg)
ARL = Acceptable Risk Level (unit less) = $1x10^{-5}$
CSF = Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$
ADAF = Adjusted Age Dependent Adjustment Factor[1]
BW and IR are the same as above

The country foods screening levels are presented in Attachment A, Table A11.

6.3.6.4 Country Foods COPCs

To identify COPCs in country foods screening levels developed for country foods were compared to the maximum concentrations measured in country foods when available. If the maximum concentration for a chemical was greater than its screening level, the chemical was considered to be a country food COPC as shown in Attachment A, Table A12. This was only possible for fish and plants as no tissue data was available for the other country foods (moose, hare, and grouse). Constituents with tissue concentrations greater than their respective screening levels were considered to be country foods – fish COPCs.

For moose, hare, and grouse COPCs identified in soil, surface water, and country foods fish and plant were also carried forward as country food COPCs for moose, hare and grouse.

6.3.7 Identified COPC

COPCs in Environmental Media are summarized in Table 5.

Table 5 Summary of COPCs in Environmental Media

Constituent	Air	Soil	Surface Water	Groundwater	Sediment	Country Foods
Aluminum			X			X
Antimony			X	X		
Arsenic		X	X	X	X	X
Barium					X	X
Bismuth		X	X		X	X
Boron						X
Cadmium		X	X	X	X	X
Chromium			X			X
Cobalt			X	X	X	X
Copper					X	X
Iron		X	X		X	X
Lead			X		X	X

1 The ADAF adjusts the toxicity value to take into account the age-dependent sensitivity to carcinogens. Both toddler (5) and adult (1) ADAFs were used.

Constituent	Air	Soil	Surface Water	Groundwater	Sediment	Country Foods
Manganese			X	X	X	X
Mercury		X	X	X	X	X
Molybdenum						
Nickel						X
Nitrate				X		
Selenium		X	X	X	X	X
Strontium						X
Tellurium		X				X
Thallium			X			X
Uranium						X
Vanadium			X			X
Zinc						X

6.4 Receptors of Concern (ROCs)

The selection of ROCs considered the known or reasonably-anticipated types of human activities in the LSA. Although relatively close to Stewart, the Project area is quite remote, and the majority of the area is high alpine. An existing access road from Highway 37 extends for approximately 13 km along the Bitter Creek valley, close to the location of the proposed Processing Plant and TMF, but stops short of the proposed mine site, which is currently accessible by foot or helicopter. Hiking, hunting, trapping, and fishing, however, are known to occur in the LSA. Dolly Varden are present in the lower reaches of Bitter Creek and associated tributaries. Currently, the closest dwelling to the Project is in Stewart, BC. Other communities located near the Project include the following:

- Gitlaxt'aamiks: approximately 170 km from Stewart by road;
- Gitwinksihlkw: approximately 180 km from Stewart by road;
- Laxgalts'ap: approximately 215 km from Stewart by road;
- Gingolx: approximately 245 km from Stewart by road;
- Terrace: approximately 240 km from Stewart by road;
- Smithers: approximately 270 km from Stewart by road; and
- Hyder, Alaska: approximately 4 km from Stewart by road.

The NLG has indicated that that Nisga'a citizens have the right to reside in the watershed and be safe from any chemical contamination. As such, Nisga'a citizens and Aboriginal Group members in general, have been carried forward for consideration in the HHRA. Although not explicitly stated throughout the HHRA, the ROCs were identified with Aboriginal Groups members in mind, however, non-Aboriginals Group members are also included as potential ROCs.

- Hunter/Trapper/Fisher (teens and adults);
- Guide/Outfitter (teens and adults);
- Recreational User (infants, toddlers, children, teens, and adults);
- Summer Resident (infants, toddlers, children, teens, and adults);
- Year Round Resident (toddlers and adults); and
- Country Food Consumer.

The hunter, trapper, and fisher are assumed to spend equal amounts of time in the Project area. During this period, the hunter or trapper may spend time overnight camping or may travel back to their homes. Hunters and trappers may eat the animals they catch. It is also possible that they may sell their catch to others. Fishers may do the same. No hunter or trapper cabins were identified in the watershed.

The guide/outfitter may take people into the Project area for hunting or for backcountry trekking. Outfitter cabins have been identified in the watershed. The recreational user (hiker/biker) hikes or rides the trails in the Bitter Creek watershed and are likely accompanied by guides unless they live in the area. There has been no documentation identified describing mountain biking in the watershed, but, guides are known to take hikers into the watershed. One hiking route takes people to the top of Otter Mountain.

The types of exposures for the guide/outfitter and the hunter/trapper/fisher are likely to be similar; however, the hunter/trapper/fisher are likely to spend more time in the watershed. Therefore, the hunter/trapper/fisher was carried forward as the ROC for quantitative evaluation in the HHRA. The assumption being that if the risk to the hunter/trapper/fisher resulting from exposure to Project stressors was acceptable, then the risk to the guide/outfitter would also be acceptable.

The recreational (hiker/biker) exposures may differ from those of the hunter/trapper/fisher, although of a shorter duration. As their exposure type may differ, the recreational user was carried forward for quantitative evaluation in the HHRA.

As noted above no residents, hunter cabins, or trapper cabins are present in the Bitter Creek watershed. The closest residence in located in Stewart, BC. However, based on the assertion that Nisga'a citizens should be able to hunt, trap, fish, gather food, and/or live in the Bitter Creek watershed for seasonal living in the Project vicinity, a summer and year-round resident were also included for quantitative evaluation in the HHRA. However, no known residences are present in the vicinity of the Project at this time.

6.5 Exposure Pathways

The potential exposure pathways and routes considered in the HHRA for both the baseline conditions and predicted future conditions in the LSA include the following:

- Inhalation of air;
- Incidental ingestion of and dermal contact with soil;
- Ingestion and dermal contact with surface water;
- Ingestion and dermal contact with groundwater;
- Incidental ingestion and dermal contact with sediment; and
- Consumption of Country Foods mammals, birds, plants, and fish.

Each of these potential exposure pathways are discussed below:

- **Exposure to contamination in air via inhalation**. Air quality in the Bitter Creek watershed portion of the LSA may be affected by the emissions of particulate (i.e., fugitive dust) from mining operations, roadways and waste rock, and emissions of particulate and non-particulate from the processing plant. However, no air COPCs were identified in predicted future conditions resulting from the Project. Therefore, the air inhalation exposure pathway was considered to be incomplete.

- **Exposure to contamination in soil via incidental ingestion, and dermal contact**. Soil quality in the Bitter Creek watershed portion of the LSA may be affected by the deposition of COPCs in air particulate that resulted from project emissions. Modelling indicates that there is a potential for air particulate deposition to increase soil COPC concentrations above their soil screening levels and at concentrations more than 1% above local background concentrations. Therefore, the exposure pathways between soil and receptors using the watershed were considered complete.

- **Exposure to contamination in surface water via incidental ingestion and dermal contact**. There are several waterbodies in the LSA that may be affected by the proposed Project. Furthermore, surface water may be used as a drinking water source in the LSA by recreational users, hunters/trappers/ fishers, and by future summer residents. Therefore, the exposure pathways between surface water and receptors were considered complete.

- **Exposure to contamination in groundwater via ingestion and dermal contact**. Groundwater at the LSA is currently not used for drinking water, and its future use as a drinking water source in the Bitter creek watershed is not anticipated in the two areas with the potential to be adversely affected by the Project (the Mine Site and the TMF). Groundwater wells installed at these two areas had relatively low hydraulic conductivity, ranging from 7.4×10^{-9} m/s to 2.9×10^{-5} m/s, with a geometric mean of 3.0×10^{-7} m/s, which is insufficient to provide adequate water to supply one home. Furthermore, these two high alpine locations are quite remote. It is recognized that remoteness in itself is not enough to discount future use of groundwater and that hydraulic conductivity, by itself, should not be used to determine water availability in bedrock environments. However, the combination of these factors makes it unlikely that groundwater will be used for drinking water in the area. Therefore, the exposure pathways between groundwater and receptors were considered incomplete.

- **Exposure to contamination in sediment via incidental ingestion and dermal contact**. There are several surface water bodies (creeks) in the LSA. However, it is unlikely that significant exposure between sediment and ROCs will occur. Creeks in the LSA are very cold and are unlikely to be used for swimming or wading, based on information gleaned during early and ongoing community engagement. Sediment exposure may occur as a result of harvesting shellfish. Shellfish were not identified as being present in the creeks of Bitter Creek Valley. Minor sediment dermal exposure to hands may occur when handling fish during fishing. Sediment exposure while fishing for Dolly Varden was considered to be negligible. Exposure to contaminants via sediment exposures are being evaluated via the food chain. Exposure to suspended sediment was evaluated as part of the exposure to surface water. Therefore, the exposure pathways between receptors and sediment were considered to be incomplete.

- **Exposure to contamination in country foods via ingestion**. Hunting, trapping and fishing is known to occur in the LSA. Plants, mammals, and birds may be exposed to elevated concentrations of COPCs in soil as a result of project emissions. Fish, mammals, and birds may be exposed to elevated concentrations of COPCs in surface water in the future. The potential exists for elevated tissue concentrations in plants, fish, mammals, and birds as a result of exposure to elevated COPC concentrations in soil and surface water in the Bitter Creek watershed portion of the LSA. Furthermore, human receptors consuming these types of country foods may be exposed to these elevated concentrations of COPCs. Therefore, the exposure pathways between receptors and country foods were considered to be complete.

To address the cumulative impact of COPC exposure to Aboriginal and non-Aboriginal receptors, if a COPC was identified in one exposure media it was evaluated in all exposure media this included air. Air was eliminated as an exposure media because no chemical exceeded their air screening levels and thus there was considered to be no source. However, air exposure will contribute to the exposure to COPCs identified in soil surface water and country foods. Therefore, for COPCs identified in other media (i.e., soil, surface water, country foods) the risk associated with exposure to those COPCs in air was also evaluated.

6.6 Conceptual Site Model

A conceptual site model for the Project that integrates potential sources of COPCs, ROCs, and complete exposure pathways identified during the problem formulation process is illustrated in Figure 14 and Figure 15.

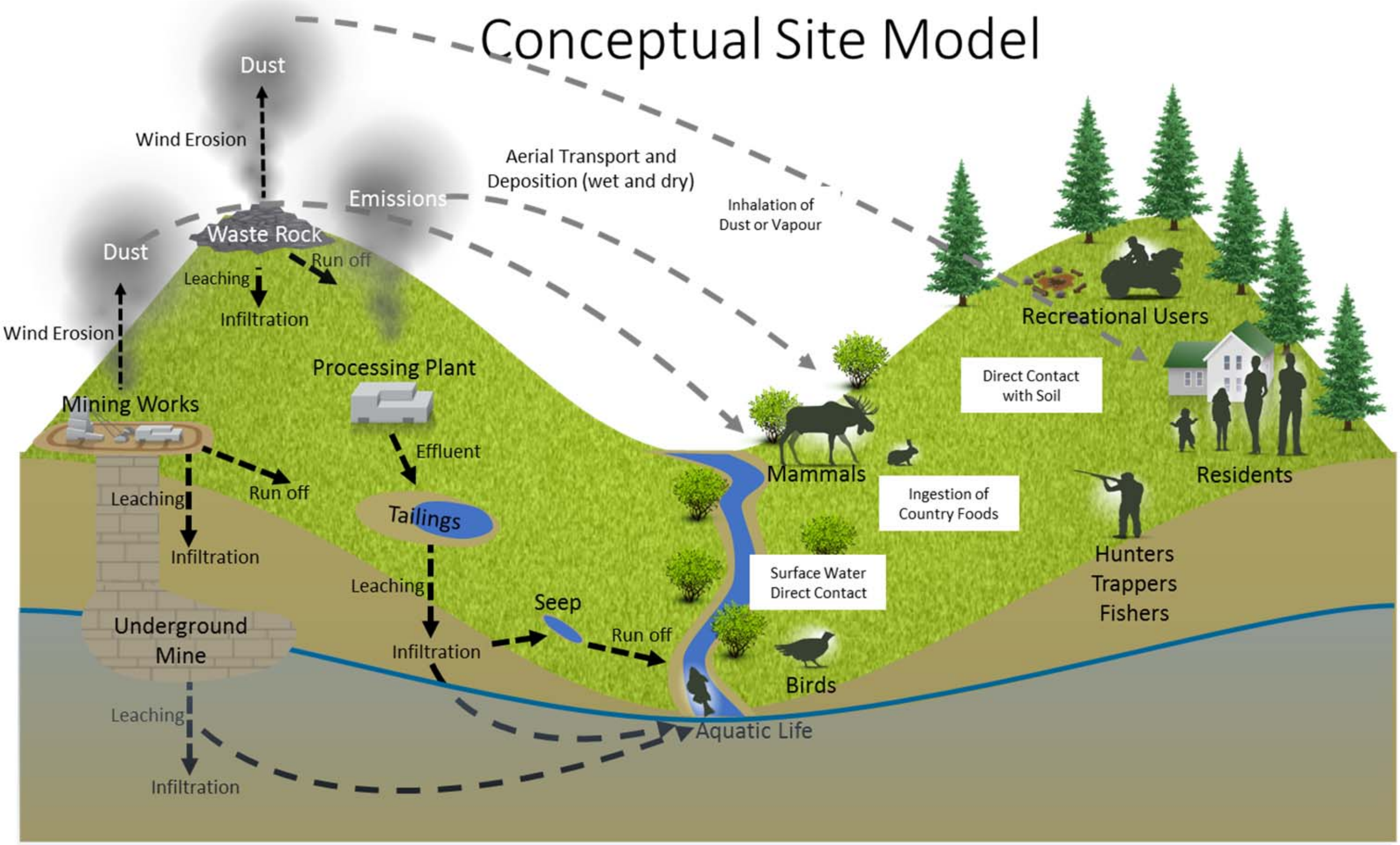
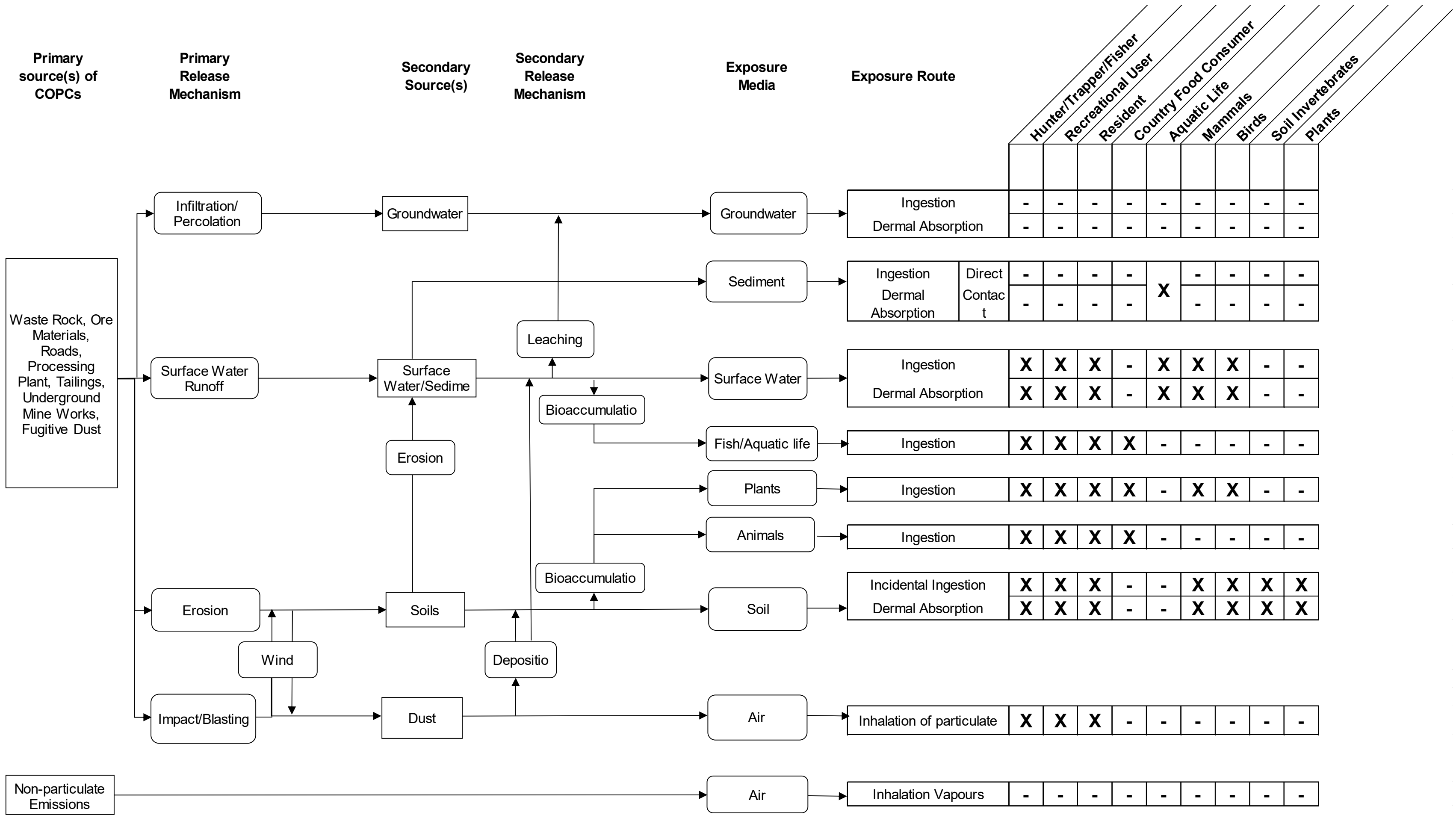


Figure 14 Human Health Conceptual Site Model: Red Mountain Underground Gold Project



X Exposure Route Probable
- Exposure Route not probable

Figure 15 Box and line Conceptual Site Model: Red Mountain Underground Gold Project

A summary of the problem formulation, outlining the COPCs, ROCs, and complete exposure pathways requiring further quantitative assessment in the HHRA, is presented in Table 6 (and in Attachment A, Table A13). All COPCs identified were metals.

Table 6 Summary Table: Conceptual Site Model Elements

Receptors of Concern	Complete Exposure Pathways	Soil COPCs	Surface Water COPCs	Country Food COPCs
Hunter/ Trapper/ Fisher, Recreational User, Summer and Year Round Resident	Ingestion of Soil	Arsenic	Aluminum	Aluminum
	Inhalation of Air Particulate	Bismuth	Antimony	Arsenic
	Dermal Contact with Soil	Cadmium	Arsenic	Barium
	Ingestion of Surface water	Iron	Bismuth	Bismuth
	Dermal Contact with Surface Water	Mercury	Cadmium	Boron
	Ingestion of Country foods	Selenium	Chromium	Cadmium
		Tellurium	Cobalt	Chromium
			Iron	Cobalt
			Lead	Copper
			Manganese	Iron
			Mercury	Lead
			Selenium	Manganese
			Thallium	Mercury
			Vanadium	Nickel
				Selenium
				Strontium
				Tellurium
				Thallium
				Vanadium
				Uranium
				Zinc

7 EXPOSURE ASSESSMENT

The objective of the exposure assessment was to evaluate the ways ROCs may be exposed (exposure pathways) to COPCs (source) and to what amount they could be exposed (dose). The exposure assessment follows Health Canada guidance and used reasonable maximum exposure (RME) methods. There are two primary tasks for an exposure assessment:

1. Determine the estimated environmental concentrations (EECs), at the points of potential human contact, for all identified COPCs. For the baseline condition, EECs for soil, surface water, fish, and plants were derived from measured concentrations, and EECs for air particulate and terrestrial country foods were estimated from models. Predicted future EECs for all exposure media were estimated from models.
2. Estimate the dose for operable exposure pathways of potentially exposed populations (receptor groups). The doses were estimated using EECs and RME assumptions for a variable such as exposure duration, ingestion rate and other parameters that describe human receptor group activities.

The HHRA does not consider all potential exposures to COPCs. It characterizes risk to human health associated with potential exposure to air, soil, surface water, and country foods that may be potentially contaminated as a result of the Project.

7.1 Estimated Environmental Concentrations

The EECs represent the chemical concentration in the exposure medium that the human receptor may potentially come into contact with during time spent in the LSA near the Project area (Bitter Creek valley). The following section explains how the EECS were developed from measured data and models.

7.1.1 Air

The baseline EECs for metals in air were based on baseline PM_{10} concentrations and represented by those concentrations acquired from other locations as discussed in Section 6.3.1 and presented in Attachment A, Tables A1 and A2. The predicted EECs for air were based on the maximum of the three annual PM_{10} metals in air concentrations discussed in Section 6.3.1.2 and presented in Attachment A, Table A2. This is consistent with Health Canada (2011) Detailed Quantitative Risk Assessment guidance (DQRA).

7.1.2 Soil

Summary statistics (i.e., minimum, average, median, 75th percentile, 90th percentile, 95th percentile, and maximum) for the baseline soil sample data provided in the *Ecosystems, Vegetation, Terrain and Soils Baseline Report* (Volume 8, Appendix 9-A) and the *Geochemical Characterization of Waste Rock, Ore, and Talus* (Volume 7, Appendix 1-B), are provided in Attachment B, Table B1**.** Soil data from samples from 0 – 100 cm were included in the baseline soil data set. The soil EEC for each COPC for direct contact was based on 95th percentile concentration. The use of the 95th percentile concentration is consistent with BCMOE's (2017) approach for determining background soil quality. Predicted future soil EECs were estimated by adding predicted air particulate dustfall data to baseline EECs. The derivation of the predicted future soil EECs is provided in Attachment C, and EECs are provided in Attachment A, Table A3. For predicted direct soil contact it was assumed that dustfall mixed with the upper 2 cm of background soil.

7.1.3 Surface Water

As noted above in section 6.3.3, surface water data provided in the *Baseline Surface Water and Ground Water Quality Report* (Volume 8, Appendix 14-A) were used to calculate baseline surface water EECs. Baseline data for 14 sample locations were available for this exercise. However, predicted unfiltered surface water concentration data were only available for 6 sample locations. Only data from these six locations were used to estimate baseline and predicted EECs, as it was only feasible to calculate incremental risk where predicted data were available. The six sample locations represent areas that may be affected by the proposed Project. The baseline EEC was the average of the P90 monthly concentrations across the six sample stations (Attachment B, Table B19). Unfiltered surface water concentrations were predicted for two scenarios: Operation Phase, and Reclamation and Closure / Post Closure Phases. The average of the monthly 90th percentile concentration across the six sample stations were predicted for each chemical, for each scenario (Attachment B, Table B19). The higher of the average P90 monthly concentrations for each chemical, for each scenario, was used as the predicted future EEC.

The surface water statistics are provided in Attachment B, Tables B2 to B19. The mean of the monthly 90th percentile concentrations used for the baseline EECs and predicted future EECs in surface water are provided in Attachment A, Table A14b.

7.1.4 Country Foods – Fish

Summary statistics were developed from the baseline fish tissue data provided in the *Baseline Fisheries and Aquatic Resources* (Volume 8, Appendix 18-A). The 90th percentile COPC concentrations in Dolly Varden fish tissue were used as the EECs for the baseline condition (Attachment A, Table A15). As noted in Section 6.1.4, Dolly Varden served as a surrogate for salmon in the LSA. Exposure media concentrations used to estimate tissue concentrations for fish are presented in Attachment D, Tables D1 and D2. The predicted future EECs were estimated by multiplying fish bioconcentration factors (i.e., BCF_{Fish}, expressed in wet-weight) by predicted future surface water EECs, as shown in the following equation:

$$C_{Fish\text{-}Predicted} = BCF_{Fishwwi} \times C_{w\text{-}Predicted}$$

Where:

$C_{Fish\text{-}Predicted}$ = Predicted future concentration of COPC "i" in fish mg COPC/kg fish; and

$C_{w\text{-}Predicted}$ = Predicted future concentration of COPC "i" in surface water in mg/L

The BCF_{Fish} was estimated for each COPC from baseline conditions, and assumed to also apply to predict future conditions, by dividing the mean Dolly Varden fish tissue COPC concentrations by the mean COPC surface water concentrations, as expressed by the following equation:

$$BCF_{Fishwwi} = C_{Fish} / Cw_{Baseline}$$

Where:

$BCF_{Fishwwi}$ = Bioconcentration factor for COPC "i" in fish wet-weight (L/kg wet weight);
C_{Fishi} = Concentration of COPC "i" in fish mg COPC/kg wet weightfish; and
$Cw_{Baselinei}$ = Baseline concentration of COPC "i" in dissolved surface water (mg/L)

Table A16 (Attachment A) presents the mean dissolved metal concentration in surface water. The mean values were used to calculate the BCF. Table A16 documents baseline surface water concentrations and fish tissue concentration alternatives used to calculate site specific bioconcentration factors (BCFs). The selection of the predicted P90 dissolved surface water concentration and BCF to generate the predicted fish tissue concentration was not a straight forward issue. The following discussion provides clarification on the approach used for selecting which fish tissue data and which surface water data were used to generate a reasonable BCF and subsequent predicted fish tissue concentration.

Site-specific (co-located) sample BCFs were not calculated because these calculations would necessary assume the fish are stationary and do not move around within a creek or other waterbody. Table A16 documents calculated BCFs for four different scenarios: BCF1) a semi co-located sample, fish caught in the same reach; BCF2) the average fish tissue residue concentration of fish caught in Bitter Creek down gradient of the Bitter Creek fish break divided by the average concentration of surface water samples collected down gradient of the fish break; BCF3) the average fish tissue residue concentration of fish caught in Bitter Creek down gradient of the Bitter Creek fish break and fish caught in the Bear River divided by the average concentration of water samples collected down gradient of the Bitter Creek fish break and in the Bear River; and BCF4) the average COPC concentration in all fish tissue samples divided by the average concentration of all water samples collected from the reaches where the fish tissue samples were collected.

Data for fish sample caught at and water samples collected from the first reach of Bitter Creek just above the confluence with the Bear River and at the reach containing the confluence of Roosevelt Creek and Bitter Creek were used to estimate fish BCFs (BCF3). BCF3 was used to predict fish tissue concentrations. Water samples and fish samples were collected from stations reasonably close to each other at these locations. Fish spending time in these locations are likely to be exposed to COPCs released as a result of the Project while at these locations.

Surface water data from sample locations BR06, BC02, BC06 (Figure 12) were used to estimate the $BCF_{Fish.}$ The fish BCFs and predicted fish tissue concentrations are provided in Attachment A, Table A16.

7.1.5 Country Foods – Plants

As noted above in section 6.1.4, Sitka willow tissue COPCs concentrations were used as a surrogate for berries. The maximum COPC concentrations in Sitka willow tissue were used as the plant tissue EEC for baseline conditions. Exposure media concentrations used to estimate tissue concentrations for plants are presented in Tables D1 and D2. The Estimated Environmental Concentrations (EECs) calculated for plants were based on uptake from soil and direct deposition of particulate on the plants, using the formula presented below (not previously provided in the HHRA (Volume 8, Appendix 22-A):

$$C_{plant\text{-}predicted\text{-}total}\ (mg/kg\text{-}dry\text{-}wt) =$$
$$C_{plant\ \text{-}predicted\text{-}(by\ root\text{-}uptake)}\ (mg/kg\text{-}dry\text{-}wt) +$$
$$Pd_{plant\ (aboveground)\ concentration\ due\ to\ direct\ deposition}\ (mg/kg\text{-}dry\text{-}wt)$$

Site specific BCFs, Eco-SSL (USEAP 2007) BCFs, ORNL RAIS (2017) BCFs, and average (Table 17b) and 90th percentile predicted plant COPC concentrations are tabulated in a second new table, Table A17c.

Seven plant samples were collected for COPC tissue analysis this project. The plant samples were not co-located with soil samples. Sitka willow was the plant collected. Site-specific BCFs were calculated using the average of baseline soil concentration and average plant sample tissue dry weight concentration. The site-specific BCFs for each COPC were compared to USEPA Ecological -Soil Screening Levels (Eco-SSLs) BCFs (USEPA 2007) and to US Department of Energy (USDOE) Oak Ridge National Laboratory (ORNL) Risk Assessment Information System (RAIS) (2017) BCFs.

The BCFs differed between those calculated using the site-specific method and those calculated using the literature sources. No method or source had the most conservative BCFs for every chemical. Options for assessing plant tissue residue risk included: excluding the measured plant tissue metal data and instead modelling baseline and predicted plant concentrations based on baseline and predicted soil concentrations and literature-derived BCF; or utilizing measured plant tissue metal data and choosing between one of three BCFs available (modelled site-specific BCFs, Eco-SSLs BCFs, or ORNL-RAIS BCFs). As use of measured in data is generally preferred the site-specific plant data were used. Site-specific BCFs were also used because they generally fell between the two literature-based values; however, sometimes they were the lowest and sometimes they were the highest.

The plan was to use the maximum plant tissue metal concentrations to estimate baseline risk and the 95th percentile predicted soil concentration to estimate the predicted plant tissue metal concentrations. However, the measured maximum COPC plant tissue concentrations were much higher than the predicted plant tissue concentrations based on the 95th percentile or maximum COPC soil concentrations; in contrast, predicted tissue residue concentrations based on the average predicted soil concentrations were greater than the baseline average concentration. As an increase in concentration from baseline to predicted is consistent with what should be observed, the average predicted soil concentration was used to generate the predicted plant tissue concentrations (Attachment A, Table A17c). The predicted concentration of root zone soil was based on the assumption that deposited soil mixed with the upper 20 cm of soil and that the plant root zone was from 0-20 cm in depth (Attachment A, Table A17c).

The contribution from soil was estimated by multiplying plant bioconcentration factors (i.e., BCF_{Plant} in dry weight) by the predicted future soil EECs (USEPA 2005a), as expressed by the following equation:

$$C_{Plant\text{-}Predicted\ by\ root\ uptake} = BCF_{Plant\ dry\text{-}wt} \times C_{Soil\text{-}Predicted}$$

Where:

$C_{Plant\text{-}Predicted}$ = Predicted concentration of COPC "i" in plants mg COPC/kg dry weight plant; and

$C_{Soili\text{-}Predicted}$ = Predicted concentration of COPC "i" in soil (mg COPC/kg soil).

The BCF_{plant} for each COPC was estimated from baseline conditions, and assumed to also apply to predicted future conditions, by dividing the mean Sitka willow plant tissue concentration by the mean soil concentration (Zaung 2007), as shown in the following equation:

$$BCF_{Plantdwi} = C_{PlantBaselinei} / CSoil_{Baselinei}$$

Where:

$BCF_{Plantdwi}$	= Bioconcentration factor for COPC "i" in plants (kg soil/kg dry weight plant);
$C_{PlantBaslinei}$	= Baseline concentration of COPC "i" in plants in mg COPC/kg dry weight plant;
and	
$Csoil_{Baselinei}$	= Baseline concentration of COPC "i" in soil in mg COPC/kg soil.

Uptake from deposition of airborne particles was estimated using the following equation by USEPA (2005):

$$Pd = \frac{1000 \times D \times Rp \times (1 - \exp(-kp \times Tp))}{Yp \times kp}$$

Where:

Pd	= Plant (aboveground) concentration due to direct deposition (mg/kg dry-wt)
1000	= Units conversion factor
D	= Annual deposition rate (g_{COPC}/m^2-y)
Rp	= Interception fraction of the edible portion of plant (unit-less)
kp	= Plant surface loss coefficient (yr^{-1})
Tp	= Length of plant exposure to deposition per harvest of the edible portion of the plant (yr)
Yp	= Yield or biomass of the edible portion of the plant (productivity) (kg dry weight/m^2)

The annual deposition rate and concentration of metals are provided in Attachment D, Table D2. The interception fraction of the edible portion of the plant (Rp) was set 0.05, which is based on a weighted average of class-specific values as recommended by the US EPA (2005) for mixtures of plant species. The plant surface loss coefficient (kp) was set to the default value of 18 $year^{-1}$ recommended by the US EPA (2005). The length of plant exposure to deposition per harvest of the edible portion of the plant (Tp) was set to one month per year. The yield or standing crop biomass of the edible portion of the plant (Yp) was set to 2.24, which the US EPA (2005) recommends for exposed fruits and vegetables. The concentration of COPCs on plants from dust deposition and the total concentration of metals in plants from deposition and root uptake are provided in Attachment D, Table D2. For deposition of dust on plants, it was assumed that the deposition concentration was based on the 95^{th} percentile background soil concentration and not the average soil concentration as was used for the root zone.

Predicted plant tissue concentrations are provided in Attachment A, Table A17d. Plant BCF values are provided in Attachment D, Table D3.

Tissue concentration were calculated for baseline and predicted in dry weight. Dry weight was converted to wet weight for use in human health dose calculation using the following formula.

Plant Concentration wet weight = (Plant Concentration dry weight) X (1- (plant moisture content))

7.1.6 Country Foods – Moose, Hare, and Grouse

Moose, hare, and grouse tissue EECs for both the baseline and predicted future conditions were calculated using a methodology described in USEPA (2005), which incorporates exposure to COPCs via wildlife consumption of soil, surface water and food items. Attachment D provides the detailed country foods calculations. For the baseline condition, measured concentrations in soil, plants and surface water were used. For predicted future conditions, concentrations in exposure media and plants were estimated based on the methodologies described in Sections 7.1.1, 7.1.2, 7.1.3, 7.1.4, and 7.1.5, respectively. To calculate the tissue EECs for moose, hare, and grouse, a COPC-specific biotransfer factor (BTF) was multiplied by the estimated daily dose of a COPC (mg of COPC/day) from food (e.g., plant food items), soil, and water:

$$C_{animal} = BTF_a \times \sum (C_{Fi} \times P_{Fi} \times F_{Fi} \times FIR) + (C_{soil} \times FIR \times P_{Soil} \times F_{Fi} \times BCF_{Soil\ to\ Plant}) + (C_{water} \times WIR)$$

Where:

Where:

- C_{animal} = COPC concentration in moose, hare, or grouse (mg COPC/kgWW-tissue);
- BTF_a = adjusted BTF for fat content of tissue (day/kg-WW tissue);
- C_{Fi} = COPC concentration in food item “i” (mg COPC/kg DW $food_i$);
- P_{Fi} = proportion of food item “i” in diet (kg DW $food_i$/kg DW food);
- F_{Fi} = fraction of diet from area affected by project “i” (unitless, assumed to be 1);
- FIR = food ingestion rate (kg DW food/day);
- C_{soil} = COPC concentration in surficial soil (mg COPC/kg soil);
- P_{soil} = proportion of soil in diet (kg soil/total kg dw food);
- $BCF_{soil\ to\ plant}$ = bioconcentration factor for COPC “I” in dry-weight (unitless);
- C_{water} = COPC concentration in water (mg COPC/L); and
- WIR = water ingestion rate (L/day).

Species-specific BTFa were acquired from ORNL (2017) and are provided in Attachment D, Table D3.

The proportion of plant food items in the diet was 100%, 100%, and 99% for moose, hare, and grouse, respectively. The proportion of incidental soil ingestion varied for these receptor groups. Moose and hare were reported to have 2% and 6% incidental soil ingestion, respectively (Environment Canada 2014). The incidental soil ingestion for grouse was not available; therefore, an assumption that 2% of the diet comprised incidental soil ingestion was made based on provincial (BCMELP 2000) guidance.

Moose are known to uptake contaminants into their organs at concentration greater than present in muscle. This is particularly true for certain metals including arsenic, cadmium and, to a lesser degree, lead and mercury. Chan et al. (2011) presents concentration data for arsenic, cadmium, lead and mercury in moose kidney, liver and muscle. Chan et al. (2011) present data for consumption rates for moose kidney, liver, and muscle.

It was assumed that the modelled moose meat concentration for each metal represented the metal concentration in moose muscle and not the average concentration for the entire moose. Using the ratio of muscle to liver to kidney metal “i” concentration from Chan et al. (2011), site specific liver and kidney concentration for metal “i” was then estimated from the modelled site-specific metal “i” muscle tissue concentration based on these ratios. The mass of each organ consumed per day was multiplied by the organ specific metal “i” concentration to estimate the mass of metal “i” in each organ Chan et al. (2011). The mass of metal “i” in each organ was then summed, and this sum was divided by the mass of muscle +kidney +liver consumed each day to determine the weighted average concentration. This process was completed for arsenic, cadmium, lead and mercury (Table D11).

Grouse were assumed to have approximately 1.4% invertebrates in its diet. The EECs for invertebrates were estimated by multiplying invertebrate bioconcentration factors (i.e., BCF_{Invert} in dry weight, units of kg soil/kg DW invertebrate) by the baseline and predicted future soil EECs (USEPA 2005a), as expressed by the following equation:

$$C_{Invert\ -dry\ wi} = BCF_{Invert}\ x\ C_{Soil}$$

Where:

C_{Invert} = Concentration of COPC “i” in invertebrates (mg COPC/kg DW invertebrate); and

C_{Soil} = Concentration of COPC “i” in soil (mg COPC/kg soil).

Predicted invertebrate tissue concentrations are provided in Attachment A, Table A18. Invertebrate BCF values were acquired from US DOE (1999) and are provided in Attachment D, Table D3.

7.2 Receptor Exposure Factors

Receptor Exposure factors consist of receptor type and age-specific characteristics as well as exposure assumptions associated with the duration and frequency of time spent in the LSA near the Project area (Bitter Creek watershed). The following section explains how the receptors characteristics and exposure assumptions were developed and provides a summary of the values used to model exposure.

7.2.1 Receptor Characteristics

The receptor characteristics used for the ROCs (i.e. hunter/trapper/fisher, recreational user, and summer resident) were generally obtained from Health Canada (2012a,b) and are provided below in Table 7.

Table 7 ROC Exposure Characteristics

Exposure Characteristic/Receptor Type	Infant	Toddler	Child	Teen	Adult
Age group duration	0 – 6 months	7 months – 4 years	5 – 11 years	12 – 19 years	>= 20 years
Years	0.5	4.5	7	8	60
Body weight (kg)	8.2	16.5	32.9	59.7	70.7
Soil ingestion rate (kg/d)	0.00002	0.00008	0.00002	0.00002	0.00002
Inhalation rate (m^3/d)	2.2	8.3	14.5	15.6	16.6
Water ingestion rate (L/d)	0.3	0.6	0.8	1	1.5
Skin surface area (cm^2)					
- hands	320	430	590	800	890
- arms	550	890	1480	2230	2500
- legs	910	1690	3070	4970	5720
- hands+legs+arms	1780	3010	5140	8000	9110
Total Body	3620	6130	10140	15470	17640
Soil loading to exposed skin (kg/cm^2/event)					
- hands	1.00E-07	1.00E-07	1.00E-07	1.00E-07	1.00E-07
- surfaces other than hands	1.00E-08	1.00E-08	1.00E-08	1.00E-08	1.00E-08
First Nations food ingestion (kg/d)*					
- plants/berries	0	0.091	0.134	0.188	0.290
- fish	0	0.091	0.134	0.188	0.290
- other country foods	0	0.091	0.134	0.188	0.290

* Modified values based on Chan *et al.* (2011).

The ingestion rates of fish and wild game country foods were based on the 95th percentile consumption rate for adults of 290 grams/ person/ day provided in *Food Nutrition & Environment Study* by Chan et al. (2011), which is higher than the rate recommended by Health Canada (2012a,b). In order to include equivalent (i.e., higher) rates for the other age groups, the ratio of the adult rates (equal to 1.075) between Chan et al. (2011) and Health Canada (2012a,b) was used to adjust the Health Canada rates for the other age groups. This ratio was also used to adjust the plants/berries consumption rate from Health Canada (2012a,b). It was assumed that the infant did not eat country foods.

7.2.2 Exposure Assumptions

The receptor exposure assumptions used for the ROCs (i.e., hunter/trapper/fisher, recreational user, and summer and year round resident) are provided below in Table 8. The assumptions considered in the selection of the exposure assumptions were conservative to account for the variability of the ROC's exposure to COPCs, and are based on Health Canada guidance (Health Canada 2012a,b).

The hunter trapper/fisher receptor was assumed to be exposed to COPCs in soil and air particulate from the Project area while in the LSA, via the incidental ingestion, dermal contact, and inhalation of particulate pathways, for a total of 8 weeks per year, over a period of 3 months in the year. While in the LSA it was assumed that creek surface water was used for drinking water.

The recreational user, specifically, persons that utilize the watershed for recreational, hunting, fishing, camping, and hiking, among other activities, was assumed to be present in the Bitter Creek watershed for 3 weeks per year, over a period of 3 months in the year (likely associated with favourable weather). This could occur during one or over several visits. While in the LSA they have direct contact with soil via incidental ingestion, dermal contact, and inhalation of air particulate. It was assumed that camping could occur within the LSA, but not within the gated Project area, and creek surface water would be used for drinking water.

The hypothetical summer resident was assumed to live in the lower part of the Bitter Creek watershed within the LSA for up to 3 months of the year, over a period of 6 months in the year. The hypothetical year round resident was assumed to live in the lower part of the Bitter Creek watershed within the LSA for the entire year. While in the LSA they have direct contact with soil via incidental ingestion, dermal contact, and inhalation of air particulate, and creek surface water was used for drinking water.

The country food consumer does not spend any time in the Bitter Creek watershed but eats country food harvested from the watershed seven days per week for 26 weeks over a year.

Table 8 ROC Exposure Durations and Frequency Assumptions

ROC	Hours per day	Hours per day outside	Days per week	Weeks per year	Dermal exposure events per day	Days/year of contaminated food ingestion	Amortization period
Trapper/ Hunter/Fisher	24	24	7	8	1	56	12 weeks
Recreational User	24	24	7	3	1	21	12 weeks
Summer Resident	24	24	7	13	1	91	26 weeks
Potential Year-Round Resident	24	24	7	52	1	365	52 weeks
Country Food Consumer	24	24	7	26	0	182	52 weeks

7.3 Dose Estimates

For ingestion and dermal contact exposure pathways, intake of COPCs by potentially exposed receptors was calculated by estimating the mass of COPC taken into the body per unit body weight per unit time (mg per kilogram of body weight per day [mg/kg-day]). For the inhalation exposure pathway, the intake of COPCs by potentially exposed receptors was calculated by estimating a time-weighted exposure concentration that takes into account the exposure time, frequency, and duration for each receptor as well as the period over which the exposure is averaged (i.e., the averaging time). The dose for each exposure pathway for each receptor was calculated using the media specific equation below. The equations are based on the exposure characteristics and exposure frequency and duration assumptions provided in Table 7 and Table 8.

For non-cancer COPCs, the dose is averaged over the duration of the exposure to the COPC. For evaluation of carcinogenic COPCs, the dose is averaged over the entire lifetime. The calculated carcinogenic dose for the adult recreational receptor is greater than the carcinogenic dose for the toddler recreational receptor because the length of exposure is greater for the adult compared to the toddler while the averaging time term is the same. In contrast, for non-cancer exposures, the dose for the child is greater than the dose for the adult because the averaging time terms are based on the exposure duration. As a result, the non-cancer hazards are greater for the child relative to the adult.

Incidental ingestion of soil is assumed to occur daily when receptors are in the Bitter Creek valley. Health Canada recommendations were used in calculating the chemical intake from ingestion of soil. The daily soil consumption rates ranged from 20 mg/day for the infant, child, teen, and adult to 80 mg/day for the toddler (Health Canada 2012; Table 4).

Dermal contact with soil was assumed to occur daily while receptors in the valley. It was assumed that soil dermal contact with hands, arms and legs will occur for all receptors. The soil dermal contact surface area for each receptor is presented in Table 4 (Health Canada 2012).

Ingestion of surface water was assumed to occur through daily water consumption when receptors are in the Bitter Creek valley. Health Canada recommendations were used in calculating the chemical intake from ingestion of surface water. Surface water in the watershed was assumed to be the only source of water for potentially exposed populations when they are in the watershed. The daily water consumption rates ranged from 0.3 litres/day for the infant to 1.5 liters/day for the adult (Health Canada 2012a,b; Table 4).

Dermal contact with surface water was also assumed to occur daily while receptors are in the valley. It was assumed that surface dermal contact with hands, arms will occur for all receptors. The surface water dermal contact surface area for each receptor is presented in Table 4 (Health Canada 2012).

Exposure to COPCs in air particulate, via inhalation, occurs when receptors are in the Bitter Creek watershed, and is dependent on the inhalation rate (Table 7) and the exposure duration (Table 8).

The ingestion of country foods is assumed to occur through daily country food consumption by receptors when they are present in the Bitter Creek watershed. Country foods may also be ingested by non-users of the watershed. Human receptors that hunt, fish, trap, and or gather berries in the watershed may give or sell their harvest to family, friends, or others. For the Country Foods Consumer receptor, the exposure duration was 6 months per year, amortized over 1 year. The ingestion rates of country foods ranged from 91 to 290.3 grams/day (Table 5) (Chan et al 2011).

As noted above, arsenic is a COPC in fish and mammal tissue. However, the arsenic that is present in fish tissue is mostly in a relatively non-toxic, organo-arsenic form. Forms of organic arsenic include arsenobetaine, monomethylarseinic acid (MMA), dimethyl arsenic acid (DMA), arsenocholine, arsenosugars, and arsenolipids (Schoof et al. 1999). Numerous studies have measured the fraction of total arsenic in fish that exists as inorganic (toxic) arsenic (e.g., Yost et al. 1998; Schoof et al. 1999; WHO 2001; USEPA 2005b). Most measured values of inorganic arsenic in fish are below 1% (WHO 2001). However, for this HHRA, it was assumed that inorganic arsenic was 10% of the total arsenic measured in fish tissue samples (as per the work completed by the US EPA and discussed in Schoof and Yager (2007).

COPC dose estimates for each of the ROC exposure pathways were quantified using equations from Health Canada (2012a,b) and are presented below in the following sections.

Dose estimates are combined with toxicity reference values (TRVs) to evaluate hazard and risk to receptors assumed to be exposed to COPCs.

7.3.1 Air Exposure

7.3.1.1 Dose Estimate for Inhalation of Airborne Particles (Fugitive Dust)

Noncarcenogenic

$$TADC_A\ (\mathrm{mg}/m^3) = \mathrm{C_{Air}} \times \mathrm{RAF_{Inh}} \times D_1 \times \mathrm{D_2} \times \mathrm{D_3}$$

Where:

	$TADC_A$	= time-adjusted average daily air concentration (mg/m^3)
	C_{Air}	= concentration of COPC in airborne dust (mg/m^3)
	RAF_{Inh}	= relative absorption factor from the respiratory tract (unit-less)
	D_1	= hours per day exposed (24 hours/24 - hours)
	D_2	= days per week exposed (7 days/7-day week)
	D_3	= weeks per year exposed (weeks/52-week year)

The denominator D_3 is not necessarily 52 weeks. It is the amortization period for noncarcinogens (Table 8).

Carcinogenic

$$\text{Dose (mg/kg-day)}=\frac{C_{Air}\times IR_A \times D_1 \times D_2 \times D_3 \times D_4}{BW\times LE}$$

Where:

	Dose	= predicted chronic daily intake (mg/kg-day)
	C_{Air}	= concentration of COPC in airborne dust (mg/m^3)
	IR_A	= ROC inhalation rate for fugitive dust (m^3/day)
	RAF_{Inh}	= relative absorption factor from the respiratory tract (unit-less)
	D_1	= hours per day exposed (24 hours/24-hour)
	D_2	= days per week exposed (7days/7-day week)
	D_3	= weeks per year exposed (weeks/52-week year)
	D_4	= total years exposed (year)(for assessment of carcinogens only)
	BW	= body weight (kg)
	LE	= life expectancy (year) (for assessment of carcinogens only)

The denominator D_3 is always 52 weeks for carcinogens (Table 8).

7.3.2 Soil Exposure

This section presents dose estimate equations for three soil exposure routes: inadvertent ingestion of soil, inhalation of soil particulate, and dermal contact with contaminated soil.

7.3.2.1 Dose Estimate for Inadvertent Soil Ingestion

$$\text{Dose (mg/kg} - \text{day)} = \frac{C_s \times IR_s \times RAF_{Oral} \times D_2 \times D_3 (\times D_4)}{BW(\times LE)}$$

Where:

	Dose	= predicted chronic daily intake (mg/kg-day)
	C_S	= concentration of COPC in soil (mg/kg soil)
	IR_S	= ROC ingestion rate for soil (kg/day soil)
	RAF_{Oral}	= relative absorption factor from the gastrointestinal tract (unit-less)

D_2	= days per week exposed (days/7-day week)
D_3	= weeks per year exposed (weeks/52-week year)
D_4	= total years exposed (year)(for assessment of carcinogens only)
BW	= body weight (kg)
LE	= life expectancy (year) (for assessment of carcinogens only)

Relative absorption factors represent the ratio of the fraction of the chemical that is absorbed via the exposure route of concern (i.e., ingestion) to the fraction of the chemical estimated to be absorbed in the toxicological study upon which the TRV was based. The example calculation provided in Attachment H demonstrates use of this parameter for arsenic dose estimates. The RAF_{oral} for exposure from soil ingestion was set to one for all chemicals with the exception of arsenic. The arsenic RAF_{oral}, is based on the gastrointestinal absorption that occurred in the study used to develop the toxicity value. The arsenic RAF oral for soil used in this study was 0.33. This was based on an average value as provided in Leufroy et al (2011). The relative oral bioavailability of arsenic has been well studied and arsenic is one of the few chemicals for which there is a reasonable amount of data indicating that human arsenic uptake from soil is less than that from water (Roberts et al 2007).

7.3.2.2 Dose Estimate for Dermal Contact with Contaminated Soil

$$Dose(mg/kg-day) = \frac{\left((C_S \times SA_H \times SL_H) + (C_S \times SA_O \times SL_O)\right) \times RAF_{Derm} \times D_1 \times D_2 \times D_3 (\times D_4)}{BW(\times LE)}$$

Where:

Dose	= Predicted chronic daily intake (mg/kg-day)
C_S	= concentration of COPC in soil (mg/kg soil)
SA_H	= surface area of hands exposed for soil loading (cm^2)
SL_H	= soil loading rate to exposed skin of hands (kg soil/cm^2-event)
SA_O	= surface area exposed other than hands for soil loading (cm^2)
SL_O	= soil loading rate to exposed skin other than hands (kg/cm^2-event)
RAF_{Derm}	= relative absorption factor from the gastrointestinal tract (unit-less)
D_1	= events per day, assumed to be 1 (events/day)
D_2	= days per week exposed (days/7-day week)
D_3	= weeks per year exposed (weeks/52-week year)
D_4	= total years exposed to Site (year)(for assessment of carcinogens only)
BW	= body weight (kg)
LE	= life expectancy (year) (for assessment of carcinogens only)

Chemical specific dermal RAFs for soil were taken from Health Canada (Health Canada 2011) where available, and when no dermal RAF was available for a metals the default metal RAF of 0.01 was used (USEPA 2017).

7.3.3 Surface Water Exposures

This section presents dose estimate equations for two surface water exposure routes: inadvertent ingestion of surface water and dermal contact with surface water.

7.3.3.1 Dose Estimate for Ingestion of Surface Water

$$\text{Dose (mg/kg} - \text{day)} = \frac{C_W \times IR_W \times RAF_{Oral} \times D_2 \times D_3 (\times D_4)}{BW (\times D_4)}$$

Where:

Dose		= Predicted chronic daily intake (mg/kg-day)
C_W		= concentration of COPC in water (mg/L)
IR_w		= ROC ingestion rate for water (L/day)
RAF_{Oral}		= relative absorption factor from the gastrointestinal tract (unit-less)
D_2		= days per week exposed (days/7-day week)
D_3		= weeks per year exposed (weeks/52-week year)
D_4		= total years exposed to Site (year)(for assessment of carcinogens only)
BW		= body weight (kg)
LE		= life expectancy (year) (for assessment of carcinogens only)

7.3.3.2 Dermal Contact with Surface Water

$$\text{Dose (mg/kg} - \text{day)} = \frac{C_W \times SA \times K_P \times CF \times D_1 \times D_2 \times D_3 (\times D_4)}{BW (\times D_4)}$$

Where:

Dose		= Predicted chronic daily intake (mg/kg-day)
C_W		= concentration of COPC in surface water (mg/kg)
SA		= surface area of body exposed to water (cm^2)
K_P		= dermal permeability coefficient (cm/hour)
CF		= conversion factor (L/cm^3)
D_1		= number of hours per day, assumed to be 1 hour (hours/day)
D_2		= days per week exposed (days/7-day week)
D_3		= weeks per year exposed (weeks/52-week year)
D_4		= total years exposed to Site (year)(for assessment of carcinogens only)
BW		= body weight (kg)
LE		= life expectancy (year) (for assessment of carcinogens only)

7.3.4 Country Food Exposure

This section presents dose estimate equation for ingestion of country foods.

7.3.4.1 Ingestion of Country Foods

$$\text{Dose (mg/kg} - \text{day)} = \frac{C_{Foodi} \times IR_{Foodi} \times RAF_{Orali} \times D_i(\times D_4)}{BW(\times LE)X\,365}$$

Where:

C_{Foodi}	= concentration of COPC in food “i’' (mg/kg wet weight)
IR_{Foodi}	= receptor ingestion rate for food “i’' (kg/day wet weight/day)
RAF_{Orali}	= relative absorption factor from the gastrointestinal tract for COPC “i’' (unitless)
D_i	= days per year during which consumption of food “i’' will occur
D_4	= total years exposed (for assessment of carcinogens only)
BW	= body weight (kg)
365	= total days per year (constant)
LE	= life expectancy (years) (for assessment of carcinogens only)

The RAF oral for country foods was set to 1 the default value recommended by Health Canada 2012, with the exception of arsenic with respect to plants and fish. Exposure estimates from ingestion of arsenic often do not consider differences between the bioavailability of arsenic in water, soil, plants and fish. The use of default values that assume equivalent bioavailabilities in these matrices may overestimate risk (Bradham et al 2011; Koch et al 2013; Leufroy et al 2011). Bioavailability is expected to vary across food types (Koch et al 2013), and small adjustments in bioavailability estimates can significantly affect the estimated risk.

For ingestion of plants, the RAF of 0.29 from Koch et al. (2013) was used. This assumes that all the arsenic absorbed from plants was inorganic arsenic. The inorganic arsenic RAF for ingestion of fish was of 0.5 (Leufroy et al 2011).

Arsenic that is present in fish tissue is mostly in a relatively non-toxic, organic arsenic form. Forms of organic arsenic include arsenobetaine, monomethylarsinic acid (MMA), dimethyl arsenic acid (DMA), arsenocholine, arsenosugars, and arsenolipids (Schoof 1999). Numerous studies (e.g., Yost et al. 1998; Schoof et al. 1999; USEPA 2005c) have shown that the fraction of total arsenic in fish that exists as inorganic (toxic) arsenic is typically below 10%, with a value of about 4% being typical (USEPA 2005c). For this HHRA, it was assumed that inorganic arsenic was 10% of the total arsenic measured in fish tissue samples.

With regard to estimating dose for country foods it was assumed that receptors ate only one country food type. Using this assumption dose estimates were calculated for each country food type. The highest estimated dose amongst the types of country foods was used to represent the contribution of COPC dose from country foods. This is a conservative approach because it assumes that uptake COPCs from the country food basket is equal to the country food with the highest COPC uptake.

8 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to identify the toxic potential of the identified COPCs. Specifically, there are two major objectives:

- To identify the potential toxicological effects associated with the COPCs.
- To identify the TRVs used to estimate risk.

8.1 Toxicity Profiles

Toxicity profiles provide detail about the health effects for each COPCs. Toxicity profiles for each chemical are provided in Attachment E. Toxicity profiles include information about biomagnification potential of COPCs.

8.2 Toxicity Reference Values

As this project is under both Canadian federal jurisdiction and British Columbia provincial jurisdiction, the selection of TRVs generally followed the hierarchy outlined in BC Ministry of Environment Technical Guidance on Contaminated Sites No. 7 (November 2015). One exception was the selection of a nickel non-cancer oral TRV, which was based on a 2017 peer-reviewed article (Haber et al., 2017), rather than using available values based on studies published in 2000 (Health Canada 2010a) and 1991 (USEPA 2017b). Health Canada (2010) was the preferred source of TRVs for this HHRA, with other sources selected, in order of priority as recommended by Health Canada:

- Health Canada;
- USEPA Integrated Risk Information System (IRIS);
- Netherlands National Institute of Public Health and the Environment (RIVM) – human toxicological maximum permissible risk levels;
- World Health Organization (WHO); and,
- US Agency for Toxic Substances and Disease Registry (ATSDR) – toxicological profiles.

The TRVs can take the form of (i) a tolerable exposure (TDI: also referred to as a reference dose [RfD]), (ii) a tolerable concentration (TC): also referred to as a reference concentration [RfC]), (iii) a risk-specific dose (RSD), or (iv) a toxic potency factor such as a cancer slope factor (CSF).

The TDI is the daily intake to which the general population can be exposed over a lifetime without adverse health effects. These values are based on toxicity data from either laboratory animal studies or epidemiological studies with humans, depending on the best available data. They are used to evaluate oral exposures.

The TC represents the air concentration to which the general population can be continuously exposed over a lifetime without adverse effects. Health Canada typically develops TCs for the protection of all age groups, with consideration of sensitive subpopulations. The increased exposure that a young child may receive as compared with an adult, as a result of greater inhalation rate and lower body weight, has been incorporated into the derivation of the TC, and no further adjustment is required (Health Canada 2017). The US EPA, uses the term “reference concentration” to refer to air concentrations that will be protective of the general population from non-cancer effects. When a TC was not available for a chemical the TC was derived from the TDI by multiplying the TDI by 16.5 kg /8.3 m^3 (or =1.99 =2.0), the toddler body weight divided by the toddler inhalation rate. In cases where age group specific TDIs were available the age group specific inhalation were derived by multiplying the age -specific TDI by the age-specific (body weight/inhalation rate).

A slope factor is the estimated cancer risk for a chemical at a specified dose rate (i.e., units of (µg/kg bw/day)$^{-1}$ or (mg/kg bw/day)$^{-1}$). More specifically, a slope factor in units of (mg/kg bw/day)$^{-1}$ represents the ILCR if a person were exposed to a dose rate of 1 mg/kg bw/day of that COPC for every day of her/his life.

A summary of the TRVs used for each of the COPCs is provided in in Attachment A, Table A19. Toxicity profiles provide detail about the health effects for each COPCs. Toxicity profiles for each chemical are provided in Attachment E. Toxicity profiles include information about biomagnification potential for each COPCs.

9 RISK CHARACTERIZATION

The risk characterization section of the HHRA integrates the exposure and toxicity assessments to estimate potential health risks to people that may hunt/ trap /fish, recreate, or live in the Bitter Creek valley portion of the LSA and who could be exposed to the releases of the proposed Project. The risk estimates presented in this section should be interpreted in the context of uncertainties and assumptions associated with each step of the HHRA process and in the context of the data and models upon which the HHRA was developed.

9.1 Risk Estimate Procedure

Risk estimates were determined for both the baseline and future predicted conditions and considered individual routes of COPC exposures as well as additive effects. The HHRA risk characterization puts the estimated exposure into context by comparing potential Project risks to risks that are associated with baseline conditions.

The province of British Columbia has a target hazard index of 1 for the assessment of Human Health risks at contaminated sites in British Columbia; however, Health Canada recommends using a hazard index of 1 only when background exposures (outside of the area affected by the Project) and exposures from multiple media are considered. When this is not done, Health Canada recommends the target hazard quotient of 0.2 be employed.

Although this HHRA considered multiple pathways, background exposures were not assessed because the database of information available was felt to be incomplete. Therefore, multipathway risks for non-carcinogenic COPC were assessed assuming the target has a hazard quotient of 0.2.

Hazard quotients of less than 0.2 are associated with low health risk and no adverse health effects are anticipated. Hazard quotient estimates greater than 0.2 indicate the possibility or potential for adverse effects to people. This is balanced against the level of conservatism incorporated into the assessment.

Risk estimates were evaluated to one decimal place. If the difference, when rounded to one decimal place, was 0.1 or greater, the risks were considered further, and factors such as the source of the toxicity information, the nature of the effects associated with toxicity, and the magnitude of the guideline exceedance were investigated to provide a more complete understanding of the risks. When appropriate and if available, estimated exposure concentrations were compared to the applicable guidelines (e.g., water quality guideline) to provide context for the estimated risk. When the exposure concentrations were less than applicable guidelines, this provided further evidence that estimated hazard quotient though greater than 0.2 may not pose an unacceptable hazard. The numerical risk estimates presented in this section should be interpreted in the context of uncertainties and assumptions associated with each step of the HHRA process and in the context of the data and models upon which the HHRA was developed.

The estimates of non-carcinogenic health and carcinogenic health risks were developed separately because of fundamental differences in the calculation of critical toxicity values.

9.1.1 Non-carcinogenic Hazard Quotients

Non-carcinogens are considered to be threshold COPCs because a critical chemical dose must be exceeded before a health effect is observed. The likelihood of a potential adverse health effect from non-carcinogens is represented by the ratio of a COPC exposure concentration and the route-specific non-carcinogenic TRV:

$$HQ = \frac{Dose\ (or\ TDAC_A)}{TRV}$$

Where:

HQ	= non-cancer hazard quotient;
Dose	= dose for each chemical of potential concern (mg/kg/day); and
$TDAC_A$	= time-adjusted average daily air concentration (mg/m^3)
TRV	= non-carcinogenic TRV (in mg/kg/day or mg/m^3)

As illustrated in the conceptual site exposure model in Figure 14 and Figure 15, ROCs were assumed to be exposed to COPCs in soil, surface water, and country foods via one or more of the following three exposure pathways:

- Ingestion (soil, surface water, and country foods);
- Dermal contact (soil and surface water); and
- Inhalation (air particulate).

Each of these pathways was initially evaluated separately for both the baseline condition and predicted future condition. Non-cancer HQs were calculated for each COPC and route-specific pathway combination. The additive hazard index (HI) was then calculated as the sum of HQs for a given COPC across all exposure routes (note: HQs were summed only when using the same TRV). The maximum country foods HQ were included the calculation of the HI, as a conservative approach. To put the HIs into context, the Project hazard was calculated as the difference between HIs for the baseline condition and predicted future condition.

The Target Organ HI was also calculated as the sum of HIs for COPCs with similar target tissues. Only the ingestion and dermal contact Target Organ HIs are shown, since these pathways were evaluated with the same TRVs, as per Health Canada (2010).

The HQ and HI estimates for non-carcinogenic COPCs were initially compared with the Health Canada acceptable HQ threshold of 0.2 and the province of British Columbia acceptable HI threshold of 1 (BC CSR 1997, Section 18.3). The Health Canada threshold of HQ=0.2 is set for individual chemical exposure (Health Canada 2010).

9.1.2 Cancer Risk

Cancer risk is described as the excess probability of developing cancer attributable to exposures to Project related contaminants. Cancer risk estimates are the product of exposure assumptions (dose) and the chemical-specific cancer slope factor. Cancer slope factors (CSF) typically represent the upper 95th percentile estimate of the dose response relationship; however, for arsenic the cancer slope factor is based on central tendency estimates of cancer potency.

The increased likelihood of cancer from exposure to a chemical it is called the incremental lifetime cancer risk (ILCR). An impossible event has a 0 probability of occurring; a certain event has a probability of 1 of occurring. For carcinogens, the risk of cancer is assumed to be proportional to the dose, and any exposure results in a non-zero probability of risk. Cancer risk probabilities were calculated by multiplying the estimated dose by the CSF which, in this case, is the route-specific cancer slope factor for each carcinogen. The following formula was used to calculate risk estimates for carcinogenic adverse health effects (i.e. incremental lifetime cancer risk or ILCR):

$$ILCR_{Lifestage\ i} = LADD_i \times SF \times ADAF_i$$

Where:

$ILCR_{Lifestage\ i}$	= incremental lifetime cancer risk during lifestage "I";
$LADD_i$	= dose received during lifestage "i" averaged over a lifetime (mg/kg/day);
SF	= Route- and chemical-specific cancer slope factor $(mg/kg/day)^{-1}$; and
$ADAF_i$	= age-dependent adjustment factor for lifestage "i"

The results of the ILCR estimates were compared with the Health Canada acceptable cancer risk threshold of $1x10^{-5}$. In other words, no more than 1 in 100,000 people exposed to a given chemical should develop cancer as a result of the exposure. This is considered highly conservative when compared with the statistic that, on average, 1 in 3 people will develop cancer in their lifetime. Because this assumed 'acceptable' cancer risk level was specifically developed to address cancer risks over and above background cancer incidence, a portion of which includes background exposure to Project-related contaminants, background exposures were not included in the assessment of potential health risks for non-threshold (i.e., carcinogenic) chemicals (Health Canada, 2010).

As for the evaluation of non-cancer risk, each pathway was initially evaluated separately for both the baseline condition and predicted future condition. Arsenic ILCRs were calculated for each COPC and route-specific pathway combination. ILCRs for arsenic were then summed across all exposure routes, and the Project Hazard was calculated as the difference between ILCRs for the baseline condition and predicted future condition. As for non-cancer risk estimates, the maximum country foods ILCR was used to calculate the summed ILCR across all exposure pathways, as a conservative approach.

Cadmium, chromium, and nickel cancer risks were evaluated for the inhalation pathway only, so a summed ILCR was not necessary for these COPCs.

9.2 Risk Estimate Results

9.2.1 Non-Cancer

Attachment D provides detailed risk results for country foods exposure, and Attachment F provides detailed risk results for soil and surface water exposure. Detailed risk results for the sum of all pathways are provided in Attachment G.

It should be noted that the risk estimates in Attachment D assume that country foods are consumed 365 days per year. However, this annual exposure was amortized to reflect the amount of time each receptor was assumed to spend at the site, or, in the case of the country food consumer, the number of days they consumed country foods (on- and off-site).

For example, the Hunter/Trapper /Fisher receptor spends 8 weeks of the 52 weeks in a year at the Bitter Creek valley portion of the LSA. He/she is anticipated to spend to do this over a 12-week period. Thus, the country food hazard was multiplied by 8/12. The 12 weeks is referred to as the amortization period. If the exposure was not amortized over 12-weeks, then the exposure would have been considered to be subacute and would demand the use of subacute non-carcinogenic toxicity values. These are typically 10 times higher than chronic toxicity values and the result would have been hazard quotients for the Hunter Trapper Fisher that were 6.6 times lower than those estimated for most contaminants. The same would be true for the Recreational User (2.5 times lower) and the Summer Resident (5 times lower). The values for the Year-Round Resident and the Country Food Consumer would not be affected.

A summary of the non-cancer risk estimate HI results, which combine exposures across all pathways for each of the ROCs, is provided in Table 9. Country foods ingestion is included in the combined exposure estimates for these ROCs, but the frequency of ingestion is amortized as described in Sections 7.2.2 and 7.3.4. Several COPCs in the country foods exposure estimates had HQs that exceeded the Health Canada acceptable HQ threshold of 0.2 and the province of British Columbia acceptable HI threshold of 1 (Attachment D), under both the baseline and predicted future conditions, and were typically higher in the baseline condition.

Summed risk estimates (HIs) for several COPCs exceeded the threshold of 0.2 under both baseline and future predicted conditions. Six COPCs exhibited predicted HIs that were higher than the baseline condition by more than 0.05 (Table 9) for receptors groups for each age range: cobalt, iron, lead, mercury, manganese, and strontium.

Table 9 Summary of Non-Cancer Risks

ROC	Type	COPCs with Baseline HI >0.2*	COPCs with Predicted Future HI >0.2	COPCs with Detectable Incremental Change*
Hunter/ Trapper/ Fisher	Teen	Cadmium (2.7), Chromium (0.3), Cobalt (0.5), Iron (0.6), Lead (0.2), Manganese (1.4), Nickel (0.3), Selenium (1.0), Thallium (0.7), Zinc (0.5)	Cadmium (2.7), Chromium (0.3), Cobalt (0.8), Iron (0.7), Lead (0.3), Manganese (1.4), Nickel (0.3), Selenium (1.0), Thallium (0.7), Zinc (0.5)	Cobalt, Iron, Lead
Hunter/ Trapper/ Fisher	Adult	Arsenic (0.2), Cadmium (3.5), Chromium (0.4), Cobalt (0.6), Iron (0.7), Lead (0.3), Manganese (1.7), Nickel (0.5), Selenium (1.4), Thallium (1.0), Zinc (0.7)	Arsenic (0.3), Cadmium (3.5), Chromium (0.4), Cobalt (1.0), Iron (0.9), Lead (0.4), Manganese (1.7), Nickel (0.5), Selenium (1.4), Thallium (1.0), Zinc (0.7)	Cobalt, Iron, Lead
Recreational User	Infant	None	None	None
Recreational User	Toddler	Cadmium (1.6), Chromium (0.3), Cobalt (0.3), Iron (0.5), Lead (0.4), Manganese (0.9), Selenium (0.6), Thallium (0.5), Zinc (0.4)	Cadmium (1.6), Chromium (0.3), Cobalt (0.5), Iron (0.5), Lead (0.6), Manganese (0.9), Selenium (0.6), Thallium (0.5), Zinc (0.4)	Cobalt, Iron, Lead
Recreational User	Child	Cadmium (1.2), Cobalt (0.2), Iron (0.3), Lead (0.2), Manganese (0.7), Selenium (0.4), Thallium (0.3), Zinc (0.3)	Cadmium (1.2), Cobalt (0.4), Iron (0.3), Lead (0.4), Manganese (0.7), Selenium (0.4), Thallium (0.3), Zinc (0.3)	Cobalt, Iron, Lead
Recreational User	Teen	Cadmium (0.9), Cobalt (0.2), Manganese (0.5), Selenium (0.3), Thallium (0.3)	Cadmium (0.9), Cobalt (0.3), Manganese (0.5), Selenium (0.3), Thallium (0.3)	Cobalt
Recreational User	Adult	Cadmium (1.2), Iron (0.3), Manganese (0.6), Selenium (0.5), Thallium (0.3)	Cadmium (1.2), Iron (0.3), Manganese (0.6), Selenium (0.5), Thallium (0.3)	None
Summer Resident	Infant	Chromium (0.3), Iron (0.3), Lead (0.3),	Chromium (0.3), Iron (0.4), Lead (0.3),	None
Summer Resident	Toddler	Aluminum (0.3), Arsenic (0.3), Cadmium (3.5), Chromium (0.7), Cobalt (0.7), Iron (1.0), Lead (0.9), Manganese (2.0), Mercury (0.2), Nickel (0.5), Selenium (1.3), Thallium (1.0), Zinc (0.8)	Aluminum (0.3), Arsenic (0.4), Cadmium (3.6), Chromium (0.7), Cobalt (1.1), Iron (1.1), Lead (1.2), Manganese (2.0), Mercury (0.3), Nickel (0.5), Selenium (1.3), Thallium (1.0), Zinc (0.8)	Cobalt, Iron, Lead
Summer Resident	Child	Cadmium (2.6), Chromium (0.4), Cobalt (0.5), Iron (0.6), Lead (0.5), Manganese (1.6), Nickel (0.3), Selenium (0.9), Thallium (0.7), Zinc (0.6)	Cadmium (2.6), Chromium (0.4), Cobalt (0.8), Iron (0.7), Lead (0.8), Manganese (1.6), Nickel (0.3), Selenium (0.9), Thallium (0.7), Zinc (0.6)	Cobalt, Iron, Lead

ROC	Type	COPCs with Baseline HI >0.2*	COPCs with Predicted Future HI >0.2	COPCs with Detectable Incremental Change*
Summer Resident	Teen	Cadmium (2.0), Chromium (0.3), Cobalt (0.4), Iron (0.4), Manganese (1.1), Nickel (0.3), Selenium (0.7), Thallium (0.5), Zinc (0.4)	Cadmium (2.0), Chromium (0.3), Cobalt (0.6), Iron (0.5), Manganese (1.0), Nickel (0.3), Selenium (0.7), Thallium (0.6), Zinc (0.4)	Cobalt, Iron
Summer Resident	Adult	Cadmium (2.6), Chromium (0.3), Cobalt (0.5), Iron (0.5), Lead (0.2), Manganese (1.2), Nickel (0.3), Selenium (1.1), Thallium (0.7), Zinc (0.5)	Cadmium (2.6), Chromium (0.3), Cobalt (0.8), Iron (0.6), Lead (0.3), Manganese (1.2), Nickel (0.3), Selenium (1.1), Thallium (0.7), Zinc (0.5)	Cobalt, Iron, Lead
Year Round Resident	Toddler	Aluminum (0.6), Arsenic (0.7), Barium (0.4), Boron (0.3), Cadmium (7.1), Chromium (1.4), Cobalt (1.3), Iron (1.9), Lead (1.7), Manganese (3.9), Mercury (0.5), Nickel (1.0), Selenium (2.6), Strontium (0.1), Thallium (2.0), Vanadium (0.4), Zinc (1.6)	Aluminum (0.6), Arsenic (0.7), Barium (0.4), Boron (0.3), Cadmium (7.1), Chromium (1.4), Cobalt (2.2), Iron (2.2), Lead (2.4), Manganese (4.0), Mercury (0.5), Nickel (1.0), Selenium (2.6), Strontium (0.3), Thallium (2.0), Vanadium (0.4), Zinc (1.6)	Cobalt, Iron, Lead, Manganese, Mercury[1], Strontium
Year Round Resident	Adult	Aluminum (0.3), Arsenic (0.4), Barium (0.3), Cadmium (5.3), Chromium (0.6), Cobalt (0.9), Iron (1.1), Lead (0.4), Manganese (2.5), Mercury (0.4), Nickel (0.7), Selenium (2.1), Thallium (1.4), Zinc (1.0)	Aluminum (0.3), Arsenic (0.4), Barium (0.3), Cadmium (5.2), Chromium (0.6), Cobalt (1.5), Iron (1.3), Lead (0.6), Manganese (2.5), Mercury (0.4), Nickel (0.7), Selenium (2.1), Thallium (1.4), Zinc (1.0)	Cobalt, Iron, Lead,
Country Food Consumer	Toddler	Cadmium (3.5), Chromium (0.3), Cobalt (0.6), Iron (0.5), Lead (0.5), Manganese (1.9), Mercury (0.2), Nickel (0.4), Selenium (1.3), Thallium (0.9), Zinc (0.8)	Cadmium (3.5), Chromium (0.3), Cobalt (1.0), Iron (0.7), Lead (0.8), Manganese (1.8), Mercury (0.3), Nickel (0.4), Selenium (1.1), Thallium (0.6), Zinc (0.8)	Cobalt, Iron, Lead,
Country Food Consumer	Child	Cadmium (2.6), Cobalt (0.4), Iron (0.4), Lead (0.4), Manganese (1.6), Nickel (0.3), Selenium (0.9), Thallium (0.7), Zinc (0.6)	Cadmium (2.6), Cobalt (0.7), Iron (0.5), Lead (0.6), Manganese (1.5), Nickel (0.3), Selenium (0.8), Thallium (0.5), Zinc (0.6)	Cobalt, Iron, Lead,
Country Food Consumer	Teen	Cadmium (2.0), Cobalt (0.3), Iron (0.3), Manganese (1.0), Selenium (0.7), Thallium (0.5), Zinc (0.4)	Cadmium (2.0), Cobalt (0.5), Iron (0.4), Manganese (1.0), Selenium (0.6), Thallium (0.4), Zinc (0.4)	Cobalt, Iron,

ROC	Type	COPCs with Baseline HI >0.2*	COPCs with Predicted Future HI >0.2	COPCs with Detectable Incremental Change*
Country Food Consumer	Adult	Cadmium (2.6), Cobalt (0.4), Iron (0.4), Manganese (1.2), Nickel (0.3), Selenium (1.0), Thallium (0.7), Zinc (0.5)	Cadmium (2.6), Cobalt (0.7), Iron (0.5), Manganese (1.2), Nickel (0.3), Selenium (0.9), Thallium (0.5), Zinc (0.5)	Cobalt, Iron, Lead

*Baseline and predicted His are rounded to one significant digit, per Barnes and Dourson (1988) and Felter and Dourson (1998). In some cases, an apparent difference between predicted and baseline appears as a result of rounding, even if there is no detectable difference between the two values (e.g., a baseline HI of 0.64 will round to 0.6 and a predicted HI of 0.66 would round to 0.7). An incremental change in HI from baseline conditions to predicted future was considered 'detectable' if the HI differed by >0.05.

[1] – Although mercury HQ for baseline and predicted HQ =0.5 the difference between the two values was greater than 0.05; therefore it was identified as a COPC with detectable incremental change.

With respect to receptor HQs and HIs resulting from exposure to soil, surface water, and air, three chemicals (chromium, iron, lead,) had HIs greater than 0.2 at baseline and predicted concentrations, with a maximum HI of 0.25 for iron (Attachment F Tables). However, the baseline and predicted HIs for these chemicals were equal after rounding as the difference between the His was less than 0.05. The difference between baseline and predicted HIs, referred to as the Project HI, for each chemical as a result of exposure to soil, surface water, and air, ranged from an HI of 0.04 to <0.000001.

Non-carcinogenic risk (HIs) were driven by the consumption of country foods and for the most part was driven by consumption of fish (Attachment D, Tables D13 and D21). Elevated HIs were also associated with consumption of plants (Tables D12 and D20) and to a lesser degree moose (Tables D15 and D23); however, for plants and moose the baseline and predicted HIs were similar and thus they did not contribute significantly to the Project HI for each chemical. HIs associated with consumption of rabbit (Tables D14 and D22) and grouse (Tables D16 and D24) were less than 0.2 for all chemicals.

Additional consideration of the potential risks for the six parameters with HIs higher than 0.2 and where the future HI is predicted to be higher than the baseline HI by >0.05 is provided in the following section (9.2.2).

9.2.2 Additional evaluation of potential risks for parameters with elevated HIs

9.2.2.1 Cobalt

The HI for almost every receptor for every age group had a baseline and predicted HI in excess of 0.2 with a difference in the baseline and predicted HI of 0.1 or greater as a result of exposure to cobalt. The highest cobalt HI, baseline (was HI=1.3) and predicted (HI=2.2), was for the year-round resident toddler that eats fish from Bitter Creek every day. This corresponds to a change in the cobalt HI of 0.8 as a result of the Project.

The estimated site specific BCF (644 L/kg) for cobalt was more than 3 times higher than the literature based experimental BCF of 200 L/kg (ORNL RAIS 2017). Using this lower literature based BCF would have resulted a fish tissue concentration very similar to the baseline cobalt fish tissue concentration and no incremental risk for cobalt would have been associated with cobalt fish tissue ingestion. According to

McGeer et al (2003), Adams (2011) and DeForest et al (2007), little or no change in fish tissue concentration is anticipated for fish exposed to cobalt at the predicted levels estimated for Bitter Creek surface water concentrations.

Baseline and predicted cobalt hazard was driven by exposure to cobalt from fish consumption. Baseline cobalt concentration in fish tissue were measured in samples collected from Bitter Creek and nearby creeks. Predicted cobalt fish tissue concentrations were estimated using chemical-specific BCFs calculated from site baseline data. The approach used for this risk assessment assumed a linear relationship between the metal concentrations in surface water and metal concentrations in fish tissue (i.e., followed a linear relationship approach as described in USEPA (2005)). Therefore, when surface water metal concentrations increase so will metal concentrations in fish tissue.

However, McGeer et al (2003) and Adams (2011) have demonstrated that for metals there is no linear relationship, but instead an inverse relationship between BCF and metal water concentration. They go on to demonstrate how BCFs are higher when metal concentrations in water are lower and, conversely, when metal water concentrations are higher the BCFs are lower. Furthermore, aquatic organisms, and fish in particular, have the ability to regulate metals uptake (Adams 2011). According to Adams (2011) this is a problem for metal hazard assessments. Adams (2011) goes on further to say that larger than anticipated BCFs generally means "low exposure and low potential for chronic effects or secondary poisoning". This has implications for predicting the potential for adverse effects to human health associated with the fish ingestion exposure pathway for all metals, since assuming a linear relationship for the BCF will overestimate fish tissue concentrations as water concentrations increase. This will result in an overestimation of the potential risk to human consumers.

9.2.2.2 Iron

The HI for almost every receptor for every age group had a baseline and predicted HI in excess of 0.2 with a difference in the baseline and predicted HI of 0.1 or greater as a result of exposure to iron. The highest iron HI, baseline (was HI=1.9) and predicted (HI=2.2), was for the year-round resident toddler that eats fish from Bitter Creek every day. This corresponds to a change in the HI of 0.3 as a result of the Project.

The estimated site specific BCF (2210 L/kg) for iron was more than 10 times higher than the literature based experimental BCF of 200 L/kg (ORNL RAIS 2017). Using the lower literature based BCF would have resulted in no incremental risk for iron associated with fish ingestion. According to McGeer et al (2003), Adams (2011) and DeForest et al (2007), little or no change in fish tissue concentration is anticipated for fish exposed to iron at the predicted concentrations estimated for Bitter Creek surface water.

Predicted iron tissue concentrations were estimated using chemical specific BCFs calculated from Project baseline data. When predicting iron tissue residue concentrations, it was assumed that that the relationship between surface water dissolved iron concentrations and fish tissue iron concentrations is linear. For example, when dissolved iron surface water concentrations increase iron fish tissue concentrations will increase.

However, evidence is increasing that fish are able to regulate their iron levels, increasing uptake when levels are low and decreasing uptake when they are high (Carriquiriborde et al 2004). McGeer et al

(2003) and Adam (2011) have demonstrated that there is not a direct linear relationship between surface water, BCF for metals and fish tissue concentrations, but instead there is an inverse relationship. When iron surface water concentrations increase, BCF values for iron will decrease.

Based on an evaluation of the available literature, in contrast to what was predicted by the BCF model, little or no change in the fish tissue concentration is anticipated and iron concentrations in fish are not anticipated to increase substantially with respect to the baseline condition. This will result in negligible change in hazard associated with iron levels in fish as a result of the Project, and thus no difference in the potential effects associated with baseline and predicted condition is anticipated.

9.2.2.3 Lead

The HI for almost every receptor for every age group had a baseline and predicted HI in excess of 0.2 with a difference in the baseline and predicted HI of 0.1 or greater as a result of exposure to lead. The highest lead HI, baseline (was HI=1.7) and predicted (HI=2.4), was for the year-round resident toddler that eats fish from Bitter Creek every day. This corresponds to a change in the Lead HI of 0.7 as a result of the Project. The estimated site specific BCF (256 L/kg) for lead was similar to the literature based experimental BCF of 300 L/kg (ORNL RAIS 2017).

The Project HHRA uses a TDI of 0.0006 mg/kg that is based on the most sensitive endpoint (i.e., nervous system and brain development); Wilson and Richardson (2012) determined that a HQ of 1 relates to a 1-point decrease in IQ. Therefore, the detected HQ increase from baseline (1.7) to predicted (2.5) would translate to a change in IQ of 0.7. This change in IQ is unlikely to have a measurable effect in real-life situations, according to Barnes and Dourson (1988); Felter and Dourson (1998).

It is also unlikely that the predicted change in the surface water concentration of lead from baseline (0.00683 mg/L) to predicted (0.00778 mg/L) will cause the corresponding change in the fish tissue predicted. Predicted lead fish tissue concentrations were estimated using chemical-specific BCFs calculated from site baseline data. As noted above, the general assumption used in this risk assessment is that the relationship between the metal concentrations in surface water and metal concentrations in fish tissue is linear.

As noted above for cobalt and iron, McGeer et al (2003) and Adams (2011) have demonstrated there is an inverse relationship between BCF and metal water concentration that aquatic organisms, in particular fish, have the ability to regulate metals uptake (Adams 2011), and that larger than anticipated BCFs generally means “low exposure and low potential for chronic effects or secondary poisoning” (Adams 2011). As a result, in contrast to what was predicted by the BCF model little or no change in the fish tissue concentration is anticipated and lead concentrations in fish are not anticipated to increase substantively with respect to the baseline condition. This will result in negligible change in hazard associated with lead levels in fish as a result of the Project, and thus no difference in the potential effects associated with baseline and predicted conditions is anticipated.

9.2.2.4 Manganese

The highest manganese HI (and only occurrence where the incremental change was 0.1 or greater), baseline (was HI=4.9) and predicted (HI=5.0), was for the year-round resident toddler that eats fish from Bitter Creek every day. This corresponds to a change in the manganese HI of 0.1 as a result of the Project.

Exposure to the hypothetical future year-round toddler resident in Bitter Creek valley has an incremental change in the hazard between baseline and predicted condition of 0.1. According to Barnes and Dourson (1988) and Felter and Dourson (1998), this difference is not meaningful in the context of risk assessment (i.e. does not produce a meaningful and measurable health effect). Neurotoxic effects from exposure to manganese are associated with a level of exposure causing a hazard quotient of 5. No evidence was identified indicating that the effects would be worse due to a change from an HQ of 4.9 to an HQ of 5. (ATSDR 2012; Milton et al 2017). Thus, we agree with Barnes and Dourson (1988); Felter and Dourson (1998) that there is no measurable difference between baseline and predicted exposures and thus no difference in the potential effects associated with baseline and predicted conditions.

As noted above for cobalt, iron, and lead, McGeer et al (2003) and Adams (2011) have demonstrated there is an inverse relationship between BCF and metal water concentration that aquatic organisms, in particular fish, have the ability to regulate metals uptake (Adams 2011), and that larger than anticipated BCFs generally means “low exposure and low potential for chronic effects or secondary poisoning” (Adams 2011). As a result, in contrast to what was predicted by the BCF model little or no change in the fish tissue concentration is anticipated and manganese concentrations in fish are not anticipated to increase substantively with respect to the baseline condition. This will result in negligible change in hazard associated with lead levels in fish as a result of the Project, and thus no difference in the potential effects associated with baseline and predicted conditions is anticipated.

9.2.2.5 Mercury

The HI for the toddler for every applicable receptor (the toddler age group was not applicable to the Hunter/Trapper/Fisher receptor) and for the year round resident Adult had a predicted HI in excess of 0.2. in most cases the difference between the baseline and predicted HQ was less than 0.05. The highest lead HI, baseline (was HI=0.5) and predicted (HI=0.5), was for the year-round resident toddler that eats fish from Bitter Creek every day. This corresponded to a change in the Mercury HI of 0.05 as a result of the Project.

Exposure to the hypothetical future toddler year round resident in Bitter Creek valley has an incremental hazard of 0.05 times greater than the baseline hazard. This difference is not meaningful in the context of risk assessment (i.e., does not produce a meaningful and measurable health effect). The increase is not expected to result in a health effect resulting from mercury exposure (Poulin and Gibb 2008).

9.2.2.6 Strontium

There are no harmful effects of stable strontium in humans at the levels typically found in the environment. The only chemical form of stable strontium that is very harmful by inhalation is strontium chromate, but this is because of toxic chromium and not strontium itself. Problems with bone growth may occur in children eating or drinking unusually high levels of strontium, especially if the diet is low in calcium and protein. As the average crustal abundance of strontium is 360 mg/kg and the predicted concentration in Bitter Creek valley is approximately 97.5 mg/kg, strontium would be considered to be at typical concentration and thus is not harmful (ASTDR 2017).

Target Organs

Information on the potential additive effects to target organs is presented in Attachment G.

9.2.3 Country Foods Basket Approach

This calculation of HQs, and thus the summing of HIs, was based on the use of the maximum HQ amongst the various classes of country foods (i.e., the highest HQ amongst fish, plants, moose, grouse, or rabbit). This conservatively assumed that all of a person's daily country foods consumption was coming from the grouping of food with the highest COPC content, without consideration of the variety of country foods that people might eat (that contribute lesser amounts of COPCs if considered as part of a mixture of country foods). Therefore, non-carcinogenic risks from cobalt, iron, lead, manganese, mercury, and strontium were further re-evaluated using a country foods basket approach that considered country foods identified in Chan et al (2011) that may be consumed aboriginals and non-aboriginals.

Country foods food items listed in Chan et al. (2011) were classified based on the groupings used in the HHRA (large mammals, small mammals, birds, fish, and plants), and were assigned concentrations of cobalt, iron, lead, manganese, mercury, selenium and strontium accordingly for the baseline and predicted future conditions. Where baseline concentrations were higher than predicted future concentrations, the predicted future concentrations were made equal to the baseline concentration (i.e., the difference was zero).

The selected food items were those assumed to be applicable for exposure at the site. Although some fish types (e.g., salmon, ling cod, eulachon, cod) may be consumed by receptors from the site, it is unlikely that COPC body burdens in these fish will be a result of the Project as they spend all or a large part of their adult life in the marine environment. Concentrations for these food items were therefore assumed to be zero. The 95th percentile consumption rates (average of all ages) presented in Chan et al (2011) for each food item were then normalized for daily toddler ingestion rates. Only risks for toddlers are presented because risks are highest for this age group.

The results of the country foods basket calculations are presented in Tables G43-G48. Risks are presented for both the baseline and predicted future conditions. Among all the metals considered, the largest difference between the predicted future risk and the baseline risks was 0.04 (cobalt), indicating that risks from country foods exposure are negligible when less conservative exposure conditions are considered (i.e., when the food basket approach is used, taking into consideration the consumption amount and frequency of a class of country foods and the concentration in that country food).

When baseline and predicted HIs for soil, surface water, and air exposures were summed with the country food exposures, the largest difference between the predicted risk and the baseline risks was just under HI = 0.1 for cobalt. If average surface water concentrations (which would be more representative of annual exposure concentrations for a year-round resident) were used instead of 90th percentile concentrations the difference between predicted risk and the baseline risks would decrease by half that again or more. HQs for all other year round receptors is less than that for the toddler year round resident. HQs for the summer resident is half of that for the year round resident.

The difference between the baseline and predicted HQs for each COPCs is less than HQ=0.1 for all chemicals and for all receptors is less than 0.1 when the country food basket is applied and if mean concentrations were used for all exposure media less than half of that estimated. At these small incremental changes in HQ no difference in effect to receptors can be identified.

9.2.4 Cancer Risk

Attachment D provides detailed risk results for country foods exposure and Attachment F provides detailed risk results for soil and surface water exposure. Detailed risk results for the sum of all pathways are provided in Attachment G. The risk estimates in Attachment D assume that country foods are consumed 365 days per year.

A summary of the summed ILCR results, which combine exposures across all pathways, for each of the ROCs, is provided in Table 10. Country foods ingestion is included in the combined exposure estimates for these ROCS, but the frequency of ingestion is amortized as described in Sections 7.2.2 and 7.3. Arsenic exceeded the threshold of $1x10^{-5}$ under both baseline and future predicted conditions for at least one receptor in each ROC class, and was detectably higher in the predicted condition for 12 receptors/age group combinations (Table 10).

Table 10 Summary of Cancer Risks

ROC	Receptors	COPCs with Baseline ILCR >$1x10^{-5}$	COPCs with Predicted Future ILCR>$1x10^{-5}$	COPC with Detectable Incremental Change in ILCR
Hunter/ Trapper/ Fisher	Teen	Arsenic (1.7 x 10^{-5})	Arsenic (1.8 x 10^{-5})	Arsenic
Hunter/ Trapper/ Fisher	Adult	Arsenic (8.0 x 10^{-5})	Arsenic (8.6 x 10^{-5})	Arsenic
Recreational User	Infant	None	None	None
Recreational User	Toddler	Arsenic (2.0 x 10^{-5})	Arsenic (2.1 x 10^{-5})	Arsenic
Recreational User	Child	Arsenic (1.1 x 10^{-5})	Arsenic (1.2 x 10^{-5})	Arsenic

ROC	Receptors	COPCs with Baseline ILCR >1x10^{-5}	COPCs with Predicted Future ILCR>1x10^{-5}	COPC with Detectable Incremental Change in ILCR
Recreational User	Teen	None	None	None
Recreational User	Adult	Arsenic (2.9 x 10^{-5})	Arsenic (3.1 x 10^{-5})	Arsenic
Summer Resident	Infant	Arsenic (1.1 x 10^{-5})	Arsenic (1.2 x 10^{-5})	Arsenic
Summer Resident	Toddler	Arsenic (8.5 x 10^{-5})	Arsenic (9.1 x 10^{-5})	Arsenic
Summer Resident	Child	Arsenic (4.8 x 10^{-5})	Arsenic (5.2 x 10^{-5})	Arsenic
Summer Resident	Teen	Arsenic (2.6 x 10^{-5})	Arsenic (2.8 x 10^{-5})	Arsenic
Summer Resident	Adult	Arsenic (1.2 x 10^{-4})	Arsenic (1.3 x 10^{-4})	Arsenic
Year Round Resident	Toddler	Arsenic (3.4 x 10^{-4})	Arsenic (3.7 x 10^{-4})	Arsenic
Year Round Resident	Adult	Arsenic (5.0 x 10^{-4})	Arsenic (5.3 x 10^{-4})	Arsenic
Country Food Consumer	Toddler	Arsenic (6.1 x 10^{-5})	Arsenic (6.1 x 10^{-5})	None
Country Food Consumer	Child	Arsenic (4.2 x 10^{-5})	Arsenic (4.2 x 10^{-5})	None
Country Food Consumer	Teen	Arsenic (2.5 x 10^{-5})	Arsenic (2.5 x 10^{-5})	None
Country Food Consumer	Adult	Arsenic (1.2 x 10^{-4})	Arsenic (1.2 x 10^{-4})	None

Incremental carcinogenic risk greater than 1×10^{-5} related to the Project releases was identified and for the most part was associated with exposure to surface water arsenic and to a lesser degree exposure to surface soils. The highest arsenic cancer risk, baseline (5.0 x 10^{-4}) and predicted (5.3 x 10^{-4}), was for the year-round resident adult that drinks unfiltered water from Bitter Creek every day and has daily exposure to surface soils in the Bitter Creek Valley. This corresponds to a change in the arsenic cancer risk of 3.9 x 10^{-5}.

The baseline and the predicted arsenic fish tissue concentrations were estimated to be equal, and thus no project related risk associated with consumption of fish tissue arsenic was identified.

Baseline (0.00845 mg/L) and predicted (0.00979 mg/L) 90th percentile total arsenic surface water exposure concentrations used to evaluate HQs for drinking water were less than the drinking water guideline for arsenic of 0.01 mg/L. The mean total arsenic concentrations in surface water for the predicted and baseline condition are approximately half that again. For a full-time resident, the average water concentration is more likely to approximate the annual exposure concentration rather than an upper percentile concentration.

The risk assessment assumed that the arsenic concentrations remain high during the Operation Phase and throughout Closure/Post-Closure (since higher of the P90 concentrations between the Project phases was used). However, water quality modelling indicates that arsenic concentrations will reduce back to baseline concentrations almost immediately after the mine closes and experiences a very minor increase in arsenic surface water concentrations approximately 100 years later. The exposure to elevated arsenic levels as predicted during the operation phase will last for 7.5 years. The 7.5-year exposure period is 8 times shorter than the 60-year exposure period assumed in the risk assessment and would result in an incremental lifetime cancer risk that is less of $4.9 \times 10^{-6,}$ which is less than threshold of $1x10^{-5}$.

Together, this indicates that surface water in the Bitter Creek can be used for drinking water. Should a home be constructed in the Bitter Creek Valley it is likely that water will be plumbed to the residence and as part of this it is assumed that some sort of filtration system will be installed, such as a sand filter or a UV water treatment system including pre-filters. This is consistent with Health Canada's and Northern Health's recommendations that surface water should be treated prior to consumption. Filtration will remove the majority of suspended solids in the surface water samples (thus removing the particle-bound arsenic), reducing the cancer risk associated with consumption of surface water from Bitter Creek.

Given that : 1) the Project related cancer risk associated with exposure to arsenic in country food is less than $1x10^{-5}$; 2) arsenic surface water concentrations for baseline and predicted conditions are less than the surface water guidelines; and 3) surface water arsenic can be considered to be elevated relative to baseline conditions for 7.5 years and not 60, arsenic releases related to the project will not pose a cancer risk in excess of the cancer risk threshold of $1x10^{-5}$.

10 UNCERTAINTY ANALYSIS

Quantitative evaluation of the risks to humans from environmental contamination is often limited by uncertainty arising from a number of key data inputs, such as the following:

- The concentration of COPCs in the environment;
- The true level of human contact with contaminated media; and
- The true dose-response curves for non-cancer and cancer effects.

In the HHRA, assumptions and best estimates for exposure factors and toxicity values were made based on limited data available. Accordingly, the results of risk calculations based on these assumptions and estimates are, themselves, uncertain.

The interpretation of risk estimates is subject to uncertainties because of the numerous assumptions inherent in the risk assessment process. Risk estimates can most appropriately be viewed as upper-bound estimates of risks; actual risks may be substantially lower than those calculated using quantitative risk assessment techniques. Typically, sources of uncertainty in HHRAs can be categorized into those associated with standard risk assessment procedures (e.g., uncertainty factors used for derivation of TRVs, summing hazard quotients despite dissimilar target organs or mechanisms of toxicity) and those associated with site-specific factors (i.e., variability in analytical data, modeling results, and exposure parameter assumptions). The extensive use of modelling is also a significant source of uncertainty in this HHRA. Each of the primary uncertainties in this HHRA is discussed in the subsections below.

10.1 Uncertainties from Chemicals Not Evaluated

Exposure and risks were quantified only for a selected subset of COPCs detected in environmental media at the LSA. While the omission of other COPCs might tend to underestimate total risks, this is not a significant source of uncertainty because:

- the COPCs that were excluded were known to be present at concentrations that are well below a level of concern (methyl mercury, for example, is unlikely to be present at elevated concentrations since total mercury was found at very low concentrations and enhanced methylating conditions are unlikely);
- the COPC that were excluded because their concentration in soil was significantly below their crustal abundance; and
- the COPCs that were considered to be innocuous.

10.2 Uncertainties from Exposure Pathways Not Evaluated

Humans may be exposed to Project-related COPCs by a number of pathways, but not all of these pathways were evaluated quantitatively in this HHRA. This was because the contributions of the omitted pathways were believed to be minor compared to the other pathways evaluated. Omitted pathways may result in a small underestimation of exposure and risk, but the magnitude of this underestimation is expected to be insignificant.

10.3 Uncertainties in Estimated Environmental Concentrations

In all exposure calculations the desired input parameter is the true mean concentration of a contaminant within a medium, averaged over the area where random exposure occurs. Due to the limited data set, the 90th percentile concentration was used, which may result in an overestimate of the true mean. Underestimation is of the true mean is unlikely.

Modeling was used to estimate EECs. For the baseline condition, EECs for air particulate and terrestrial country foods were estimated from models. Predicted future EECs for all exposure media were estimated from models. The models include several parameters and assumptions regarding input values, some of which are discussed elsewhere, that lead to uncertainties in the estimated concentrations. In some cases, this may lead to artifacts in the results.

EECs for air particulate for the entire Bitter Creek Valley were based on modelled data from locations very close to the mine site and the plant site. This assumption is very conservative and likely overestimates exposure by 3 to 10 times, depending on the chemical. The same is true for predicted soil concentrations. It is very unlikely that EECs for soil and air have been under estimated, and thus this has resulted in an estimate that is biased high. This would also result in an over estimate of the terrestrial country food EECs.

Estimates of fish EECs and plant EECs was affected by BCF estimates. The predicted exposure concentrations calculated using modelling and their subsequent risk estimates were often lower than baseline exposures and risks estimates. This is an artifact of the modelled and literature based BCFs used to predict future constituent concentrations in food that may occur when the baseline and predicted concentrations are so similar.

BCF estimates for COPCs were based on soil analytical data and plant (e.g., Sitka willow) analytical data from samples collected in the Bitter Creek watershed. Sitka willow is known to be a hyper-accumulator of multiple metals (Rescan 2013 and 2014) and is likely to have tissue concentrations higher than other plants that might be consumed by wildlife or people. Predicted plant tissue concentrations were based on predicted soil concentrations, and predicted country food (moose, hare, and grouse) tissue concentrations were based on plant concentrations.

Calculations of BCFs for fish also resulted in predicted concentrations that were in some instances lower than baseline concentrations. Variability in three factors contributed to this result: how much time Dolly Varden spent in Bitter Creek versus other creeks in the area; how many Dolly Varden in Bitter Creek are anadromous; and how many Dolly Varden overwinter in Bitter Creek. The less time Dolly Varden spend in Bitter Creek the weaker the relationship between Bitter Creek water chemistry and Dolly Varden fish tissue chemistry. It is also possible that water concentrations of some metals may decrease downstream of the Project where water treatment of mine discharge is proposed. In all cases where the predicted risk is less than the baseline risk, we suggest that it implies that, effectively, there is no difference in the concentrations (i.e. conservatively assumed that there was no detectable incremental change and that the tissue concentrations remain the same).

In addition, available literature suggests that there is an inverse relationship between water concentrations and tissue concentrations in fish (Carriquiriborde et al 2004; McGeer et al 2003; and Adam 2011); the use of a linear BCF model in this risk assessment is expected to overestimate the tissue concentrations of most metals.

The intent of the modeling is to be both predictive and protective, but actual conditions in the future may be significantly different. By using conservative assumptions, it is more likely that the risks are over-estimated than under-estimated.

Consumption of COPCs in fish is the main pathway causing baseline and future risk to human receptors. For this Project, it was assumed to be due to consumption of Dolly Varden. However, anecdotal information and available studies tell us that Sockeye and other types of salmon are much preferred to Dolly Varden. The Food Nutrition & Environment Study by Chan *et al.* (2011) lists over 200 traditional foods that are consumed by Aboriginal Groups in British Columbia and Dolly Varden are only eaten by approximately 35% of the Aboriginal population in the area, whereas 99% consume salmon. Furthermore, even among those who eat Dolly Varden, receptors generally eat 15 to 50 times more salmon as they do Dolly Varden. This is an important consideration, as salmon do not reside in Bitter Creek and spend most of their adult lives in the marine environment, thus the only fish species available for consumption in the Bitter Creek watershed, is Dolly Varden. It is unlikely that Aboriginal receptors and non-Aboriginal receptors will only eat Dolly Varden when salmon can be caught for consumption nearby. The assumption that receptors eat significant amounts of Dolly Varden is unlikely, resulting in a more conservative estimate of potential human health risk associated with fish consumption.

10.4 Uncertainties in Human Exposure Parameters

Accurate calculation of risk values requires accurate estimates of the level of human exposure that is occurring. Many of the required exposure parameters are not known with certainty and must be estimated from limited data or knowledge. For example, little information was available about the frequency of use of the Bitter Creek watershed for recreational activities. The local population within 50 km of Bitter Creek is small and the Bitter Creek watershed is not known to be a destination location for potential recreational receptors. In general, when exposure data were limited or absent, the exposure parameters were chosen in a way that was intended to be conservative. Because of this generally conservative approach, the values selected are thought to be more likely to overestimate than to underestimate actual exposure and risk. It was assumed that the bioavailability of most COPCs via the ingestion and inhalation routes of exposure was assumed to be 100 percent. This assumption would likely result in a conservatively high dose for the COPCs.

10.5 Uncertainties in Toxicity Values

Toxicity information for many chemicals is often limited. Therefore, there are varying degrees of uncertainty associated with TRVs (i.e., cancer slope factors, tolerable daily intakes). For example, uncertainties can arise from the following sources:

- Extrapolation from animal studies to humans;
- Extrapolation from high dose to low dose;
- Extrapolation from continuous exposure to intermittent exposure; and
- Limited availability of toxicity studies.

Uncertainty in TRVs is one of the largest sources of uncertainty in risk estimates. Because of the conservative methods Health Canada uses in dealing with uncertainties, it is much more likely that the uncertainty will result in an overestimation rather than an underestimation of risk.

10.6 Uncertainties in Risk Estimates

Because risk estimates for a COPC are derived by combining uncertain estimates of exposure and toxicity (see above), the risk estimates for each COPC are more uncertain than either the exposure estimate or the toxicity estimate alone. Additional uncertainty arises from the issue of how to combine risk estimates across different chemicals. In some cases, the effects caused by one COPC do not influence the effects caused by other COPCs. In other cases, the effects of one chemical may interact with effects of other COPCs, causing responses that are approximately additive, greater than additive (synergistic), or less than additive (antagonistic). In most cases, available toxicity data are not sufficient to define what type of interaction is expected, so Health Canada assumes effects are additive for non-carcinogens that act on the same target organ.

11 CONCLUSION

Human Health was identified as a VC and the potential for change in risk to Human Health due to interactions with the Project was evaluated. This HHRA was conducted to determine the predicted risk to Human Health as a result of the Project from exposure to COPCs within the Human Health LSA.

The potential interactions between Human Health and Project infrastructure, activities, or components were identified. Project activities that could affect air quality, water quality, soil quality, vegetation quality and country foods quality, also have the potential to cause a change in Human Health. Predictive models were developed to estimate concentrations of COPCs in air, water, soil, vegetation, and country foods. The results of the predictive modeling were used as inputs into the predicted future risk estimates, which used the same methodologies, approaches, study area, and assumptions as the baseline risk estimates.

Incremental changes in non-cancer risks resulting from the Project were identified for several COPCs (cobalt, iron, lead, manganese, mercury, selenium, strontium), However, none of these incremental changes are anticipated to result in an increase in human health effects. Similarly, Project-related incremental increases in COPCs associated with cancer risk (i.e., arsenic) are not anticipated to result in a detectable increase in risk.

The risk estimates incorporate multiple conservative assumptions which suggests that risks under both baseline and predicted conditions are likely overestimated, in particular those associated with consumption of fish. The potential for adverse health effects resulting from the Project is considered negligible.

Monitoring of air, air particulate deposition, soil, surface water, sediment, groundwater, mammal tissue, fish tissue, and plant tissue should be completed during mine development, operations and closure to confirm key exposure assumptions made in the risk assessment.

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Attachment A
Tables in support of the screening and identification of COPCs

Table A1: Air Screening (Particulate Matter and Non-Metals)

Constituent	Calculation Basis & Averaging Time	Ambient Air Quality Objectives ($\mu g/m^3$)	Baseline ($\mu g/m^3$)	Maximum Future Predicted ($\mu g/m^3$)
Nitrogen Dioxide (NO2; Ozone Limiting Method)	98th Percentile of Daily 1-hour Maximum	188	21	187
Nitrogen Dioxide (NO2; 100%)	Annual Maximum	60	5.0	47
Sulphur Dioxide (SO2)	99th Percentile of Daily 1-hour Maximum	196	4.0	78
	Annual Maximum	13	2.0	6.5
Carbon Monoxide (CO)	1-hour Maximum	14300	100.0	605
	8-hour Block Maximum	5500	100.0	471
Particulate Matter (PM2.5)	98th Percentile of 24-hour Block Averages	25	1.3	18.6
	Annual Maximum	8 (5)	1.3	4.4
Particulate Matter (PM10)	24-hour Block Maximum	50	3.4	42.7
Total Particulate Matters (TPM)	24-hour Block Maximum	120	10.0	91.3
	Annual Maximum	60	10.0	24.6
Total Dustfall	Annual Maximum	1.7 mg/dm2/day	0.56	0.98
Wet Deposition	Annual Maximum			0.61
Dry Deposition	Annual Maximum			0.95

Table A2: Air Screening (Metals)

Chemical	Texas CEQ 1-Hour ESL (µg/m^3)	Texas CEQ Annual ESL (µg/m^3)	Ontario MOECC AAQCs: 24-hour averaging period (µg/m^3)	Baseline PM10 (µg/m^3)	PM10 Max (µg/m3)	Future Predicted Maximum Annual (µg/m3)			Future Predicted Maximum 24-hour (µg/m3)		
						Annual PM10 Bitter Creek Down Stream of Tailings Management Facility (ug/m3)	Annual PM10 Between Lower Portal and Bitter Creek (ug/m3)	Annual PM10 Road Between lower portal and Plant site (ug/m3)	Bitter Creek Downstream of Tailings Management Facility (PM10)	Between Lower Portal and Bitter Creek (PM10)	Road Between lower portal and Plant site (PM10)
Aluminum	50	5	4.8	9.96E-02	0.85	1.48E-01	1.12E-01	1.27E-01	0.53	0.32	0.71
Antimony	5	0.5	25	2.33E-05	0.000267	4.18E-05	2.65E-05	3.18E-05	0.00016	0.00012	0.00019
Arsenic	3	0.067	0.3	2.36E-04	0.00485	4.26E-04	2.70E-04	3.24E-04	0.0016	0.0012	0.0019
Barium	5	0.5	10	1.46E-03	0.0093	2.14E-03	1.74E-03	1.88E-03	0.0083	0.0052	0.0114
Beryllium	0.02	0.002	0.01	2.04E-06	0.0000188	3.07E-06	2.40E-06	2.64E-06	0.000012	0.000008	0.000017
Bismuth	50	5		1.11E-06	0.0000249	3.33E-06	1.86E-06	2.10E-06	0.000012	0.000014	0.000012
Boron	50	5	120**	6.80E-05	0.0009	9.99E-05	7.36E-05	8.53E-05	0.00002	0.00006	0.00003
Cadmium	5.4	0.0033	0.025	3.73E-06	0.000079	8.20E-06	4.86E-06	5.73E-06	0.00003	0.00003	0.00004
Calcium				6.68E-02	0.415	9.71E-02	7.91E-02	8.56E-02	0.34	0.21	0.48
Chromium	3.6 (III)	0.041 (III)	0.5 (divalent)	3.37E-04	0.00229	4.95E-04	3.99E-04	4.33E-04	0.0019	0.0012	0.0026
Cobalt	0.2	0.02	0.1	7.57E-05	0.000656	1.11E-04	8.67E-05	9.62E-05	0.00041	0.00025	0.00056
Copper	10	1	120**	3.61E-04	0.00407	5.74E-04	4.18E-04	4.74E-04	0.0021	0.0014	0.0027
Gallium				4.11E-05	0.000311	5.79E-05	4.39E-05	5.06E-05	0.00020	0.00011	0.00028
Gold	25	2.5		4.90E-08	0.00000049	6.91E-08	5.22E-08	6.04E-08	0.0000008	0.0000004	0.0000011
Iron	50	50	120**	1.98E-01	1.69	2.91E-01	2.25E-01	2.52E-01	1.02	0.63	1.38
Lanthanum				4.55E-05	0.000309	6.56E-05	5.44E-05	5.83E-05	0.00022	0.00014	0.00032
Lead			0.5	1.36E-04	0.00108	2.10E-04	1.54E-04	1.76E-04	0.0008	0.0005	0.0010
Magnesium*		50		1.01E-01	0.74	1.45E-01	1.08E-01	1.25E-01	0.52	0.29	0.70
Manganese	2	0.2	0.4	3.11E-03	0.0285	4.61E-03	3.78E-03	4.04E-03	0.016	0.011	0.023
Mercury	0.25	0.025	2	2.72E-07	0.00013731	1.50E-05	3.73E-06	5.68E-06	0.00005	0.00008	0.00003
Molybdenum	30	3	120**	1.05E-04	0.00054	1.49E-04	1.12E-04	1.30E-04	0.0006	0.0003	0.0008
Nickel	0.33	0.059	0.1	1.79E-04	0.00147	2.62E-04	2.09E-04	2.29E-04	0.0010	0.0006	0.0013
Phosphorus	1	0.1		7.94E-03	0.0528	1.14E-02	8.66E-03	9.90E-03	0.039	0.023	0.054
Potassium	20	2	8	5.61E-03	0.0768	1.06E-02	7.68E-03	8.23E-03	0.037	0.033	0.046
Scandium				2.30E-05	0.000209	3.28E-05	2.74E-05	2.93E-05	0.00012	0.00007	0.00016
Selenium	2	0.2	10	1.54E-05	0.000142	2.44E-05	1.76E-05	2.01E-05	0.00009	0.00006	0.00012
Silver	0.1	0.01	1	3.40E-06	0.0000584	6.71E-06	4.33E-06	4.97E-06	0.00003	0.00003	0.00004
Sodium				2.08E-03	0.0230	3.46E-03	2.70E-03	2.87E-03	0.012	0.009	0.016
Strontium	20	2	120**	3.29E-04	0.00204	4.83E-04	3.72E-04	4.17E-04	0.0017	0.0010	0.0023
Sulfur	50	5	20	4.11E-02	0.179	5.78E-02	4.36E-02	5.05E-02	0.20	0.11	0.27
Tellurium	1	0.1	10	1.07E-06	0.0000826	4.48E-06	1.82E-06	2.40E-06	0.000023	0.000023	0.000022
Thallium	2	0.1	0.24	1.02E-06	0.0000110	1.73E-06	1.14E-06	1.36E-06	0.0000065	0.0000046	0.0000080

Chemical	Texas CEQ 1-Hour ESL ($\mu g/m^3$)	Texas CEQ Annual ESL ($\mu g/m^3$)	Ontario MOECC AAQCs: 24-hour averaging period ($\mu g/m^3$)	Baseline PM10 ($\mu g/m^3$)	PM10 Max (µg/m3)	Future Predicted Maximum Annual (µg/m3)			Future Predicted Maximum 24-hour (µg/m3)		
						Annual PM10 Bitter Creek Down Stream of Tailings Management Facility (ug/m3)	Annual PM10 Between Lower Portal and Bitter Creek (ug/m3)	Annual PM10 Road Between lower portal and Plant site (ug/m3)	Bitter Creek Downstream of Tailings Management Facility (PM10)	Between Lower Portal and Bitter Creek (PM10)	Road Between lower portal and Plant site (PM10)
Thorium				5.70E-06	0.0000609	8.78E-06	1.26E-05	9.26E-06	0.000028	0.000031	0.000051
Tin	20	2	10	1.97E-06	0.0000489	3.97E-06	2.39E-06	2.87E-06	0.00001	0.00001	0.00002
Titanium	50	5	120**	7.86E-03	0.0474	1.14E-02	8.82E-03	9.91E-03	0.039	0.024	0.054
Tungsten	50	5		1.37E-05	0.000195	2.04E-05	1.47E-05	1.72E-05	0.00035	0.00018	0.00046
Uranium	0.5	0.05	0.15	4.11E-06	0.0000459	6.89E-06	5.15E-06	5.62E-06	0.000024	0.000018	0.000031
Vanadium	20	2	2	3.68E-04	0.00342	5.47E-04	4.28E-04	4.73E-04	0.0020	0.0013	0.0027
Yttrium	10	1	2.4	Not Available	0.0000	9.56E-07	2.25E-07	3.50E-07	0.0000034	0.0000055	0.0000020
Zinc	20	2	120	4.88E-04	0.00707	9.42E-04	5.98E-04	7.00E-04	0.0050	0.0036	0.0060

* The screening level for magnesium is based on the reference concentration from the Michigan Department of Environmental Quality (MDEQ); ** Where the Ontario MOECC AACQs exceeded the British Columbia PM10 guideline of 50 ug/m3, 50 ug/m3 was used as 24-hour particulate cutoff value; TCEQ - Texas Commission on Environmental Quality. 2018. http://www17.tceq.texas.gov/tamis/index.cfm?fuseaction=home.welcome; TCEQ. 2017. Download Effects Screening Levels (ESLs) Used in the Review of Air Permitting Data; ESL - Effects Screening Levels; Ontario Ministry of Environment and Climate Change (MOECC). 2017. Ontario’s Ambient Air Quality Criteria; AAQCs - Ambient Air Quality Criteria; PM10 - PM10 is particulate matter 10 micrometers or less in diameter

Table A3: Predicted Soil Concentration Based on 95th Percentile Background Concentration

Constituent	95th Percentile Background Concentration (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Deposition near Road Between lower portal and Plant site Root Zone (mg/kg)	Deposition Between Lower Portal and Bitter Creek Root Zone (mg/kg)	Deposition near Bitter Creek Downstream of TMF Root Zone (mg/kg)	Predicted Soil Concentration at Bitter Creek Down Stream of TMF (mg /kg soil)	Predicted Soil Concentration at Road Between Lower Portal and Plant site (mg /kg soil)	Predicted Soil Concentration Between Lower Portal and Bitter Creek (mg /kg soil)
Aluminum	29300	19900	85800	32800	1.58E+02	159.28089	173.135633	29458.085	29459.281	29473.136
Antimony	6.86	2.6	117	35	4.47E-02	4.01E-02	4.10E-02	6.905	6.900	6.901
Arsenic	69.52	27.6	793	788.4	4.56E-01	4.08E-01	4.18E-01	69.976	69.928	69.938
Barium	428.56	453.3	984	226.4	2.29E+00	2.36E+00	2.69E+00	430.853	430.923	431.253
Beryllium	0.6	0.57	1.38	1.5	3.28E-03	3.32E-03	3.73E-03	0.603	0.603	0.604
Bismuth	0.3275	0.546	19.2	10	3.56E-03	2.64E-03	2.88E-03	0.331	0.330	0.330
Boron	20	10	10.2	59	1.07E-01	1.07E-01	1.14E-01	20.107	20.107	20.114
Cadmium	1.097	0.82	22.78	26.4	8.77E-03	7.21E-03	7.53E-03	1.106	1.104	1.105
Calcium	19650	20460	17584	17440	1.04E+02	1.08E+02	1.23E+02	19753.795	19757.706	19772.695
Chromium	99.08	100.92	122	148.6	5.29E-01	5.45E-01	6.18E-01	99.609	99.625	99.698
Cobalt	22.27	18.5	26.6	29	1.18E-01	1.21E-01	1.34E-01	22.388	22.391	22.404
Copper	106.1	79.5	798.4	269.4	6.14E-01	5.96E-01	6.49E-01	106.714	106.696	106.749
Gallium	12.075	6.2	NA	NA	6.19E-02	6.37E-02	6.82E-02	12.137	12.139	12.143
Gold	0.014425	0.00702	NA	NA	7.39E-05	7.60E-05	8.10E-05	0.014	0.015	0.015
Iron	58150	45100	112620	79840	3.11E+02	3.17E+02	3.49E+02	58461.491	58466.598	58498.628
Lanthanum	13.375	14.96	10	5	7.02E-02	7.34E-02	8.44E-02	13.445	13.448	13.459
Lead	39.97	27.292	183.6	118.4	2.25E-01	2.21E-01	2.39E-01	40.195	40.191	40.209
Magnesium	29700	14500	20799.9	26720	1.55E+02	1.58E+02	1.68E+02	29855.146	29857.788	29867.902
Manganese	916	1068.4	1275	1632.4	4.93E+00	5.09E+00	5.87E+00	920.929	921.090	921.869
Mercury	0.08	0.05	105	140.5	1.60E-02	7.15E-03	5.79E-03	0.096	0.087	0.086
Molybdenum	30.98	14.04	4	5	1.59E-01	1.63E-01	1.73E-01	31.139	31.143	31.153
Nickel	52.57	50.1	62.4	78	2.80E-01	2.88E-01	3.24E-01	52.850	52.858	52.894
Phosphorus	2335	1358	1830	1680	1.22E+01	1.25E+01	1.34E+01	2347.202	2347.464	2348.427
Potassium	1650	2400	39180	4440	1.14E+01	1.04E+01	1.19E+01	1661.357	1660.359	1661.910
Scandium	6.775	7.42	NA	NA	3.51E-02	3.69E-02	4.24E-02	6.810	6.812	6.817
Selenium	4.54	2.98	31.9	11.5	2.61E-02	2.53E-02	2.73E-02	4.566	4.565	4.567
Silver	1	0.869	28.799	2.94	7.17E-03	6.25E-03	6.71E-03	1.007	1.006	1.007
Sodium	612.5	832	6900	1193.99	3.70E+00	3.61E+00	4.18E+00	616.196	616.106	616.683
Strontium	96.85	71.9	134.8	151.2	5.16E-01	5.25E-01	5.76E-01	97.366	97.375	97.426
Sulfur	12075	5660	NA	NA	6.18E+01	6.36E+01	6.76E+01	12136.830	12138.55	12142.59
Tellurium	0.315	0.128	25	25	4.79E-03	3.02E-03	2.83E-03	0.320	0.318	0.318
Thallium	0.3	0.12	2.5	2.5	1.85E-03	1.71E-03	1.77E-03	0.3019	0.302	0.30177
Thorium	1.675	10.4	NA	NA	9.39E-03	1.17E-02	1.96E-02	1.684	1.687	1.695
Tin	0.58	0.3	10	10	4.24E-03	3.61E-03	3.71E-03	0.584	0.584	0.584
Titanium	2312.5	1680	3000.000119	1650.0	1.22E+01	1.25E+01	1.37E+01	2324.687	2324.975	2326.178

Constituent	95th Percentile Background Concentration (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Deposition near Road Between lower portal and Plant site Root Zone (mg/kg)	Deposition Between Lower Portal and Bitter Creek Root Zone (mg/kg)	Deposition near Bitter Creek Downstream of TMF Root Zone (mg/kg)	Predicted Soil Concentration at Bitter Creek Down Stream of TMF (mg /kg soil)	Predicted Soil Concentration at Road Between Lower Portal and Plant site (mg /kg soil)	Predicted Soil Concentration Between Lower Portal and Bitter Creek (mg /kg soil)
Tungsten	4.025	1.7	10	10	2.19E-02	2.17E-02	2.28E-02	4.047	4.047	4.048
Uranium	1.208	1.364	7.5	10	7.36E-03	7.07E-03	7.99E-03	1.215	1.215	1.216
Vanadium	108.19	97.58	234	189	5.85E-01	5.95E-01	6.65E-01	108.775	108.785	108.855
Yttrium			7.1	9	1.02E-03	4.41E-04	3.50E-04	0.00102	0.00044	0.00035
Zinc	143.67	97.6	2597	1633.6	1.01E+00	8.81E-01	9.28E-01	144.677	144.551	144.598

Table A4: Soil Screening Levels Evaluated in the Identification of Human Health COPCs

Chemicals	BC Background (Protocol 4) (mg/kg)	CEQG Soil Quality for the Protection of Human Health (Residential/ Parkland) (mg/kg)	BC CSR Schedule 3.1 Part 2 Residential/ Parkland (mg/kg)	BC CSR Schedule 3.1 Part 1 Residential/ Parkland (mg/kg)	Screening value (mg/kg)
Aluminum[1]	40000		40000		40000
Antimony		20	250		250
Arsenic	15	12		20	12
Barium	400	6800		8500	6800
Beryllium	2	75		85	75
Bismuth					
Boron			8500		8500
Cadmium[2]	0.6	14		20	14
Chloride				1000000	1000000
Chromium	65	220		100	100
Cobalt	15	50		25	25
Copper	50	1100		3500	1100
Gallium[3]					
Gold[4]					
Iron[5]	30000		35000		35000
Lead	15	140		120	120
Manganese				6000	6000
Mercury[2]	0.15	6.6		10	6.6
Molybdenum	1	10		200	200
Nickel	50	200		450	200
Scandium[6]					
Selenium[2]	0.25	80		200	80
Silver	1	20	200		20
Sodium[7]				1000000	1000000
Strontium	47000		9500		9500
Sulfur[8]					
Thallium		1			1
Thorium[9]					
Tin	4	50	25000		25000
Titanium[10]					
Tungsten			15		15
Uranium		23		100	23
Vanadium	100			200	200
Zinc	150	200		10000	10000

Additional References: BCMOE. 2017. Protocol for Contaminated Sites Establishing Background Concentrations in Soil. Version 9. Queens Printers. Victoria, British Columbia; BCMOE. 2017. BC Contaminated Sites Regulation. https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources; CCME. 2017. Environmental Quality Guidelines Summary Tables. http://stts.ccme.ca/index.html; USEPA. 2017. Regional Screening Levels. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017

Table A5: Soil COPCs

Chemicals	95th Percentile Background Concentration (mg/kg)	Background Plus Deposition Bitter Creek Downstream of TMF (mg/kg)	Background Plus Deposition Road Between lower portal and Plant site (mg/kg)	Background Plus Deposition Between Lower Portal and Bitter Creek (mg/kg)	Screening Levels (mg/kg)	COPCs (mg/kg)
Aluminum[1]	29300	29315.808	29459.281	29473.136	40000	No
Antimony	6.86	6.864	6.9	6.901	250	No
Arsenic	69.52	69.566	69.928	69.938	12	Yes
Barium	428.56	428.789	430.923	431.253	6800	No
Beryllium	0.6	0.600	0.603	0.604	75	No
Bismuth	0.3275	0.328	0.33	0.33	NA*	Yes
Boron	20	20.011	20.107	20.114	8500	No
Cadmium[2]	1.097	1.098	1.104	1.105	14	Yes[1]
Calcium	19650	19660.379	19757.706	19772.695	NA	No[2]
Chromium	99.08	99.133	99.625	99.698	100	No
Cobalt	22.27	22.282	22.391	22.404	25	No
Copper	106.1	106.161	106.696	106.749	1100	No
Gallium[3]	12.075	12.081	12.139	12.143	NA*	No[4]
Gold[4]	0.014425	0.014	0.015	0.015	NA*	No
Iron[5]	58150	58181.149	58466.598	58498.628	35000	Yes
Lanthanum	13.375	13.382	13.448	13.459	NA*	No[4]
Lead	39.97	39.992	40.191	40.209	120	No
Magnesium	29700	29715.515	29857.788	29867.902	NA*	No[2]
Manganese	916	916.493	921.09	921.869	6000	No
Mercury[2]	0.08	0.082	0.087	0.086	6.6	Yes[1]
Molybdenum	30.98	30.996	31.143	31.153	200	No
Nickel	52.57	52.598	52.858	52.894	200	No
Phosphorus	2335	2336.220	2347.464	2348.427	NA*	No[2]
Potassium	1650	1651.136	1660.359	1661.91	NA*	No[2]
Scandium[6]	6.775	6.779	6.812	6.817	NA*	No[4]
Selenium[2]	4.54	4.543	4.565	4.567	80	Yes[1]
Silver	1	1.001	1.006	1.007	20	No
Sodium[7]	612.5	612.870	616.106	616.683	1000000	No
Strontium	96.85	96.902	97.375	97.426	9500	No
Sulfur[8]	12075	12081.183	12138.553	12142.594	NA*	No[3]
Tellurium	0.315	0.315	0.318	0.318	NA*	No

Chemicals	95th Percentile Background Concentration (mg/kg)	Background Plus Deposition Bitter Creek Downstream of TMF (mg/kg)	Background Plus Deposition Road Between lower portal and Plant site (mg/kg)	Background Plus Deposition Between Lower Portal and Bitter Creek (mg/kg)	Screening Levels (mg/kg)	COPCs (mg/kg)
Thallium	0.3	0.3002	0.302	0.30177	1	No
Thorium[9]	1.675	1.676	1.687	1.695	NA*	No[4]
Tin	0.58	0.580	0.584	0.584	25000	No
Titanium[10]	2312.5	2313.719	2324.975	2326.178	NA*	No[4]
Tungsten	4.025	4.027	4.047	4.048	15	No
Uranium	1.208	1.209	1.215	1.216	23	No
Vanadium	108.19	108.248	108.785	108.855	200	No
Yttrium		0.000	0	0	NA*	No[4]
Zinc	143.67	143.771	144.551	144.598	10000	No

*Screening levels were not available (NA) for bismuth, calcium gallium, gold, lanthanum, magnesium, phosphorous, potassium, scandium, sulfur, tellurium, thorium, titanium, and yttrium; 1- Cadmium, mercury and selenium were carried forward as COPCs because of their potential to biomagnify in the food chain; 2 - The essential nutrients calcium, magnesium, phosphorus, potassium, and sodium were not carried forward as COPCs, since they are generally only toxic at extremely high concentrations (higher than what is present at the project); 3 - Sulphur was not carried forward as a COPC because it is generally considered to have low toxicity- to humans; 4 - Because the average crustal concentration of the rare earth elements gallium (19 mg/kg) lanthanum (30 mg/kg), scandium (22 mg/kg), thorium (9.6 mg/kg), and yttrium (24 mg/kg) are considerably greater than their predicted future concentrations in soil, they were not carried forward as COPCs. (Wedepohl, K.H. 1995. The composition of the continental crust. Geochemica et Cosmochemica Acta 46(4): 741-752.). Gold generally considered to be non-toxic (Tang D., Yuan R., and Chai Y. 2007. Biochemical and immunochemical characterization of the antigen–antibody reaction on a non-toxic biomimetic interface immobilized red blood cells of crucian carp and gold nanoparticles. Biosensors and Bioelectronics 22(6): 1116-1120.), and was thus not carried forward as a COPC.

Table A6: Surface Water Screening Levels

Parameter	Health Canada MAC* (mg/L)	BC CSR Schedule 3.2 Generic Numerical Water Standards for Drinking Water** (mg/L)	Regional Screening Levels*** (mg/L)	Screening Level (mg/L)
Chloride		250		250
Fluoride		1.5		1.5
Bromide (WHO 2009)	2			2
Sulphate (SO4)		500		500
Nitrate Nitrogen	10	10		10
Nitrite Nitrogen	1	1		1
Total Nitrogen				
Ammonia Nitrogen				
Cyanide Total	0.2	0.2		0.2
Aluminum		9.5		9.5
Antimony	0.006	0.006		0.006
Arsenic	0.01	0.01		0.01
Barium	1	1		1
Beryllium		0.008		0.008
Bismuth				
Boron	5	5		5
Cadmium	0.005	0.005		0.005
Calcium				
Chromium	0.05	0.05		0.05
Cobalt			0.006	0.006
Copper		1.5		1.5
Iron		6.5		6.5
Lead	0.01	0.01		0.01
Magnesium				
Manganese		1.5		1.5
Mercury	0.001	0.001		0.001
Molybdenum		0.25		0.25
Nickel		0.08		0.08
Selenium	0.05	0.01		0.01
Silicon				
Silver		0.02		0.02
Sodium		200		200
Strontium	2.5			2.5
Thallium			0.0002	0.0002
Tin		2.5		2.5
Titanium				
Uranium	0.02	0.02		0.02

Parameter	Health Canada MAC* (mg/L)	BC CSR Schedule 3.2 Generic Numerical Water Standards for Drinking Water** (mg/L)	Regional Screening Levels*** (mg/L)	Screening Level (mg/L)
Vanadium		0.02		0.02
Zinc		3		3

*MAC = Maximum Acceptable Concentration; Health Canada. 2017. Guidelines for Canadian Drinking Water Quality – Summary Table. https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table-health-canada-2012.html; ** BCMOE. 2017. BC Contaminated Sites Regulation (CSR). https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources ***USEPA. 2017. Regional Screening Levels. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017. WHO **(**World Health Organization). 2009. Bromide in drinking-water Background document for development of WHO Guidelines for Drinking-water Quality. WHO Press. Geneva, Switzerland.)

Table A7: Identification of COPCs in Surface Water (Unfiltered), Red Mountain Underground Gold Project

Constituent	Screening Level (mg/L)	Maximum Baseline Concentration (mg/L)	Predicted Maximum 90th Percentile Concentration Operation (mg/L)	Predicted Maximum 90th Percentile Concentration Closure/ Post Closure (mg/L)	Maximum Concentration (mg/L)	COPC
Field pH		8.33	9.45	9.45	9.45	No
Hardness CaCO3		416	260.8	233.3	416	NA
Total Dissolved Solids		507	362.5	344.7	507	NA
Total Suspended Solids		2000	927.6	920.4	2000	NA
Turbidity (NTU)		2320	667.8	659.2	2320	NA
Alkalinity-Total CaCO3		135	102.6	92.24	135	NA
Acidity (as CaCO3)		32	19.23	16.91	32	NA
Chloride	250	2.5	0.9318	0.9101	2.5	No
Fluoride	1.5	0.297	0.2094	0.207	0.297	No
Bromide	2	0.25	0.05712	0.0536	0.25	No
Sulphate (SO4)	500	265	294.3	176.6	294.3	No
Nitrate Nitrogen	10	0.603	2.059	0.2925	2.059	No
Nitrite Nitrogen	1	0.005	0.04745	0.001351	0.04745	No
Total Nitrogen		0.445	2.368	0.2496	2.368	NA
Ammonia Nitrogen		0.0155	0.2609	0.03455	0.2609	No
Ortho-Phosphate		0.0035	0.002709	0.002606	0.0035	NA
Phosphorus - Total		1.55	1.158	1.145	1.55	No
Total Organic Carbon		3.96	2.663	2.642	3.96	NA
Dissolved Organic		1.11	0.8703	0.8342	1.11	NA
Aluminum	9.5	36.8	26.4	26.06	36.8	Yes
Antimony	0.006	0.2	0.02598	0.02308	0.2	Yes
Arsenic	0.01	0.0808	0.05085	0.05038	0.0808	Yes
Barium	1	0.537	0.2633	0.2613	0.537	No
Beryllium	0.008	0.001	0.001075	0.0009992	0.001075	No
Bismuth[1]		0.2	0.126	0.1245	0.2	Yes
Boron	5	0.1	0.1075	0.09992	0.1075	No
Cadmium	0.005	0.00293	0.006953	0.001634	0.006953	Yes
Calcium[2]		145	98.68	97.95	145	No
Chromium	0.05	0.058	0.03826	0.03822	0.058	Yes
Cobalt	0.006	0.0649	0.01737	0.01764	0.0649	Yes
Copper	1.5	0.175	0.09272	0.09148	0.175	No
Iron	6.5	100	65.86	65.01	100	Yes
Lead	0.01	0.0339	0.01769	0.0177	0.0339	Yes
Magnesium[3]		30	25.49	25.3	30	No
Manganese	1.5	1.98	1.833	1.165	1.98	Yes
Mercury[4]	0.001	0.000086	0.0004778	0.00005016	0.000478	Yes

Constituent	Screening Level (mg/L)	Maximum Baseline Concentration (mg/L)	Predicted Maximum 90th Percentile Concentration Operation (mg/L)	Predicted Maximum 90th Percentile Concentration Closure/ Post Closure (mg/L)	Maximum Concentration	COPC
Molybdenum	0.25	0.03	0.01418	0.01211	0.03	No
Nickel	0.08	0.21	0.1173	0.117	0.21	No
Selenium	0.01	0.0125	0.008669	0.005565	0.0125	Yes
Silicon		47.2	30.7	30.36	47.2	No
Silver	0.02	0.0016	0.001017	0.00105	0.0016	No
Sodium	200	12	6.42	4.979	12	No
Strontium	2.5	1.06	0.5337	0.5075	1.06	No
Thallium	0.0002	0.00021	0.000215	0.0001998	0.000215	Yes
Tin	2.5	0.0005	0.0005375	0.0004996	0.000538	No
Titanium[5]		0.466	0.4522	0.449	0.466	No
Uranium	0.02	0.00156	0.0009434	0.0009259	0.00156	No
Vanadium	0.02	0.134	0.08637	0.0854	0.134	Yes
Zinc	3	0.258	0.4318	0.1553	0.4318	No
Cyanide (Total)	0.2	NA	0.00297	0.0000932	0.00297	No
Cyanide WAD	0.2	NA	0.000127	0.00000398	0.000127	No

1-Bismuth - No drinking water guideline or toxicity value available Therefore included as a COPC; 2-There is no evidence of adverse health effects specifically attributable to Calcium in drinking water. (Government of Canada. 2017). Guidelines for Canadian Drinking Water Quality: Supporting Documents – Calcium. https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-supporting-documents-calcium.html; 3-There is no evidence of adverse health effects specifically attributable to magnesium in drinking water. (Government of Canada. 2017. Guidelines for Canadian Drinking Water Quality: Supporting Documents – Magnesium. https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-supporting-documents-magnesium.html; 4 - Mercury did not screen in; however, because of the potential for bioaccumulation it was considered to be a COPC; 5 - Titanium is relatively non-toxic. It does not accumulate in the human body (New Brunswick. 2017. Facts on Drinking Water.http://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/HealthyEnvironments/water/GeneralChemistry_Metalse.pdf; NA – Not Available. 6 – The phosphorus upper limit of dietary intake ranges from 65 grams for a one year old to 350 grams for an adult. As the maximum concentration of phosphorus in surface water is 1.55 mg/L the phosphorus from Bitter Creek contributes less than one percent of the upper limit of dietary intake phosphorus was not considered to be a COPC in surface water (World Health Organization (WHO). 2005. Nutrients in Drinking Water. WHO Press. Geneva, Switzerland).

Table A8: Groundwater Sample Locations

Sample ID	Established	Location Description	Notes
RMS1	August 2014	Seep on east side of waste rock dump	Included in geochemistry evaluation
RMS2	August 2014	Seep on southwest side of waste rock dump	Included in geochemistry evaluation
RMS3	August 2014	Seep on northwest side of waste rock dump	Included in geochemistry evaluation
RMS4	June 2014	Ponded water in the underground decline	Included in baseline water quality evaluation
RMS5	July 2015	Artesian drill holes located on steep slope on the southern edge of cirque, the inclined pipe is sampled	Included in baseline water quality evaluation
RMS6	August 2014	Artesian drill hole located in cirque near GSC09 and GSC07	Included in baseline water quality evaluation
RMS7	September 2014	Artesian drill hole located on steep slope on the northern side of cirque	Included in baseline water quality evaluation
NCribs	October 2015	Two separate cribs (Ncrib N and Ncrib S) containing waste rock near portal entrance	Included in geochemistry evaluation
MW16-002	August 2016	Monitoring well near Bromley Humps west of south embankment of proposed tailings facility	Monitoring initiated in September 2016
MW16-003	August 2016	Monitoring well near Bromley Humps west of south embankment of proposed tailings facility	Monitoring initiated in September 2016
MW16-004	August 2016	Monitoring well near Bromley Humps northwest of north embankment of proposed tailings facility	Monitoring initiated in September 2016

Table A9: Groundwater COPCs

Chemical	Drinking Water Screening Level (mg/L)	Maximum Baseline Concentration (mg/L)	Maximum Predicted Future Concentration (mg/L)	COPC
Ammonia	NA	15	-	No
Nitrite	1	0.01	-	No
Nitrate	10	15	-	Yes
Chloride	250	1.5	-	No
Cyanide (SAD)	0.2	NA	-	No[1]
Sulphate	500	198.15	340	No
Aluminum	9.5	0.2346	0.067	No
Antimony	0.006	0.11	0.031	Yes
Arsenic	0.01	0.0178	0.01	Yes
Barium	1	0.04015	-	No
Beryllium	0.008	0.000244	-	No
Bismuth		Non-detect at <0.05	-	No[1]
Boron	5	0.11	-	No
Cadmium	0.005	0.0012	0.0082	Yes
Calcium		90.05	97	No[2]
Chromium	0.05	0.0036	0.004	No
Cobalt	0.006	0.00332	0.011	Yes
Copper	1.5	0.080925	0.018	No
Iron	6.5	0.0948	0.37	No
Lead	0.01	0.0017225	0.002	No
Magnesium		15	13	No
Manganese	1.5	0.3287	2.2	Yes
Mercury	0.001	0.0002075	0.0002	Yes[3]
Molybdenum	0.25	0.03	0.011	No
Nickel	0.08	0.014179955	0.065	No
Selenium	0.01	0.006	0.0099	Yes[3]
Silicon		4.049	-	No[4]
Silver	0.02	0.0001	0.00008	No
Sodium	200	8.085	-	No
Strontium	2.5	1.751	-	No
Sulfur		65.78	-	No
Thallium	0.0002	0.000011	-	No
Tin	2.5	0.00015	-	No
Titanium		0.013	-	No
Uranium	0.02	0.0011	-	No
Vanadium	0.02	NA	-	No[1]
Zinc	3	0.07435	0.51	No

1 – Groundwater modelling indicates that chemical unlikely to reach groundwater; 2 - The essential nutrients calcium, magnesium, phosphorus, potassium, and sodium were not carried forward as COPCs, since they are generally only toxic at extremely high concentrations' 3 - Mercury and selenium did not screen in; however, because of the potential for bioaccumulation they were considered to be COPCs; 4 – non-toxic; NA – not available

Table A10: Sediment COPCs

Constituent	Sediment Screening Level (mg/kg)	95th Percentile Baseline Concentration (mg/kg)	Maximum Future Predicted Concentration (mg/kg)	COPC
Aluminum	40000	23350	33227	No
Antimony	250	8.628	19.855	No
Arsenic	12	119.616	218.351	Yes
Barium	6800	542.12	1208.13	No
Beryllium	75	0.704	1.122	No
Bismuth	NA	0.91	1.08	Yes
Cadmium	14	3.33	12.84	Yes[1]
Calcium	NA	33836	38458.52	No[2]
Chromium	100	55.72	95.93	No
Cobalt	25	37.01	330.79	Yes
Copper	1100	608.70	1798.15	Yes
Iron	35000	72017.00	124478.5	Yes
Lead	120	62.43	279.52	Yes
Lithium	65	25.33	-	No
Magnesium	NA	17199.40	21202.78	No[2]
Manganese	6000	1573.54	22123.88	Yes
Mercury	6.6	0.08	0.16	Yes[1]
Molybdenum	200	88.43	194.53	No
Nickel	200	70.58	121.66	No
Potassium	NA	1795.60	-	No[2]
Selenium	80	9.29	15.34	Yes[1]
Silver	20	1.27	6.64	No
Sodium	1000000	252.14	346.95	No
Strontium	9500	155.12	161.93	No
Thallium	1	0.22	0.28	No
Tin	25000	0.52	0.58	No
Titanium	NA	905.60	973.66	No[2]
Uranium	23	1.78	2.51	No
Vanadium	200	132.20	137.54	No
Zinc	10000	440.60	1306.70	No

COPC – Contaminant of Potential Concern; NA – Not Available; 1 – Identified as a COPC as a COPC because of the potential to bioaccumulate; 2 – The essential nutrients calcium, magnesium, and potassium were not carried forward as COPCs since they are generally only toxic at extremely high concentrations. The concentration titanium in sediment was not carried forward as COPCs as the concentration was much lower than the average concentrations in the earth's crust for 5,650 mg/kg for titanium (Wedepohl, K.H. 1995. The composition of the continental crust. Geochemica et Cosmochemica Acta 46(4): 741-752).

Table A11: Country Food Screening Levels

Chemicals	Toxicity Reference Value		Screening Level (Fish and Plants)			
	Total Daily Intake (TDI) (mg/kg-d)	Cancer Slope Factor (CSF) (mg/kg-d)-1	Non-carcinogenic (Adult) (mg/kg)	Non-carcinogenic (Toddler) (mg/kg)	Carcinogenic (Adult) (mg/kg)	Carcinogenic (Toddler) (mg/kg)
Aluminum	1	NA	48.76	36.26	NA	NA
Antimony	0.006	NA	0.293	0.218	NA	NA
Arsenic	0.001	1.8	0.049	0.036	0.00135	0.00020
Barium	0.2	NA	9.75	7.25	NA	NA
Beryllium	0.002	NA	0.10	0.07	NA	NA
Bismuth	NA	NA	NA	NA	NA	NA
Boron	0.2	NA	9.75	7.25	NA	NA
Cadmium	0.001	NA	0.049	0.036	NA	NA
Chromium	0.001	NA	0.05	0.04	NA	NA
Cobalt	0.0014	NA	0.068	0.051	NA	NA
Copper (Adult)	0.141	NA	6.87	5.11	NA	NA
Iron	0.7	NA	34.13	25.38	NA	NA
Lead (Adult)	0.0015	NA	0.07	NA	NA	NA
Lead (Toddler)	0.0006	NA	NA	0.02	NA	NA
Manganese (Adult)	0.156	NA	7.61	NA	NA	NA
Manganese (Toddler)	0.136	NA	NA	4.93	NA	NA
Mercury	0.0002	NA	0.010	0.007	NA	NA
Molybdenum	0.028	NA	1.37	1.02	NA	NA
Nickel	0.02	NA	0.98	0.73	NA	NA
Selenium (Adult)	0.0057	NA	0.28	NA	NA	NA
Selenium (Toddler)	0.0062	NA	0.30	0.22	NA	NA
Silver	0.005	NA	NA	0.18	NA	NA
Strontium	0.6	NA	29.26	21.76	NA	NA
Thallium	0.00001	NA	0.00049	0.00036	NA	NA
Tin	0.6	NA	29.26	21.76	NA	NA
Titanium	3	NA	146.28	108.79	NA	NA
Uranium	0.0006	NA	0.029	0.022	NA	NA
Vanadium	0.005	NA	0.24	0.18	NA	NA
Zinc (Adult)	0.57	NA	27.79	NA	NA	NA
Zinc (Toddler)	0.48	NA	NA	17.41	NA	NA

Notes:
NA = TRV not available and screening not calculated.
The following equations were used to calculate the noncarcinogenic and carcinogenic screening levels for country foods.

$$noncarcinogenic\ SL = 0.2 \times \frac{(TDI \times BW)}{IR}$$

$$carcinogenic\ SL = \frac{\left(\frac{ARL}{CSF} \times BW\right)}{IR} \times ADAF$$

Calculation general input values not included in table:	Adult	Toddler
Body weight (kg; BW)	70.7	16.5
Ingestion Rate (kg/day; IR)	0.29	0.091
Acceptable cancer risk level (ARL) (unitless)	1.00E-05	1.00E-05
ADAFs (unitless Health Canada 2013)		5

Reference: Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada Part II: Toxicolog-ical Reference Values (TRVs) and Chemical-Specific Factors, Version 2.0. September 2010; Health Canada. 2013. Interim Guidance on Human Health Risk Assessment for Short-Term Exposure to Carcinogens at Contaminated Sites. Publications Health Canada. Ottawa Ontario. Oakridge National Laboratory Risk Assessment Information System (RAIS). 2017. Available online at: http://rais.ornl.gov/. Last accessed on Aug. 30, 2017. Richardson M., and Wilson R. 2012. Proposed Toxicological Reference Values and Risk-based Soil Concentrations for Protection of Human Health from Lead (Pb) at Federal Contaminated Sites. RPIC Federal Contaminated Sites National Workshop, April 30 – May 3. Toronto. United States Environmental Protection Agency Health Effects Assessment Summary Tables (HEAST). 2017. Available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=2877. Last accessed on Aug. 30, 2017. United States Environmental Protection Agency Integrated Risk Information System (IRIS). 2017. Available online at: http://www.epa.gov/iris/. Last accessed on Aug. 30, 2017. United States Environmental Protection Agency Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV). 2017. Available online at: http://hhpprtv.ornl.gov/. Last accessed on Aug. 30, 2017. United States Environmental Protection Agency Regional Screening Levels (RSLs). 2017. Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls. Last accessed on Aug. 30, 2017.

Table A12: Country Food – Fish and Plant COPCs

Constituent	Country Foods – Fish and Plants Screening Level (mg/kg)	Maximum Measured Fish Concentration (mg/kg)	Maximum Measured Plant Concentration (mg/kg)	COPC
Aluminum	36.264	56.90	54.53	Yes
Antimony	0.218	0.127	0.029	No
Arsenic	0.0002	10.30	0.38	Yes
Barium	7.253	2.86	29.49	Yes
Beryllium	0.073	0.0020	0.00256	No
Bismuth	NA	0.020	0.0037	No
Boron	7.253	0.10	17.32	Yes
Cadmium	0.036	1.03	2.65	Yes
Calcium	NA	10300	8893.80	No
Chromium	0.036	0.10	0.25	Yes
Cobalt	0.05	0.51	0.48	Yes
Copper	5.11	2.47	5.46	Yes
Iron	25.38	314.00	139.45	Yes
Lead	0.02	1.02	0.138	Yes
Manganese	4.93	7.63	235.97	Yes
Mercury	0.007	0.0110	0.0054	Yes[1]
Molybdenum	1.02	0.600	0.16	No
Nickel	0.73	0.59	4.87	Yes
Phosphorus	NA	7400.00	1395.90	No
Selenium	0.21	3.44	1.28	Yes
Silver	0.18	0.040	0.0073	No
Sodium	NA	1060.00	14.27	No
Strontium	21.76	9.43	38.53	Yes
Thallium	0.00036	0.030	0.00074	Yes
Tin	21.76	0.070	0.0110	No
Titanium	108.79	2.11	1.70	No
Uranium	0.022	0.0290	0.00146	Yes
Vanadium	0.18	0.26	0.168	Yes
Zinc	17.4	40.50	129.93	Yes

1 – Identified as a COPC as a COPC because of the potential to bioaccumulate

Table A13: Country Food – Wild Game, Fish and Plant COPCs

Constituent	Soil COPC	Surface Water COPC	Country Food COPC based on Fish and Plant Screening	Country Foods COPC based on Soil and Surface Water
Aluminum		X	X	X
Antimony		X		
Arsenic	X	X	X	X
Barium			X	X
Bismuth	X	X		X
Boron			X	X
Cadmium	X	X	X	X
Chromium		X	X	X
Cobalt		X	X	X
Copper				X
Iron	X	X	X	X
Lead		X	X	X
Manganese		X	X	X
Mercury	X	X	X	X
Nickel			X	X
Selenium	X	X	X	X
Strontium			X	X
Tellurium	X			X
Thallium		X	X	X
Vanadium		X	X	X
Uranium			X	X
Zinc			X	X

Table A14a: Baseline, Operational, and Post Closure Dissolved Surface Water Concentrations

Constituent	Baseline Mean P90 (mg/L)	Operational Mean P90 (mg/L)	Post Closure Mean P90 (mg/L)
Total Hardness	1.34E+02	1.44E+02	1.37E+02
TDS	1.82E+02	1.84E+02	1.80E+02
Turbidity	2.82E+02	2.83E+02	2.79E+02
Alkalinity	6.49E+01	6.67E+01	6.48E+01
Acidity	6.46E+00	6.83E+00	6.37E+00
Chloride	5.58E-01	5.70E-01	5.53E-01
Fluoride	6.37E-02	6.39E-02	6.30E-02
Bromide	5.04E-02	5.08E-02	4.98E-02
Sulfate	6.18E+01	7.42E+01	6.56E+01
Nitrate Nitrogen (mg/L as N)	1.30E-01	3.01E-01	1.29E-01
Nitrite Nitrogen (mg/L as N)	1.01E-03	1.97E-03	1.01E-03
Nitrogen, total	1.73E-01	1.98E-01	1.72E-01
Ammonia Nitrogen	6.97E-03	1.63E-02	1.18E-02
Phosphate	1.60E-03	1.60E-03	1.58E-03
Phosphorus, total	3.57E-01	3.58E-01	3.54E-01
Total Organic Carbon	1.04E+00	1.07E+00	1.03E+00
Dissolved Organic Carbon	6.10E-01	6.31E-01	6.04E-01
Aluminum, dissolved	8.22E-02	8.44E-02	8.21E-02
Antimony, dissolved	1.02E-03	2.18E-03	1.40E-03
Arsenic, dissolved	7.32E-04	1.09E-03	8.32E-04
Barium, dissolved	5.65E-02	5.66E-02	5.58E-02
Beryllium, dissolved	9.41E-04	9.42E-04	9.30E-04
Bismuth, dissolved	1.04E-02	1.05E-02	1.04E-02
Boron, dissolved	9.41E-02	9.47E-02	9.32E-02
Cadmium, dissolved	1.33E-04	4.30E-04	2.16E-04
Calcium, dissolved	4.50E+01	4.81E+01	4.61E+01
Chromium, dissolved	9.41E-04	1.08E-03	1.27E-03
Cobalt, dissolved	3.33E-04	7.68E-04	8.00E-04
Copper, dissolved	1.40E-03	2.07E-03	1.58E-03
Iron, dissolved	6.50E-02	7.78E-02	7.38E-02
Lead, dissolved	4.97E-04	5.69E-04	7.37E-04
Magnesium, dissolved	5.17E+00	5.58E+00	5.26E+00
Manganese, dissolved	1.88E-02	9.87E-02	3.93E-02
Mercury, dissolved	7.16E-06	1.45E-05	8.10E-06

Constituent	Baseline Mean P90 (mg/L)	Operational Mean P90 (mg/L)	Post Closure Mean P90 (mg/L)
Molybdenum, dissolved	4.64E-03	5.05E-03	4.77E-03
Nickel, dissolved	2.09E-03	4.43E-03	2.85E-03
Selenium, dissolved	1.90E-03	2.26E-03	2.10E-03
Silicon, dissolved	1.84E+00	1.85E+00	1.82E+00
Silver, dissolved	1.92E-05	2.24E-05	5.72E-05
Sodium, dissolved	2.15E+00	2.48E+00	2.13E+00
Strontium, dissolved	2.57E-01	2.57E-01	2.53E-01
Thallium, dissolved	1.88E-04	1.88E-04	1.86E-04
Tin, dissolved	4.78E-04	4.79E-04	4.72E-04
Titanium, dissolved	1.03E-02	1.03E-02	1.02E-02
Uranium, dissolved	4.11E-04	4.12E-04	4.05E-04
Vanadium, dissolved	7.08E-04	7.10E-04	7.01E-04
Zinc, dissolved	6.84E-03	2.53E-02	1.34E-02
Cyanide, total	Not Available	4.61E-04	1.52E-05
Cyanide, WAD	Not Available	1.97E-05	6.48E-07

Table A14b: Baseline, Operational, and Closure and Reclamation/Post Closure Unfiltered Surface Water Concentrations (mg/L)

Constituent	Baseline Mean P90 (mg/L)	Operational Mean P90 (mg/L)	Post Closure Mean P90 (mg/L)
Total Hardness	1.27E+02	1.56E+02	1.40E+02
TDS	1.77E+02	1.92E+02	1.85E+02
Turbidity	2.17E+02	2.23E+02	2.20E+02
Alkalinity	5.01E+01	5.36E+01	4.87E+01
Acidity	6.33E+00	7.43E+00	6.47E+00
Chloride	5.36E-01	5.44E-01	5.24E-01
Fluoride	6.52E-02	6.78E-02	6.58E-02
Bromide	5.02E-02	5.07E-02	4.90E-02
Sulfate	7.10E+01	1.06E+02	8.43E+01
Nitrate Nitrogen (mg/L as N)	7.15E-02	3.17E-01	7.41E-02
Nitrite Nitrogen (mg/L as N)	1.00E-03	5.11E-03	1.03E-03
Nitrogen, total	1.14E-01	3.09E-01	1.14E-01
Ammonia Nitrogen	6.24E-03	3.09E-02	8.81E-03
Phosphate	1.59E-03	1.75E-03	1.70E-03
Phosphorus, total	2.53E-01	2.68E-01	2.63E-01
Total Organic Carbon	8.39E-01	8.62E-01	8.32E-01
Dissolved Organic Carbon	5.75E-01	5.93E-01	5.67E-01
Aluminum, total	5.89E+00	6.15E+00	6.03E+00
Antimony, total	2.05E-03	5.74E-03	3.30E-03
Arsenic, total	8.45E-03	9.79E-03	8.81E-03
Barium, total	1.13E-01	1.19E-01	1.16E-01
Beryllium, total	9.19E-04	9.56E-04	9.27E-04
Bismuth, total	8.36E-03	8.44E-03	8.29E-03
Boron, total	9.19E-02	9.57E-02	9.27E-02
Cadmium, total	4.83E-04	1.33E-03	7.14E-04
Calcium, total	4.75E+01	5.84E+01	5.33E+01
Chromium, total	6.68E-03	7.13E-03	7.62E-03
Cobalt, total	5.03E-03	6.12E-03	6.44E-03
Copper, total	3.01E-02	3.36E-02	3.24E-02
Iron, total	9.17E+00	9.66E+00	9.42E+00
Lead, total	6.83E-03	7.39E-03	7.78E-03
Magnesium, total	9.62E+00	1.12E+01	1.04E+01
Manganese, total	2.94E-01	5.38E-01	3.53E-01
Mercury, total	1.21E-05	6.91E-05	1.47E-05

Constituent	Baseline Mean P90 (mg/L)	Operational Mean P90 (mg/L)	Post Closure Mean P90 (mg/L)
Molybdenum, total	5.84E-03	6.66E-03	6.43E-03
Nickel, total	2.06E-02	2.72E-02	2.30E-02
Selenium, total	2.30E-03	3.26E-03	2.91E-03
Silicon, total	8.02E+00	8.12E+00	7.97E+00
Silver, total	1.61E-04	1.70E-04	2.71E-04
Sodium, total	2.67E+00	3.13E+00	2.87E+00
Strontium, total	2.69E-01	2.96E-01	2.86E-01
Thallium, total	1.84E-04	1.92E-04	1.86E-04
Tin, total	4.65E-04	4.81E-04	4.67E-04
Titanium, total	9.82E-02	1.01E-01	9.92E-02
Uranium, total	4.91E-04	5.06E-04	4.93E-04
Vanadium, total	1.35E-02	1.37E-02	1.36E-02
Zinc, total	5.81E-02	1.13E-01	7.38E-02
Cyanide, total	NA	2.31E-04	7.58E-06
Cyanide, WAD	NA	9.86E-06	3.24E-07

P90 – 90th Percentile

Table A15: Summary Statistics Fish Tissue Residue Data

Constituent	Minimum (mg/L)	Maximum (mg/L)	75th Percentile (mg/L)	90th Percentile (mg/L)	95th Percentile (mg/L)	Mean (mg/L)
Moisture	72.2	77.5	76.100	76.970	77.425	75.208
Aluminum	2.1	56.9	17.850	35.350	50.100	14.921
Antimony	0.002	0.127	0.022	0.062	0.071	0.021
Arsenic	0.052	10.3	0.280	0.736	2.079	0.698
Barium	0.12	2.86	1.275	1.683	2.025	1.073
Beryllium	0.002	0.002	0.002	0.002	0.002	0.002
Bismuth	0.02	0.02	0.020	0.020	0.020	0.020
Boron	0.1	0.1	0.100	0.100	0.100	0.100
Cadmium	0.053	1.03	0.286	0.848	0.943	0.280
Calcium	1490	10300	6447.500	8730.000	10033.500	5250.417
Chromium	0.01	0.1	0.070	0.094	0.100	0.048
Cobalt	0.079	0.51	0.221	0.286	0.355	0.190
Copper	0.45	2.47	1.313	1.686	2.102	1.166
Iron	13	314	82.000	128.800	193.800	71.542
Lead	0.006	1.02	0.066	0.106	0.354	0.097
Magnesium	237	370	316.250	326.000	351.100	291.875
Manganese	0.43	7.63	4.040	5.039	6.855	3.415
Mercury	0.003	0.011	0.008	0.009	0.010	0.007
Molybdenum	0.01	0.6	0.038	0.049	0.069	0.051
Nickel	0.03	0.59	0.165	0.214	0.280	0.130
Phosphorus	2680	7400	5275.000	6099.000	6865.000	4595.000
Potassium	3310	4000	3735.000	3807.000	3835.500	3595.833
Selenium	0.97	3.44	2.365	2.906	3.122	2.045
Silver	0.01	0.04	0.025	0.034	0.037	0.020
Sodium	641	1060	888.750	999.700	1038.500	825.208
Strontium	1	9.43	5.760	7.997	8.803	4.803
Thallium	0.006	0.03	0.016	0.023	0.028	0.014
Tin	0.03	0.07	0.060	0.066	0.068	0.050
Titanium	0.18	2.11	0.640	1.035	1.603	0.609
Uranium	0.001	0.029	0.003	0.006	0.015	0.004
Vanadium	0.03	0.26	0.125	0.194	0.236	0.085
Zinc	15.9	40.5	36.650	37.770	38.905	30.071

Table A16: Baseline Fish Tissue Residue and Predicted Fish Tissue Residue

Parameters	Average Fish Tissue Concentrations Fish Sample Stations			Average Baseline Water Concentration				Bioconcentration Factors					Predicted P90 Water Sample Concentrations	Predicted Tissue Residue
	BR1, BR8, BC1, BC2, BC3, ROC1 (mg/kg)	BC1, BC2, BC3, ROC1 (mg/kg)	Average BC1, BC2, BC3 (mg/kg)	BC2, BC4, BC6, BR8, BR6, OC1 (mg/L)	BC2, BC4, BC6, BR8, BR6 (mg/L)	BC2, BC4, BC6 (mg/L)	BC2 (mg/L)	BCF1 (L/kg)	BCF2 (L/kg)	BCF3 (L/kg)	BCF4 (L/kg)	ORNL RAIS BCF (L/kg)	BC2, BC6, BR6 (mg/L)	TP1 (mg/kg)
	F1	F2	F3	WB1	WB2	WB3	WB4	F1/WB1	F1/WB2	F2/WB3	F3/WB4		WP1	BCF3/WP1
Aluminum	36.5646	16.5531	14.9208	0.0860	0.0974	0.1297	0.0778	425.416	375.4835	127.6591	191.8873	500.00	0.0820	10.4680
Antimony	0.0201	0.0177	0.0207	0.0006	0.0006	0.0007	0.0014	34.682	32.4868	24.0112	14.3935	100.00	0.0014	0.0336
Arsenic	0.5487	0.5453	0.6984	0.0006	0.0006	0.0007	0.0008	938.265	879.3737	763.0306	856.4275	300.00	0.00083	0.6349
Barium	2.4002	1.3050	1.0729	0.0485	0.0460	0.0345	0.0544	49.4718	52.2239	37.7896	19.7258	4.00	0.0558	2.1087
Beryllium	0.0057	0.0030	0.0010	0.0007	0.0007	0.0008	0.0010	7.7982	7.7753	3.8627	1.0204		0.00093	0.0036
Bismuth	0.0100	0.0100	0.0100	0.0069	0.0083	0.0121	0.0041	1.4475	1.2098	0.8262	2.446		0.0104	0.0086
Boron	0.1538	0.1000	0.1000	0.0728	0.0730	0.0777	0.0981	2.1138	2.1069	1.2870	1.0195		0.0932	0.1199
Cadmium	0.3082	0.2421	0.2802	0.0001	0.0001	0.0001	0.0003	4255.75	4147.88	3073.5559	857.561	200.00	0.0002	0.6639
Calcium	4815.4	4842.18	5250.41	29.16	26.2400	29.3000	49.9167	165.1000	183.5144	165.2624	105.18		46.1000	7618.5953
Chromium	0.0787	0.0600	0.0483	0.0008	0.0008	0.0008	0.0013	104.4710	103.4543	72.5222	36.59	200.00	0.0013	0.0921
Cobalt	0.1824	0.1686	0.1896	0.0003	0.0003	0.0003	0.0011	637.1508	696.8583	607.0678	174.6775	200.00	0.0008	0.4857
Copper	1.2379	1.1638	1.1658	0.0009	0.0010	0.0011	0.0021	1303.52	1256.2580	1043.7220	546.0578		0.0016	1.6491
Iron	136.5625	71.9375	71.5417	0.0332	0.0325	0.0320	0.0585	4115.3943	4196.75	2250.3910	1222.586	200.00	0.0738	166.0789
Lead	0.2011	0.0902	0.0971	0.0004	0.0004	0.0004	0.0008	569.1038	571.5842	237.3355	116.6049	300.00	0.0007	0.1749
Magnesium	306.5625	289.6563	291.8750	3.5550	2.8680	3.3900	6.1608	86.2342	106.89	85.4443	47.3759		5.2600	449.4371
Manganese	6.0552	3.7713	3.4146	0.0097	0.0079	0.0071	0.0287	622.9638	766.0942	533.9193	119.0096	400.00	0.0393	20.9830
Mercury	0.0099	0.0074	0.0069	0.000006	0.000006	0.000006	0.000017	1659.1991	1650.2340	1276.6878	404.28		0.000008	0.0103
Molybdenum	0.0398	0.0417	0.0509	0.0024	0.0026	0.0034	0.0046	16.6391	15.3424	12.1007	11.1419		0.0048	0.0581
Nickel	0.1146	0.1128	0.1300	0.0017	0.0012	0.0014	0.0026	66.6247	94.4005	78.3420	50.2092	100.00	0.0029	0.2233
Phosphorus	4476.45	4440.00	4595.00	-	-	-	-	-	-	-	-			-
Potassium	3688.75	3657.50	3595.33	-	-	-	-	-	-	-	-			-
Selenium	1.5983	1.8141	2.0446	0.0014	0.0012	0.0016	0.0030	1112.40	1356.58	1124.4189	680.39	200.00	0.0021	2.3613
Silicon	-	-	-	1.1900	1.1940	1.2933	1.8502	-	-	-	-		1.8200	-
Silver	0.0218	0.0200	0.0200	0.0000	0.0000	0.0000	0.0001	1258.7413	1251.0425	1094.8905	274.223		0.0001	0.0624
Sodium	824.1458	813.9063	825.2083	1.3633	1.3280	1.4567	1.8921	604.5079	620.5917	558.7457	436.137		2.1300	1190.1284
Strontium	4.9217	4.4666	4.8025	0.1685	0.1538	0.1703	0.2663	29.2087	32.0004	26.2225	18.037	60.00	0.2530	6.6343
Thallium	0.0164	0.0132	0.0138	0.0001	0.0001	0.0002	0.0002	114.7661	114.3648	86.3971	70.515	10000.00	0.0002	0.0161

Parameters	Average Fish Tissue Concentrations Fish Sample Stations			Average Baseline Water Concentration				Bioconcentration Factors					Predicted P90 Water Sample Concentrations	Predicted Tissue Residue
	BR1, BR8, BC1, BC2, BC3, ROC1 (mg/kg)	BC1, BC2, BC3, ROC1 (mg/kg)	Average BC1, BC2, BC3 (mg/kg)	BC2, BC4, BC6, BR8, BR6, OC1 (mg/L)	BC2, BC4, BC6, BR8, BR6 (mg/L)	BC2, BC4, BC6 (mg/L)	BC2 (mg/L)	BCF1 (L/kg)	BCF2 (L/kg)	BCF3 (L/kg)	BCF4 (L/kg)	ORNL RAIS BCF (L/kg)	BC2, BC6, BR6 (mg/L)	TP1 (mg/kg)
Tin	0.0420	0.0420	0.0500	0.0004	0.0004	0.0004	0.0005	109.0909	110.2941	103.8747	101.351		0.0005	0.0490
Titanium	1.2060	0.5788	0.6092	0.0099	0.0100	0.0112	0.0108	122.1720	120.6042	51.7203	56.4479		0.0102	0.5275
Uranium	0.0048	0.0035	0.0041	0.0003	0.0002	0.0003	0.0004	18.7135	21.2955	12.7301	10.7670	10.00	0.0004	0.0052
Vanadium	0.1765	0.0871	0.0852	0.0007	0.0007	0.0008	0.0007	252.1739	243.7472	109.6476	115.2365		0.0007	0.0769
Zinc	29.8438	28.2750	30.0708	0.0048	0.0043	0.0045	0.0163	6258.7382	6989.166	6334.9515	1850.5128	1000.00	0.0134	84.8883

F1 – stands for fish tissue concentration for scenario 1; BR1 – Bear River sample station 1; BR8 - Bear River sample station 8; BC1 - Bitter Creek sample station 1; BC2 - Bitter Creek sample station 2; BC3 - Bitter Creek sample station 3; BC4 - Bitter Creek sample station 4; BC6 - Bitter Creek sample station 6; ROC1 - Roosevelt Creek sample station 1; WBi – Average concentration of dissolved metal i in surface water; WPi – Predicted 90th percentile concentration of dissolved metal i in surface water; BCFi – Bioconcentration factor i; ORNL RAIS - Oak Ridge National Laboratory (ORNL). 2017. *Risk Assessment Information System Chemical Specific Parameters*. Oak Ridge National Laboratory. Available online at: https://rais.ornl.gov/cgi-bin/tools/TOXsearch. Last accessed on June 14, 2017

Table A17: Plant Tissue Residue Data

Constituent	Sample V33 (leaf) (mg/kg)	Sample 023 (leaf) (mg/kg)	Sample V38 (leaf) (mg/kg)	Sample V36 (leaf) (mg/kg)	026 (leaf) (mg/kg)	Sample 1 (leaf) (mg/kg)	Plot 22 (leaf) (mg/kg)	Mean (mg/kg)	Maximum (mg/kg)
Aluminum	54.534	20.9613	3.6226	6.2667	28.9168	28.0476	7.1852	21.3620	54.534
Antimony	0.02928	0.010272	0.001842	0.003564	0.014322	0.012614	0.00284	0.011	0.02928
Arsenic	0.37698	0.121659	0.01842	0.021087	0.328383	0.135044	0.050836	0.150	0.37698
Barium	16.141	6.003	22.165	29.492	2.141	6.270	6.816	12.718	29.4921
Beryllium	0.00256	0.00064	0.00031	0.00030	0.00102	0.00111	0.00028	0.0009	0.002562
Bismuth	0.00366	0.00321	0.00307	0.00297	0.00341	0.00371	0.00284	0.0033	0.00371
Boron	2.562	8.1213	11.9116	17.3151	9.5821	8.162	14.3988	10.293	17.3151
Cadmium	2.6535	1.06572	0.8903	0.7425	0.217899	1.57675	1.79204	1.277	2.6535
Calcium	8893.8	5489.1	6140	6623.1	8729.6	6195.7	6532	6943	8893.8
Chromium	0.24888	0.0963	0.05219	0.04752	0.11935	0.14469	0.0568	0.109	0.24888
Cobalt	0.48312	0.119733	0.11359	0.150282	0.42966	0.347627	0.113032	0.251	0.48312
Copper	4.2456	2.71887	5.4646	2.83041	1.01959	4.7859	3.2944	3.480	5.4646
Iron	139.446	65.805	27.63	26.433	84.227	83.846	30.672	65.437	139.446
Lead	0.138348	0.047829	0.011666	0.027027	0.065813	0.061957	0.019028	0.053	0.138348
Magnesium	1050.42	831.39	991.61	1092.96	1636.8	1291.08	661.72	1079	1636.8
Manganese	147.132	22.7268	48.506	68.31	235.972	89.04	39.76	93.064	235.972
Mercury	0.00366	0.004173	0.001842	0.002673	0.00341	0.004081	0.005396	0.004	0.005396
Molybdenum	0.0732	0.14445	0.13815	0.06534	0.04774	0.15582	0.1136	0.105	0.15582
Nickel	4.8678	1.78155	0.79206	0.18711	0.28644	3.07559	0.9514	1.706	4.8678
Phosphorus	695.4	921.27	1384.57	1395.9	941.16	1153.81	994	1069	1395.9
Potassium	4575	6741	4697.1	5643	4603.5	5713.4	6503.6	5497	6741
Selenium	0.4941	1.00152	0.04912	0.02673	0.28985	0.3339	1.28368	0.497	1.28368
Silver	0.00732	0.001605	0.001535	0.001485	0.001705	0.001855	0.00142	0.002	0.00732
Sodium	14.274	8.346	6.14	5.346	11.594	10.759	8.804	9.323	14.274
Strontium	36.966	18.618	20.5997	23.3145	38.533	20.7389	21.2432	25.716	38.533
Thallium	0.000732	0.000161	0.000154	0.000594	0.000341	0.000742	0.000568	0.00047	0.000742
Tin	0.01098	0.00642	0.00307	0.00297	0.00341	0.00371	0.00284	0.005	0.01098
Titanium	1.69824	0.72546	0.16271	0.27918	1.43902	1.04993	0.29536	0.807	1.69824
Uranium	0.001464	0.000963	0.000154	0.000149	0.001023	0.001113	0.00142	0.001	0.001464
Vanadium	0.16836	0.0642	0.01228	0.02079	0.09207	0.10759	0.02272	0.070	0.16836
Zinc	129.93	50.718	38.068	42.471	14.663	78.652	46.292	57.256	129.93

Table A17b: Estimated Root Zone Soil Concentration Based on Particulate Deposited Soil Mixing with Upper 20 Centimetres of Soil 95th Percentile Background Concentration

Chemicals (mg/kg)	Background (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Bitter Creek. Down Stream of TMF (mg/kg)	Road Between lower portal and Plant site(mg/kg)	Between Lower Portal and Bitter Creek (mg/kg)	Background Plus Deposition Bitter Creek. Down Stream of TMF (mg/kg)	Background Plus Deposition Road Between lower portal and Plant Site (mg/kg)	Background Plus Deposition Between Lower Portal and Bitter Creek (mg/kg)
Aluminum	29300	19900	85800	32800	1.58E+01	15.928089	17.31356	29315.808	29315.928	29317.314
Antimony	6.86	2.6	117	35	4.47E-03	4.01E-03	4.10E-03	6.864	6.864	6.864
Arsenic	69.52	27.6	793	788.4	4.56E-02	4.08E-02	4.18E-02	69.566	69.561	69.562
Barium	428.56	453.3	984	226.4	2.29E-01	2.36E-01	2.69E-01	428.789	428.796	428.829
Beryllium	0.6	0.57	1.38	1.5	3.28E-04	3.32E-04	3.73E-04	0.600	0.600	0.600
Bismuth	0.3275	0.546	19.2	10	3.56E-04	2.64E-04	2.88E-04	0.328	0.328	0.328
Boron	20	10	10.2	59	1.07E-02	1.07E-02	1.14E-02	20.011	20.011	20.011
Cadmium	1.097	0.82	22.78	26.4	8.77E-04	7.21E-04	7.53E-04	1.098	1.098	1.098
Calcium	19650	20460	17584	17440	1.04E+01	1.08E+01	1.23E+01	19660.379	19660.771	19662.269
Chromium	99.08	100.92	122	148.6	5.29E-02	5.45E-02	6.18E-02	99.133	99.134	99.142
Cobalt	22.27	18.5	26.6	29	1.18E-02	1.21E-02	1.34E-02	22.282	22.282	22.283
Copper	106.1	79.5	798.4	269.4	6.14E-02	5.96E-02	6.49E-02	106.161	106.160	106.165
Gallium	12.075	6.2	NA	NA	6.19E-03	6.37E-03	6.82E-03	12.081	12.081	12.082
Gold	0.014425	0.00702	NA	NA	7.39E-06	7.60E-06	8.10E-06	0.014	0.014	0.014
Iron	58150	45100	112620	79840	3.11E+01	3.17E+01	3.49E+01	58181.149	58181.660	58184.863
Lanthanum	13.375	14.96	10	5	7.02E-03	7.34E-03	8.44E-03	13.382	13.382	13.383
Lead	39.97	27.292	183.6	118.4	2.25E-02	2.21E-02	2.39E-02	39.992	39.992	39.994
Magnesium	29700	14500	20800	26720	1.55E+01	1.58E+01	1.68E+01	29715.515	29715.779	29716.790
Manganese	916	1068.4	1275	1632.4	4.93E-01	5.09E-01	5.87E-01	916.493	916.509	916.587
Mercury	0.08	0.05	105	140.5	1.60E-03	7.15E-04	5.79E-04	0.082	0.081	0.081
Molybdenum	30.98	14.04	4	5	1.59E-02	1.63E-02	1.73E-02	30.996	30.996	30.997
Nickel	52.57	50.1	62.4	78	2.80E-02	2.88E-02	3.24E-02	52.598	52.599	52.602
Phosphorus	2335	1358	1830	1680	1.22E+00	1.25E+00	1.34E+00	2336.220	2336.246	2336.343
Potassium	1650	2400	39180	4440	1.14E+00	1.04E+00	1.19E+00	1651.136	1651.036	1651.191

Chemicals (mg/kg)	Background (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Bitter Creek. Down Stream of TMF (mg/kg)	Road Between lower portal and Plant site(mg/kg)	Between Lower Portal and Bitter Creek (mg/kg)	Background Plus Deposition Bitter Creek. Down Stream of TMF (mg/kg)	Background Plus Deposition Road Between lower portal and Plant Site (mg/kg)	Background Plus Deposition Between Lower Portal and Bitter Creek (mg/kg)
Scandium	6.775	7.42	NA	NA	3.51E-03	3.69E-03	4.24E-03	6.779	6.779	6.779
Selenium	4.54	2.98	31.9	11.5	2.61E-03	2.53E-03	2.73E-03	4.543	4.543	4.543
Silver	1	0.869	28.8	2.94	7.17E-04	6.25E-04	6.71E-04	1.001	1.001	1.001
Sodium	612.5	832	6900	1194	3.70E-01	3.61E-01	4.18E-01	612.870	612.861	612.918
Strontium	96.85	71.9	134.8	151.2	5.16E-02	5.25E-02	5.76E-02	96.902	96.903	96.908
Sulfur	12075	5660	NA	NA	6.18E+00	6.36E+00	6.76E+00	12081.183	12081.355	12081.759
Tellurium	0.315	0.128	25	25	4.79E-04	3.02E-04	2.83E-04	0.315	0.315	0.315
Thallium	0.3	0.12	2.5	2.5	1.85E-04	1.71E-04	1.77E-04	0.3002	0.300	0.30018
Thorium	1.675	10.4	NA	NA	9.39E-04	1.17E-03	1.96E-03	1.676	1.676	1.677
Tin	0.58	0.3	10	10	4.24E-04	3.61E-04	3.71E-04	0.580	0.580	0.580
Titanium	2312.5	1680	3000	1650	1.22E+00	1.25E+00	1.37E+00	2313.719	2313.747	2313.868
Tungsten	4.025	1.7	10	10	2.19E-03	2.17E-03	2.28E-03	4.027	4.027	4.027
Uranium	1.208	1.364	7.5	10	7.36E-04	7.07E-04	7.99E-04	1.209	1.209	1.209
Vanadium	108.19	97.58	234	189	5.85E-02	5.95E-02	6.65E-02	108.248	108.249	108.256
Yttrium	NA	NA	7.1	9	1.02E-04	4.41E-05	3.50E-05	0.000	0.000	0.000
Zinc	143.67	97.6	2597	1633.6	1.01E-01	8.81E-02	9.28E-02	143.771	143.758	143.763

Table A17c: Predicted Root Zone Soil Concentration Based on Particulate Deposition Mixing with Upper 20 Centimetres of Soil Average Concentration

Chemicals (mg/kg)	Background (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Bitter Creek. Down Stream of TMF (mg/kg)	Road Between lower portal and Plant site(mg/kg)	Between Lower Portal and Bitter Creek (mg/kg)	Background Plus Deposition Bitter Creek. Down Stream of TMF (mg/kg)	Background Plus Deposition Road Between lower portal and Plant site (mg/kg)	Background Plus Deposition Between Lower Portal and Bitter Creek (mg/kg)
Aluminum	20133.33	14415.9	31126	24962.67	1.07E+01	10.897	11.920	20144.04	20144.2	20145.3
Antimony	2.90	2.34	72	24.77	2.10E-03	1.82E-03	1.93E-03	2.899	2.899	2.899
Arsenic	28.19	65.95	357	325.44	1.92E-02	1.83E-02	2.29E-02	28.212	28.211	28.215
Barium	181.43	255.67	368	154.98	9.77E-02	1.02E-01	1.21E-01	181.527	181.532	181.550
Beryllium	0.41	0.39	1	0.58	2.19E-04	2.24E-04	2.52E-04	0.410	0.410	0.410
Bismuth	0.14	0.71	6	4.38	1.41E-04	1.20E-04	1.68E-04	0.138	0.138	0.139
Boron	20.00	20.00	9	36.11	1.06E-02	1.10E-02	1.24E-02	20.011	20.011	20.012
Cadmium	0.506	0.91	13	10.43	4.12E-04	3.50E-04	4.05E-04	0.50634	0.5063	0.5063
Calcium	10266.67	8389.47	10490	8487.98	5.41E+00	5.56E+00	6.17E+00	10272.075	10272.228	10272.83
Chromium	43.34	60.55	54	69.00	2.33E-02	2.43E-02	2.88E-02	43.368	43.369	43.373
Cobalt	14.37	12.68	19	21.35	7.67E-03	7.85E-03	8.76E-03	14.382	14.382	14.383
Copper	75.23	59.34	439	171.47	4.26E-02	4.20E-02	4.60E-02	75.272	75.271	75.275
Gallium	8.15	5.18	NA	NA	4.18E-03	4.33E-03	4.71E-03	8.154	8.154	8.155
Gold	0.00	0.01	NA	NA	2.40E-06	2.53E-06	2.92E-06	0.005	0.005	0.005
Iron	37416.67	30268.4	70190	66129.2	2.01E+01	2.04E+01	2.26E+01	37436.79	37437.11	37439.26
Lanthanum	6.83	10.64	6	5.49	3.63E-03	3.85E-03	4.64E-03	6.837	6.837	6.838
Lead	16.10	17.11	91	60.13	9.29E-03	9.17E-03	1.04E-02	16.111	16.111	16.112
Magnesium	19066.67	10563.1	10816	20049.1	9.97E+00	1.02E+01	1.09E+01	19076.64	19076.834	19077.58
Manganese	581.00	701.42	605	869.18	3.10E-01	3.23E-01	3.74E-01	581.31	581.323	581.374
Mercury	0.0387	0.03	25	65.86	5.96E-04	2.69E-04	2.20E-04	0.039	0.039	0.039
Molybdenum	11.37	9.26	2	2.44	5.88E-03	6.11E-03	6.79E-03	11.372	11.372	11.373
Nickel	32.43	28.55	25	26.64	1.70E-02	1.76E-02	1.97E-02	32.447	32.447	32.449
Phosphorus	1263.33	1050.00	1484	1318.64	6.69E-01	6.86E-01	7.62E-01	1264.0	1264.019	1264.10
Potassium	1000.00	1842.11	13626	4627.79	6.40E-01	6.17E-01	7.45E-01	1000.64	1000.617	1000.75
Scandium	5.12	4.75	NA	NA	2.64E-03	2.76E-03	3.11E-03	5.12	5.119	5.120
Selenium	2.20	3.18	17	7.35	1.30E-03	1.29E-03	1.51E-03	2.197	2.197	2.198

Chemicals (mg/kg)	Background (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Bitter Creek. Down Stream of TMF (mg/kg)	Road Between lower portal and Plant site(mg/kg)	Between Lower Portal and Bitter Creek (mg/kg)	Background Plus Deposition Bitter Creek. Down Stream of TMF (mg/kg)	Background Plus Deposition Road Between lower portal and Plant site (mg/kg)	Background Plus Deposition Between Lower Portal and Bitter Creek (mg/kg)
Silver	0.51	0.70	16	1.58	3.76E-04	3.29E-04	3.72E-04	0.508	0.508	0.508
Sodium	415.00	413.16	1960	2105.26	2.40E-01	2.36E-01	2.64E-01	415.240	415.236	415.264
Strontium	50.67	38.82	54	71.23	2.69E-02	2.75E-02	3.02E-02	50.694	50.694	50.697
Sulfur	4616.67	1763.16	NA	NA	2.36E+00	2.42E+00	2.54E+00	4619.027	4619.085	4619.208
Tellurium	0.10	0.10	25	25.00	3.68E-04	1.90E-04	1.69E-04	0.099	0.099	0.099
Thallium	0.13	0.11	3	1.35	9.05E-05	7.94E-05	8.51E-05	0.128	0.128	0.128
Thorium	1.15	3.40	NA	NA	6.13E-04	6.90E-04	9.47E-04	1.151	1.151	1.151
Tin	0.32	0.24	10	13.18	3.13E-04	2.36E-04	2.41E-04	0.323	0.323	0.323
Titanium	1093.33	794.74	1623	793.60	5.78E-01	5.90E-01	6.47E-01	1093.911	1093.924	1093.981
Tungsten	1.00	1.88	4	8.53	6.03E-04	6.02E-04	7.36E-04	1.001	1.001	1.001
Uranium	0.57	0.84	8	6.57	3.87E-04	3.57E-04	4.11E-04	0.573	0.573	0.573
Vanadium	71.82	66.92	101	129.23	3.85E-02	3.94E-02	4.42E-02	71.861	71.862	71.866
Yttrium	NA	NA	2	4.79	4.25E-05	1.83E-05	1.45E-05	0.00004	0.00002	0.00001
Zinc	89.67	97.15	987	518.91	5.60E-02	5.30E-02	5.93E-02	89.734	89.731	89.737

Table A17d: Predicted Plant Tissue Concentrations

Parameter	Dry Soil (mg/kg)			Dry Weight Plant (mg/kg)		Wet Weight Plant (mg/kg)		Site Specific BCF Dry Dry Plant/ Dry Soil	ORNL RAIS Plant BCF	ECO-SSL Plant BCF*	Predicted Plant Concentrations (ORNL RAIS)	Predicted Plant Concentration (ECO-SSL)	Predicted Dry Weight Plant Average Soil Concentration Root Zone exposure	Predicted Dry Weight Plant P90 Soil Concentration Root Zone exposure
	Baseline Average	Predicted Average	Predicted P90	Average	Maximum	Average	Maximum	(unit less)	(unit less)	(unit less)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aluminum	20133.3	20145.3	29317.314	61.843	149.000	21.362	54.534	0.003	0.004	-	117	-	61.879	90.053
Antimony	2.897	2.899	6.864	0.031	0.080	0.011	0.029	0.011	0.2	0.035	1.48	0.26	0.031	0.073
Arsenic	28.193	28.215	69.562	0.435	1.030	0.150	0.377	0.015	0.04	0.038	2.92	2.7	0.435	1.074
Barium	181.430	181.550	428.829	40.211	99.300	12.718	29.492	0.222		-	-	-	40.238	95.044
Beryllium	0.410	0.410	0.600	0.003	0.007	0.001	0.003	0.006	0.01	-	-	-	0.003	0.004
Bismuth	0.138	0.139	0.328	0.010	0.010	0.003	0.004	0.072	-	-	-	-	0.010	0.024
Boron	20.000	20.012	20.011	32.886	58.300	10.293	17.315	1.644	-	-	-	-	32.906	32.904
Cadmium	0.506	0.506	1.098	3.881	7.250	1.277	2.654	7.672	0.5	0.54	0.67	0.73	3.884	8.423
Chromium	43.344	43.373	99.142	0.321	0.680	0.109	0.249	0.007	0.0075	0.041	0.82	4.5	0.322	0.735
Cobalt	14.374	14.383	22.283	0.738	1.320	0.251	0.483	0.051	0.02	0.0075	0.46	0.17	0.738	1.144
Copper	75.229	75.275	106.165	10.699	17.800	3.480	5.465	0.142	0.4	-	-	-	10.705	15.098
Gallium	8.150	8.155	12.082	-	-	-	-	-	-	-	-	-	-	-
Gold	0.005	0.005	0.014	-	-	-	-	-	-	-	-	-	-	-
Iron	37416.7	37439.259	58184.863	192.286	381.000	65.437	139.446	0.005	0.004	-	228.2	-	192.402	299.014
Lead	16.102	16.112	39.994	0.155	0.378	0.053	0.138	0.010	0.045	0.051	1.92	2.2	0.155	0.384
Manganese	581.000	581.374	916.587	276.114	692.000	93.064	235.972	0.475	0.25	0.079	229.8	72.6	276.292	435.599
Mercury	0.039	0.039	0.081	0.011	0.019	0.004	0.005	0.288	0.9	-	0.083	-	0.011	0.023
Nickel	32.430	32.449	52.602	4.934	13.300	1.706	4.868	0.152	0.6	-	-	-	4.937	8.004
Selenium	2.196	2.198	4.543	1.570	4.520	0.497	1.284	0.715	0.025	0.60	0.12	2.8	1.571	3.248
Silver	0.507	0.508	1.001	0.007	0.020	0.002	0.007	0.014	0.4	-	-	-	0.007	0.014
Strontium	50.667	50.697	96.908	78.329	113.000	25.716	38.533	1.546	2.5	-	-	-	78.375	149.816
Tellurium	0.098	0.099	0.315	-	-	-	-	-	-	-	-	-	-	-
Thallium	0.128	0.128	0.300	0.001	0.002	0.000	0.001	0.011	0.004	-	0.0013	-	0.001	0.003
Tin	0.323	0.323	0.580	0.014	0.030	0.005	0.011	0.044	0.03				0.014	0.026
Titanium	1093.33	1093.981	2313.868	2.351	4.640	0.807	1.698	0.002	0.0055	-	12.4	-	2.353	4.976
Tungsten	1.000	1.001	4.027	-	-	-	-	-	0.45	-	-	-	-	-
Uranium	0.573	0.573	1.209	0.003	0.005	0.001	0.001	0.005	0.0085	-	-	-	0.003	0.006
Vanadium	71.822	71.866	108.256	0.201	0.460	0.070	0.168	0.003	0.0055	-	0.61	-	0.202	0.304
Zinc	89.678	89.737	143.763	171.143	355.000	57.256	129.930	1.908	0.99	0.42	234.83	100.0	171.256	274.360

BCF - Biconcentration Factor; ORNL RAIS - Oak Ridge National Laboratory Risk Assessment Information System; Eco- SSL - Ecological Soil Screening Level; P90 - 90th Percentile

Oak Ridge National Laboratory (ORNL). 2017. Risk Assessment Information System Chemical Specific Parameters. Oak Ridge National Laboratory. Available online at: https://rais.ornl.gov/cgi-bin/tools/TOX_search. Last accessed on June 14, 2017

USEPA. 2007. Attachment 4-1 Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs) Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLsd.

Table A18: Soil Invertebrate Tissue Residue Data

Constituent	Baseline Soil Concentrations (mg/kg)	Predicted Soil Concentrations (mg/kg)	Soil to Soil Invertebrate BCFs (USDOE SRS 2012)	Baseline Soil Invertebrates (mg/kg)	Predicted Soil Invertebrates (mg/kg)
Aluminum	29300	29473.14	7.50E-02	2197.5	2210
Antimony	6.86	6.90	5.00E-02	0.34	0.35
Arsenic	69.5	69.94	6.60E-03	0.46	0.46
Barium	429	431.25	7.50E-03	3.2	3.2
Bismuth	0.328	0.3304	1.00E+00	0.33	0.33
Boron	20	20.1141	1.00E+00	20.0	20.11
Cadmium	1.1	1.105	1.10E+01	12.1	12.1
Chromium	99.1	99.70	1.60E-01	15.9	16.0
Cobalt	22.3	22.40	1.00E+01	22.3	22.4
Copper	106.1	106.75	0.16	17.0	17
Iron	58150.0	58498.63	1.00E+00	58150.0	58499
Lead	40	40.21	16.88	674.7	678.7
Manganese	916	921.87	2.00E-02	18.3	18.4
Mercury	0.08	0.086	3.40E-01	0.027	0.029
Nickel	52.6	52.89	2.30E-01	12.1	12.2
Selenium	4.54	4.57	7.60E-01	3.5	3.5
Strontium*	95.6	97.43	4.00E-03	0.38	0.39
Tellurium	0.315	0.318	1.00E+00	0.32	0.32
Thallium	0.3	0.302	1.00E+00	0.30	0.30
Titanium	2312.5	2326.18	1.00E+00	2312.5	2326
Uranium*	1.21	1.216	0.3	0.36	0.37
Vanadium	108.2	108.85	1.30E-01	14.1	14.2
Zinc	143.7	144.60	1.80E+01	258.6	260.3

BCF – Bioconcentration Factor

All BCFs were acquired from USDOE-SRS (2012), with the exception of those noted with * which were acquired from Robertson et al (2003).

Reference: 1) United States Department of (USDOE) Savannah River Site (SRS). 2012. Environmental Compliance and Area Completion Projects Regulatory Document Handbook. ERD-AG-003 Revision 17. Module 7 - Ecological Risk Module, P.7.4. Bioaccumulation and Bioconcentration Screening; 2) Robertson, D.E., Cataldo, D.A., Napier, B.A., Krupka, K.M., and Sasser, L.B. 2003. Literature Review and Assessment of Plant and Animal Transfer Factors Used in Performance Assessment Modeling, NUREG/CR6825, PNNL14321. Pacific Northwest National Laboratory, Richland, WA.

Table A19: Toxicity Reference Values

COPCs	Age Group	Non-carcinogenic TRVs				Carcinogenic TRVs				Dermal		Target
		Oral TDI or RfD (mg/kg-day)	Source	Inhalation TC/ RfC (mg/m^3)	Source	Oral SF (mg/kg-day)$^{-1}$	Source	Inhalation SF (mg/kg-day)$^{-1}$	Source	RAF	Source	Organ
Aluminum		1.00E+00	a	5.0E-03	a	NA	NA	NA	NA	0.01	b	Lung/ Neuro
Antimony		6.0E-03	d	1.2E-02	e	NA	NA	NA	NA	0.01	b	Blood
Arsenic		1.00E-03	d	1.0E-03	d	1.80E+00	c	2.70E+01	c	0.03	c	Skin
Barium		2.00E-01	c	1.0E-03	d	NA	NA	NA	NA	0.1	c	Kidney
Bismuth		NA	NA	NA	NA	NA	NA	NA	NA	0.01	b	
Boron		2.00E-01	b	4.0E-01	e	NA	NA	NA	NA	0.01	c	Develop
Cadmium		1.00E-03	c	2.0E-03	e	NA	NA	4.20E+01	c	0.01	c	Kidney
Chromium (Total)		1.00E-03	c	6.0E-02	d	NA	NA	4.60E+01	c	0.10	c	Liver/ Gastro
Cobalt		1.40E-03	d	5.0E-04	d	NA	NA	NA	NA	0.01	b	Heart/ Lung
Copper	infant	9.10E-02	c	1.0E-03	d						b	Liver/ Gastro
	toddler	9.10E-02	c	1.0E-03	d						b	Liver/ Gastro
	child	1.10E-01	c	1.0E-03	d						b	Liver/ Gastro
	teen	1.26E-01	c	1.0E-03	d						b	Liver/ Gastro
	adult	1.41E-01	c	1.0E-03	d	NA	NA	NA	NA	0.06	b	Liver/ Gastro
Iron		7.00E-01	a	1.4E+00	e	NA	NA	NA	NA	0.01	b	Gastro/ Heart
Lead	infant	0.0006	j	2.2E-03	e	NA	NA	NA	NA	0.01	b	Neuro
	toddler	0.0006	j	1.2E-03	e	NA	NA	NA	NA	0.01	b	Neuro
	child	0.0006	j	1.4E-03	e	NA	NA	NA	NA	0.01	b	Neuro
	teen	1.50E-03	j	5.74E-03	e	NA	NA	NA	NA	0.01	b	Neuro
	adult	1.50E-03	j	6.4E-03	e	NA	NA	NA	NA	0.01	b	Neuro
Manganese	infant	0.136	c	5.1E-01	e	NA	NA	NA	NA	0.01	b	Neuro
	toddler	0.136	c	2.7E-01	e	NA	NA	NA	NA	0.01	b	Neuro
	child	0.122	c	2.8E-01	e	NA	NA	NA	NA	0.01	b	Neuro
	teen	0.142	c	5.4E-01	e	NA	NA	NA	NA	0.01	b	Neuro

COPCs	Age Group	Non-carcinogenic TRVs		Inhalation TC/ RfC (mg/m^3)	Source	Carcinogenic TRVs				Dermal		Target
		Oral TDI or RfD (mg/kg-day)	Source			Oral SF (mg/kg-day)$^{-1}$	Source	Inhalation SF (mg/kg-day)$^{-1}$	Source	RAF	Source	Organ
	adult	0.156	c	6.6E-01	e	NA	NA	NA	NA	0.01	b	Neuro
Mercury (Inorganic)		3.00E-04	c	3.0E-04	b	NA	NA	NA	NA	1.00	a	Kidney
Methyl Mercury	infant	2.00E-04	c			NA	NA	NA	NA	0.06	c	Develop/ Neuro
	toddler	2.00E-04	c			NA	NA	NA	NA	0.06	c	Develop/ Neuro
	child	2.00E-04	c			NA	NA	NA	NA	0.06	c	Develop/ Neuro
	teen	4.70E-04	c			NA	NA	NA	NA	0.06	c	Develop/ Neuro
	adult	4.70E-04	c			NA	NA	NA	NA	0.06	c	Develop/ Neuro
Nickel (Soluble)		1.10E-02	c	2.0E-05	c	NA	NA	3.00E+00	c	0.09	c	Respro
Selenium	infant	0.0055	c	2.1E-02	e	NA	NA	NA	NA	0.01	c	Skin/ Blood
	toddler	0.0062	c	1.2E-02	e	NA	NA	NA	NA	0.01	c	Skin/ Blood
	child	0.0063	c	1.4E-02	e	NA	NA	NA	NA	0.01	c	Skin/ Blood
	teen	0.0062	c	2.4E-02	e	NA	NA	NA	NA	0.01	c	Skin/ Blood
	adult	0.0057	c	2.4E-02	e	NA	NA	NA	NA	0.01	c	Skin/ Blood
Strontium		6.00E-01	b	1.2E+00	e	NA	NA	NA	NA	0.01	c	Musculoskeletal
Tellurium		NA	NA	NA	NA	NA	NA	NA	NA	0.01	b	
Thallium		7.00E-05	b	1.4E-04	e	NA	NA	NA	NA	0.01	b	Neuro
Titanium		3.00E+00	i	6.0E+00	e	NA	NA	NA	NA	0.01	c	
Uranium		6.00E-04	c	8.0E-04	f	NA	NA	NA	NA	0.1	c	
Vanadium		5.00E-03	b	1.0E-04	f	NA	NA	NA	NA	0.01	b	Skin
Zinc	infant	4.90E-01	c	1.8E+00	e	NA	NA	NA	NA	0.10	c	Body weight
	toddler	4.80E-01	c	9.5E-01	e	NA	NA	NA	NA	0.10	c	Body weight
	child	4.80E-01	c	1.1E+00	e	NA	NA	NA	NA	0.10	c	Body weight
	teen	5.40E-01	c	2.1E+00	e	NA	NA	NA	NA	0.10	c	Body weight
	adult	5.70E-01	c	2.4E+00	e	NA	NA	NA	NA	0.10	c	Body weight

Notes:

1. The selection of Toxicity reference values (TRVs) was based on a review of the recommended sources according to the hierarchy outlined in BC MOE Technical Guidance on Contaminated Sites No. 7 (November 2015). TRVs were compiled prior June 2017.
2. Abbreviations: COPC = Chemical of Potential Concern; IARC = International Agency for Research on Cancer; US EPA = United States Environmental Protection Agency; RfD = Reference Dose; SF = Slope Factor; RfC = Reference Concentration; UR = Unit Risk; RAF = relative absorption factor; IRIS = Integrated Risk Information System; NA = not listed, not assessed, or insufficient data to assess,
3. RfC to TDI conversion were based on the equation in Health Canada (2005) using 1.4 m^3/hour inhalation rate and 70.7 kg body weight for the worker receptor (adult) evaluated in this risk assessment.

4 Chromium (VI) TRVs used for chromium (total) for cancer endpoint

Sources a - PPRTV (Regional Screening Levels for Chemical Contaminants at Superfund Sites), 2017. United States Environmental Protection Agency. Waste and Cleanup Risk Assessment. https://hhpprtv.ornl.gov/quickview/pprtv.php; b - IRIS (Integrated Risk Information System), 2017. Available online at: https://www.epa.gov/iris. Last accessed on Aug. 30, 2017; c - Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada Part II: Toxicological Reference Values (TRVs) and Chemical-Specific Factors, Version 2.0. September 2010; d - RIVM = Netherlands National Institute of Public Health and the Environment, 2001. http://www.rivm.nl/bibliotheek/rapporten/711701025.pdf; e - Based on Oral TRV; f - ATSDR (Agency for Toxic Substances and Disease Registry, 2017. Toxicological Profiles. http://www.atsdr.cdc.gov/toxprofiles/index.asp. Last accessed June 2017; g - Haber LT, Bates HK, Allen BC, Vincent MJ, Oler AR. 2017. Derivation of an oral toxicity reference value for nickel. Regulatory Toxicology and Pharmacology. 87:S1-S18; h - HEAST (Health Effects Assessment Summary Tables, US EPA). 2017. Available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=2877. Last accessed on Aug. 30, 2017; i = NSF (NSF International), 2017. Cited in International Toxicity Estimates for Risk Assessment (ITER). Available online at: https://iter.ctc.com/publicURL/p_report_l2_non.cfm?crn=7440-32-6&type=NCO. Last accessed on Aug. 30, 2017; j - Richardson M., and Wilson R. 2012. Proposed Toxicological Reference Values and Risk-based Soil Concentrations for Protection of Human Health from Lead (Pb) at Federal Contaminated Sites. RPIC Federal Contaminated Sites National Workshop, April 30 – May 3. Toronto.

Attachment B
Summary Statistics Tables

Table B1: Summary Statistics for Baseline Soils (Local Background)

Constituent	Count	Minimum	Mean	Median	75 Percentile	90 Percentile	95 Percentile	Maximum
Aluminum	6	9700	20133.33	20950	27225	29000	29300	29600
Antimony	27	0.32	2.90	2.5	3.6	5.06	6.86	8.06
Arsenic	27	0.9	28.19	21.5	31.1	59.64	69.52	124
Barium	27	49.1	181.43	107	178.5	306.4	428.56	1238.8
Beryllium	21	0.2	0.41	0.4	0.5	0.6	0.6	0.9
Bismuth	6	0.03	0.14	0.10	0.18	0.29	0.328	0.37
Boron	6	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Cadmium	27	0.03	0.51	0.45	0.73	0.92	1.10	1.36
Calcium	6	1300.00	10266.67	8250.00	17550.00	19600.00	19650.00	19700.00
Chromium	27	8.3	43.34	29	62.7	77.22	99.08	146.5
Cobalt	27	5.3	14.37	14.1	15.6	19.14	22.27	29
Copper	27	1.59	75.23	72	86.395	101.06	106.1	194
Gallium	6	3.7	8.15	8.45	10.1	11.55	12.075	12.6
Gold	6	0.0003	0.00	0.00095	0.00715	0.01265	0.014425	0.0162
Iron	6	22700	37416.67	36200	40625	52700	58150	63600
Lanthanum	6	3	6.83	5.8	6.575	11.15	13.375	15.6
Lead	27	1.01	16.10	12.8	22.25	30.82	39.97	42.7
Magnesium	6	8700	19066.67	19450	26400	29000	29700	30400
Manganese	6	201	581.00	608.5	677	838	916	994
Mercury	27	0	0.04	0.05	0.06	0.072	0.08	0.08
Molybdenum	27	0.66	11.37	4.7	9.55	20.12	30.98	122.9
Nickel	27	4.2	32.43	30.3	44.4	50.22	52.57	55.4
Phosphorus	6	440	1263.33	1115	1187.5	1960	2335	2710
Potassium	6	400	1000.00	950	1425	1600	1650	1700
Scandium	6	2.1	5.12	5.6	6.575	6.75	6.775	6.8
Selenium	27	0.1	2.20	1.8	3	3.62	4.54	8.3
Silver	27	0.006	0.51	0.5	0.625	0.94	1	1.1
Sodium	6	310	415.00	360	467.5	575	612.5	650
Strontium	6	16.3	50.67	44.8	70.7	90.4	96.85	103.3
Sulfur	6	800	4616.67	2800	5425	10150	12075	14000
Tellurium	6	0.02	0.10	0.045	0.0575	0.23	0.315	0.4
Thallium	27	0.02	0.13	0.1	0.2	0.3	0.3	0.4
Thorium	6	0.6	1.15	1.15	1.275	1.55	1.675	1.8
Tin	21	0.2	0.32	0.3	0.3	0.46	0.58	0.7
Titanium	6	50	1093.33	1135	1285	1985	2312.5	2640
Tungsten	6	0.1	1.00	0.15	0.2	2.75	4.025	5.3
Uranium	27	0.1	0.57	0.5	0.58	1.108	1.208	1.92
Vanadium	27	11	71.82	70	82.6	97.26	108.19	115
Zinc	27	33.6	89.68	85	100	134.4	143.67	242

Units = mg/kg

Table B2: Summary Statistics for Surface Water Sampling Station AC02 in American Creek

Constituent	All										
	Mean	Std. Dev.	Min.	5th Perc.	25th Perc.	Median	75th Perc.	90th Perc.	95th Perc.	Max.	Count
Field pH	7.77	0.329	7.33	7.34	7.54	7.7	8.16	8.23	8.26	8.27	16
Conductivity	106	32.5	66.3	71.4	81.6	99.5	130	158	161	161	19
Hardness CaCO3	50	15.8	30.7	32.6	37.5	46.6	61.1	76	77.1	78.1	19
Total Dissolved Solids	72.6	19.7	47	47.9	58	68	91	96.8	102	116	19
Total Suspended Solids	25.7	28.6	3	3	7.1	14.4	37.8	59.5	72.4	112	19
Turbidity	18.9	32.8	0.15	0.177	2.2	11	I've	33	48.2	146	19
Alkalinity-Total CaCO3	40.7	11.7	25.6	27.3	31.2	39	51.3	57.5	57.9	60.8	19
Acidity (as CaCO3)	1.52	0.388	1	1.09	1.2	1.6	1.75	1.9	1.96	2.5	19
Chloride Cl	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	19
Fluoride F	0.0431	0.0111	0.029	0.0317	0.0355	0.041	0.0455	0.0604	0.0625	0.067	19
Bromide Br	0.05	1.43E-17	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	19
Sulphate SO4	12.6	4.24	7.3	7.71	9.49	11.5	15	19.4	19.8	20.5	19
Nitrate Nitrogen N	0.113	0.0919	0.0249	0.0279	0.0345	0.0722	0.167	0.23	0.271	0.33	19
Nitrite Nitrogen N	0.001	4.46E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	19
Total Nitrogen	0.102	0.102	0.03	0.0372	0.066	0.102	0.138	0.16	0.167	0.174	2
Ammonia Nitrogen N	0.005	8.91E-19	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	19
Ortho-Phosphate	0.00117	0.000481	0.001	0.001	0.001	0.001	0.00105	0.00132	0.00192	0.003	19
Phosphorus (P)-Total	0.077	0.105	0.002	0.00236	0.0153	0.0377	0.0619	0.3	0.3	0.3	19
Total Organic Carbon	0.526	0.0663	0.5	0.5	0.5	0.5	0.5	0.6	0.685	0.73	19
Dissolved Organic Carbon	0.593	0.157	0.5	0.5	0.5	0.5	0.625	0.784	0.831	1.11	19
Aluminum T-Al	1.08	1.53	0.0079	0.0107	0.122	0.571	1.3	1.9	2.86	6.67	19
Aluminum D-Al	0.0295	0.018	0.0041	0.00491	0.013	0.0302	0.0412	0.0528	0.0565	0.0622	19
Antimony T-Sb	0.000451	0.0000984	0.00027	0.000315	0.00036	0.0005	0.0005	0.0005	0.000518	0.00068	19
Antimony D-Sb	0.000413	0.000121	0.0002	0.000218	0.0003	0.0005	0.0005	0.0005	0.0005	0.0005	19
Arsenic T-As	0.000964	0.000459	0.00064	0.00064	0.0007	0.00074	0.00107	0.0014	0.00167	0.00252	19
Arsenic D-As	0.000532	0.000107	0.00033	0.000375	0.0005	0.0005	0.0006	0.000678	0.000711	0.00072	19
Barium T-Ba	0.114	0.0338	0.088	0.0889	0.0996	0.105	0.119	0.128	0.141	0.243	19
Barium D-Ba	0.0849	0.0238	0.0575	0.0578	0.068	0.075	0.0988	0.123	0.129	0.13	19
Beryllium T-Be	0.000668	0.000446	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	19
Beryllium D-Be	0.000668	0.000446	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	19
Bismuth T-Bi	0.000125	0.000168	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	19

Constituent	All										
	Mean	Std. Dev.	Min.	5th Perc.	25th Perc.	Median	75th Perc.	90th Perc.	95th Perc.	Max.	Count
Bismuth D-Bi	0.000121	0.000169	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	19
Boron T-B	0.0677	0.0435	0.01	0.01	0.0135	0.1	0.1	0.1	0.1	0.1	19
Boron D-B	0.0673	0.044	0.01	0.01	0.012	0.1	0.1	0.1	0.1	0.1	19
Cadmium T-Cd	0.0000245	0.0000257	0.000005	0.000005	0.0000073	0.0000135	0.0000286	0.0000506	0.0000682	0.000106	19
Cadmium D-Cd	0.0000147	0.00000363	0.000005	0.0000095	0.0000124	0.000017	0.000017	0.000017	0.000017	0.000017	19
Calcium T-Ca	18.3	5.63	11.6	12	13.8	17	22.3	26.9	27.8	28.4	19
Calcium D-Ca	18.1	5.74	11.2	11.8	13.5	16.8	22.1	27.6	28.1	28.4	19
Chromium T-Cr	0.000727	0.000378	0.0001	0.000127	0.000345	0.001	0.001	0.001	0.001	0.001	19
Chromium D-Cr	0.000668	0.000446	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	19
Cobalt T-Co	0.000547	0.00056	0.0001	0.000127	0.0003	0.0003	0.000605	0.000888	0.00123	0.00261	19
Cobalt D-Co	0.000226	0.0000991	0.0001	0.0001	0.0001	0.0003	0.0003	0.0003	0.0003	0.0003	19
Copper T-Cu	0.00225	0.00315	0.0005	0.000608	0.001	0.00104	0.00235	0.00296	0.00458	0.0148	19
Copper D-Cu	0.000719	0.000378	0.0002	0.0002	0.00025	0.001	0.001	0.001	0.001	0.001	19
Iron T-Fe	1.1	1.48	0.01	0.028	0.161	0.525	1.32	2.09	3	6.33	19
Iron D-Fe	0.0272	0.00777	0.01	0.01	0.0285	0.03	0.03	0.0312	0.0328	0.04	19
Lead T-Pb	0.0012	0.00161	0.00005	0.00028	0.0005	0.00055	0.00135	0.00181	0.00279	0.00742	19
Lead D-Pb	0.000337	0.00022	0.00005	0.00005	0.000057	0.0005	0.0005	0.0005	0.0005	0.0005	19
Magnesium T-Mg	1.56	0.503	1.24	1.24	1.34	1.43	1.6	1.69	1.89	3.54	19
Magnesium D-Mg	1.16	0.344	0.677	0.735	0.901	1.11	1.43	1.68	1.7	1.72	19
Manganese T-Mn	0.0464	0.0624	0.00093	0.000966	0.00819	0.022	0.0558	0.0866	0.121	0.271	19
Manganese D-Mn	0.00529	0.0042	0.00068	0.000689	0.00197	0.00475	0.00687	0.0119	0.0135	0.0137	19
Mercury T-Hg	0.00000616	0.00000234	0.000005	0.000005	0.000005	0.000005	0.000005	0.00001	0.0000102	0.000012	19
Mercury D-Hg	0.00000579	0.00000187	0.000005	0.000005	0.000005	0.000005	0.000005	0.00001	0.00001	0.00001	19
Molybdenum T-Mo	0.000861	0.000199	0.000494	0.000512	0.000708	0.001	0.001	0.001	0.001	0.001	19
Molybdenum D-Mo	0.000838	0.000227	0.000426	0.000449	0.00065	0.001	0.001	0.001	0.001	0.001	19
Nickel T-Ni	0.000817	0.000246	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.001	0.001	19
Nickel D-Ni	0.000816	0.000248	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.001	0.001	19
Selenium T-Se	0.00023	0.0000773	0.000146	0.00015	0.000162	0.00021	0.000304	0.000338	0.000358	0.000376	19
Selenium D-Se	0.000209	0.0000914	0.0001	0.000114	0.000137	0.000174	0.000281	0.00034	0.000365	0.000373	19
Silicon T-Si	2.85	2.46	1.48	1.52	1.56	2.18	3.03	4.05	5.23	12.3	19
Silicon D-Si	1.06	0.33	0.615	0.68	0.778	0.973	1.36	1.49	1.56	1.59	19

Constituent	All										
	Mean	Std. Dev.	Min.	5th Perc.	25th Perc.	Median	75th Perc.	90th Perc.	95th Perc.	Max.	Count
Silver T-Ag	0.0000261	0.0000272	0.00001	0.00001	0.00002	0.00002	0.000023	0.0000306	0.0000433	0.000136	19
Silver D-Ag	0.0000163	0.00000496	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	19
Sodium T-Na	1.51	0.666	0.521	0.535	0.758	2	2	2	2	2	19
Sodium D-Na	1.48	0.712	0.35	0.39	0.702	2	2	2	2	2	19
Strontium T-Sr	0.108	0.031	0.0681	0.0684	0.0846	0.107	0.133	0.155	0.155	0.157	19
Strontium D-Sr	0.106	0.0321	0.0647	0.0652	0.0818	0.102	0.129	0.153	0.154	0.164	19
Thallium T-Tl	0.000132	0.0000912	0.00001	0.00001	0.0000205	0.0002	0.0002	0.0002	0.0002	0.0002	19
Thallium D-Tl	0.00013	0.0000942	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	19
Tin T-Sn	0.000344	0.000201	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	18
Tin D-Sn	0.000348	0.000196	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	18
Titanium T-Ti	0.0337	0.0395	0.0003	0.00719	0.01	0.019	0.041	0.0612	0.0735	0.177	19
Titanium D-Ti	0.00798	0.00401	0.0003	0.0003	0.01	0.01	0.01	0.01	0.01	0.01	19
Uranium T-U	0.000159	0.0000563	0.000072	0.0000756	0.000096	0.0002	0.0002	0.0002	0.0002	0.0002	19
Uranium D-U	0.000148	0.0000712	0.000036	0.0000369	0.000068	0.0002	0.0002	0.0002	0.0002	0.0002	19
Vanadium T-V	0.0028	0.00299	0.0005	0.0005	0.000615	0.0017	0.00358	0.00511	0.00713	0.0128	19
Vanadium D-V	0.000579	0.000187	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	19
Zinc T-Zn	0.00655	0.00466	0.003	0.003	0.005	0.005	0.00625	0.0089	0.0126	0.024	19
Zinc D-Zn	0.00357	0.00192	0.001	0.001	0.00115	0.005	0.005	0.005	0.005	0.005	19

Units = mg/L

Table B3: Summary Statistics for Surface Water Sampling Station BC02 in Bitter Creek

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.94	0.405	7.05	7.39	7.7	7.89	8.27	8.48	8.5	8.65	41
Conductivity	196	100	78	81.3	104	167	290	346	366	375	63
Hardness CaCO3	92.9	52.6	29	35.2	47.8	77	133	177	195	218	64
Total Dissolved Solids	131	69.4	43	50.3	68.9	118	186	230	237	350	64
Total Suspended Solids	268	306	1	1	23.8	149	387	611	873	1340	64
Turbidity	197	253	0.4	1.23	20	129	267	472	559	1500	63
Alkalinity-Total CaCO3	65.9	26.9	28.4	33.5	43.4	59.2	94.7	105	110	111	64
Acidity (as CaCO3)	2.38	2.18	0.1	1	1	1.4	2.98	5.72	7	12	58
Chloride Cl	0.525	0.116	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.03	21
Fluoride F	0.0329	0.0186	0.02	0.02	0.02	0.02	0.04	0.065	0.066	0.071	21
Bromide Br	0.05	7.11E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	21
Sulphate SO4	35.5	25.9	7	8.07	12	24.8	60.3	75.8	82.5	87.8	64
Nitrate Nitrogen N	0.0868	0.0933	0.0113	0.0126	0.0166	0.036	0.138	0.208	0.231	0.339	21
Nitrite Nitrogen N	0.001	4.44E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	21
Total Nitrogen	0.203	0.0542	0.15	0.152	0.16	0.207	0.25	0.25	0.25	0.25	4
Ammonia Nitrogen N	0.00662	0.00284	0.005	0.005	0.005	0.005	0.0071	0.0109	0.0119	0.0149	21
Ortho-Phosphate	0.00128	0.0003	0.001	0.001	0.001	0.0012	0.0015	0.0017	0.0017	0.0019	21
Phosphorus (P)-Total	0.38	0.382	0.0024	0.004	0.05	0.3	0.492	0.919	0.954	1.46	21
Total Organic Carbon	1.02	0.764	0.5	0.5	0.5	0.5	1.48	2.36	2.64	2.68	21
Dissolved Organic Carbon	0.522	0.0732	0.5	0.5	0.5	0.5	0.5	0.52	0.62	0.82	21
Aluminum T-Al	5.47	6.13	0.0015	0.0143	0.707	3.84	9	12.4	15.8	34	64
Aluminum D-Al	0.0491	0.0464	0.0005	0.00128	0.0077	0.038	0.0751	0.119	0.139	0.179	63
Antimony T-Sb	0.00162	0.0011	0.00048	0.000501	0.00079	0.00146	0.00203	0.00284	0.00319	0.00657	63
Antimony D-Sb	0.000673	0.000284	0.0002	0.00034	0.00049	0.00064	0.00074	0.00113	0.0012	0.0017	63
Arsenic T-As	0.0144	0.0155	0.0007	0.00077	0.00547	0.0112	0.0142	0.0318	0.038	0.0661	21
Arsenic D-As	0.000597	0.000153	0.00039	0.00044	0.0005	0.00056	0.00063	0.00073	0.00087	0.00108	21
Barium T-Ba	0.119	0.0829	0.035	0.0473	0.0616	0.0899	0.165	0.215	0.251	0.532	64
Barium D-Ba	0.0382	0.0155	0.0159	0.0192	0.027	0.0333	0.0495	0.06	0.0683	0.0775	64
Beryllium T-Be	0.000685	0.000416	0.0001	0.0001	0.00014	0.001	0.001	0.001	0.001	0.001	21

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Beryllium D-Be	0.000657	0.000448	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	21
Bismuth T-Bi	0.00257	0.0109	0.00005	0.00005	0.000069	0.000101	0.00041	0.0005	0.0005	0.05	21
Bismuth D-Bi	0.00251	0.0109	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.05	21
Boron T-B	0.0659	0.0446	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	21
Boron D-B	0.0658	0.0447	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	21
Cadmium T-Cd	0.000393	0.000384	0.0000354	0.0000578	0.0001	0.00028	0.0005	0.000984	0.001	0.00197	63
Cadmium D-Cd	0.0001	0.0000728	0.000005	0.000017	0.000035	0.0001	0.000105	0.0002	0.0002	0.00031	63
Calcium T-Ca	36.7	16.8	14.5	16.5	22.9	30.9	51.1	61.2	64.5	75.4	64
Calcium D-Ca	30.9	16.7	10.3	12.3	16.6	26.3	41.6	55	60.2	75.4	64
Chromium T-Cr	0.0122	0.0116	0.00013	0.001	0.0044	0.0105	0.0149	0.0239	0.0273	0.0492	21
Chromium D-Cr	0.000672	0.00043	0.0001	0.0001	0.00015	0.001	0.001	0.001	0.001	0.001	21
Cobalt T-Co	0.00386	0.00459	0.00007	0.00008	0.00053	0.00262	0.00584	0.00922	0.0111	0.0269	63
Cobalt D-Co	0.000299	0.000653	0.00003	0.000033	0.000075	0.0001	0.0003	0.000452	0.001	0.005	63
Copper T-Cu	0.022	0.0248	0.0002	0.00081	0.00315	0.017	0.0315	0.0443	0.0598	0.149	63
Copper D-Cu	0.00136	0.00347	0.00005	0.0001	0.0003	0.0006	0.001	0.00184	0.0038	0.0252	63
Iron T-Fe	7.85	10.1	0.01	0.0161	0.91	4.74	12.2	18.3	24.6	60.6	64
Iron D-Fe	0.0293	0.0231	0.005	0.0055	0.01	0.03	0.0348	0.06	0.0836	0.1	63
Lead T-Pb	0.00581	0.00653	0.00005	0.000101	0.001	0.00389	0.00747	0.0154	0.017	0.0306	63
Lead D-Pb	0.000351	0.00091	0.000025	0.000025	0.00005	0.00008	0.0005	0.0005	0.001	0.00709	63
Magnesium T-Mg	7.62	3.03	2.12	3.75	6.18	7.43	8.62	10.3	11.4	24.5	64
Magnesium D-Mg	3.8	2.32	0.809	1.17	1.82	2.76	6.12	7.28	7.81	8.14	64
Manganese T-Mn	0.237	0.296	0.00185	0.00223	0.024	0.166	0.354	0.523	0.679	1.81	64
Manganese D-Mn	0.00812	0.0315	0.00005	0.0001	0.000553	0.00153	0.00438	0.0139	0.0229	0.25	64
Mercury T-Hg	0.0000116	0.00000731	0.000005	0.000005	0.000005	0.00001	0.0000137	0.000025	0.000025	0.000025	21
Mercury D-Hg	0.0000061 9	0.00000218	0.000005	0.000005	0.000005	0.000005	0.000005	0.00001	0.00001	0.00001	21
Molybdenum T-Mo	0.00419	0.00352	0.001	0.00179	0.00292	0.00395	0.00453	0.0052	0.00657	0.03	64
Molybdenum D-Mo	0.00339	0.00361	0.00089	0.00102	0.0018	0.0032	0.00393	0.00437	0.00488	0.03	64
Nickel T-Ni	0.015	0.0258	0.00051	0.00103	0.00253	0.00872	0.0183	0.0276	0.0395	0.19	64
Nickel D-Ni	0.00115	0.00118	0.00015	0.000315	0.000523	0.001	0.0014	0.0016	0.00275	0.009	64
Selenium T-Se	0.00225	0.00104	0.00094	0.00107	0.00143	0.00191	0.0031	0.00339	0.00371	0.00482	21
Selenium D-Se	0.00156	0.00119	0.00036	0.000459	0.000649	0.00101	0.00222	0.00351	0.00358	0.00374	21

Constituent	All									
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silicon T-Si	13.5	9.92	2.47	2.53	6.97	10.8	18.5	25.1	27.4	43.6	25
Silicon D-Si	1.16	0.696	0.451	0.461	0.658	0.873	1.42	2.37	2.5	2.55	25
Silver T-Ag	0.000278	0.000311	0.00001	0.00002	0.000111	0.000199	0.000265	0.000608	0.000733	0.00134	21
Silver D-Ag	0.0000162	0.00000498	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	21
Sodium T-Na	1.86	0.826	0.8	0.849	1.34	1.9	2.1	2.59	3.06	6.2	59
Sodium D-Na	1.21	0.692	0.25	0.325	0.558	1.11	2	2	2.05	2.8	64
Strontium T-Sr	0.206	0.0974	0.0846	0.095	0.116	0.175	0.3	0.344	0.37	0.436	63
Strontium D-Sr	0.178	0.1	0.0598	0.071	0.0935	0.143	0.264	0.336	0.353	0.38	63
Thallium T-Tl	0.000144	0.0000756	0.00001	0.000036	0.000054	0.0002	0.0002	0.0002	0.0002	0.0002	21
Thallium D-Tl	0.000128	0.0000945	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	21
Tin T-Sn	0.00035	0.000196	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	21
Tin D-Sn	0.000349	0.000197	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	21
Titanium T-Ti	0.199	0.15	0.00133	0.01	0.108	0.156	0.288	0.401	0.443	0.466	21
Titanium D-Ti	0.0083	0.00385	0.0003	0.0003	0.01	0.01	0.01	0.01	0.011	0.011	21
Uranium T-U	0.000415	0.000171	0.000185	0.000252	0.0003	0.000379	0.00049	0.00051	0.00077	0.00091	21
Uranium D-U	0.000236	0.000149	0.000027	0.000044	0.0002	0.0002	0.0003	0.00048	0.000486	0.00051	21
Vanadium T-V	0.0255	0.0262	0.0005	0.0005	0.00896	0.0199	0.0306	0.0506	0.0539	0.114	21
Vanadium D-V	0.000619	0.000218	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	21
Zinc T-Zn	0.043	0.0447	0.003	0.0041	0.011	0.028	0.062	0.101	0.128	0.237	63
Zinc D-Zn	0.00355	0.00398	0.0003	0.000405	0.001	0.003	0.005	0.005	0.006	0.028	63

Units = mg/L

Table B4: Summary Statistics Surface Water Sampling Station BC04 in Bitter Creek

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.92	0.961	1.5	7.3	7.74	8.02	8.37	8.64	8.7	8.9	59
Conductivity	189	119	69	75	90.8	128	301	380	395	424	80
Hardness CaCO3	87.8	60.2	26	29.1	43.3	61.2	122	180	204	249	82
Total Dissolved Solids	129	79.6	34	49	62	100	200	260	261	280	81
Total Suspended Solids	293	316	1	3	63.3	255	396	596	653	2000	82
Turbidity	217	278	0.3	1.24	52	150	283	470	580	2070	81
Alkalinity-Total CaCO3	60.4	29.7	16	31.1	36	49.1	87.6	108	110	134	82
Acidity (as CaCO3)	2.33	3.75	0.1	0.1	1	1.1	2.8	4.2	5	32	81
Chloride Cl	0.501	0.0064	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.53	22
Fluoride F	0.0362	0.0242	0.02	0.02	0.02	0.02	0.054	0.0698	0.0729	0.098	22
Bromide Br	0.05	1.42E-17	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	22
Sulphate SO4	38.5	34.2	1.5	6.1	11.6	21.4	62.1	95.6	100	111	82
Nitrate Nitrogen N	0.0574	0.0634	0.0102	0.0107	0.0138	0.0248	0.0809	0.138	0.168	0.236	22
Nitrite Nitrogen N	0.001	6.66E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	22
Total Nitrogen	0.238	0.15	0.107	0.113	0.139	0.2	0.299	0.387	0.416	0.445	4
Ammonia Nitrogen N	0.00601	0.00188	0.005	0.005	0.005	0.005	0.0058	0.0082	0.00925	0.0122	22
Ortho-Phosphate	0.00139	0.000343	0.001	0.001	0.00103	0.00135	0.0016	0.0017	0.0018	0.0023	22
Phosphorus (P)-Total	0.353	0.354	0.002	0.00454	0.0346	0.335	0.476	0.615	0.751	1.55	22
Total Organic Carbon	0.865	0.562	0.5	0.5	0.5	0.5	1.07	1.66	1.98	2.37	22
Dissolved Organic Carbon	0.523	0.0754	0.5	0.5	0.5	0.5	0.5	0.5	0.719	0.78	22
Aluminum T-Al	6.48	6.22	0.0025	0.0304	1.53	5.71	9.81	13.9	16.1	36.6	82
Aluminum D-Al	0.0679	0.0675	0.0005	0.0033	0.0111	0.0464	0.0991	0.168	0.189	0.342	82
Antimony T-Sb	0.00216	0.00183	0.00007	0.000592	0.000913	0.00172	0.00265	0.00379	0.00602	0.012	82
Antimony D-Sb	0.000751	0.000323	0.00007	0.000352	0.00053	0.000705	0.00088	0.00116	0.00129	0.00195	82
Arsenic T-As	0.0148	0.0162	0.00072	0.000912	0.0031	0.0119	0.0196	0.0226	0.0323	0.0756	22
Arsenic D-As	0.000653	0.000164	0.00044	0.000491	0.000545	0.00063	0.000685	0.00088	0.00104	0.00105	22
Barium T-Ba	0.127	0.0866	0.02	0.0427	0.0627	0.0975	0.17	0.221	0.279	0.536	82
Barium D-Ba	0.0327	0.0133	0.015	0.0156	0.0234	0.0287	0.0389	0.0532	0.0579	0.0788	82
Beryllium T-Be	0.000701	0.000406	0.0001	0.00014	0.000208	0.001	0.001	0.001	0.001	0.001	22
Beryllium D-Be	0.000673	0.000443	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	22
Bismuth T-Bi	0.0116	0.0434	0.00005	0.00005	0.0000755	0.000148	0.00048	0.0005	0.0475	0.2	22

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.0115	0.0434	0.00005	0.00005	0.00005	0.00005	0.000388	0.0005	0.0475	0.2	22
Boron T-B	0.0673	0.0443	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	22
Boron D-B	0.0673	0.0443	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	22
Cadmium T-Cd	0.000492	0.000441	0.0000675	0.00009	0.0001	0.000381	0.00072	0.0011	0.0012	0.0022	81
Cadmium D-Cd	0.0000942	0.0000664	0.000005	0.000017	0.00007	0.0001	0.0001	0.00012	0.00019	0.00046	81
Calcium T-Ca	36.8	21.2	7.97	15.2	19.2	28.1	56.2	69.3	77.9	87	82
Calcium D-Ca	30	20.2	8.97	10	14.8	20.9	48.4	60.8	67.4	87	82
Chromium T-Cr	0.0119	0.0119	0.00016	0.001	0.00235	0.0122	0.0149	0.0199	0.0236	0.0558	22
Chromium D-Cr	0.00069	0.000425	0.0001	0.0001	0.000133	0.001	0.001	0.001	0.001	0.001	22
Cobalt T-Co	0.00586	0.00849	0.00005	0.00011	0.0014	0.00398	0.007	0.0101	0.016	0.0649	81
Cobalt D-Co	0.000162	0.000155	0.00003	0.00004	0.00007	0.0001	0.00022	0.0003	0.0003	0.00104	81
Copper T-Cu	0.027	0.0276	0.0004	0.000604	0.00537	0.0229	0.037	0.0535	0.0647	0.166	82
Copper D-Cu	0.000595	0.000498	0.00005	0.0001	0.0003	0.000475	0.000938	0.001	0.00143	0.00237	82
Iron T-Fe	9.35	10.3	0.01	0.0373	2.03	6.42	13.3	18.3	24	63.2	82
Iron D-Fe	0.0353	0.0348	0.005	0.01	0.01	0.03	0.0438	0.0749	0.107	0.202	82
Lead T-Pb	0.00693	0.00674	0.00005	0.000153	0.0015	0.00506	0.00902	0.016	0.0187	0.0316	82
Lead D-Pb	0.000178	0.000182	0.000025	0.0000263	0.00005	0.00008	0.000198	0.0005	0.0005	0.00069	82
Magnesium T-Mg	8.23	3.66	2.53	3.61	6.32	7.68	9.95	12	13	25.1	82
Magnesium D-Mg	3.52	2.64	0.725	1	1.6	2.34	5.88	7.58	8.45	9.2	82
Manganese T-Mn	0.29	0.294	0.00266	0.00724	0.0621	0.233	0.426	0.609	0.647	1.93	82
Manganese D-Mn	0.00373	0.00604	0.0001	0.000103	0.00037	0.00141	0.00465	0.00837	0.0129	0.03	82
Mercury T-Hg	0.0000138	0.000016	0.000005	0.000005	0.00000543	0.00001	0.0000129	0.000024	0.000025	0.000081	22
Mercury D-Hg	0.00000614	0.00000214	0.000005	0.000005	0.000005	0.000005	0.000005	0.00001	0.00001	0.00001	22
Molybdenum T-Mo	0.00481	0.00324	0.00147	0.00201	0.00309	0.00467	0.0057	0.00658	0.007	0.03	82
Molybdenum D-Mo	0.00367	0.00343	0.00046	0.00109	0.00172	0.00356	0.00468	0.0058	0.00628	0.03	82
Nickel T-Ni	0.0171	0.0215	0.00118	0.00194	0.00498	0.0118	0.0196	0.0308	0.0487	0.163	82
Nickel D-Ni	0.00125	0.00107	0.00006	0.0003	0.0005	0.001	0.0016	0.0024	0.0027	0.0068	82
Selenium T-Se	0.00269	0.00247	0.00089	0.00107	0.00151	0.00191	0.00298	0.00433	0.00538	0.0125	22
Selenium D-Se	0.00197	0.0025	0.0004	0.000448	0.000573	0.000984	0.00253	0.00345	0.00488	0.0117	22
Silicon T-Si	13.7	10.1	2.58	2.64	4.87	14.1	18.9	20.2	22	46.8	22
Silicon D-Si	1.25	0.897	0.394	0.534	0.598	0.787	1.96	2.55	2.83	3.32	22

Constituent	All									
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.000273	0.00032	0.00001	0.00002	0.000059	0.000235	0.000325	0.000428	0.00053	0.00154	22
Silver D-Ag	0.0000166	0.00000473	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	22
Sodium T-Na	1.77	0.69	0.58	0.854	1.24	1.71	2.19	2.5	2.8	5	82
Sodium D-Na	1.12	0.744	0.216	0.273	0.469	0.774	2	2	2.2	2.6	82
Strontium T-Sr	0.211	0.122	0.0513	0.0886	0.117	0.159	0.33	0.395	0.42	0.472	81
Strontium D-Sr	0.176	0.122	0.039	0.0609	0.0837	0.12	0.264	0.371	0.394	0.452	81
Thallium T-Tl	0.000147	0.0000728	0.00001	0.0000451	0.0000708	0.0002	0.0002	0.0002	0.0002	0.0002	22
Thallium D-Tl	0.000131	0.000093	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	22
Tin T-Sn	0.000356	0.000195	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	22
Tin D-Sn	0.000364	0.000189	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	22
Titanium T-Ti	0.187	0.134	0.00096	0.01	0.0533	0.197	0.275	0.325	0.381	0.458	22
Titanium D-Ti	0.00857	0.00379	0.0003	0.000516	0.01	0.01	0.01	0.01	0.0119	0.013	22
Uranium T-U	0.000436	0.00018	0.000183	0.000249	0.00033	0.000392	0.00053	0.000632	0.000706	0.00096	22
Uranium D-U	0.000273	0.000193	0.000037	0.0000418	0.0002	0.0002	0.000453	0.000538	0.00054	0.0007	22
Vanadium T-V	0.0247	0.0271	0.0005	0.0005	0.0049	0.0243	0.0297	0.0395	0.0437	0.129	22
Vanadium D-V	0.000614	0.000214	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	22
Zinc T-Zn	0.0508	0.0443	0.001	0.00491	0.0203	0.042	0.0691	0.101	0.121	0.254	82
Zinc D-Zn	0.00412	0.00489	0.0004	0.001	0.001	0.00225	0.005	0.00793	0.016	0.022	82

Units = mg/L

Table B5: Summary Statistics for Surface Water Sampling Station BC06 in Bitter Creek

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.62	0.73	6.25	6.6	7.67	7.76	7.82	8.15	8.3	8.46	7.62
Conductivity	165	133	77.1	79.9	84.4	106	125	377	404	430	165
Hardness CaCO3	79	67.8	34.4	35.8	42.2	50	55.8	187	200	213	79
Total Dissolved Solids	137	90.5	68	68	75	86	218	263	276	290	137
Total Suspended Solids	363	382	5.8	8.4	277	307	332	587	948	1310	363
Turbidity	418	721	3.29	4.03	219	232	250	674	1500	2320	418
Alkalinity-Total CaCO3	47.2	22.6	31.4	31.6	32.5	37.9	44.2	81.1	87.4	93.6	47.2
Acidity (as CaCO3)	1.19	0.31	1	1	1	1	1.3	1.64	1.72	1.8	1.19
Chloride Cl	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Fluoride F	0.0337	0.0275	0.02	0.02	0.02	0.02	0.02	0.0758	0.0834	0.091	0.0337
Bromide Br	0.05	7.36E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Sulphate SO4	37.5	47.2	8.4	9.32	10.9	16.5	19.3	114	122	130	37.5
Nitrate Nitrogen N	0.0219	0.0185	0.0073	0.00878	0.0131	0.0135	0.0168	0.047	0.0549	0.0629	0.0219
Nitrite Nitrogen N	0.001	N/A	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Total Nitrogen	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ammonia Nitrogen N	0.00646	0.00231	0.005	0.005	0.005	0.005	0.007	0.00928	0.0104	0.0116	0.00646
Ortho-Phosphate	0.00161	0.000434	0.001	0.001	0.0013	0.0018	0.0019	0.00204	0.00212	0.0022	0.00161
Phosphorus (P)-Total	0.438	0.426	0.0055	0.0091	0.246	0.357	0.543	0.743	1.09	1.44	0.438
Total Organic Carbon	0.951	1.15	0.5	0.5	0.5	0.5	0.5	1.67	2.82	3.96	0.951
Dissolved Organic Carbon	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Aluminum T-Al	10.3	10.8	0.0901	0.195	7.64	8.32	9.74	17.4	27.1	36.8	10.3
Aluminum D-Al	0.272	0.615	0.0092	0.011	0.0758	0.0804	0.0925	0.464	1.19	1.91	0.272
Antimony T-Sb	0.00246	0.00181	0.00114	0.00118	0.00171	0.00218	0.00227	0.00345	0.00528	0.00711	0.00246
Antimony D-Sb	0.000782	0.000299	0.0005	0.0005	0.00052	0.0007	0.00104	0.00116	0.00123	0.0013	0.000782
Arsenic T-As	0.0195	0.024	0.001	0.00124	0.0102	0.0151	0.0192	0.0319	0.0564	0.0808	0.0195
Arsenic D-As	0.000894	0.00065	0.00057	0.000582	0.00061	0.00067	0.00073	0.00129	0.00194	0.0026	0.000894
Barium T-Ba	0.177	0.143	0.049	0.0506	0.133	0.155	0.176	0.251	0.394	0.537	0.177
Barium D-Ba	0.0327	0.0135	0.021	0.0214	0.022	0.028	0.044	0.0524	0.0532	0.054	0.0327
Beryllium T-Be	0.001	N/A	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Beryllium D-Be	0.001	N/A	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Bismuth T-Bi	0.0224	0.0666	0.00005	0.00005	0.000074	0.000107	0.000202	0.0404	0.12	0.2	0.0224

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.0223	0.0667	0.00005	0.00005	0.00005	0.00005	0.00005	0.04	0.12	0.2	0.0223
Boron T-B	0.1	1.47E-17	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Boron D-B	0.1	1.47E-17	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cadmium T-Cd	0.000605	0.000663	0.000118	0.000119	0.000322	0.000432	0.00061	0.00104	0.00167	0.00229	0.000605
Cadmium D-Cd	0.0000421	0.0000383	0.000017	0.000017	0.000017	0.000017	0.000077	0.0000994	0.0001	0.000101	0.0000421
Calcium T-Ca	35	22	16.4	16.8	21.8	23.8	48.7	67.9	70.5	73.1	35
Calcium D-Ca	27	22.7	12.2	12.6	14.2	17.3	19.3	63.3	67.6	71.8	27
Chromium T-Cr	0.0158	0.0169	0.001	0.001	0.011	0.0124	0.0157	0.0262	0.0421	0.058	0.0158
Chromium D-Cr	0.00112	0.000367	0.001	0.001	0.001	0.001	0.001	0.00122	0.00166	0.0021	0.00112
Cobalt T-Co	0.00774	0.0092	0.0003	0.00036	0.00445	0.00583	0.00732	0.0131	0.0221	0.0311	0.00774
Cobalt D-Co	0.000372	0.000217	0.0003	0.0003	0.0003	0.0003	0.0003	0.00043	0.00069	0.00095	0.000372
Copper T-Cu	0.0424	0.052	0.0018	0.00216	0.024	0.0298	0.0405	0.0722	0.124	0.175	0.0424
Copper D-Cu	0.00139	0.00117	0.001	0.001	0.001	0.001	0.001	0.0017	0.0031	0.0045	0.00139
Iron T-Fe	16.6	19	0.217	0.374	10.4	13.5	16.4	27.5	46	64.4	16.6
Iron D-Fe	0.0313	0.00282	0.03	0.03	0.03	0.03	0.0305	0.0338	0.0359	0.038	0.0313
Lead T-Pb	0.00889	0.00997	0.0005	0.0005	0.00536	0.00686	0.00859	0.0153	0.0246	0.0339	0.00889
Lead D-Pb	0.000611	0.000333	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.0011	0.0015	0.000611
Magnesium T-Mg	9.07	6.12	5.52	5.54	7.11	7.28	8.2	11.6	18.4	25.2	9.07
Magnesium D-Mg	2.85	2.71	0.96	1.04	1.34	1.72	1.87	7.1	7.69	8.29	2.85
Manganese T-Mn	0.487	0.587	0.0165	0.0195	0.274	0.369	0.486	0.799	1.39	1.98	0.487
Manganese D-Mn	0.00934	0.0208	0.00024	0.000264	0.00044	0.00072	0.00718	0.02	0.0421	0.0642	0.00934
Mercury T-Hg	0.0000191	0.0000258	0.000005	0.000005	0.0000084	0.0000096	0.0000127	0.0000372	0.0000616	0.000086	0.0000191
Mercury D-Hg	0.000005	N/A	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005
Molybdenum T-Mo	0.00431	0.00247	0.0018	0.00204	0.0025	0.0031	0.0073	0.00756	0.00768	0.0078	0.00431
Molybdenum D-Mo	0.00327	0.00243	0.0011	0.00126	0.0015	0.0023	0.0044	0.00708	0.00724	0.0074	0.00327
Nickel T-Ni	0.0198	0.021	0.0041	0.0043	0.0117	0.015	0.0182	0.0327	0.0531	0.0735	0.0198
Nickel D-Ni	0.00192	0.0014	0.001	0.001	0.001	0.001	0.0035	0.00372	0.00396	0.0042	0.00192
Selenium T-Se	0.00229	0.00146	0.00113	0.00116	0.00151	0.00171	0.00275	0.00378	0.00473	0.00569	0.00229
Selenium D-Se	0.00131	0.00108	0.000484	0.000526	0.000659	0.000834	0.00135	0.00287	0.00321	0.00355	0.00131
Silicon T-Si	16.6	12.9	2.63	2.69	14.3	15.8	16.8	24.4	35.8	47.2	16.6
Silicon D-Si	1.47	1.46	0.512	0.523	0.574	0.712	2.15	2.94	3.88	4.82	1.47

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.00037	0.000478	0.00002	0.00002	0.000195	0.000267	0.000351	0.000605	0.0011	0.0016	0.00037
Silver D-Ag	0.000022	0.000006	0.00002	0.00002	0.00002	0.00002	0.00002	0.0000236	0.0000308	0.000038	0.000022
Sodium T-Na	2.14	0.265	2	2	2	2	2.1	2.54	2.62	2.7	2.14
Sodium D-Na	2.04	0.133	2	2	2	2	2	2.08	2.24	2.4	2.04
Strontium T-Sr	0.198	0.125	0.0956	0.0994	0.126	0.139	0.231	0.393	0.412	0.431	0.198
Strontium D-Sr	0.157	0.141	0.0649	0.068	0.0813	0.0967	0.108	0.4	0.405	0.41	0.157
Thallium T-Tl	0.000201	0.00000333	0.0002	0.0002	0.0002	0.0002	0.0002	0.000202	0.000206	0.00021	0.000201
Thallium D-Tl	0.0002	2.87E-20	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Tin T-Sn	0.0005	N/A	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Tin D-Sn	0.0005	N/A	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Titanium T-Ti	0.216	0.136	0.01	0.0108	0.214	0.228	0.257	0.336	0.391	0.445	0.216
Titanium D-Ti	0.0167	0.02	0.01	0.01	0.01	0.01	0.01	0.022	0.046	0.07	0.0167
Uranium T-U	0.000479	0.000275	0.00025	0.000266	0.0003	0.00034	0.00073	0.000788	0.000904	0.00102	0.000479
Uranium D-U	0.000306	0.00021	0.0002	0.0002	0.0002	0.0002	0.0002	0.000654	0.000682	0.00071	0.000306
Vanadium T-V	0.0342	0.0396	0.0005	0.000804	0.0231	0.0269	0.0346	0.0562	0.0951	0.134	0.0342
Vanadium D-V	0.00115	0.00195	0.0005	0.0005	0.0005	0.0005	0.0005	0.00167	0.00401	0.00635	0.00115
Zinc T-Zn	0.0676	0.0748	0.0088	0.00908	0.0397	0.0516	0.0634	0.112	0.185	0.258	0.0676
Zinc D-Zn	0.00572	0.00128	0.005	0.005	0.005	0.005	0.0061	0.0071	0.0079	0.0087	0.00572

Units = mg/L

Table B6: Summary Statistics Surface Water Sampling Station BC08 in Bitter Creek

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	8.24	0.48	7.6	7.6	7.82	8.22	8.56	8.9	8.99	9.17	23
Conductivity	161	123	49.5	56.5	70.3	93	261	330	389	478	31
Hardness CaCO3	79	63.7	20.9	21.5	32.2	52	131	170	196	257	31
Total Dissolved Solids	118	81.5	41	44	64.5	79	179	230	260	358	31
Total Suspended Solids	315	270	3	3	165	267	390	550	820	1200	31
Turbidity	219	173	0.54	1.26	120	180	286	460	560	660	31
Alkalinity-Total CaCO3	48.9	27.8	20.4	22.3	27	38	72.1	94	100	104	31
Acidity (as CaCO3)	2.53	4.47	0.1	0.545	1	1	1.45	3.53	12.5	20	30
Chloride Cl	0.534	0.152	0.5	0.5	0.5	0.5	0.5	0.5	0.534	1.18	20
Fluoride F	0.0476	0.0649	0.02	0.02	0.02	0.02	0.049	0.0735	0.14	0.297	20
Bromide Br	0.05	7.12E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	20
Sulphate SO4	40.6	41.8	5.43	6.9	9.55	17	66.9	100	116	147	31
Nitrate Nitrogen N	0.00973	0.004	0.005	0.005	0.00608	0.01	0.0121	0.014	0.0153	0.0194	20
Nitrite Nitrogen N	0.001	4.45E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	20
Total Nitrogen	0.085	0.0551	0.03	0.033	0.045	0.08	0.12	0.138	0.144	0.15	4
Ammonia Nitrogen N	0.00565	0.00236	0.005	0.005	0.005	0.005	0.005	0.00572	0.00724	0.0155	20
Ortho-Phosphate	0.00164	0.000475	0.001	0.001	0.00133	0.0016	0.00203	0.00212	0.00232	0.0026	20
Phosphorus (P)-Total	0.262	0.167	0.002	0.00238	0.181	0.3	0.324	0.426	0.533	0.584	20
Total Organic Carbon	0.766	0.347	0.5	0.5	0.5	0.54	1.08	1.2	1.35	1.54	20
Dissolved Organic Carbon	0.532	0.0957	0.5	0.5	0.5	0.5	0.5	0.545	0.691	0.9	20
Aluminum T-Al	6.85	6.78	0.0085	0.0391	2.91	5.87	7.93	11.5	14.7	36	30
Aluminum D-Al	0.0771	0.0498	0.005	0.00671	0.0355	0.0804	0.102	0.131	0.138	0.23	30
Antimony T-Sb	0.00209	0.000897	0.0005	0.000749	0.00152	0.00202	0.0025	0.00362	0.00386	0.004	30
Antimony D-Sb	0.000892	0.000514	0.00018	0.000263	0.0005	0.00076	0.00134	0.00144	0.00172	0.0023	30
Arsenic T-As	0.0104	0.00691	0.0005	0.00088	0.00555	0.0112	0.0132	0.0147	0.022	0.028	20
Arsenic D-As	0.000785	0.000177	0.00032	0.000491	0.000698	0.00079	0.000865	0.001	0.00104	0.00106	20
Barium T-Ba	0.114	0.0612	0.02	0.0386	0.0656	0.112	0.14	0.162	0.22	0.31	30
Barium D-Ba	0.0255	0.0138	0.00828	0.00888	0.0168	0.0226	0.028	0.0438	0.0565	0.0612	30
Beryllium T-Be	0.00066	0.000429	0.0001	0.0001	0.000155	0.001	0.001	0.001	0.001	0.001	20
Beryllium D-Be	0.00064	0.000452	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	20
Bismuth T-Bi	0.0127	0.0455	0.00005	0.00005	0.0000673	0.000124	0.0005	0.00545	0.0575	0.2	20

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.0126	0.0455	0.00005	0.00005	0.00005	0.00005	0.0005	0.00545	0.0575	0.2	20
Boron T-B	0.064	0.0452	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	20
Boron D-B	0.064	0.0452	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	20
Cadmium T-Cd	0.000362	0.000303	0.0000414	0.0000509	0.0002	0.000313	0.000472	0.000602	0.000702	0.0016	29
Cadmium D-Cd	0.0000619	0.0000633	0.000005	0.0000094	0.000017	0.000037	0.0001	0.000114	0.000188	0.000262	29
Calcium T-Ca	34	23.1	11.5	13.1	17	23.4	53.8	66.5	76.6	85.1	30
Calcium D-Ca	27.2	22	7	7.53	11.1	17	45.3	59.2	67.2	86.7	30
Chromium T-Cr	0.00823	0.00509	0.0001	0.000955	0.00419	0.00903	0.0113	0.0125	0.0165	0.0184	20
Chromium D-Cr	0.000644	0.000448	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	20
Cobalt T-Co	0.00529	0.00482	0.0001	0.0003	0.00239	0.00437	0.0069	0.0101	0.0126	0.023	30
Cobalt D-Co	0.000206	0.000104	0.00006	0.00008	0.0001	0.00024	0.0003	0.0003	0.000317	0.00035	30
Copper T-Cu	0.0291	0.0262	0.0005	0.001	0.0139	0.024	0.034	0.0583	0.0755	0.12	30
Copper D-Cu	0.000797	0.000608	0.0002	0.0002	0.0004	0.00097	0.001	0.001	0.00107	0.0035	30
Iron T-Fe	11.9	18.1	0.044	0.114	4.13	8.91	11.9	19.5	27.3	100	30
Iron D-Fe	0.0509	0.0339	0.01	0.0136	0.03	0.0385	0.0653	0.0888	0.124	0.14	30
Lead T-Pb	0.00682	0.00534	0.0005	0.0005	0.0031	0.00539	0.01	0.0129	0.0168	0.022	29
Lead D-Pb	0.000265	0.000207	0.00005	0.00005	0.000082	0.000128	0.0005	0.0005	0.0005	0.0005	29
Magnesium T-Mg	8.13	5.87	2.6	3.63	5.38	5.92	7.96	12.4	19.9	30	30
Magnesium D-Mg	2.89	2.4	0.57	0.712	1.09	2	4.87	5.81	7.19	9.9	30
Manganese T-Mn	0.325	0.311	0.00549	0.0117	0.153	0.279	0.395	0.584	0.727	1.6	30
Manganese D-Mn	0.00819	0.0155	0.00044	0.000464	0.000853	0.00202	0.00924	0.0212	0.0263	0.0802	30
Mercury T-Hg	0.0000105	0.00000589	0.000005	0.000005	0.000005	0.00001	0.0000109	0.000017	0.000025	0.000025	20
Mercury D-Hg	0.00000625	0.00000222	0.000005	0.000005	0.000005	0.000005	0.00000625	0.00001	0.00001	0.00001	20
Molybdenum T-Mo	0.00555	0.00369	0.0016	0.00201	0.00263	0.00425	0.00873	0.0112	0.012	0.013	30
Molybdenum D-Mo	0.00454	0.00361	0.000719	0.00118	0.00163	0.0029	0.00718	0.0101	0.0109	0.0115	30
Nickel T-Ni	0.0148	0.0117	0.0016	0.0022	0.00927	0.0119	0.0191	0.0293	0.0348	0.055	30
Nickel D-Ni	0.00143	0.0013	0.0004	0.000432	0.0005	0.001	0.00165	0.00282	0.00397	0.00589	30
Selenium T-Se	0.0014	0.000349	0.00083	0.000834	0.00118	0.00136	0.00167	0.00185	0.00193	0.00204	20
Selenium D-Se	0.000959	0.000537	0.000303	0.000405	0.000535	0.000799	0.00143	0.00158	0.00182	0.00221	20
Silicon T-Si	10.6	5	1.65	1.75	8.38	11	14.8	16.1	16.7	18.2	20
Silicon D-Si	1.24	1.52	0.267	0.319	0.463	0.702	1.37	1.95	4.47	6.4	20

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.000187	0.000125	0.00001	0.0000195	0.0000878	0.000207	0.000242	0.000276	0.000434	0.000459	20
Silver D-Ag	0.000016	0.00000503	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	20
Sodium T-Na	2.1	1.25	0.73	0.799	1.26	2	2.1	3.12	4.59	6.6	30
Sodium D-Na	1.6	1.26	0.191	0.227	0.532	2	2	2.29	2.69	6.6	30
Strontium T-Sr	0.21	0.153	0.0663	0.0731	0.096	0.142	0.361	0.455	0.466	0.47	29
Strontium D-Sr	0.174	0.145	0.0395	0.0414	0.0657	0.095	0.307	0.403	0.419	0.455	29
Thallium T-Tl	0.000138	0.0000783	0.00001	0.0000281	0.000052	0.0002	0.0002	0.0002	0.0002	0.0002	20
Thallium D-Tl	0.000124	0.0000955	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	20
Tin T-Sn	0.000367	0.000194	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	18
Tin D-Sn	0.000384	0.000182	0.0001	0.0001	0.000178	0.0005	0.0005	0.0005	0.0005	0.0005	18
Titanium T-Ti	0.14	0.0831	0.0038	0.00969	0.086	0.161	0.208	0.223	0.245	0.277	20
Titanium D-Ti	0.00823	0.00392	0.0003	0.000405	0.01	0.01	0.01	0.01	0.0101	0.012	20
Uranium T-U	0.000435	0.000247	0.000194	0.000204	0.00025	0.000334	0.000578	0.000811	0.000829	0.000994	20
Uranium D-U	0.000314	0.000283	0.00002	0.0000286	0.00017	0.0002	0.000375	0.000773	0.000805	0.000891	20
Vanadium T-V	0.0173	0.0107	0.0005	0.0005	0.00972	0.0201	0.0224	0.0273	0.035	0.0361	20
Vanadium D-V	0.000625	0.000222	0.0005	0.0005	0.0005	0.0005	0.000625	0.001	0.001	0.001	20
Zinc T-Zn	0.0506	0.0404	0.003	0.00483	0.0336	0.0439	0.0675	0.0888	0.126	0.18	30
Zinc D-Zn	0.00441	0.00375	0.0007	0.000885	0.00193	0.00475	0.005	0.0055	0.0113	0.0186	30

Units = mg/L

Table B7: Summary Statistics Surface Water Sampling Station BR06 in Bear River

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.8	0.412	7	7.09	7.6	7.8	8.03	8.38	8.42	8.51	34
Conductivity	151	69.9	69.8	78.1	95.1	127	209	257	262	310	46
Hardness CaCO3	74.4	33.3	31.1	37.2	45.5	66.5	107	129	130	140	46
Total Dissolved Solids	103	43.9	46	54.3	65	91	140	168	170	200	46
Total Suspended Solids	179	198	1	1.5	13.5	100	302	470	518	730	46
Turbidity	120	133	0.26	0.505	7.8	80.9	205	301	365	520	46
Alkalinity-Total CaCO3	57	23	26.6	31.4	38.3	50.3	78	88	97.5	110	46
Acidity (as CaCO3)	2.06	1.25	1	1	1.1	1.6	2.6	3.77	5.13	5.8	42
Chloride Cl	0.501	0.00655	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.53	21
Fluoride F	0.0369	0.017	0.02	0.02	0.023	0.03	0.047	0.066	0.066	0.066	21
Bromide Br	0.05	7.11E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	21
Sulphate SO4	22.1	13.7	7.82	8.12	11.5	16.9	31.1	43.5	47.7	56	46
Nitrate Nitrogen N	0.0932	0.0863	0.0167	0.0174	0.0251	0.0496	0.142	0.212	0.227	0.31	21
Nitrite Nitrogen N	0.001	4.44E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	21
Total Nitrogen	0.189	0.0466	0.15	0.151	0.154	0.178	0.213	0.235	0.243	0.25	4
Ammonia Nitrogen N	0.00556	0.00152	0.005	0.005	0.005	0.005	0.005	0.0063	0.0066	0.0118	21
Ortho-Phosphate	0.00121	0.000261	0.001	0.001	0.001	0.0011	0.0014	0.0017	0.0017	0.0018	21
Phosphorus (P)-Total	0.26	0.222	0.002	0.0041	0.05	0.3	0.326	0.611	0.622	0.71	21
Total Organic Carbon	0.813	0.482	0.5	0.5	0.5	0.61	0.88	1.27	1.48	2.54	21
Dissolved Organic Carbon	0.561	0.138	0.5	0.5	0.5	0.5	0.5	0.67	0.95	0.95	21
Aluminum T-Al	4.23	5.28	0.001	0.0183	0.178	2.6	6.17	11.2	11.9	27	46
Aluminum D-Al	0.0557	0.0453	0.0005	0.00125	0.0073	0.0585	0.0873	0.116	0.128	0.18	46
Antimony T-Sb	0.00553	0.0293	0.00044	0.000458	0.000678	0.001	0.00165	0.00258	0.00307	0.2	46
Antimony D-Sb	0.00052	0.000169	0.00026	0.0003	0.000433	0.0005	0.000585	0.00068	0.000793	0.0012	46
Arsenic T-As	0.00837	0.00722	0.00051	0.00052	0.00256	0.00685	0.00975	0.0198	0.0207	0.0224	21
Arsenic D-As	0.000536	0.000111	0.00033	0.00037	0.0005	0.0005	0.00055	0.00068	0.00079	0.00081	21
Barium T-Ba	0.121	0.056	0.057	0.066	0.083	0.0972	0.155	0.195	0.22	0.31	46
Barium D-Ba	0.053	0.0225	0.0242	0.028	0.0335	0.047	0.0723	0.088	0.0901	0.096	46
Beryllium T-Be	0.000679	0.000424	0.0001	0.0001	0.00012	0.001	0.001	0.001	0.001	0.001	21
Beryllium D-Be	0.000657	0.000448	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	21
Bismuth T-Bi	0.00254	0.0109	0.00005	0.00005	0.00005	0.000069	0.000213	0.0005	0.0005	0.05	21

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.00251	0.0109	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.05	21
Boron T-B	0.0663	0.044	0.01	0.01	0.012	0.1	0.1	0.1	0.1	0.1	21
Boron D-B	0.0659	0.0445	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	21
Cadmium T-Cd	0.000291	0.000258	0.0000138	0.0000261	0.0000975	0.0002	0.00041	0.000677	0.000732	0.0012	44
Cadmium D-Cd	0.0000692	0.0000569	0.000005	0.000017	0.00002	0.00007	0.0000925	0.000163	0.0002	0.0002	44
Calcium T-Ca	28.6	11.7	12.8	16	19.1	24.2	38	45.6	48.5	57	46
Calcium D-Ca	24.6	10.9	10.9	13	15.8	21.7	33	43.4	44.8	47	46
Chromium T-Cr	0.007	0.00567	0.0001	0.001	0.0018	0.0056	0.0114	0.0153	0.0154	0.0168	21
Chromium D-Cr	0.00066	0.000444	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	21
Cobalt T-Co	0.00297	0.00388	0.00007	0.0001	0.0003	0.00186	0.00382	0.00803	0.00825	0.022	46
Cobalt D-Co	0.000217	0.00023	0.00005	0.0000625	0.0000925	0.0001	0.0003	0.0003	0.000828	0.001	46
Copper T-Cu	0.0161	0.0201	0.0002	0.0005	0.002	0.00967	0.0211	0.0414	0.0446	0.11	46
Copper D-Cu	0.000673	0.000399	0.0002	0.0002	0.000358	0.00057	0.001	0.001	0.001	0.0021	46
Iron T-Fe	6.86	11.8	0.01	0.036	0.263	4	8.51	16.2	18.2	75	46
Iron D-Fe	0.0311	0.0191	0.0066	0.01	0.0135	0.03	0.0385	0.0515	0.0728	0.084	46
Lead T-Pb	0.00491	0.00512	0.00005	0.000135	0.000543	0.00345	0.00669	0.0124	0.0153	0.021	46
Lead D-Pb	0.000269	0.00027	0.00004	0.00005	0.0000725	0.00012	0.0005	0.0005	0.000875	0.001	46
Magnesium T-Mg	5.29	2.94	2.3	2.85	3.57	4.66	5.73	7.46	8.23	21	46
Magnesium D-Mg	2.49	1.26	0.926	1.03	1.49	2.12	3.43	4.41	4.71	5.27	46
Manganese T-Mn	0.199	0.257	0.0052	0.00906	0.018	0.123	0.278	0.511	0.594	1.4	46
Manganese D-Mn	0.00773	0.00674	0.0003	0.000325	0.00201	0.00615	0.011	0.0174	0.0201	0.026	46
Mercury T-Hg	0.0000102	0.00000967	0.000005	0.000005	0.000005	0.00001	0.0000101	0.0000133	0.0000143	0.00005	21
Mercury D-Hg	0.0000064	0.00000224	0.000005	0.000005	0.000005	0.000005	0.0000091	0.00001	0.00001	0.00001	21
Molybdenum T-Mo	0.00246	0.000971	0.001	0.00126	0.002	0.00225	0.00278	0.0033	0.00417	0.0063	46
Molybdenum D-Mo	0.00176	0.000592	0.000719	0.000873	0.0013	0.00185	0.00211	0.00255	0.00268	0.003	46
Nickel T-Ni	0.0139	0.0276	0.0005	0.000715	0.00208	0.00515	0.0129	0.0218	0.048	0.17	46
Nickel D-Ni	0.000848	0.000469	0.0003	0.00032	0.0005	0.001	0.001	0.0012	0.00153	0.003	46
Selenium T-Se	0.00117	0.000399	0.00049	0.00054	0.000944	0.00112	0.00145	0.00157	0.0016	0.0022	21
Selenium D-Se	0.000803	0.000445	0.00027	0.00027	0.000429	0.00068	0.001	0.00144	0.00158	0.00165	21
Silicon T-Si	9.32	6.23	1.81	1.89	3.92	7.63	14	18.4	18.9	20.5	23
Silicon D-Si	1.08	0.484	0.491	0.538	0.682	0.968	1.39	1.86	1.9	1.94	23

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.000175	0.000155	0.00001	0.00002	0.000038	0.000138	0.000254	0.000431	0.000438	0.000474	21
Silver D-Ag	0.0000162	0.00000498	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	21
Sodium T-Na	1.52	0.694	0.54	0.705	1	1.4	2	2	2.54	4.1	43
Sodium D-Na	1.1	0.679	0.272	0.316	0.49	0.995	2	2	2	2.2	46
Strontium T-Sr	0.158	0.0581	0.0753	0.088	0.11	0.146	0.209	0.245	0.259	0.27	46
Strontium D-Sr	0.139	0.0617	0.0619	0.0692	0.085	0.119	0.2	0.24	0.242	0.251	46
Thallium T-Tl	0.000146	0.0000743	0.00001	0.000029	0.000067	0.0002	0.0002	0.0002	0.0002	0.0002	21
Thallium D-Tl	0.000128	0.0000945	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	21
Tin T-Sn	0.000349	0.000197	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	21
Tin D-Sn	0.000351	0.000198	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.00053	21
Titanium T-Ti	0.139	0.11	0.00042	0.01	0.05	0.124	0.235	0.275	0.309	0.332	21
Titanium D-Ti	0.00821	0.00378	0.0003	0.00032	0.01	0.01	0.01	0.01	0.01	0.01	21
Uranium T-U	0.000267	0.000102	0.000138	0.000189	0.00021	0.00023	0.00027	0.000387	0.00047	0.00055	21
Uranium D-U	0.000166	0.0000712	0.000036	0.000036	0.000141	0.0002	0.0002	0.00023	0.00024	0.000264	21
Vanadium T-V	0.0152	0.0128	0.0005	0.0005	0.00384	0.012	0.0236	0.0341	0.0349	0.0351	21
Vanadium D-V	0.000619	0.000218	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	21
Zinc T-Zn	0.0385	0.0404	0.0019	0.00278	0.0103	0.0255	0.0566	0.0776	0.118	0.2	46
Zinc D-Zn	0.00381	0.00454	0.0003	0.0004	0.00103	0.00255	0.005	0.00575	0.00663	0.029	46

Units = mg/L

Table B8: Summary Statistics Surface Water Sampling Station BR08 in Bear River

Constituent	All									
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.67	0.345	7	7.11	7.53	7.62	7.81	8.18	8.21	8.23	26
Conductivity	115	50	51	51.2	73.5	105	160	180	198	232	38
Hardness CaCO3	54.6	22.3	23.5	25.9	34.2	51.1	74.1	83.3	95.2	101	38
Total Dissolved Solids	78.3	33.7	39	41.7	54.5	73	98.5	110	115	220	38
Total Suspended Solids	29.2	33.7	1	1	3	15.5	47.8	75.3	98.4	127	38
Turbidity	25.7	30.8	0.24	0.296	1.03	13.6	40.5	77.8	92	92.1	38
Alkalinity-Total CaCO3	44.6	19	18.2	21.7	27.5	43.4	61	74	75	76	38
Acidity (as CaCO3)	2.51	2.63	1.1	1.1	1.4	1.9	2.4	3.76	4.92	16	33
Chloride Cl	0.506	0.0262	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.62	21
Fluoride F	0.043	0.0145	0.024	0.025	0.033	0.04	0.054	0.066	0.066	0.067	21
Bromide Br	0.05	7.11E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	21
Sulphate SO4	14.3	6.69	5.84	6.77	9.3	13.5	17	21.2	25.9	38.2	38
Nitrate Nitrogen N	0.103	0.0867	0.0219	0.0223	0.0313	0.0615	0.145	0.225	0.243	0.311	21
Nitrite Nitrogen N	0.001	4.44E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	21
Total Nitrogen	0.0918	0.0598	0.046	0.0478	0.055	0.0715	0.108	0.15	0.164	0.178	4
Ammonia Nitrogen N	0.005	8.89E-19	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	21
Ortho-Phosphate	0.00109	0.000162	0.001	0.001	0.001	0.001	0.0011	0.0013	0.0015	0.0015	21
Phosphorus (P)-Total	0.0917	0.113	0.002	0.002	0.0056	0.0435	0.138	0.3	0.3	0.3	21
Total Organic Carbon	0.553	0.12	0.5	0.5	0.5	0.5	0.53	0.72	0.73	0.98	21
Dissolved Organic Carbon	0.572	0.164	0.5	0.5	0.5	0.5	0.54	0.8	0.94	1.09	21
Aluminum T-Al	1.22	1.55	0.005	0.00803	0.031	0.535	1.57	3.65	4.35	5.8	38
Aluminum D-Al	0.0422	0.0355	0.0005	0.00084	0.00568	0.0451	0.062	0.09	0.1	0.15	38
Antimony T-Sb	0.000549	0.000225	0.0002	0.000277	0.000423	0.0005	0.00058	0.00079	0.0011	0.0012	38
Antimony D-Sb	0.000362	0.000159	0.00007	0.0001	0.0002	0.000415	0.0005	0.0005	0.000503	0.00062	38
Arsenic T-As	0.00186	0.00161	0.00042	0.0005	0.00077	0.00142	0.002	0.00331	0.00513	0.00671	21
Arsenic D-As	0.00044	0.0000965	0.00024	0.00025	0.00039	0.0005	0.0005	0.0005	0.0005	0.00052	21
Barium T-Ba	0.109	0.0317	0.068	0.075	0.0883	0.101	0.119	0.162	0.18	0.184	38
Barium D-Ba	0.0732	0.0202	0.046	0.0477	0.0565	0.069	0.09	0.103	0.11	0.112	38
Beryllium T-Be	0.000658	0.000447	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	21
Beryllium D-Be	0.000657	0.000448	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	21
Bismuth T-Bi	0.00251	0.0109	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.05	21

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.00251	0.0109	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.05	21
Boron T-B	0.0666	0.0437	0.01	0.01	0.013	0.1	0.1	0.1	0.1	0.1	21
Boron D-B	0.0661	0.0442	0.01	0.01	0.011	0.1	0.1	0.1	0.1	0.1	21
Cadmium T-Cd	0.000127	0.000109	0.000005	0.0000111	0.0000526	0.0001	0.00018	0.000209	0.000327	0.0005	38
Cadmium D-Cd	0.000066	0.0000625	0.0000088	0.0000164	0.0000193	0.0000289	0.0001	0.0002	0.0002	0.0002	38
Calcium T-Ca	20	8.12	8.82	9.68	13.4	18.3	25.2	33.9	34.1	37	38
Calcium D-Ca	18.7	7.48	8.36	9.11	12	17.9	22.5	28.2	33.2	35.2	38
Chromium T-Cr	0.000845	0.000306	0.0001	0.00028	0.00076	0.001	0.001	0.001	0.00107	0.0013	21
Chromium D-Cr	0.00066	0.000444	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	21
Cobalt T-Co	0.000746	0.000762	0.00006	0.000077	0.000285	0.00038	0.001	0.00203	0.00241	0.0028	38
Cobalt D-Co	0.000259	0.000276	0.00004	0.00006	0.0001	0.000115	0.0003	0.00051	0.001	0.001	38
Copper T-Cu	0.00313	0.00382	0.0004	0.0004	0.001	0.00157	0.00357	0.00703	0.0112	0.019	38
Copper D-Cu	0.000909	0.000914	0.0002	0.0002	0.000385	0.001	0.001	0.00127	0.00192	0.0056	38
Iron T-Fe	1.53	2.03	0.005	0.0299	0.0828	0.696	1.6	4.63	6.16	7.1	38
Iron D-Fe	0.0357	0.0239	0.01	0.01	0.0223	0.03	0.0448	0.0586	0.0705	0.14	38
Lead T-Pb	0.00353	0.0037	0.00005	0.000164	0.0006	0.00247	0.00478	0.00875	0.0107	0.014	37
Lead D-Pb	0.00035	0.000294	0.00004	0.0000694	0.000092	0.000273	0.0005	0.0007	0.001	0.001	37
Magnesium T-Mg	2.23	0.728	1.1	1.22	1.62	2	2.9	3.18	3.4	3.55	38
Magnesium D-Mg	1.68	0.743	0.632	0.778	1.02	1.56	2.13	2.67	3.05	3.41	38
Manganese T-Mn	0.0827	0.0991	0.00675	0.00995	0.0164	0.0365	0.0896	0.252	0.296	0.34	38
Manganese D-Mn	0.0106	0.00468	0.0034	0.00474	0.00705	0.00994	0.0131	0.0153	0.0182	0.025	38
Mercury T-Hg	0.00000746	0.00000397	0.000005	0.000005	0.000005	0.000005	0.00001	0.0000112	0.0000115	0.000021	21
Mercury D-Hg	0.00000619	0.00000218	0.000005	0.000005	0.000005	0.000005	0.000005	0.00001	0.00001	0.00001	21
Molybdenum T-Mo	0.000983	0.000275	0.0002	0.000522	0.001	0.001	0.0011	0.0013	0.0014	0.0015	38
Molybdenum D-Mo	0.00087	0.000294	0.0002	0.000323	0.000667	0.001	0.001	0.00113	0.00122	0.0014	38
Nickel T-Ni	0.00336	0.00886	0.00029	0.0005	0.001	0.001	0.00195	0.00477	0.00758	0.054	38
Nickel D-Ni	0.000901	0.00072	0.0002	0.0003	0.0005	0.001	0.001	0.001	0.00156	0.0042	38
Selenium T-Se	0.000264	0.000194	0.0001	0.000111	0.000165	0.000229	0.000348	0.000391	0.000409	0.001	21
Selenium D-Se	0.000248	0.000202	0.000088	0.000094	0.000113	0.000191	0.00032	0.000408	0.000409	0.001	21
Silicon T-Si	3.1	1.96	1.29	1.37	1.66	2.54	3.63	5.27	7.75	8.41	24
Silicon D-Si	1.01	0.399	0.462	0.522	0.674	0.932	1.31	1.61	1.68	1.7	24

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.00005	0.0000417	0.00001	0.00002	0.00002	0.000034	0.000054	0.000103	0.000152	0.000156	21
Silver D-Ag	0.0000162	0.00000498	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	21
Sodium T-Na	1.45	0.899	0.422	0.449	0.682	1.55	2	2	2.11	4.9	34
Sodium D-Na	1.17	0.703	0.237	0.309	0.49	1.1	2	2	2	2.2	38
Strontium T-Sr	0.125	0.0485	0.0574	0.0633	0.079	0.121	0.162	0.192	0.211	0.216	38
Strontium D-Sr	0.119	0.0479	0.05	0.0581	0.0785	0.118	0.158	0.187	0.201	0.211	38
Thallium T-Tl	0.000142	0.0000776	0.00001	0.00002	0.000058	0.0002	0.0002	0.0002	0.0002	0.0002	21
Thallium D-Tl	0.000128	0.0000942	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	21
Tin T-Sn	0.00034	0.000201	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	20
Tin D-Sn	0.00034	0.000201	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	20
Titanium T-Ti	0.0378	0.0369	0.0003	0.01	0.01	0.026	0.043	0.083	0.116	0.137	21
Titanium D-Ti	0.00822	0.00377	0.0003	0.00036	0.01	0.01	0.01	0.01	0.01	0.01	21
Uranium T-U	0.000169	0.0000458	0.000084	0.000085	0.000144	0.0002	0.0002	0.0002	0.0002	0.00021	21
Uranium D-U	0.000146	0.0000749	0.000026	0.000026	0.000068	0.0002	0.0002	0.0002	0.0002	0.0002	21
Vanadium T-V	0.00318	0.00289	0.0005	0.0005	0.00059	0.0025	0.00384	0.00727	0.00753	0.0109	21
Vanadium D-V	0.000619	0.000218	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	21
Zinc T-Zn	0.0225	0.0253	0.003	0.00478	0.0054	0.0129	0.0253	0.0549	0.0615	0.13	38
Zinc D-Zn	0.00415	0.00455	0.0003	0.0004	0.00123	0.005	0.005	0.005	0.0053	0.029	38

Units = mg/L

Table B9: Summary Statistics Surface Water Sampling Station GSC02 in Goldslide Creek

Constituent	All									
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.42	0.448	6.26	6.65	7.19	7.43	7.63	7.89	8.04	8.73	70
Conductivity	139	36.9	71	85	119	134	160	189	194	250	88
Hardness CaCO3	57.5	16.4	24	34.4	47	58	66.5	78.6	89.3	110	88
Total Dissolved Solids	95.4	24.7	36	63.4	76	94	110	120	125	200	89
Total Suspended Solids	3.15	6.17	0.5	1	1	1	3	4.08	13.4	51	87
Turbidity	0.499	0.892	0.1	0.1	0.16	0.23	0.46	0.932	1.56	6.9	85
Alkalinity-Total CaCO3	14.3	7.12	7	8	10	12	15	22.4	28.6	56	89
Acidity (as CaCO3)	3.58	4.36	1	1.4	2	2.7	3.7	4.18	6.29	29	83
Chloride Cl	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	20
Fluoride F	0.0412	0.00753	0.031	0.032	0.0358	0.0405	0.0443	0.0522	0.0542	0.057	20
Bromide Br	0.05	7.12E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	20
Sulphate SO4	46	16.3	18	22	35.9	45.3	56.7	68	70.8	98	88
Nitrate Nitrogen N	0.0157	0.00604	0.005	0.00719	0.00983	0.0174	0.0196	0.0237	0.0241	0.0249	20
Nitrite Nitrogen N	0.001	4.45E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	20
Total Nitrogen	0.0515	0.0176	0.03	0.033	0.045	0.0515	0.058	0.067	0.07	0.073	4
Ammonia Nitrogen N	0.005	8.9E-19	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	20
Ortho-Phosphate	0.00108	0.000174	0.001	0.001	0.001	0.001	0.0011	0.0013	0.00132	0.0017	20
Phosphorus (P)-Total	0.0726	0.118	0.002	0.002	0.00215	0.005	0.05	0.3	0.3	0.3	20
Total Organic Carbon	0.518	0.0805	0.5	0.5	0.5	0.5	0.5	0.5	0.518	0.86	20
Dissolved Organic Carbon	0.519	0.0568	0.5	0.5	0.5	0.5	0.5	0.542	0.57	0.75	20
Aluminum T-Al	0.056	0.0921	0.001	0.00412	0.0148	0.0415	0.0612	0.0962	0.129	0.653	85
Aluminum D-Al	0.0159	0.0142	0.0005	0.000734	0.00692	0.014	0.022	0.0266	0.0358	0.103	87
Antimony T-Sb	0.000332	0.000268	0.00005	0.0000625	0.0001	0.000295	0.0005	0.00063	0.000758	0.0016	86
Antimony D-Sb	0.00021	0.000177	0.00001	0.00005	0.0001	0.0001	0.000338	0.0005	0.0005	0.00072	86
Arsenic T-As	0.000375	0.000201	0.0001	0.0001	0.000163	0.0005	0.0005	0.0005	0.000515	0.00079	20
Arsenic D-As	0.000349	0.000191	0.0001	0.0001	0.00013	0.0005	0.0005	0.0005	0.0005	0.0005	20
Barium T-Ba	0.0311	0.035	0.018	0.02	0.023	0.025	0.0274	0.0339	0.0391	0.314	87
Barium D-Ba	0.0237	0.00459	0.017	0.0182	0.021	0.023	0.0254	0.0287	0.0305	0.0419	87
Beryllium T-Be	0.00064	0.000452	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	20
Beryllium D-Be	0.00064	0.000452	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	20
Bismuth T-Bi	0.00264	0.0111	0.00005	0.00005	0.00005	0.00005	0.000163	0.0005	0.00298	0.05	20

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.00264	0.0111	0.00005	0.00005	0.00005	0.00005	0.000163	0.0005	0.00298	0.05	20
Boron T-B	0.064	0.0452	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	20
Boron D-B	0.064	0.0452	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	20
Cadmium T-Cd	0.000348	0.00032	0.00005	0.0001	0.0002	0.000268	0.0004	0.0006	0.0009	0.00223	86
Cadmium D-Cd	0.000226	0.000132	0.00007	0.00009	0.000133	0.0002	0.000286	0.00034	0.00046	0.00085	86
Calcium T-Ca	21.2	6.51	9.9	12.7	16.6	20.7	24.3	28.4	31.5	50.8	87
Calcium D-Ca	19.3	5.46	7.4	11.5	15.3	19.3	22.5	27	29.8	34.1	87
Chromium T-Cr	0.000645	0.000447	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	20
Chromium D-Cr	0.00065	0.000442	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	20
Cobalt T-Co	0.000676	0.00117	0.00005	0.000063	0.0003	0.00045	0.00071	0.001	0.00107	0.00914	87
Cobalt D-Co	0.000382	0.000251	0.00003	0.00006	0.00016	0.00036	0.0005	0.000682	0.000964	0.001	87
Copper T-Cu	0.0084	0.0138	0.0005	0.00173	0.00333	0.0047	0.007	0.0138	0.0265	0.0904	87
Copper D-Cu	0.00341	0.00262	0.00005	0.0005	0.00169	0.0028	0.00415	0.00652	0.00866	0.013	87
Iron T-Fe	0.0606	0.115	0.01	0.01	0.01	0.03	0.06	0.12	0.192	0.751	85
Iron D-Fe	0.0156	0.0113	0.005	0.01	0.01	0.01	0.0155	0.03	0.03	0.07	87
Lead T-Pb	0.000905	0.00232	0.00005	0.00005	0.000145	0.0005	0.000745	0.00154	0.0028	0.02	87
Lead D-Pb	0.000205	0.000306	0.00002	0.0000395	0.00005	0.00008	0.00019	0.0005	0.00085	0.002	87
Magnesium T-Mg	2.75	1.46	1.39	1.67	2.07	2.53	2.98	3.43	3.88	12.5	87
Magnesium D-Mg	2.28	0.576	0.87	1.38	1.84	2.3	2.6	2.98	3.23	4.07	87
Manganese T-Mn	0.00791	0.00704	0.00012	0.000228	0.00306	0.00669	0.011	0.0146	0.0186	0.0403	84
Manganese D-Mn	0.00713	0.00916	0.0001	0.000163	0.00288	0.00551	0.00823	0.0125	0.0156	0.0692	86
Mercury T-Hg	0.00000625	0.00000222	0.000005	0.000005	0.000005	0.000005	0.00000625	0.00001	0.00001	0.00001	20
Mercury D-Hg	0.00000625	0.00000222	0.000005	0.000005	0.000005	0.000005	0.00000625	0.00001	0.00001	0.00001	20
Molybdenum T-Mo	0.00597	0.00325	0.0027	0.00355	0.00447	0.0053	0.0066	0.00792	0.00908	0.03	87
Molybdenum D-Mo	0.00535	0.00309	0.00114	0.00315	0.0039	0.00493	0.00615	0.0072	0.00793	0.03	87
Nickel T-Ni	0.00579	0.0236	0.0003	0.000715	0.00109	0.0015	0.0028	0.00482	0.0168	0.21	87
Nickel D-Ni	0.00117	0.00062	0.00015	0.00033	0.0008	0.0011	0.0014	0.002	0.0024	0.00304	87
Selenium T-Se	0.00156	0.000375	0.001	0.00111	0.00127	0.0015	0.00172	0.00214	0.00219	0.00231	20
Selenium D-Se	0.00158	0.000387	0.001	0.00109	0.00129	0.0015	0.00183	0.00219	0.00221	0.00228	20
Silicon T-Si	2.85	0.389	2.26	2.27	2.62	2.73	3.13	3.26	3.32	3.95	24
Silicon D-Si	2.78	0.386	2.19	2.25	2.55	2.71	3.02	3.28	3.36	3.76	24

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.0000161	0.00000497	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	20
Silver D-Ag	0.000016	0.00000503	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	20
Sodium T-Na	1.57	0.541	0.79	0.955	1.22	1.47	1.98	2	2.17	4.35	82
Sodium D-Na	1.34	0.383	0.627	0.755	1.08	1.3	1.58	2	2	2	87
Strontium T-Sr	0.138	0.0548	0.047	0.0752	0.102	0.121	0.161	0.221	0.246	0.29	85
Strontium D-Sr	0.129	0.051	0.038	0.065	0.0915	0.118	0.152	0.206	0.228	0.277	85
Thallium T-Tl	0.000124	0.0000955	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	20
Thallium D-Tl	0.000124	0.0000955	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	20
Tin T-Sn	0.000343	0.000198	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	20
Tin D-Sn	0.000356	0.000199	0.0001	0.0001	0.000135	0.0005	0.0005	0.0005	0.000507	0.00064	20
Titanium T-Ti	0.00813	0.00398	0.0003	0.0003	0.01	0.01	0.01	0.01	0.0101	0.011	20
Titanium D-Ti	0.00806	0.00398	0.0003	0.0003	0.01	0.01	0.01	0.01	0.01	0.01	20
Uranium T-U	0.000125	0.0000939	0.00001	0.00001	0.0000138	0.0002	0.0002	0.0002	0.0002	0.0002	20
Uranium D-U	0.000125	0.0000937	0.00001	0.00001	0.0000148	0.0002	0.0002	0.0002	0.0002	0.0002	20
Vanadium T-V	0.00064	0.000256	0.0005	0.0005	0.0005	0.0005	0.000625	0.001	0.00102	0.0013	20
Vanadium D-V	0.000625	0.000222	0.0005	0.0005	0.0005	0.0005	0.000625	0.001	0.001	0.001	20
Zinc T-Zn	0.0231	0.0223	0.0046	0.00785	0.0126	0.0172	0.024	0.041	0.0513	0.173	86
Zinc D-Zn	0.0147	0.00757	0.001	0.00454	0.0101	0.014	0.0175	0.024	0.0303	0.045	86

Units = mg/L

Table B10: Summary Statistics Surface Water Sampling Station OC06 in Otter Creek

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.94	0.601	7.14	7.32	7.65	7.74	8.04	8.69	9	9.45	14
Conductivity	260	213	58.3	67.2	106	167	361	634	687	715	19
Hardness CaCO3	138	127	26.7	29	47.7	79.6	191	355	411	412	19
Total Dissolved Solids	174	149	38	49.7	66.5	112	228	435	484	507	19
Total Suspended Solids	33.1	55.9	3	3	7.05	14.4	31.2	57.9	104	247	19
Turbidity	17.5	26.3	0.9	0.9	2.66	9.28	19.1	32.5	59.7	112	19
Alkalinity-Total CaCO3	62.5	38	20	25	33.4	48.1	83.9	129	134	135	19
Acidity (as CaCO3)	1.65	0.508	1	1	1.25	1.7	1.9	2.04	2.28	3	19
Chloride Cl	0.711	0.631	0.5	0.5	0.5	0.5	0.5	0.9	2.5	2.5	19
Fluoride F	0.0501	0.0484	0.02	0.02	0.02	0.023	0.0635	0.129	0.152	0.17	19
Bromide Br	0.0711	0.0631	0.05	0.05	0.05	0.05	0.05	0.09	0.25	0.25	19
Sulphate SO4	74.8	81.9	7.23	7.91	18.8	36.3	101	217	247	265	19
Nitrate Nitrogen N	0.0241	0.0163	0.005	0.005	0.0107	0.0211	0.0331	0.0486	0.0518	0.0599	19
Nitrite Nitrogen N	0.00142	0.00126	0.001	0.001	0.001	0.001	0.001	0.0018	0.005	0.005	19
Total Nitrogen	0.06	N/A	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	1
Ammonia Nitrogen N	0.005	8.91E-19	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	19
Ortho-Phosphate	0.00124	0.000344	0.001	0.001	0.001	0.001	0.00145	0.0018	0.00182	0.002	19
Phosphorus (P)-Total	0.0843	0.114	0.0022	0.00346	0.0102	0.0233	0.0991	0.3	0.3	0.3	19
Total Organic Carbon	0.539	0.112	0.5	0.5	0.5	0.5	0.5	0.592	0.777	0.93	19
Dissolved Organic Carbon	0.509	0.0286	0.5	0.5	0.5	0.5	0.5	0.524	0.548	0.62	19
Aluminum T-Al	0.75	0.947	0.0143	0.0244	0.0722	0.507	0.987	1.33	2.24	3.96	19
Aluminum D-Al	0.0288	0.022	0.005	0.005	0.0083	0.0266	0.0469	0.0549	0.0638	0.0771	19
Antimony T-Sb	0.000451	0.00018	0.00014	0.000185	0.00037	0.0005	0.0005	0.000538	0.000709	0.00088	19
Antimony D-Sb	0.000383	0.000178	0.0001	0.0001	0.000175	0.0005	0.0005	0.0005	0.0005	0.0005	19
Arsenic T-As	0.000866	0.000807	0.00021	0.000327	0.0005	0.0005	0.000705	0.00202	0.00244	0.00338	19
Arsenic D-As	0.000389	0.000167	0.00013	0.000139	0.00016	0.0005	0.0005	0.0005	0.0005	0.0005	19
Barium T-Ba	0.0812	0.0246	0.05	0.0536	0.0652	0.074	0.095	0.111	0.128	0.139	19
Barium D-Ba	0.0613	0.0169	0.039	0.0406	0.0469	0.0625	0.072	0.0792	0.089	0.098	19
Beryllium T-Be	0.000716	0.00043	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	19
Beryllium D-Be	0.000716	0.00043	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	19
Bismuth T-Bi	0.000125	0.000167	0.00005	0.00005	0.00005	0.00005	0.000064	0.0005	0.0005	0.0005	19

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.000121	0.000169	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	19
Boron T-B	0.0716	0.043	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	19
Boron D-B	0.0716	0.043	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	19
Cadmium T-Cd	0.00013	0.0000855	0.000035	0.0000395	0.0000771	0.000115	0.000156	0.000218	0.000256	0.000395	19
Cadmium D-Cd	0.000063	0.0000479	0.000011	0.000016	0.0000282	0.000051	0.000079	0.000109	0.000123	0.000211	19
Calcium T-Ca	43.9	37.6	9.79	12	16.1	28.4	60.6	110	119	125	19
Calcium D-Ca	43.8	38.4	9.43	10.3	16.2	26.4	60.8	109	125	125	19
Chromium T-Cr	0.00107	0.000612	0.00016	0.000394	0.001	0.001	0.001	0.0014	0.00228	0.00301	19
Chromium D-Cr	0.000716	0.00043	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	19
Cobalt T-Co	0.000842	0.000772	0.0001	0.000235	0.000405	0.00059	0.000845	0.00218	0.00258	0.00279	19
Cobalt D-Co	0.000409	0.000524	0.0001	0.0001	0.0001	0.0003	0.00032	0.000626	0.00115	0.00238	19
Copper T-Cu	0.00268	0.00295	0.0005	0.00095	0.001	0.0015	0.00258	0.00614	0.0103	0.0107	19
Copper D-Cu	0.000771	0.000351	0.0002	0.0002	0.000385	0.001	0.001	0.001	0.001	0.001	19
Iron T-Fe	1.14	1.39	0.101	0.142	0.304	0.57	1.24	2.39	4.28	5.37	19
Iron D-Fe	0.0364	0.0217	0.01	0.0163	0.03	0.03	0.0375	0.0574	0.0747	0.108	19
Lead T-Pb	0.00141	0.00151	0.000121	0.000376	0.0005	0.00076	0.00196	0.00267	0.00504	0.00557	19
Lead D-Pb	0.000361	0.00021	0.00005	0.00005	0.000081	0.0005	0.0005	0.0005	0.0005	0.0005	19
Magnesium T-Mg	7.34	7.35	1.04	1.52	2.35	4.06	9.77	20.5	22.8	24.2	19
Magnesium D-Mg	6.99	7.59	0.772	0.811	1.86	3.7	9.42	20.2	23.9	23.9	19
Manganese T-Mn	0.0584	0.0532	0.00504	0.0187	0.0327	0.0469	0.0579	0.101	0.167	0.233	19
Manganese D-Mn	0.0188	0.0187	0.00108	0.0032	0.00561	0.0115	0.0279	0.0354	0.0443	0.0794	19
Mercury T-Hg	0.00000625	0.00000256	0.000005	0.000005	0.000005	0.000005	0.0000051	0.00001	0.0000104	0.0000135	19
Mercury D-Hg	0.00000579	0.00000187	0.000005	0.000005	0.000005	0.000005	0.000005	0.00001	0.00001	0.00001	19
Molybdenum T-Mo	0.0017	0.00114	0.000233	0.000313	0.000649	0.0015	0.00265	0.00316	0.00341	0.0035	19
Molybdenum D-Mo	0.00138	0.00105	0.000203	0.000208	0.000595	0.001	0.00195	0.00312	0.00323	0.0035	19
Nickel T-Ni	0.00549	0.00495	0.00082	0.000865	0.00177	0.0042	0.0077	0.0123	0.0135	0.0193	19
Nickel D-Ni	0.00425	0.00524	0.0005	0.0005	0.000605	0.0018	0.0056	0.0119	0.0135	0.0193	19
Selenium T-Se	0.0028	0.003	0.00016	0.000196	0.000563	0.002	0.00406	0.00627	0.00687	0.0116	19
Selenium D-Se	0.00273	0.00316	0.00015	0.000174	0.000523	0.00153	0.00383	0.00647	0.00748	0.012	19
Silicon T-Si	2.46	1.35	1.07	1.12	1.64	2.1	2.7	3.45	4.58	7.02	19
Silicon D-Si	1.17	0.813	0.34	0.363	0.558	0.893	1.64	2.48	2.74	2.78	19

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.0000398	0.0000444	0.00001	0.00001	0.000019	0.00002	0.0000405	0.0000896	0.000109	0.000191	19
Silver D-Ag	0.0000168	0.00000478	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	19
Sodium T-Na	1.6	0.804	0.273	0.357	0.719	2	2	2.4	2.43	2.7	19
Sodium D-Na	1.54	0.832	0.195	0.197	0.608	2	2	2.22	2.32	2.5	19
Strontium T-Sr	0.249	0.206	0.0525	0.0584	0.0935	0.16	0.365	0.618	0.645	0.654	19
Strontium D-Sr	0.242	0.199	0.0505	0.0509	0.0914	0.163	0.366	0.584	0.608	0.644	19
Thallium T-Tl	0.000141	0.0000892	0.00001	0.00001	0.0000205	0.0002	0.0002	0.0002	0.0002	0.0002	19
Thallium D-Tl	0.00014	0.0000907	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	19
Tin T-Sn	0.000374	0.000191	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	19
Tin D-Sn	0.000406	0.000184	0.0001	0.0001	0.00025	0.0005	0.0005	0.0005	0.000524	0.00074	19
Titanium T-Ti	0.0233	0.0223	0.00658	0.00966	0.01	0.014	0.0245	0.0412	0.079	0.0877	19
Titanium D-Ti	0.00923	0.00467	0.00035	0.000404	0.01	0.01	0.01	0.0106	0.0138	0.021	19
Uranium T-U	0.000459	0.00047	0.000054	0.0000792	0.000164	0.00025	0.00057	0.00132	0.00145	0.00156	19
Uranium D-U	0.000412	0.000454	0.000035	0.0000386	0.000146	0.0002	0.00053	0.00122	0.00144	0.00145	19
Vanadium T-V	0.00203	0.00205	0.0005	0.0005	0.00057	0.00114	0.00253	0.00401	0.00675	0.00785	19
Vanadium D-V	0.000579	0.000187	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	19
Zinc T-Zn	0.0156	0.00968	0.0048	0.00507	0.00715	0.0134	0.0197	0.0267	0.0372	0.0378	19
Zinc D-Zn	0.00726	0.00752	0.001	0.001	0.0026	0.005	0.0086	0.0129	0.0173	0.0332	19

Units = mg/L

Table B11: Summary Statistics Surface Water Sampling Station RBC02 in Rio Blanco Creek

Constituent	All									
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.74	0.323	6.8	7.24	7.6	7.72	7.87	8.16	8.28	8.51	53
Conductivity	282	308	68	110	150	236	330	409	500	2690	73
Hardness CaCO3	117	64.5	34	50	67	107	150	211	224	416	73
Total Dissolved Solids	170	87.5	42	72	100	147	217	277	354	420	73
Total Suspended Solids	47.4	127	1	1	3	8	27	103	207	724	73
Turbidity	24.5	85.6	0.14	0.318	1.1	2.8	10.2	41.7	69.6	640	72
Alkalinity-Total CaCO3	47.1	22.4	21	26	30.8	41	56.2	68.8	100	124	73
Acidity (as CaCO3)	3.09	3.37	0.1	1	1.88	2.3	3.4	4	6	22	72
Chloride Cl	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	19
Fluoride F	0.0598	0.0241	0.03	0.0327	0.0425	0.05	0.084	0.0916	0.0949	0.103	19
Bromide Br	0.05	1.43E-17	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	19
Sulphate SO4	77.6	45.6	16	22.6	37.6	71	110	139	163	180	73
Nitrate Nitrogen N	0.00893	0.00506	0.005	0.005	0.005	0.0053	0.0127	0.0168	0.0174	0.0187	19
Nitrite Nitrogen N	0.001	4.46E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	19
Total Nitrogen	0.0433	0.0115	0.03	0.032	0.04	0.05	0.05	0.05	0.05	0.05	3
Ammonia Nitrogen N	0.005	8.91E-19	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	19
Ortho-Phosphate	0.00142	0.00069	0.001	0.001	0.001	0.0012	0.00135	0.00212	0.00305	0.0035	19
Phosphorus (P)-Total	0.086	0.121	0.002	0.002	0.00425	0.021	0.117	0.3	0.3	0.3	19
Total Organic Carbon	0.518	0.056	0.5	0.5	0.5	0.5	0.5	0.55	0.569	0.74	19
Dissolved Organic Carbon	0.514	0.0456	0.5	0.5	0.5	0.5	0.5	0.514	0.582	0.69	19
Aluminum T-Al	0.783	2.21	0.0005	0.00834	0.027	0.12	0.359	1.62	3.69	14	73
Aluminum D-Al	0.0144	0.0172	0.0003	0.0005	0.0026	0.00836	0.0179	0.0376	0.0521	0.0775	73
Antimony T-Sb	0.000585	0.000465	0.0001	0.0002	0.00035	0.00049	0.0006	0.000908	0.00171	0.00267	73
Antimony D-Sb	0.000329	0.000171	0.0001	0.0001	0.0002	0.00029	0.0005	0.0005	0.00058	0.00087	73
Arsenic T-As	0.00188	0.00174	0.00057	0.000597	0.000705	0.00099	0.00234	0.00517	0.00534	0.00575	19
Arsenic D-As	0.000617	0.000144	0.0005	0.0005	0.0005	0.00059	0.00067	0.000768	0.00086	0.00104	19
Barium T-Ba	0.0474	0.0373	0.02	0.023	0.03	0.038	0.0452	0.0673	0.107	0.249	73
Barium D-Ba	0.031	0.00861	0.0181	0.02	0.024	0.031	0.037	0.0427	0.0475	0.0545	73
Beryllium T-Be	0.000668	0.000446	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	19
Beryllium D-Be	0.000668	0.000446	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	19
Bismuth T-Bi	0.00015	0.000193	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	18

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.00015	0.000193	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	18
Boron T-B	0.0671	0.0443	0.01	0.01	0.011	0.1	0.1	0.1	0.1	0.1	19
Boron D-B	0.0668	0.0446	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	19
Cadmium T-Cd	0.00034	0.000497	0.00004	0.000086	0.0001	0.000172	0.00028	0.00101	0.0012	0.00293	73
Cadmium D-Cd	0.000141	0.0000933	0.00007	0.00008	0.0001	0.0001	0.000156	0.000222	0.0003	0.00071	73
Calcium T-Ca	44.2	25.1	16.5	19.3	24	39	53.8	72.7	90.8	145	73
Calcium D-Ca	39.8	21.3	11.7	17.6	22.8	37.3	50.1	68.4	73.7	145	73
Chromium T-Cr	0.000912	0.000368	0.00013	0.00022	0.000955	0.001	0.001	0.00119	0.00147	0.0016	19
Chromium D-Cr	0.000668	0.000446	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	19
Cobalt T-Co	0.000859	0.00158	0.00007	0.0001	0.0002	0.000305	0.00073	0.00169	0.00319	0.00993	72
Cobalt D-Co	0.000194	0.000151	0.00003	0.0000328	0.0000975	0.00015	0.0003	0.000318	0.000424	0.00099	72
Copper T-Cu	0.00919	0.0171	0.0003	0.0005	0.0014	0.0036	0.007	0.0194	0.0523	0.085	73
Copper D-Cu	0.000846	0.00091	0.00005	0.0001	0.00032	0.00066	0.001	0.00159	0.00176	0.00693	73
Iron T-Fe	1.23	3.34	0.01	0.0268	0.07	0.2	0.67	2.92	4.68	23.1	73
Iron D-Fe	0.0204	0.0201	0.005	0.01	0.01	0.01	0.03	0.03	0.0572	0.12	73
Lead T-Pb	0.00149	0.00242	0.00005	0.000088	0.000258	0.00054	0.00136	0.00331	0.00705	0.0124	73
Lead D-Pb	0.000174	0.000197	0.000025	0.000034	0.00005	0.00008	0.000195	0.0005	0.0005	0.001	73
Magnesium T-Mg	5.52	3.57	1.8	2.08	3.04	4.32	6.9	11.3	14	17.5	73
Magnesium D-Mg	4.36	2.52	1.1	1.83	2.33	3.7	5.43	7.78	9.96	13	73
Manganese T-Mn	0.0571	0.118	0.00053	0.0015	0.0052	0.0123	0.0392	0.13	0.313	0.583	73
Manganese D-Mn	0.0138	0.0282	0.00005	0.000188	0.0013	0.00458	0.00907	0.0206	0.0909	0.13	73
Mercury T-Hg	0.00000632	0.00000226	0.000005	0.000005	0.000005	0.000005	0.0000075	0.00001	0.00001	0.00001	19
Mercury D-Hg	0.00000632	0.00000226	0.000005	0.000005	0.000005	0.000005	0.0000075	0.00001	0.00001	0.00001	19
Molybdenum T-Mo	0.00302	0.00357	0.000949	0.00102	0.0016	0.0022	0.003	0.0051	0.00681	0.03	73
Molybdenum D-Mo	0.00197	0.00104	0.00039	0.000794	0.0013	0.00171	0.00256	0.00299	0.00399	0.00645	72
Nickel T-Ni	0.0083	0.0184	0.00016	0.0015	0.0021	0.0028	0.0053	0.0167	0.0285	0.13	73
Nickel D-Ni	0.00215	0.00222	0.00012	0.0003	0.0008	0.0016	0.00221	0.00389	0.00636	0.0115	73
Selenium T-Se	0.00253	0.00123	0.00102	0.00112	0.00155	0.00224	0.0036	0.00421	0.00436	0.00477	19
Selenium D-Se	0.00254	0.0013	0.00094	0.00106	0.00154	0.00215	0.00372	0.00441	0.00448	0.00466	19
Silicon T-Si	3.07	0.726	1.9	2.06	2.47	3.27	3.74	3.98	4.01	4.06	19
Silicon D-Si	2.44	0.867	1.34	1.37	1.76	2.22	3.34	3.56	3.58	3.77	19

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.0000259	0.0000183	0.00001	0.00001	0.00002	0.00002	0.000023	0.0000428	0.0000574	0.000088	19
Silver D-Ag	0.0000163	0.00000496	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	19
Sodium T-Na	2.05	1.62	0.554	0.7	1.1	1.74	2.35	3.53	4.84	12	73
Sodium D-Na	1.71	1.34	0.305	0.612	0.8	1.6	2	2.69	3.55	10	73
Strontium T-Sr	0.208	0.157	0.0734	0.084	0.109	0.157	0.244	0.325	0.515	1.06	72
Strontium D-Sr	0.19	0.14	0.0489	0.0758	0.101	0.153	0.23	0.33	0.455	0.966	72
Thallium T-Tl	0.00013	0.0000938	0.00001	0.00001	0.0000105	0.0002	0.0002	0.0002	0.0002	0.0002	19
Thallium D-Tl	0.00013	0.0000942	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	19
Tin T-Sn	0.000353	0.000198	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	19
Tin D-Sn	0.000353	0.000198	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	19
Titanium T-Ti	0.0161	0.0148	0.0024	0.00924	0.01	0.01	0.0135	0.0308	0.0435	0.066	19
Titanium D-Ti	0.00856	0.00357	0.0003	0.000444	0.01	0.01	0.01	0.01	0.0101	0.011	19
Uranium T-U	0.000277	0.000152	0.000118	0.000131	0.000191	0.0002	0.00034	0.000522	0.000577	0.00064	19
Uranium D-U	0.000252	0.000151	0.000075	0.0000813	0.000176	0.0002	0.000305	0.000486	0.000556	0.00061	19
Vanadium T-V	0.00174	0.00206	0.0005	0.0005	0.0005	0.00057	0.00184	0.00529	0.00641	0.0065	19
Vanadium D-V	0.000632	0.000226	0.0005	0.0005	0.0005	0.0005	0.00075	0.001	0.001	0.001	19
Zinc T-Zn	0.0258	0.0355	0.0011	0.0053	0.0086	0.013	0.023	0.0566	0.09	0.216	73
Zinc D-Zn	0.00615	0.00605	0.0004	0.00088	0.0034	0.005	0.0072	0.00994	0.0134	0.048	73

Units = mg/L

Table B12: Summary Statistics Surface Water Sampling Station RC02 in Roosevelt Creek

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.76	0.338	7.05	7.19	7.58	7.76	7.92	8.28	8.36	8.4	40
Conductivity	134	58.3	59.4	65.1	82	130	191	220	235	244	53
Hardness CaCO3	63.3	30.1	26	28.7	38.3	57	81.3	113	121	129	54
Total Dissolved Solids	79.3	33.3	32	39.3	53	67.5	111	130	134	149	54
Total Suspended Solids	17.7	29.4	1	1	3	7	19	40.7	63.9	147	54
Turbidity	14.2	22.7	0.16	0.352	1.8	5.76	17	31.8	42	128	53
Alkalinity-Total CaCO3	53.2	21.8	26	28.1	34.2	46.2	74.3	86.6	88.8	94	54
Acidity (as CaCO3)	2.27	3.1	0.8	1	1.03	1.75	2.1	2.94	3.44	23	54
Chloride Cl	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	20
Fluoride F	0.0217	0.00339	0.02	0.02	0.02	0.02	0.0218	0.0252	0.0273	0.033	20
Bromide Br	0.05	7.12E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	20
Sulphate SO4	15.9	7.85	4.7	6.36	9.9	13.8	20.3	28	31.1	33.6	54
Nitrate Nitrogen N	0.173	0.174	0.0143	0.0181	0.0301	0.102	0.304	0.387	0.434	0.603	20
Nitrite Nitrogen N	0.001	4.45E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	20
Total Nitrogen	0.147	0.149	0.041	0.0451	0.0615	0.082	0.2	0.27	0.294	0.317	3
Ammonia Nitrogen N	0.00514	0.000626	0.005	0.005	0.005	0.005	0.005	0.005	0.00514	0.0078	20
Ortho-Phosphate	0.00106	0.000119	0.001	0.001	0.001	0.001	0.00103	0.00121	0.00131	0.0014	20
Phosphorus (P)-Total	0.116	0.166	0.002	0.002	0.0071	0.0171	0.299	0.3	0.314	0.579	20
Total Organic Carbon	0.558	0.152	0.5	0.5	0.5	0.5	0.5	0.68	0.788	1.13	20
Dissolved Organic Carbon	0.531	0.0784	0.5	0.5	0.5	0.5	0.508	0.568	0.65	0.83	20
Aluminum T-Al	0.557	0.761	0.0005	0.00966	0.0697	0.218	0.756	1.54	2.16	3.3	54
Aluminum D-Al	0.0182	0.021	0.0005	0.0005	0.00188	0.00705	0.0308	0.0514	0.0573	0.0745	54
Antimony T-Sb	0.000431	0.00024	0.0001	0.000173	0.00025	0.0004	0.0005	0.000664	0.000861	0.0013	54
Antimony D-Sb	0.00026	0.000155	0.00005	0.0001	0.00014	0.00021	0.00047	0.0005	0.0005	0.0005	54
Arsenic T-As	0.000725	0.000431	0.00022	0.000268	0.0005	0.0005	0.000938	0.00132	0.00163	0.00169	20
Arsenic D-As	0.000365	0.000171	0.0001	0.000129	0.000188	0.0005	0.0005	0.0005	0.0005	0.0005	20
Barium T-Ba	0.085	0.0237	0.0344	0.058	0.069	0.0817	0.095	0.106	0.135	0.17	53
Barium D-Ba	0.0685	0.0178	0.0269	0.0466	0.057	0.0628	0.0836	0.0947	0.0954	0.11	53
Beryllium T-Be	0.00064	0.000452	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	20
Beryllium D-Be	0.00064	0.000452	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	20
Bismuth T-Bi	0.00014	0.000185	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	20

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.00014	0.000185	0.00005	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	20
Boron T-B	0.0659	0.0431	0.01	0.01	0.017	0.1	0.1	0.1	0.1	0.1	20
Boron D-B	0.0651	0.0439	0.01	0.01	0.013	0.1	0.1	0.1	0.1	0.1	20
Cadmium T-Cd	0.000108	0.0000975	0.0000053	0.00000705	0.0000404	0.0001	0.0001	0.000224	0.000335	0.0004	54
Cadmium D-Cd	0.0000712	0.0000497	0.00001	0.0000136	0.000017	0.000095	0.0001	0.0001	0.000135	0.0002	54
Calcium T-Ca	21.5	9.82	7.7	10	13.1	19.3	26.2	36	39.4	42	53
Calcium D-Ca	20.1	9.26	7.4	8.79	12.1	19	26	34.9	37.8	39.8	53
Chromium T-Cr	0.000812	0.000314	0.00013	0.000159	0.00062	0.001	0.001	0.001	0.001	0.001	20
Chromium D-Cr	0.000646	0.000445	0.0001	0.0001	0.000115	0.001	0.001	0.001	0.001	0.001	20
Cobalt T-Co	0.000462	0.000465	0.00006	0.000066	0.00016	0.0003	0.00061	0.000996	0.00107	0.0025	53
Cobalt D-Co	0.000134	0.0000976	0.00003	0.00003	0.00006	0.0001	0.00019	0.0003	0.0003	0.0003	53
Copper T-Cu	0.0025	0.00289	0.0001	0.00026	0.0007	0.001	0.0032	0.00618	0.00908	0.014	53
Copper D-Cu	0.000528	0.00068	0.00005	0.00005	0.00013	0.00028	0.001	0.001	0.001	0.0045	53
Iron T-Fe	0.703	0.961	0.01	0.0139	0.0828	0.3	0.913	1.92	2.3	4.4	54
Iron D-Fe	0.0265	0.0195	0.005	0.01	0.01	0.0265	0.0323	0.049	0.0561	0.11	54
Lead T-Pb	0.00137	0.00178	0.00005	0.00005	0.000293	0.00057	0.00169	0.00376	0.00427	0.01	54
Lead D-Pb	0.000169	0.000184	0.000025	0.000025	0.00005	0.000069	0.00021	0.0005	0.0005	0.0005	54
Magnesium T-Mg	4.03	1.93	1.6	1.79	2.71	3.55	4.9	6.86	7.71	9.9	54
Magnesium D-Mg	3.59	1.73	1.37	1.51	2.13	3.35	4.75	6.2	6.76	7.2	54
Manganese T-Mn	0.0452	0.0805	0.0006	0.0011	0.00405	0.0133	0.0454	0.119	0.168	0.453	54
Manganese D-Mn	0.00227	0.00242	0.00005	0.000152	0.000425	0.00125	0.00362	0.00622	0.00741	0.00951	54
Mercury T-Hg	0.0000104	0.000017	0.000005	0.000005	0.000005	0.000005	0.00001	0.0000104	0.000017	0.000082	20
Mercury D-Hg	0.000006	0.00000205	0.000005	0.000005	0.000005	0.000005	0.000005	0.00001	0.00001	0.00001	20
Molybdenum T-Mo	0.00137	0.00399	0.00005	0.000287	0.00045	0.0008	0.00103	0.0014	0.00157	0.03	54
Molybdenum D-Mo	0.0012	0.00401	0.00005	0.000167	0.000335	0.000635	0.001	0.00114	0.00124	0.03	54
Nickel T-Ni	0.00293	0.0108	0.00012	0.00015	0.000608	0.001	0.00118	0.00396	0.00631	0.08	54
Nickel D-Ni	0.000632	0.00044	0.00006	0.00015	0.0003	0.0005	0.001	0.001	0.00128	0.002	54
Selenium T-Se	0.000467	0.000367	0.000112	0.00012	0.00017	0.000336	0.00062	0.00112	0.00116	0.00118	20
Selenium D-Se	0.000485	0.000392	0.0001	0.000116	0.000168	0.000365	0.000689	0.00108	0.00117	0.00128	20
Silicon T-Si	2.09	0.567	1.38	1.56	1.69	1.99	2.3	2.82	3.07	3.66	20
Silicon D-Si	1.17	0.649	0.456	0.487	0.618	1.03	1.63	2.16	2.23	2.25	20

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.0000306	0.0000215	0.00001	0.00001	0.00002	0.00002	0.000044	0.0000591	0.00007	0.000088	20
Silver D-Ag	0.000016	0.00000503	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	20
Sodium T-Na	1.05	0.682	0.27	0.313	0.42	0.794	1.93	2	2	2.3	54
Sodium D-Na	0.926	0.691	0.2	0.237	0.32	0.665	1.4	2	2	2	54
Strontium T-Sr	0.128	0.0583	0.0487	0.0542	0.0805	0.117	0.181	0.217	0.219	0.23	53
Strontium D-Sr	0.122	0.0556	0.0425	0.0502	0.0739	0.11	0.17	0.199	0.216	0.236	53
Thallium T-Tl	0.000129	0.0000898	0.00001	0.00001	0.00003	0.0002	0.0002	0.0002	0.0002	0.0002	20
Thallium D-Tl	0.000124	0.0000955	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	0.0002	20
Tin T-Sn	0.00034	0.000201	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	0.0005	20
Tin D-Sn	0.00037	0.000188	0.0001	0.0001	0.00016	0.0005	0.0005	0.0005	0.000502	0.00054	20
Titanium T-Ti	0.0136	0.00843	0.0003	0.00173	0.01	0.01	0.019	0.024	0.0293	0.035	20
Titanium D-Ti	0.00812	0.00386	0.0003	0.0003	0.01	0.01	0.01	0.01	0.01	0.01	20
Uranium T-U	0.000145	0.0000698	0.000048	0.000049	0.0000618	0.0002	0.0002	0.0002	0.0002	0.0002	20
Uranium D-U	0.000138	0.00008	0.000018	0.0000237	0.0000508	0.0002	0.0002	0.0002	0.0002	0.0002	20
Vanadium T-V	0.00174	0.00143	0.0005	0.0005	0.0005	0.00109	0.00306	0.00396	0.00414	0.00449	20
Vanadium D-V	0.0006	0.000205	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	20
Zinc T-Zn	0.0129	0.0171	0.001	0.001	0.0035	0.0055	0.0118	0.0288	0.0568	0.075	54
Zinc D-Zn	0.00284	0.00217	0.0002	0.0003	0.001	0.002	0.005	0.005	0.00618	0.0091	54

Units = mg/L

Table B13: Summary Statistics Surface Water Sampling Station GSC09 in Goldslide Creek

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	6	0.722	5.2	5.28	5.48	5.64	6.66	6.9	6.91	6.91	7
Conductivity	153	15.7	134	136	144	151	157	169	177	185	8
Hardness CaCO3	60.2	8.01	50.6	51.7	55.7	59.2	62.4	67.6	72.3	77	8
Total Dissolved Solids	109	12.6	86	90.6	103	110	120	121	121	122	8
Total Suspended Solids	3.11	0.318	3	3	3	3	3	3.27	3.59	3.9	8
Turbidity	0.114	0.0207	0.1	0.1	0.1	0.1	0.125	0.143	0.147	0.15	8
Alkalinity-Total CaCO3	1.51	0.491	1	1	1.08	1.4	2	2.06	2.13	2.2	8
Acidity (as CaCO3)	2.63	0.763	1.9	1.94	2.08	2.3	3.08	3.69	3.8	3.9	8
Chloride Cl	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	8
Fluoride F	0.0225	0.00193	0.02	0.0204	0.021	0.0225	0.0233	0.0246	0.0253	0.026	8
Bromide Br	0.05	7.42E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	8
Sulphate SO4	65.1	8.25	54.4	56.2	59.8	63.9	67.9	74	77.7	81.4	8
Nitrate Nitrogen N	0.0254	0.00501	0.0208	0.0209	0.0215	0.024	0.0271	0.0328	0.0332	0.0336	8
Nitrite Nitrogen N	0.001	N/A	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	8
Total Nitrogen	0.03	N/A	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	1
Ammonia Nitrogen N	0.005	N/A	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	8
Ortho-Phosphate	0.001	N/A	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	8
Phosphorus (P)-Total	0.0945	0.129	0.002	0.002	0.00223	0.05	0.113	0.3	0.3	0.3	8
Total Organic Carbon	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	8
Dissolved Organic Carbon	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	8
Aluminum T-Al	0.111	0.0112	0.0968	0.0974	0.103	0.109	0.119	0.125	0.126	0.126	8
Aluminum D-Al	0.1	0.0145	0.0752	0.0806	0.0924	0.0976	0.115	0.115	0.116	0.116	8
Antimony T-Sb	0.00025	0.000207	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	8
Antimony D-Sb	0.00025	0.000207	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	8
Arsenic T-As	0.00025	0.000207	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	8
Arsenic D-As	0.00025	0.000207	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	8
Barium T-Ba	0.0171	0.00244	0.015	0.015	0.0152	0.0157	0.02	0.02	0.02	0.02	8
Barium D-Ba	0.017	0.0025	0.0146	0.0147	0.0152	0.0157	0.02	0.02	0.02	0.02	8
Beryllium T-Be	0.000438	0.000466	0.0001	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	8
Beryllium D-Be	0.000438	0.000466	0.0001	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	8
Bismuth T-Bi	0.000163	0.000208	0.00005	0.00005	0.00005	0.00005	0.000163	0.0005	0.0005	0.0005	8

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.000163	0.000208	0.00005	0.00005	0.00005	0.00005	0.000163	0.0005	0.0005	0.0005	8
Boron T-B	0.0475	0.0435	0.013	0.0134	0.0155	0.0185	0.1	0.1	0.1	0.1	8
Boron D-B	0.0455	0.0451	0.012	0.012	0.012	0.014	0.1	0.1	0.1	0.1	8
Cadmium T-Cd	0.000866	0.0000574	0.000761	0.000787	0.000842	0.000869	0.000893	0.000918	0.000938	0.000959	8
Cadmium D-Cd	0.000888	0.0000731	0.000802	0.000819	0.000855	0.000872	0.000893	0.000956	0.001	0.00105	8
Calcium T-Ca	20.3	2.4	16.7	17.3	19	20.1	21.2	22.6	23.7	24.8	8
Calcium D-Ca	19.7	2.62	16.7	17	18.3	19.2	20.4	22	23.7	25.3	8
Chromium T-Cr	0.000439	0.000465	0.0001	0.0001	0.0001	0.000105	0.001	0.001	0.001	0.001	8
Chromium D-Cr	0.000438	0.000466	0.0001	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	8
Cobalt T-Co	0.000491	0.0000236	0.00046	0.000464	0.000485	0.00049	0.000493	0.000512	0.000526	0.00054	8
Cobalt D-Co	0.000465	0.0000359	0.00039	0.000415	0.00046	0.00047	0.000473	0.000492	0.000506	0.00052	8
Copper T-Cu	0.0101	0.000804	0.00932	0.00933	0.00947	0.00974	0.0109	0.0111	0.0112	0.0113	8
Copper D-Cu	0.00946	0.000672	0.00887	0.00892	0.00911	0.00919	0.00955	0.0103	0.0106	0.0109	8
Iron T-Fe	0.0175	0.0104	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	8
Iron D-Fe	0.018	0.01	0.01	0.01	0.01	0.012	0.03	0.03	0.03	0.03	8
Lead T-Pb	0.000219	0.000233	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	0.0005	8
Lead D-Pb	0.000219	0.000233	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	0.0005	8
Magnesium T-Mg	2.77	0.39	2.21	2.29	2.5	2.79	2.98	3.17	3.31	3.44	8
Magnesium D-Mg	2.67	0.373	2.14	2.21	2.42	2.7	2.84	3.07	3.19	3.32	8
Manganese T-Mn	0.0237	0.000915	0.0223	0.0225	0.0233	0.0239	0.0241	0.0245	0.0249	0.0253	8
Manganese D-Mn	0.0227	0.00116	0.0204	0.0208	0.0226	0.023	0.0233	0.0236	0.0239	0.0241	8
Mercury T-Hg	0.00000625	0.00000231	0.000005	0.000005	0.000005	0.000005	0.00000625	0.00001	0.00001	0.00001	8
Mercury D-Hg	0.00000625	0.00000231	0.000005	0.000005	0.000005	0.000005	0.00000625	0.00001	0.00001	0.00001	8
Molybdenum T-Mo	0.000439	0.000465	0.000074	0.0000761	0.0000965	0.000127	0.001	0.001	0.001	0.001	8
Molybdenum D-Mo	0.000427	0.000475	0.000054	0.000061	0.0000823	0.000101	0.001	0.001	0.001	0.001	8
Nickel T-Ni	0.0023	0.000192	0.00206	0.00207	0.0021	0.00235	0.00245	0.00251	0.00251	0.00252	8
Nickel D-Ni	0.00218	0.000173	0.002	0.002	0.00205	0.00213	0.00236	0.0024	0.0024	0.00241	8
Selenium T-Se	0.000755	0.0000784	0.000669	0.000676	0.000704	0.000736	0.000783	0.000863	0.000879	0.000894	8
Selenium D-Se	0.000743	0.000105	0.000628	0.000645	0.000684	0.00069	0.000803	0.000887	0.000906	0.000925	8
Silicon T-Si	3.12	0.127	2.97	2.99	3.04	3.09	3.2	3.26	3.31	3.36	8
Silicon D-Si	3.03	0.119	2.92	2.92	2.95	3.02	3.06	3.14	3.21	3.29	8

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.0000138	0.00000518	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	8
Silver D-Ag	0.0000138	0.00000518	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	8
Sodium T-Na	1.6	0.359	1.21	1.23	1.28	1.52	2	2	2	2	8
Sodium D-Na	1.57	0.373	1.17	1.19	1.26	1.44	2	2	2	2	8
Strontium T-Sr	0.203	0.0196	0.17	0.177	0.194	0.202	0.212	0.221	0.229	0.237	8
Strontium D-Sr	0.197	0.0218	0.168	0.171	0.185	0.195	0.208	0.221	0.229	0.237	8
Thallium T-Tl	0.0000813	0.0000983	0.00001	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	8
Thallium D-Tl	0.0000813	0.0000983	0.00001	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	8
Tin T-Sn	0.00025	0.000207	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	8
Tin D-Sn	0.000306	0.000201	0.0001	0.0001	0.0001	0.000325	0.0005	0.0005	0.0005	0.0005	8
Titanium T-Ti	0.00636	0.00502	0.0003	0.0003	0.0003	0.01	0.01	0.01	0.01	0.01	8
Titanium D-Ti	0.00636	0.00502	0.0003	0.0003	0.0003	0.01	0.01	0.01	0.01	0.01	8
Uranium T-U	0.0000813	0.0000983	0.00001	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	8
Uranium D-U	0.0000813	0.0000983	0.00001	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	8
Vanadium T-V	0.000625	0.000231	0.0005	0.0005	0.0005	0.0005	0.000625	0.001	0.001	0.001	8
Vanadium D-V	0.000625	0.000231	0.0005	0.0005	0.0005	0.0005	0.000625	0.001	0.001	0.001	8
Zinc T-Zn	0.0567	0.0032	0.0526	0.053	0.055	0.0558	0.059	0.0602	0.0612	0.0622	8
Zinc D-Zn	0.059	0.00398	0.0534	0.0541	0.056	0.0588	0.0616	0.0642	0.0643	0.0643	8

Units = mg/L

Table B14: Summary Statistics Surface Water Sampling Station GSC07 in Goldslide Creek

Lower Bitter Creek (BC02)	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.3	0.498	6.36	6.6	7.04	7.31	7.68	7.81	7.85	7.89	8
Conductivity	149	29.5	99.9	110	132	149	164	174	192	209	11
Hardness CaCO3	63.2	16.3	41.5	45.3	52.3	61.3	70.6	75.5	88.3	101	11
Total Dissolved Solids	103	22.9	72	74.5	85.5	106	117	133	136	139	11
Total Suspended Solids	3.3	0.995	3	3	3	3	3	3	4.65	6.3	11
Turbidity	0.287	0.375	0.1	0.1	0.1	0.18	0.255	0.34	0.865	1.39	11
Alkalinity-Total CaCO3	7.8	1.62	5.9	6.05	6.65	7.5	8.85	9.7	10.3	10.9	11
Acidity (as CaCO3)	2.04	0.52	1.5	1.5	1.5	2.1	2.45	2.7	2.75	2.8	11
Chloride Cl	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	11
Fluoride F	0.0401	0.00528	0.032	0.0325	0.0375	0.039	0.044	0.046	0.0475	0.049	11
Bromide Br	0.05	7.28E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	11
Sulphate SO4	58.3	13.1	38.6	42.5	50.3	56.1	64.8	70.5	78.3	86	11
Nitrate Nitrogen N	0.028	0.0044	0.0213	0.022	0.0256	0.0283	0.0306	0.0319	0.0343	0.0366	11
Nitrite Nitrogen N	0.00109	0.000302	0.001	0.001	0.001	0.001	0.001	0.001	0.0015	0.002	11
Total Nitrogen	0.04	0.0141	0.03	0.031	0.035	0.04	0.045	0.048	0.049	0.05	2
Ammonia Nitrogen N	0.005	9.1E-19	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	11
Ortho-Phosphate	0.001	2.27E-19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	11
Phosphorus (P)-Total	0.124	0.141	0.002	0.002	0.00365	0.05	0.3	0.3	0.3	0.3	11
Total Organic Carbon	0.522	0.0724	0.5	0.5	0.5	0.5	0.5	0.5	0.62	0.74	11
Dissolved Organic Carbon	0.555	0.126	0.5	0.5	0.5	0.5	0.5	0.75	0.805	0.86	11
Aluminum T-Al	0.0218	0.0161	0.006	0.008	0.0104	0.0196	0.0276	0.0356	0.0486	0.0616	11
Aluminum D-Al	0.0138	0.00784	0.005	0.0063	0.00945	0.0104	0.015	0.0244	0.0281	0.0317	11
Antimony T-Sb	0.000251	0.000198	0.0001	0.0001	0.0001	0.00012	0.0005	0.0005	0.0005	0.0005	11
Antimony D-Sb	0.000248	0.0002	0.0001	0.0001	0.0001	0.00011	0.0005	0.0005	0.0005	0.0005	11
Arsenic T-As	0.000252	0.000197	0.0001	0.0001	0.0001	0.00011	0.0005	0.0005	0.0005	0.0005	11
Arsenic D-As	0.000247	0.0002	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	11
Barium T-Ba	0.0193	0.00136	0.0168	0.0174	0.0186	0.0195	0.02	0.02	0.021	0.022	11
Barium D-Ba	0.0193	0.00164	0.0166	0.0173	0.0182	0.0197	0.02	0.02	0.0215	0.023	11
Beryllium T-Be	0.000427	0.000454	0.0001	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	11
Beryllium D-Be	0.000427	0.000454	0.0001	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	11
Bismuth T-Bi	0.000214	0.000227	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	0.0005	11

Lower Bitter Creek (BC02)	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.000214	0.000227	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	0.0005	11
Boron T-B	0.0427	0.0454	0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.1	11
Boron D-B	0.0427	0.0454	0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.1	11
Cadmium T-Cd	0.000319	0.0000508	0.000235	0.000251	0.000286	0.000323	0.000334	0.000372	0.000393	0.000415	10
Cadmium D-Cd	0.000322	0.0000485	0.000247	0.000256	0.000293	0.000324	0.000337	0.000373	0.000393	0.000413	10
Calcium T-Ca	21.4	5.6	14.2	15.1	17.9	21.9	23.2	24.9	29.9	34.9	11
Calcium D-Ca	21.3	5.61	14	15.3	17.5	20.7	23.6	25.6	30	34.4	11
Chromium T-Cr	0.000431	0.000451	0.0001	0.0001	0.0001	0.00011	0.001	0.001	0.001	0.001	11
Chromium D-Cr	0.000437	0.000447	0.0001	0.0001	0.0001	0.0001	0.001	0.001	0.001	0.001	11
Cobalt T-Co	0.000416	0.000136	0.00025	0.000265	0.000305	0.00039	0.000515	0.0006	0.00062	0.00064	11
Cobalt D-Co	0.000404	0.000128	0.00025	0.00026	0.0003	0.00037	0.000485	0.0006	0.000605	0.00061	11
Copper T-Cu	0.00901	0.00347	0.0032	0.00429	0.00648	0.0096	0.0115	0.0134	0.0137	0.0139	11
Copper D-Cu	0.00816	0.00308	0.003	0.00392	0.00613	0.0082	0.0101	0.0117	0.0125	0.0133	11
Iron T-Fe	0.0235	0.0254	0.01	0.01	0.01	0.01	0.03	0.03	0.0625	0.095	11
Iron D-Fe	0.0173	0.0101	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	11
Lead T-Pb	0.000214	0.000227	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	0.0005	11
Lead D-Pb	0.000214	0.000227	0.00005	0.00005	0.00005	0.00005	0.0005	0.0005	0.0005	0.0005	11
Magnesium T-Mg	2.48	0.52	1.62	1.79	2.17	2.46	2.82	2.98	3.22	3.45	11
Magnesium D-Mg	2.44	0.572	1.6	1.75	2.09	2.36	2.74	3.02	3.33	3.64	11
Manganese T-Mn	0.00514	0.00307	0.00034	0.00111	0.00268	0.00563	0.00744	0.00899	0.00922	0.00944	11
Manganese D-Mn	0.00513	0.00282	0.00072	0.00132	0.00281	0.00607	0.00753	0.00826	0.00842	0.00858	11
Mercury T-Hg	0.00000682	0.00000252	0.000005	0.000005	0.000005	0.000005	0.00001	0.00001	0.00001	0.00001	11
Mercury D-Hg	0.00000682	0.00000252	0.000005	0.000005	0.000005	0.000005	0.00001	0.00001	0.00001	0.00001	11
Molybdenum T-Mo	0.0027	0.000397	0.0022	0.00225	0.00246	0.00263	0.00294	0.0032	0.00332	0.00343	11
Molybdenum D-Mo	0.00255	0.000285	0.0021	0.00215	0.0024	0.00252	0.00276	0.00291	0.00294	0.00297	11
Nickel T-Ni	0.0016	0.000267	0.001	0.00122	0.00153	0.00163	0.00169	0.0018	0.00195	0.0021	11
Nickel D-Ni	0.00162	0.000213	0.0012	0.00131	0.00153	0.00163	0.00174	0.0018	0.0019	0.002	11
Selenium T-Se	0.000829	0.00016	0.00056	0.000615	0.000729	0.000817	0.000942	0.000997	0.00105	0.00111	11
Selenium D-Se	0.000848	0.000175	0.0006	0.000648	0.000719	0.000803	0.000974	0.00104	0.00111	0.00118	11
Silicon T-Si	2.34	0.211	2.01	2.06	2.23	2.32	2.45	2.5	2.64	2.78	11
Silicon D-Si	2.32	0.237	1.99	2.06	2.17	2.32	2.39	2.56	2.71	2.86	11

Lower Bitter Creek (BC02)	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.0000136	0.00000505	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	11
Silver D-Ag	0.0000136	0.00000505	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	11
Sodium T-Na	1.31	0.554	0.699	0.757	0.917	1.03	2	2	2	2	11
Sodium D-Na	1.31	0.555	0.698	0.759	0.908	1.02	2	2	2	2	11
Strontium T-Sr	0.13	0.0406	0.0866	0.0917	0.107	0.119	0.143	0.155	0.195	0.234	11
Strontium D-Sr	0.131	0.0464	0.0878	0.0908	0.102	0.127	0.138	0.149	0.203	0.257	11
Thallium T-Tl	0.0000791	0.0000959	0.00001	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	11
Thallium D-Tl	0.0000791	0.0000959	0.00001	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	11
Tin T-Sn	0.000245	0.000202	0.0001	0.0001	0.0001	0.0001	0.0005	0.0005	0.0005	0.0005	11
Tin D-Sn	0.000272	0.000189	0.0001	0.0001	0.0001	0.00016	0.0005	0.0005	0.0005	0.0005	11
Titanium T-Ti	0.00735	0.00453	0.0003	0.0003	0.00515	0.01	0.01	0.01	0.01	0.01	11
Titanium D-Ti	0.00735	0.00453	0.0003	0.0003	0.00515	0.01	0.01	0.01	0.01	0.01	11
Uranium T-U	0.0000791	0.0000959	0.00001	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	11
Uranium D-U	0.0000791	0.0000959	0.00001	0.00001	0.00001	0.00001	0.0002	0.0002	0.0002	0.0002	11
Vanadium T-V	0.000682	0.000252	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.001	11
Vanadium D-V	0.000682	0.000252	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.001	11
Zinc T-Zn	0.0203	0.00377	0.0151	0.0157	0.0178	0.0204	0.0221	0.0235	0.026	0.0284	11
Zinc D-Zn	0.0209	0.00429	0.0149	0.0159	0.0179	0.021	0.0233	0.0245	0.0272	0.0299	11

Units = mg/L

Table B15: Summary Statistics Surface Water Sampling Station BR03 in Bear River

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Field pH	7.75	0.207	7.42	7.47	7.66	7.78	7.86	7.95	7.98	8.01	6
Conductivity	155	68.8	92.3	93	97.2	130	210	239	254	268	8
Hardness CaCO3	76.1	35.7	43.9	44	44.3	63.6	107	118	125	133	8
Total Dissolved Solids	106	40.1	67	68.1	79	89.5	134	165	165	165	8
Total Suspended Solids	173	214	3	3	3	77.9	289	459	510	560	8
Turbidity	110	124	0.38	0.499	1.52	66.4	196	290	290	291	8
Alkalinity-Total CaCO3	55.9	19.8	35.4	36.7	39.2	49.3	72.1	80.8	83.7	86.5	8
Acidity (as CaCO3)	1.27	0.591	1	1	1	1	1.15	1.76	2.18	2.6	7
Chloride Cl	0.5	N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	8
Fluoride F	0.0393	0.0176	0.02	0.02	0.0238	0.0365	0.0545	0.0605	0.0623	0.064	8
Bromide Br	0.05	7.42E-18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	8
Sulphate SO4	23	14.2	9.23	9.42	12.2	18	33	41.8	43.5	45.2	8
Nitrate Nitrogen N	0.107	0.0948	0.0209	0.0217	0.026	0.0868	0.151	0.221	0.252	0.283	8
Nitrite Nitrogen N	0.001	N/A	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	8
Total Nitrogen	0.128	0.0204	0.11	0.111	0.117	0.123	0.137	0.145	0.147	0.15	3
Ammonia Nitrogen N	0.00578	0.00162	0.005	0.005	0.005	0.005	0.00543	0.00754	0.00852	0.0095	8
Ortho-Phosphate	0.00109	0.00021	0.001	0.001	0.001	0.001	0.00103	0.00125	0.00143	0.0016	8
Phosphorus (P)-Total	0.278	0.314	0.0032	0.00453	0.0393	0.191	0.384	0.699	0.775	0.851	8
Total Organic Carbon	0.953	0.506	0.5	0.5	0.53	0.865	1.16	1.52	1.71	1.91	8
Dissolved Organic Carbon	0.561	0.0917	0.5	0.5	0.5	0.5	0.613	0.692	0.706	0.72	8
Aluminum T-Al	4.45	4.62	0.0157	0.0254	0.0786	3.25	8.16	10.3	10.9	11.5	8
Aluminum D-Al	0.0595	0.0533	0.0041	0.00508	0.0102	0.0606	0.0907	0.109	0.13	0.15	8
Antimony T-Sb	0.00109	0.000706	0.0005	0.0005	0.000508	0.000835	0.00142	0.00214	0.00218	0.00222	8
Antimony D-Sb	0.000466	0.0000447	0.00039	0.000397	0.00044	0.00049	0.0005	0.0005	0.0005	0.0005	8
Arsenic T-As	0.0074	0.00792	0.00069	0.000722	0.000825	0.00499	0.0106	0.0177	0.02	0.0223	8
Arsenic D-As	0.000634	0.0000578	0.00057	0.000581	0.0006	0.00062	0.00065	0.000683	0.000722	0.00076	8
Barium T-Ba	0.127	0.0559	0.072	0.0762	0.0881	0.0985	0.173	0.205	0.208	0.21	8
Barium D-Ba	0.0548	0.0213	0.035	0.0353	0.0375	0.0464	0.0733	0.0818	0.084	0.0861	8
Beryllium T-Be	0.000574	0.00046	0.0001	0.0001	0.0001	0.000645	0.001	0.001	0.001	0.001	8
Beryllium D-Be	0.00055	0.000481	0.0001	0.0001	0.0001	0.00055	0.001	0.001	0.001	0.001	8
Bismuth T-Bi	0.00637	0.0176	0.00005	0.00005	0.00005	0.000052	0.000259	0.0154	0.0327	0.05	8

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Bismuth D-Bi	0.00635	0.0176	0.00005	0.00005	0.00005	0.00005	0.000163	0.0154	0.0327	0.05	8
Boron T-B	0.0563	0.0468	0.012	0.012	0.012	0.057	0.1	0.1	0.1	0.1	8
Boron D-B	0.0554	0.0477	0.01	0.01	0.01	0.0565	0.1	0.1	0.1	0.1	8
Cadmium T-Cd	0.000222	0.000248	0.0000162	0.000017	0.0000228	0.000123	0.000348	0.00059	0.000606	0.000621	8
Cadmium D-Cd	0.0000187	0.00000658	0.0000056	0.00000959	0.000017	0.0000183	0.0000215	0.0000263	0.0000267	0.000027	8
Calcium T-Ca	28.6	12.1	17	17.1	19.2	24	37.7	43.9	46.2	48.4	8
Calcium D-Ca	26.5	12.2	15.4	15.5	15.8	22.2	37	40.7	43.3	45.9	8
Chromium T-Cr	0.00604	0.00596	0.0001	0.000415	0.001	0.00419	0.0101	0.0132	0.0149	0.0165	8
Chromium D-Cr	0.00055	0.000481	0.0001	0.0001	0.0001	0.00055	0.001	0.001	0.001	0.001	8
Cobalt T-Co	0.00294	0.00318	0.0001	0.00017	0.0003	0.00176	0.0049	0.00702	0.0078	0.00858	8
Cobalt D-Co	0.0002	0.000107	0.0001	0.0001	0.0001	0.0002	0.0003	0.0003	0.0003	0.0003	8
Copper T-Cu	0.0146	0.016	0.0005	0.000675	0.001	0.00917	0.0235	0.0352	0.0393	0.0434	8
Copper D-Cu	0.000664	0.000366	0.0002	0.000235	0.000338	0.00073	0.001	0.001	0.001	0.001	8
Iron T-Fe	6.5	7.27	0.036	0.0528	0.123	3.97	11.4	16	17.4	18.7	8
Iron D-Fe	0.0411	0.0241	0.01	0.017	0.03	0.031	0.0525	0.0666	0.0778	0.089	8
Lead T-Pb	0.00512	0.00568	0.00005	0.000208	0.0005	0.00327	0.00765	0.0132	0.014	0.0149	8
Lead D-Pb	0.000285	0.00023	0.00005	0.0000532	0.000077	0.000294	0.0005	0.0005	0.0005	0.0005	8
Magnesium T-Mg	4.85	1.67	3.18	3.24	3.72	4.32	5.6	7.21	7.43	7.65	8
Magnesium D-Mg	2.42	1.31	1.12	1.15	1.36	1.99	3.43	3.96	4.26	4.56	8
Manganese T-Mn	0.206	0.222	0.0125	0.0133	0.0163	0.121	0.357	0.526	0.535	0.544	8
Manganese D-Mn	0.0119	0.0078	0.00099	0.00118	0.00796	0.0128	0.0164	0.0189	0.0214	0.0238	8
Mercury T-Hg	0.0000109	0.00000749	0.000005	0.000005	0.000005	0.00000755	0.0000161	0.0000189	0.000022	0.000025	8
Mercury D-Hg	0.00000625	0.00000231	0.000005	0.000005	0.000005	0.000005	0.00000625	0.00001	0.00001	0.00001	8
Molybdenum T-Mo	0.00218	0.000375	0.0016	0.00163	0.00207	0.0022	0.00236	0.00257	0.00263	0.0027	8
Molybdenum D-Mo	0.0016	0.000533	0.001	0.00104	0.00112	0.0016	0.00209	0.00213	0.00217	0.0022	8
Nickel T-Ni	0.00689	0.0071	0.0005	0.000675	0.001	0.00437	0.011	0.016	0.0178	0.0197	8
Nickel D-Ni	0.00075	0.000267	0.0005	0.0005	0.0005	0.00075	0.001	0.001	0.001	0.001	8
Selenium T-Se	0.0012	0.000359	0.00063	0.000701	0.000939	0.00132	0.00139	0.0015	0.00161	0.00173	8
Selenium D-Se	0.00095	0.000496	0.000412	0.000424	0.000494	0.000903	0.00129	0.00156	0.00164	0.00172	8
Silicon T-Si	8.46	6.94	1.81	1.85	1.94	6.45	14.6	16.9	18	19	8
Silicon D-Si	1.25	0.486	0.697	0.728	0.819	1.22	1.69	1.8	1.81	1.81	8

Constituent	All										
	Mean	Std. Dev.	Minimum	5th Perc	25th Perc	Median	75th Perc	90th Perc	95th Perc	Maximum	Count
Silver T-Ag	0.000145	0.000158	0.00001	0.0000135	0.00002	0.0000845	0.000218	0.000372	0.000393	0.000414	8
Silver D-Ag	0.000015	0.00000535	0.00001	0.00001	0.00001	0.000015	0.00002	0.00002	0.00002	0.00002	8
Sodium T-Na	1.64	0.442	0.83	0.97	1.44	1.77	2	2	2	2	8
Sodium D-Na	1.4	0.722	0.386	0.409	0.774	1.75	2	2	2	2	8
Strontium T-Sr	0.159	0.0598	0.102	0.102	0.111	0.14	0.203	0.235	0.246	0.257	8
Strontium D-Sr	0.144	0.0676	0.0799	0.0808	0.0871	0.12	0.204	0.231	0.236	0.241	8
Thallium T-Tl	0.000123	0.0000861	0.00001	0.0000188	0.0000365	0.000153	0.0002	0.0002	0.0002	0.0002	8
Thallium D-Tl	0.000105	0.000102	0.00001	0.00001	0.00001	0.000105	0.0002	0.0002	0.0002	0.0002	8
Tin T-Sn	0.000301	0.000212	0.0001	0.0001	0.0001	0.000305	0.0005	0.0005	0.0005	0.0005	8
Tin D-Sn	0.000303	0.000211	0.0001	0.0001	0.0001	0.00031	0.0005	0.0005	0.0005	0.0005	8
Titanium T-Ti	0.117	0.119	0.00041	0.00377	0.0108	0.0739	0.23	0.256	0.277	0.297	8
Titanium D-Ti	0.00661	0.00469	0.0003	0.000577	0.0014	0.01	0.01	0.01	0.01	0.01	8
Uranium T-U	0.000244	0.000083	0.00015	0.000168	0.0002	0.000205	0.000279	0.000367	0.000374	0.00038	8
Uranium D-U	0.000163	0.0000651	0.000065	0.0000654	0.000124	0.0002	0.0002	0.00021	0.000221	0.000232	8
Vanadium T-V	0.013	0.0134	0.0005	0.0005	0.0005	0.00909	0.0232	0.0306	0.0322	0.0338	8
Vanadium D-V	0.000625	0.000231	0.0005	0.0005	0.0005	0.0005	0.000625	0.001	0.001	0.001	8
Zinc T-Zn	0.0292	0.0292	0.003	0.0037	0.005	0.0186	0.0465	0.0719	0.0733	0.0748	8
Zinc D-Zn	0.00301	0.00212	0.001	0.001	0.001	0.00305	0.005	0.005	0.005	0.005	8

Units = mg/L

Table B16: Summary Statistics for Dissolved Surface Water Baseline Conditions

Constituent	Mean	Minimum	25th Perc	75th Perc	90th Perc	Max
pH	N/A	N/A	N/A	N/A	N/A	N/A
Total Hardness	134	52	67	195	197	197
TDS	182	84	122	240	252	264
Turbidity	282	10.9	47	405	582	603
Alkalinity	65	28.8	37.8	92	92.8	92.8
Acidity	6.5	1.05	2.5575	7	16.7	16.7
Chloride	0.56	0.467	0.5	0.546	0.831	0.913
Fluoride	0.06	0.0195	0.0306	0.06675	0.069	0.208
Bromide	0.05	0.0467	0.05	0.05	0.0546	0.0546
Sulfate	61.8	14.4	21.7	88.6	114	114
Nitrate Nitrogen (mg/L as N)	0.13	0.00945	0.015325	0.277	0.296	0.296
Nitrite Nitrogen (mg/L as N)	0.0010	0.000933	0.001	0.001	0.00109	0.00109
Nitrogen, total	0.17	0.133	0.133	0.21	0.25	0.25
Ammonia Nitrogen	0.0070	0.00467	0.005	0.0083975	0.0106	0.0128
Phosphate	0.00160	0.001	0.00112	0.00219	0.002195	0.00231
Phosphorus, total	0.3568	0.0346	0.0354	0.618	0.93	1.15
Total Organic Carbon	1.04	0.467	0.5	1.4	2.055	2.65
Dissolved Organic Carbon	0.61	0.467	0.5	0.62525	0.838	0.838
Aluminum, dissolved	0.0822	0.00982	0.021	0.126	0.138	0.164
Antimony, dissolved	0.0010	0.000582	0.0006795	0.001185	0.00195	0.00195
Arsenic, dissolved	0.0007	0.000518	0.0005987	0.00094225	0.000949	0.000976
Barium, dissolved	0.057	0.024	0.03735	0.0686	0.0938	0.0938
Beryllium, dissolved	0.0009	0.00073	0.000933	0.001	0.001	0.001
Bismuth, dissolved	0.0104	0.0000467	0.00005	0.004125	0.0154	0.125
Boron, dissolved	0.094	0.073	0.0933	0.1	0.1	0.1
Cadmium, dissolved	0.0001	0.0000591	0.0000973	0.000197	0.000209	0.00025
Calcium, dissolved	45	15.6	21.3	65.6	66	66
Chromium, dissolved	0.00094	0.00073	0.000933	0.001	0.001	0.001
Cobalt, dissolved	0.00033	0.00018	0.0003	0.000336	0.00037	0.001
Copper, dissolved	0.00140	0.000862	0.000933	0.0020325	0.00211	0.004
Iron, dissolved	0.0650	0.03	0.04755	0.0788	0.103	0.109
Lead, dissolved	0.00050	0.000274	0.000467	0.0005	0.00055	0.001
Magnesium, dissolved	5.17	1.82	2.43	7.42	8.09	8.09
Manganese, dissolved	0.02	0.00355	0.01335	0.024375	0.027	0.0459
Mercury, dissolved	0.0000072	0.00000467	0.000005	0.00001	0.00001	0.00001
Molybdenum, dissolved	0.0046	0.00174	0.00254	0.00493	0.0102	0.0102
Nickel, dissolved	0.0021	0.001	0.0014325	0.00327	0.0038	0.0038
Selenium, dissolved	0.0019	0.000601	0.00115	0.00238	0.00368	0.00368
Silicon, dissolved	1.84	0.609	0.914	2.0725	2.53	5.04
Silver, dissolved	0.0000192	0.000017	0.0000187	0.00002	0.00002	0.00002
Sodium, dissolved	2.15	0.791	2	2.215	2.56	4.13
Strontium, dissolved	0.26	0.0846	0.124	0.363	0.401	0.401

Constituent	Mean	Minimum	25th Perc	75th Perc	90th Perc	Max
Thallium, dissolved	0.00019	0.000143	0.000187	0.0002	0.0002	0.0002
Tin, dissolved	0.00048	0.00038	0.000467	0.0005	0.000518	0.000518
Titanium, dissolved	0.010	0.00933	0.01	0.011	0.0112	0.0112
Uranium, dissolved	0.00041	0.000162	0.0002	0.000512	0.000838	0.000838
Vanadium, dissolved	0.00071	0.000467	0.0005	0.001	0.001	0.001
Zinc, dissolved	0.00684	0.0035	0.005	0.007055	0.0105	0.0127
Cyanide, total	N/A	N/A	N/A	N/A	N/A	N/A
Cyanide, WAD	N/A	N/A	N/A	N/A	N/A	N/A

Units = mg/L

Table B17: Summary Statistics for Dissolved Surface Water Operation Phase

Constituent	Mean	Minimum	25th Perc	75th Perc	90th Perc	Max
pH	N/A	N/A	N/A	N/A	N/A	N/A
Total Hardness	145	56	67	210.25	355	416
TDS	193	86	103	228	218	225
Turbidity	294	3.29	219	286	674	2320
Alkalinity	68	35.4	43.4	94.7	129	135
Acidity	6.89	1.9	2.08	3.7	5.72	32
Chloride	0.61	0.5	0.5	0.5	0.9	2.5
Fluoride	0.067	0.032	0.0425	0.084	0.129	0.297
Bromide	0.053	0.05	0.05	0.05	0.09	0.25
Sulfate	76.7	54.4	59.8	110	217	265
Nitrate Nitrogen (mg/L as N)	0.51	0.0249	0.0345	0.304	0.387	0.603
Nitrite Nitrogen (mg/L as N)	0.0029	0.001	0.001	0.001	0.0018	0.005
Nitrogen, total	0.22	0.15	0.16	0.299	0.387	0.445
Ammonia Nitrogen	0.034	0.005	0.005	0.0071	0.0109	0.0155
Phosphate	0.0017	0.001	0.00133	0.00203	0.00212	0.0035
Phosphorus, total	0.37	0.0055	0.246	0.543	0.919	1.55
Total Organic Carbon	1.14	0.5	0.53	1.48	2.36	3.96
Dissolved Organic Carbon	0.68	0.5	0.5	0.625	0.8	1.11
Aluminum, dissolved	0.087	0.0092	0.0758	0.0991	0.464	1.91
Antimony, dissolved	0.0025	0.0005	0.00053	0.00104	0.00116	0.00195
Arsenic, dissolved	0.0011	0.00057	0.00061	0.00073	0.00129	0.0026
Barium, dissolved	0.058	0.046	0.057	0.09	0.103	0.112
Beryllium, dissolved	0.00098	0.001	0.001	0.001	0.001	0.001
Bismuth, dissolved	0.011	0.00005	0.00005	0.000388	0.04	0.2
Boron, dissolved	0.098	0.1	0.1	0.1	0.1	0.1
Cadmium, dissolved	0.00046	0.000017	0.00007	0.000105	0.0002	0.00046
Calcium, dissolved	48.4	12.2	16.6	48.4	63.3	87
Chromium, dissolved	0.0011	0.001	0.001	0.001	0.00122	0.0021
Cobalt, dissolved	0.00088	0.0003	0.0003	0.0003	0.00051	0.005
Copper, dissolved	0.0022	0.001	0.001	0.001	0.00184	0.0252
Iron, dissolved	0.080	0.03	0.03	0.0448	0.0749	0.202
Lead, dissolved	0.00059	0.0005	0.0005	0.0005	0.0007	0.00709
Magnesium, dissolved	5.62	1.37	2.13	6.12	7.58	9.2
Manganese, dissolved	0.11	0.0034	0.00705	0.0131	0.02	0.25
Mercury, dissolved	0.000015	0.000005	0.000005	0.0000091	0.00001	0.00001
Molybdenum, dissolved	0.0052	0.0011	0.0018	0.00468	0.00708	0.03
Nickel, dissolved	0.0047	0.001	0.001	0.0035	0.00372	0.009
Selenium, dissolved	0.0023	0.000484	0.000659	0.00253	0.00351	0.0117
Silicon, dissolved	1.92	0.512	0.682	2.15	2.94	4.82
Silver, dissolved	0.000024	0.00002	0.00002	0.00002	0.0000236	0.000038
Sodium, dissolved	3.0	2	2	2	2.08	2.8
Strontium, dissolved	0.268	0.0649	0.0935	0.264	0.4	0.452
Thallium, dissolved	0.00020	0.0002	0.0002	0.0002	0.0002	0.0002

Constituent	Mean	Minimum	25th Perc	75th Perc	90th Perc	Max
Tin, dissolved	0.00050	0.0005	0.0005	0.0005	0.0005	0.00054
Titanium, dissolved	0.011	0.01	0.01	0.01	0.022	0.07
Uranium, dissolved	0.00043	0.0002	0.0002	0.000453	0.000654	0.00071
Vanadium, dissolved	0.00073	0.0005	0.0005	0.0005	0.00167	0.00635
Zinc, dissolved	0.027	0.005	0.005	0.0061	0.00793	0.029
Cyanide, total	0.00043	0.000007	0.0000653	0.00062525	0.002935	0.013
Cyanide, WAD	0.0000182	0.000000313	0.0000027	0.00002677	0.0001255	0.000554

Units = mg/L

Table B18: Summary Statistics for Dissolved Surface Water Predicted Future Conditions

Constituent	Mean	Minimum	25th Perc	75th Perc	90th Perc	Max
pH	N/A	N/A	N/A	N/A	N/A	N/A
Total Hardness	143	59	72.975	207	209	210
TDS	187	84.3	126.5	245.25	259.5	279
Turbidity	290	11	47.95	420	598.5	630
Alkalinity	67.3	29.4	39.55	94.85	96.8	97.5
Acidity	6.62	1.11	2.5975	7.155	17.1	17.3
Chloride	0.57	0.485	0.50775	0.56	0.8665	0.964
Fluoride	0.066	0.0203	0.030975	0.069	0.07075	0.219
Bromide	0.052	0.0482	0.0504	0.05155	0.056	0.0567
Sulfate	68	15.8	28.3	97.275	125.5	127
Nitrate Nitrogen (mg/L as N)	0.135	0.0128	0.019075	0.28	0.3045	0.306
Nitrite Nitrogen (mg/L as N)	0.0011	0.00103	0.00103	0.0010925	0.00122	0.00125
Nitrogen, total	0.180	0.141	0.143	0.213	0.2595	0.261
Ammonia Nitrogen	0.0075	0.00514	0.005375	0.0091175	0.01155	0.0135
Phosphate	0.0016	0.00102	0.00113	0.00224	0.002285	0.00243
Phosphorus, total	0.367	0.0351	0.035675	0.63875	0.9565	1.18
Total Organic Carbon	1.07	0.477	0.5105	1.4225	2.115	2.74
Dissolved Organic Carbon	0.624	0.486	0.51725	0.64825	0.843	0.846
Aluminum, dissolved	0.085	0.00997	0.0217	0.1315	0.142	0.172
Antimony, dissolved	0.00155	0.000782	0.000895	0.00183	0.002785	0.00307
Arsenic, dissolved	0.000850	0.000559	0.0006727	0.0010775	0.001155	0.0012
Barium, dissolved	0.0576	0.0248	0.037825	0.07015	0.0944	0.0947
Beryllium, dissolved	0.000964	0.000737	0.0009615	0.00102	0.00103	0.00104
Bismuth, dissolved	0.0109	0.0000477	0.0000503	0.00418625	0.0158	0.132
Boron, dissolved	0.0965	0.0737	0.0966	0.102	0.103	0.104
Cadmium, dissolved	0.000291	0.000138	0.000224	0.0003555	0.0003915	0.00047
Calcium, dissolved	47.8	18.8	23.425	68.825	70.7	71.2
Chromium, dissolved	0.00129	0.000867	0.0011375	0.00143	0.001505	0.00166
Cobalt, dissolved	0.00101	0.00045	0.0005957	0.0013525	0.00153	0.00179
Copper, dissolved	0.00154	0.00091	0.00111	0.00221	0.00229	0.00421
Iron, dissolved	0.0672	0.0304	0.04945	0.081725	0.107	0.115
Lead, dissolved	0.000764	0.000373	0.0006325	0.000866	0.0009195	0.00125
Magnesium, dissolved	5.47	1.9	2.6525	7.9525	8.435	8.46
Manganese, dissolved	0.0350	0.0191	0.0221	0.045225	0.0592	0.0734
Mercury, dissolved	1.67E-05	0.00000838	0.0000129	0.000020525	0.00002365	0.0000275
Molybdenum, dissolved	0.0051	0.00187	0.00279	0.005365	0.011	0.0111
Nickel, dissolved	0.00301	0.00121	0.001815	0.0045875	0.00526	0.00574
Selenium, dissolved	0.00226	0.000816	0.001355	0.003005	0.00409	0.00419
Silicon, dissolved	1.89	0.633	0.923	2.0975	2.59	5.3
Silver, dissolved	0.000071	0.0000317	0.0000415	0.000093325	0.0001065	0.000129
Sodium, dissolved	2.20	0.812	2.01	2.2675	2.66	4.37
Strontium, dissolved	0.263	0.088	0.12775	0.37125	0.411	0.416
Thallium, dissolved	0.000193	0.000144	0.000193	0.000204	0.000205	0.000207

Constituent	Mean	Minimum	25th Perc	75th Perc	90th Perc	Max
Tin, dissolved	0.000489	0.000384	0.0004812	0.00051525	0.000521	0.000523
Titanium, dissolved	0.0106	0.00964	0.0101	0.011225	0.0115	0.0117
Uranium, dissolved	0.000423	0.000164	0.0002037	0.00053125	0.00086	0.00087
Vanadium, dissolved	0.000725	0.000477	0.0005037	0.00101	0.001025	0.00103
Zinc, dissolved	0.0170	0.00736	0.0108	0.0216	0.02785	0.0325
Cyanide, total	N/A	N/A	N/A	N/A	N/A	N/A
Cyanide, WAD	N/A	N/A	N/A	N/A	N/A	N/A

Units = mg/L

Table 19: Maximum Background and Predicted 90th Percentile Unfiltered Surface Water Concentrations (mg/L) for the Operation Phase and the Closure and Reclamation/Post Closure Phases

Parameter	Maximum P90 Background (mg/L)	Average P90 Background (mg/L)	Maximum P90 Operation (mg/L)	Average P90 Operation (mg/L)	Maximum P90 Closure/ Post Closure (mg/L)	Average P90 Closure/ Post Closure (mg/L)
pH	8.33E+00	7.35E+00	8.33E+00	7.35E+00	8.33E+00	7.35E+00
Conductivity	3.88E+02	2.57E+02	5.03E+02	2.75E+02	4.79E+02	2.67E+02
Hardness	1.97E+02	1.27E+02	2.61E+02	1.56E+02	2.33E+02	1.40E+02
TDS	2.64E+02	1.77E+02	3.63E+02	1.92E+02	3.45E+02	1.85E+02
TSS	9.23E+02	2.86E+02	9.28E+02	2.97E+02	9.20E+02	2.92E+02
Turbidity	6.65E+02	2.17E+02	6.68E+02	2.23E+02	6.59E+02	2.20E+02
Alkalinity	9.28E+01	5.01E+01	1.03E+02	5.36E+01	9.22E+01	4.87E+01
Acidity	1.72E+01	6.33E+00	1.92E+01	7.43E+00	1.69E+01	6.47E+00
Chloride	9.13E-01	5.36E-01	9.32E-01	5.44E-01	9.10E-01	5.24E-01
Fluoride	2.08E-01	6.52E-02	2.09E-01	6.78E-02	2.07E-01	6.58E-02
Bromide	5.46E-02	5.02E-02	5.71E-02	5.07E-02	5.36E-02	4.90E-02
Sulphate	1.32E+02	7.10E+01	2.94E+02	1.06E+02	1.77E+02	8.43E+01
Nitrate_N	2.96E-01	7.15E-02	2.06E+00	3.17E-01	2.93E-01	7.41E-02
Nitrite_N	1.09E-03	1.00E-03	4.75E-02	5.11E-03	1.35E-03	1.03E-03
Total_Nitrogen	2.50E-01	1.14E-01	2.37E+00	3.09E-01	2.50E-01	1.14E-01
Ammonia_N	1.28E-02	6.24E-03	2.61E-01	3.09E-02	3.46E-02	8.81E-03
Phosphate	2.39E-03	1.59E-03	2.71E-03	1.75E-03	2.61E-03	1.70E-03
Total_Phosphorus	1.15E+00	2.53E-01	1.16E+00	2.68E-01	1.15E+00	2.63E-01
TOC	2.65E+00	8.39E-01	2.66E+00	8.62E-01	2.64E+00	8.32E-01
DOC	8.38E-01	5.75E-01	8.70E-01	5.93E-01	8.34E-01	5.67E-01
Aluminum_T	2.63E+01	5.89E+00	2.64E+01	6.15E+00	2.61E+01	6.03E+00
Antimony_T	2.30E-02	2.05E-03	2.60E-02	5.74E-03	2.31E-02	3.30E-03
Arsenic_T	5.05E-02	8.45E-03	5.09E-02	9.79E-03	5.04E-02	8.81E-03
Barium_T	2.62E-01	1.13E-01	2.63E-01	1.19E-01	2.61E-01	1.16E-01
Beryllium_T	1.00E-03	9.19E-04	1.08E-03	9.56E-04	9.99E-04	9.27E-04
Bismuth_T	1.25E-01	8.36E-03	1.26E-01	8.44E-03	1.25E-01	8.29E-03
Boron_T	1.00E-01	9.19E-02	1.08E-01	9.57E-02	9.99E-02	9.27E-02
Cadmium_T	1.46E-03	4.83E-04	6.95E-03	1.33E-03	1.63E-03	7.14E-04
Calcium_T	7.44E+01	4.75E+01	9.87E+01	5.84E+01	9.80E+01	5.33E+01
Chromium_T	3.80E-02	6.68E-03	3.83E-02	7.13E-03	3.82E-02	7.62E-03
Cobalt_T	1.72E-02	5.03E-03	1.74E-02	6.12E-03	1.76E-02	6.44E-03
Copper_T	9.21E-02	3.01E-02	9.27E-02	3.36E-02	9.15E-02	3.24E-02
Iron_T	6.56E+01	9.17E+00	6.59E+01	9.66E+00	6.50E+01	9.42E+00
Lead_T	1.76E-02	6.83E-03	1.77E-02	7.39E-03	1.77E-02	7.78E-03
Magnesium_T	2.53E+01	9.62E+00	2.55E+01	1.12E+01	2.53E+01	1.04E+01
Manganese_T	1.16E+00	2.94E-01	1.83E+00	5.38E-01	1.17E+00	3.53E-01
Mercury_T	4.89E-05	1.21E-05	4.78E-04	6.91E-05	5.02E-05	1.47E-05
Molybdenum_T	1.23E-02	5.84E-03	1.42E-02	6.66E-03	1.21E-02	6.43E-03
Nickel_T	1.17E-01	2.06E-02	1.17E-01	2.72E-02	1.17E-01	2.30E-02
Selenium_T	4.31E-03	2.30E-03	8.67E-03	3.26E-03	5.57E-03	2.91E-03
Silicon_T	3.05E+01	8.02E+00	3.07E+01	8.12E+00	3.04E+01	7.97E+00

Parameter	Maximum P90 Background (mg/L)	Average P90 Background (mg/L)	Maximum P90 Operation (mg/L)	Average P90 Operation (mg/L)	Maximum P90 Closure/ Post Closure (mg/L)	Average P90 Closure/ Post Closure (mg/L)
Silver_T	1.01E-03	1.61E-04	1.02E-03	1.70E-04	1.05E-03	2.71E-04
Sodium_T	4.41E+00	2.67E+00	6.42E+00	3.13E+00	4.98E+00	2.87E+00
Strontium_T	4.70E-01	2.69E-01	5.34E-01	2.96E-01	5.08E-01	2.86E-01
Thallium_T	2.00E-04	1.84E-04	2.15E-04	1.92E-04	2.00E-04	1.86E-04
Tin_T	5.00E-04	4.65E-04	5.38E-04	4.81E-04	5.00E-04	4.67E-04
Titanium_T	4.50E-01	9.82E-02	4.52E-01	1.01E-01	4.49E-01	9.92E-02
Uranium_T	9.42E-04	4.91E-04	9.43E-04	5.06E-04	9.26E-04	4.93E-04
Vanadium_T	8.58E-02	1.35E-02	8.64E-02	1.37E-02	8.54E-02	1.36E-02
Zinc_T	1.52E-01	5.81E-02	4.32E-01	1.13E-01	1.55E-01	7.38E-02
CN_Total	NA	NA	2.97E-03	2.31E-04	9.32E-05	7.58E-06
CN_WAD	NA	NA	1.27E-04	9.86E-06	3.98E-06	3.24E-07

P90 – 90th percentile

Table B20: Summary Statistics for Groundwater

Constituent	Mean	Minimum	5th Perc	25th Perc	75th Perc	90th Perc	Max
Field pH	7.57	4.55	6.44	7.39	7.90	8.08	9.00
Conductivity	341	81	105	248	439	542	660
Specific Conductivity	404	321	346	406	424	429	431
Dissolved Oxygen	3.04	0.87	1.10	1.69	4.65	4.92	5.41
Dissolved Oxygen	26	7	10	16	35	45	52
ORP	181	106	114	146	219	239	253
Turbidity	1.7	0.0	0.0	0.4	2.0	4.6	4.9
TDS	0.28	0.27	0.27	0.27	0.28	0.28	0.28
Temperature	2.85	1.20	1.29	2.18	3.58	3.81	3.90
pH	7.1	4.1	5.1	7.0	7.8	7.9	8.0
Specific Conductance	347	46	73	210	482	536	620
Hardness CaCO3	177	29	40	140	220	245	540
Total Dissolved Solids	228	0.024	0.061	112	328	368	470
Total Suspended Solids	279	0.0010	0.0020	2	118	790	6400
Turbidity	124	0.100	0.151	0.35	30	260	4700
Alkalinity-Total CaCO3	70	1.0	3.5	50	69	120	880
Alkalinity to pH 4.5	17	1.0	1.1	2	14	54	65
Alkalinity, Bicarbonate (as CaCO3)	63	47	48	58	68	72	73
Alkalinity, Carbonate (as CaCO3)	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Alkalinity, Hydroxide (as CaCO3)	ND <2						
Alkalinity, Phenolphthalein (as CaCO3)	NA						
Acidity (as CaCO3)	4.6	1.0	1.6	2.4	5.3	7.0	56.0
Chloride Cl	0.55	0.00	0.00	0.15	0.70	1.50	2.50
Fluoride F	0.10	0.00	0.00	0.04	0.10	0.20	0.50
Bromide Br	ND <0.05						
Sulphate SO4	110	0.012	0.019	52	160	189	249
Nitrate Nitrogen N	1.86	0.01	0.01	0.02	0.89	9.75	17.00
Nitrite Nitrogen N	10	0.0010	0.0015	0.0065	2.15	58	94
Total Nitrogen	ND <0.05						
Ammonia Nitrogen N	0.0090	0.0060	0.0066	0.0090	0.0100	0.0100	0.0100
Free Ammonia	2.3	0.0050	0.0068	0.012	0.56	14.5	15.0
Ortho-Phosphate	0.011	0.001	0.002	0.002	0.008	0.020	0.100
Phosphorus (P)-Total	0.19	0.00	0.00	0.01	0.21	0.40	2.70
Total Organic Carbon	ND <0.5						
Dissolved Organic Carbon	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Cyanide, total	ND <0.005						
Cyanide, WAD	ND <0.005						
Thiocyanate	0.067	0.050	0.050	0.050	0.075	0.090	0.100
Aluminum	0.043	0.001	0.002	0.006	0.032	0.091	0.651
Antimony	0.019	0.000	0.000	0.003	0.015	0.055	0.130

Constituent	Mean	Minimum	5th Perc	25th Perc	75th Perc	90th Perc	Max
Arsenic	0.0075	0.0007	0.0013	0.0039	0.0080	0.0124	0.0580
Barium	0.023	0.010	0.012	0.016	0.027	0.037	0.053
Beryllium	0.00011	0.00003	0.00004	0.00006	0.00011	0.00018	0.00034
Bismuth	ND <0.05						
Boron	0.033	0.001	0.002	0.008	0.044	0.071	0.130
Cadmium	0.00043	0.00001	0.00003	0.00018	0.00054	0.00092	0.00190
Calcium	52	5	9	26	72	82	190
Cesium	NA						
Chromium	0.0018	0.0001	0.0004	0.0008	0.0025	0.0034	0.0150
Chromium VI	ND<0.001						
Cobalt	0.00076	0.00003	0.00010	0.00019	0.00070	0.00210	0.00800
Copper	0.012	0.000	0.000	0.001	0.005	0.039	0.095
Iron	0.051	0.010	0.011	0.025	0.066	0.082	0.330
Lead	0.00035	0.00003	0.00003	0.00009	0.00029	0.00068	0.00250
Magnesium	7.0	0.9	1.3	4.0	9.4	11.3	18.0
Manganese	0.088	0.000	0.001	0.016	0.105	0.244	0.550
Mercury	0.00010	0.00003	0.00003	0.00004	0.00012	0.00019	0.00023
Molybdenum	0.0071	0.0003	0.0007	0.0017	0.0062	0.0263	0.0470
Nickel	0.0039	0.0001	0.0005	0.0012	0.0051	0.0089	0.0180
Potassium	0.79	0.01	0.05	0.14	0.59	1.91	8.00
Selenium	0.0024	0.0002	0.0007	0.0013	0.0029	0.0050	0.0060
Silicon	3.62	3.09	3.13	3.36	3.83	3.98	4.07
Silver	0.000040	0.000010	0.000010	0.000020	0.000050	0.000090	0.000110
Sodium	3.62	0.48	0.80	2.05	3.62	6.92	38.00
Strontium	0.83	0.02	0.03	0.20	1.19	1.57	2.94
Sulfur	57	44	46	55	65	65	66
Thallium	0.000011	0.000011	0.000011	0.000011	0.000011	0.000011	0.000011
Tin	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015
Titanium	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Uranium	0.00035	0.00002	0.00005	0.00013	0.00038	0.00084	0.00180
Vanadium	ND <0.03						
Zinc	0.020	0.000	0.002	0.005	0.026	0.048	0.098

Units = mg/L

Table B21: Summary Statistics for Sediment

Constituent	Mean	Minimum	75 Perc	90 Perc	Max
Aluminum	17,175	13,233	18,060	20,140	32,350
Antimony	4.89	1.62	6.5	7.804	9.26
Arsenic	65	9.9	92	112.432	145.28
Barium	226	78.7	180	347.52	1205.8
Beryllium	0.46	0.3	0.43	0.588	1.12
Bismuth	0.59	0.11	0.72	0.834	1.07
Cadmium	1.8	0.83	1.8	2.472	4.51
Calcium	18,939	1,550	24,800	32,242	34,460
Chromium	29.0	4.2	34.33	50.64	56.6
Cobalt	23	13.63	25.7	28.24	69.43
Copper	179	46.2	136.6	275.398	1215.5
Iron	50765	36100	53583	63426.8	99017
Lead	36.6	14.6	41.77	54.464	80.72
Lithium	19	15.2	23.3	25.264	25.4
Magnesium	13885	10200	14567	16496	18717
Manganese	1077	746.5	1135.6	1349.58	2011.7
Mercury	0.053	0.02	0.05	0.074	0.1
Molybdenum	18	1.38	5.78	30.04	181.33
Nickel	39	6.46	52.2	65.236	73.52
Potassium	1088	498	1,282	1,719	1,938
Selenium	5.1	0.87	7.1	8.062	12.2
Silver	0.92	0	1	1	1
Sodium	152	99.7	176	225.72	257.5
Strontium	86	14.8	108.67	152.442	161.2
Thallium	0.12	0.05	0.1475	0.2	0.28
Tin	0.30	0.12	0.37	0.458	0.58
Titanium	591	305	731.3	875.8	970.8
Uranium	0.95	0.48	1.1	1.33	2.5
Vanadium	75	44.5	83.8	104.36	137
Zinc	193	107.7	192.2	320.24	443
Zirconium	2.7	1.35	3.91	4.334	4.39

Units = mg/kg/

Attachment C
Derivation of Predicted Future Soil Quality

1 PREDICTED FUTURE METALS IN AIR PARTICULATE AND SOIL

Project related activities are anticipated to cause the release of fugitive dust and processing plant emissions to air, some of which will have elevated concentrations of metals when compared to baseline soil concentrations. This dust (air particulate), will settle out of the air onto soil, plants, and surface water, and therefore has the potential to elevate the concentrations of chemicals of potential concern in those media.

Air particulate concentrations estimated by air modelling (Volume 8, Appendix 7-A) was combined with source material concentrations to estimate COPCs concentrations in air particulate. Most air particulate falls out of the air and settles on the ground, and is referred to as dustfall. Dustfall rate contour maps were developed for the LSA, and dustfall rates were identified at 10 specified locations (**Table C1**) (**Figure C1)**. The air particulate concentrations and subsequently dust deposition rates were predicted to be greatest during the Operation phase of the project. **Figure C1** also illustrates the total deposition contours predicted to occur because of Project activities during the Operation Phase, and indicates the degree to which the LSA is affected by dust.

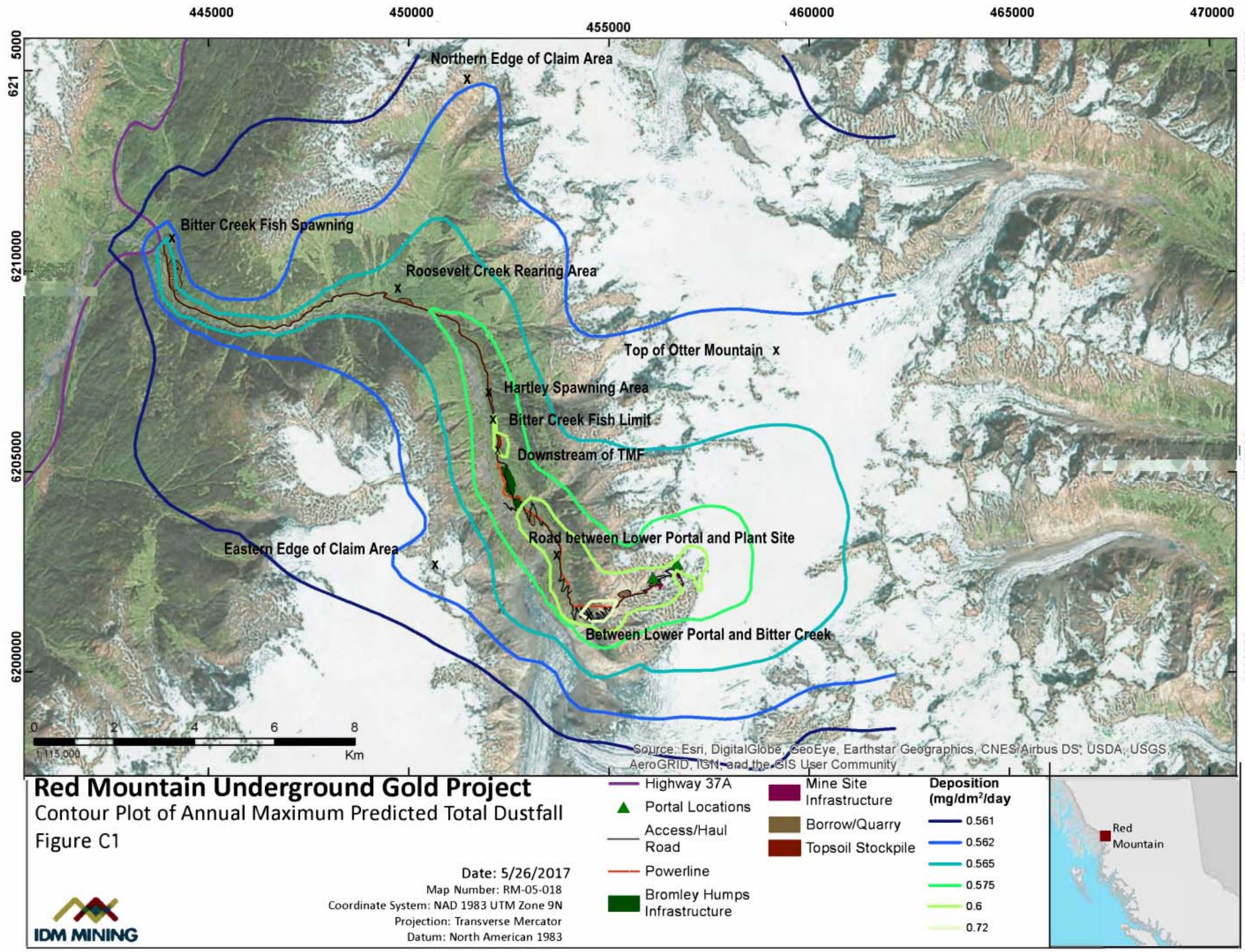
1.1 Methodology for Predicting the Yearly Deposition Rate of COPCs

Air particulate-causing activities that will occur at the proposed Project include: driving on unpaved roads, handling ore material and waste rock, and plant site emissions mainly associated with the crushing of ore material prior to refining. However, modelling indicates that the majority of the air particulate will be unrelated to Project activities, but rather a result of wind erosion from undisturbed areas of the LSA (Appendix 7-A of Red Mountain Gold Project EA Report).

The CALPUFF model was used to estimate mass fraction of each dust source in air particulate/dustfall at three locations, 1) Bitter Creek Down Stream of the TMF, 2) the Haul Road between the Lower Portal and Plant site, and 3) Between Lower Portal and Bitter Creek (**Figure C1**). Three dust sources were considered in the CALPUFF modelling, background soil, road, and non-road. Non-road sourced dust was assumed to be comprised of 50% waste rock and 50% ore material (**Table C2**). Summary statistics for baseline soil, waste rock, ore material, and road material is reported in **Tables C3 to C6**.

The constituent concentrations in the air particulate (up/m^3)/dustfall (mg/m^2/year) was calculated by multiplying the sum of the mass fraction of dust from each source by the constituent concentrations associated with each respective source type. The CALPUFF model results for maximum daily deposition rates in mg/dm2/day were multiplied by 36.5 to convert to an annual deposition rates in units of g/m^2/year.

The air particulate COPC concentration in PM10 was estimated based on the mass fraction of source at the three locations (Table C7). The highest air particulate was estimate using the mass fractions for location 2.



FigureC1: Contour Plot for Annual Maximum Predicted Total Dustfall

1.2 Methodology for Predicting COPC Concentrations in Surface Soil

The predicted future concentrations of metals in surface soil were calculated by adding the predicted future concentrations of metals associate with particulate deposition, to the baseline soil concentrations. The concentration of metals in the dust was predicted using the following formula (USEPA 2005):

$$Cs = (100 \times D)/(Zs \times BD) \times tD$$

where:

Cs = Soil concentration over exposure duration (mg COPC/kg soil)
100 = Unit conversion factor (from mg-m^2 to kg-cm^2)
D = Yearly dry deposition rate of metals (g COPC/m^2-year)
tD = Time period over which deposition occurs (years)
Zs = Soil mixing zone depth (cm)
BD = Soil bulk density (g/cm^3)

The time period over which particulate deposition was modelled was 7.5 years, 1.5 years for the Construction Phase and 6 years for the Operations Phase. Metals deposited with particulate were assumed to mix with the top 2 cm of soil. The bulk density for soil was set to 1.5 g soil/cm^3 soil (USEPA 2005). A soil loss constant was not included in the modelling as it was assumed that none of the metals deposited from particulate were lost to weathering or degradation. This is a conservative assumption. Predicted COPC soil concentrations are provided in **Table C8**.

Sample calculations for predicted soil and predicted air concentrations are provided below using aluminum data.

EXAMPLE CALCULATION 1:

Predicted Aluminum Soil Concentration at Bitter Creek Downstream of Tailings Management Facility During Mining Operations Based on 24-hour PM10

The particulate deposition rate (dustfall) of 0.58 mg/dm^2/day (as noted in Volume 8, Appendix 22-A, Table C1, for final maximum dry deposition downstream of TMF) was used to calculate the amount of aluminum deposited on soil from particulate each year. The relative particulate contributions from background (96%), roads (1.6%), and ore/waste rock (2.4%) were obtained using modelling and provided by WSP (Volume 8, Appendix 7-A, Table 6-1).

Particulate Contribution from Background

(0.58 mg/dm^2/day) x [Background Concentration of Aluminum = 29300 mg/kg[1]] x (0.96)/1000000 mg/kg = 0.01631 mg/dm^2/day

Particulate Contribution from Road

(0.58 mg/dm^2/day) x [Concentration of Aluminum on Road = 19900 mg/kg[2]] x (0.016) /1000000 mg/kg = 0.000185 mg/dm^2/day

[1]Source: Volume 8, Appendix 22-A, Attachment A, Table A3
[2]Source: Volume 8, Appendix 22-A, Attachment A, Table A3

Particulate Contribution from Ore and Waste Rock

(0.58 mg/dm^2/day) x [(Concentration of Aluminum in ore = 85800 mg/kg + Concentration of Aluminum in Waste Rock = 32800 mg/kg)/2] x (0.024) /1000000 mg/kg = 0.000825 mg/dm^2/day

Amount of aluminum particulate deposited on soil each day from background, road, and ore/waste rock

(0.01628 mg/dm^2/day) + (0.000185 mg/dm^2/day) + (0.000825 mg/dm^2/day) = 0.0173 mg/dm^2/day

Amount of aluminum particulate deposited on soil each year from background, road and ore/waste rock

(0.0173 mg/dm^2/day) x (36.5 g/m2/year) / (mg/dm2/day) = 0.631 g/m^2/year

Concentration of aluminum particulate deposited on soil from background, road and ore/waste rock (using the formula provided in Volume 8, Appendix 22-B, Attachment C, Section 1.2)

(0.631 g/m^2/year) x (100 mg-m^2/kg/cm^2) x (7.5 years) / ((2 cm) x (1.5 g/cm^3)) = 157.77 mg/kg

Predicted future soil concentration of aluminum based on background plus particulate deposits

(158.08 mg/kg) + (29300 mg/kg) = 29458.09 mg/kg

EXAMPLE CALCULATION 2:

Maximum Aluminum Particulate Concentration During Mining Operation Based on Max 24-hour PM2.5

The site-wide maximum 24-hour PM2.5 of 18.6 µg/m^3 (as noted in Volume 8, Appendix 22-A, Attachment A Table A1) was used to calculate the maximum aluminum particulate concentration. The relative particulate contributions from background (96%), roads (1.6%), and ore/waste rock (2.4%) were obtained using modelling and provided by WSP (Volume 8, Appendix 7-A, Table 6-1).

Particulate Contribution from Background

(18.6 µg/m^3 x [Background Concentration of Aluminum = 29300 mg/kg] x 0.96) /1000000 mg/kg = 0.5231 µg/m^3

Particulate Contribution from Road

(18.6 µg/m^3 x [Concentration of Aluminum on Road = 19900 mg/kg] x 0.016) /1000000 mg/kg = 0.005922 µg/m^3

Particulate Contribution from Ore/Waste Rock

(18.6 µg/m^3 x [Mean Concentration of Aluminum of Ore (85800 mg/kg) & Waste Rock (32800 mg/kg) = 59300 mg/kg] x 0.024)/1000000 mg/kg = 0.02647 µg/m^3

Maximum particulate concentration of aluminum in dust from background, road and ore/waste rock

(0.52 µg/m^3) + (0.0059 µg/m^3) + (0.026 µg/m^3) = 0.556 µg/m^3

The maximum particulate concentration based on annual PM2.5 would require the same calculation as shown above except that a PM2.5 (annual) value of 4.4 g/m^3 would be used instead of PM2.5 (24-hour) value of 18.6 g/m^3.

EXAMPLE CALCULATION 3:

Maximum Aluminum Particulate Concentration at Bitter Creek Downstream of Tailings Management Facility During Mining Operations Based on 24-hour PM10

The 24-hour PM10 of 17.79 µg/m^3 was used to calculate the maximum aluminum particulate concentration. The relative particulate contributions from background (96%), roads (1.6%), and ore/waste rock (2.4%) were obtained using modelling and provided by WSP (Volume 8, Appendix 7-A, Table 6-1).

Particulate Contribution from Background

(17.79 µg/m^3 x [Background Concentration of Aluminum = 29240 mg/kg] x 0.96) /1000000 mg/kg = 0.5004 µg/m^3

Particulate Contribution from Road

(17.79 µg/m^3 x [Concentration of Aluminum on Road = 19900 mg/kg] x 0.016) /1000000 mg/kg = 0.005664 µg/m^3

Particulate Contribution from Ore and Waste Rock

(17.79 µg/m^3 x [Mean Concentration of Aluminum of Ore (85800 mg/kg) & Waste Rock (32800 mg/kg) = 59300 mg/kg] x 0.024)/1000000 mg/kg = 0.02532 µg/m^3

Maximum particulate concentration of aluminum in dust from background, road and ore/waste rock

(0.52 µg/m^3) + (0.0059 µg/m^3) + (0.026 µg/m^3) = 0.531 µg/m^3

Table C1: Dustfall at 10 Locations

Receptor Description	Deposition Results							
	Maximum Dry Deposition ($mg/dm^2/day$)	Maximum Wet Deposition ($mg/dm^2/day$)	Maximum Total Dust Fall ($mg/dm^2/day$)	Background Dustfall ($mg/dm^2/day$)	Final Maximum Dry Deposition ($mg/dm^2/day$)	Final Maximum Wet Deposition ($mg/dm^2/day$)	Final Maximum Total Dust Fall ($mg/dm^2/day$)	AAQO ($mg/dm^2/day$)
Down Stream of Tailings Management Facility	2.35E-02	1.56E-02	2.35E-02	0.56	0.58	0.58	0.58	1.7
Bitter Creek Fish limit	1.08E-02	1.29E-02	1.08E-02	0.56	0.57	0.57	0.57	1.7
Bitter Creek Fish Spawning	1.04E-03	7.56E-04	1.04E-03	0.56	0.56	0.56	0.56	1.7
Roosevelt Creek - Rearing	1.06E-02	6.09E-03	1.06E-02	0.56	0.57	0.57	0.57	1.7
Top of Otter Mountain Highest point in area	1.82E-03	1.71E-03	1.82E-03	0.56	0.56	0.56	0.56	1.7
Hartley Spawning Area	1.17E-02	1.22E-02	1.17E-02	0.56	0.57	0.57	0.57	1.7
Eastern edge of claim Area	3.60E-03	9.90E-04	3.60E-03	0.56	0.56	0.56	0.56	1.7
Northern Edge of Claim Area	3.78E-04	2.07E-03	3.78E-04	0.56	0.56	0.56	0.56	1.7
Road Between lower portal and Plant site	4.75E-02	1.93E-02	4.75E-02	0.56	0.61	0.58	0.61	1.7
Between Lower Portal and Bitter Creek	1.56E-01	1.60E-02	1.56E-01	0.56	0.72	0.58	0.72	1.7
Max:	1.56E-01	2.23E-02	1.56E-01		0.72	0.58	0.72	

a. This total maximum dustfall rate was used in the calculations.

Table C2: Dust Deposition Rate

Road Dust	Deposition Results										
Receptor Description	**Maximum Dry Deposition mg/dm2/day**	**Maximum Wet Deposition mg/dm2/day**	**Modelled Maximum Total Dust Fall mg/dm2/day**	**Percentage of modelled source contribution**	**Percentage of overall contribution w background**	**Background Dustfall mg/dm2/day**	**Percentage of total predicted dustfall coming from the background assumption**	**Final Maximum Dry Deposition mg/dm2/day**	**Final Maximum Wet Deposition mg/dm2/day**	**Final Maximum Total Dust Fall mg/dm2/day**	**AAQO mg/dm2/day**
Bitter Crk. Down Stream of Tailings Management Facility	9.28E-03	1.10E-02	9.28E-03	40.2%	1.6%	0.56	96.0%	0.57	0.57	0.57	1.7
Road Between lower portal and Plant site	3.25E-02	1.40E-02	3.25E-02	84.3%	5.4%	0.56	93.6%	0.59	0.57	0.59	1.7
Between Lower Portal and Bitter Creek	1.17E-01	1.22E-02	1.17E-01	96.1%	17.1%	0.56	82.2%	0.68	0.57	0.68	1.7
All Other Sources Except Road Dust											
Receptor Description	**Maximum Dry Deposition mg/dm2/day**	**Maximum Wet Deposition mg/dm2/day**	**Modelled Maximum Total Dust Fall mg/dm2/day**	**Percentage of modelled source contribution**	**Percentage of overall contribution w background**	**Background Dustfall mg/dm2/day**	**Percentage of total predicted dustfall coming from the background assumption**	**Final Maximum Dry Deposition mg/dm2/day**	**Final Maximum Wet Deposition mg/dm2/day**	**Final Maximum Total Dust Fall mg/dm2/day**	**AAQO mg/dm2/day**
Bitter Crk. Down Stream of Tailings Management Facility	1.38E-02	1.30E-02	1.38E-02	59.8%	2.4%	0.56	96.0%	0.57	0.57	0.57	1.7
Road Between lower portal and Plant site	6.03E-03	1.87E-03	6.03E-03	15.7%	1.0%	0.56	93.6%	0.57	0.56	0.57	1.7
Between Lower Portal and Bitter Creek	4.72E-03	3.45E-04	4.72E-03	3.9%	0.7%	0.56	82.2%	0.56	0.56	0.56	1.7
Total											
Receptor Description	**Maximum Dry Deposition mg/dm2/day**	**Maximum Wet Deposition mg/dm2/day**	**Modelled Maximum Total Dust Fall mg/dm2/day**	**Percentage of modelled source contribution**	**Percentage of overall contribution w background**	**Background Dustfall mg/dm2/day**	**Percentage of total predicted dustfall coming from the background assumption**	**Final Maximum Dry Deposition mg/dm2/day**	**Final Maximum Wet Deposition mg/dm2/day**	**Final Maximum Total Dust Fall mg/dm2/day**	**AAQO mg/dm2/day**
Bitter Crk. Down Stream of Tailings Management Facility	2.31E-02	2.40E-02	2.31E-02			0.56	96.0%	0.58	0.58	0.58	1.7
Road Between lower portal and Plant site	3.85E-02	1.59E-02	3.85E-02			0.56	93.6%	0.60	0.58	0.60	1.7
Between Lower Portal and Bitter Creek	1.21E-01	1.25E-02	1.21E-01			0.56	82.2%	0.68	0.57	0.68	1.7

Table C3: Summary Statistics of the Concentration of Inorganic Chemicals in Baseline Soils (Local Background) (mg/kg)

Constituent	Count	Minimum	Mean	Median	75 Percentile	90 Percentile	95 Percentile	Maximum
Aluminum	6	9700	20133.33	20950	27225	29000	**29300**	29600
Antimony	27	0.32	2.90	2.5	3.6	5.06	**6.86**	8.06
Arsenic	27	0.9	28.19	21.5	31.1	59.64	**69.52**	124
Barium	27	49.1	181.43	107	178.5	306.4	**428.56**	1238.8
Beryllium	21	0.2	0.41	0.4	0.5	0.6	**0.6**	0.9
Bismuth	6	0.03	0.14	0.10	0.18	0.29	**0.33**	0.37
Boron	6	20.00	20.00	20.00	20.00	20.00	**20.00**	20.00
Cadmium	27	0.03	0.51	0.45	0.73	0.92	**1.10**	1.36
Calcium	6	1300.00	10266.67	8250.00	17550.00	19600.00	**19650.00**	19700.00
Chromium	27	8.3	43.34	29	62.7	77.22	**99.08**	146.5
Cobalt	27	5.3	14.37	14.1	15.6	19.14	**22.27**	29
Copper	27	1.59	75.23	72	86.395	101.06	**106.1**	194
Gallium	6	3.7	8.15	8.45	10.1	11.55	**12.075**	12.6
Gold	6	0.0003	0.00	0.00095	0.00715	0.01265	**0.014425**	0.0162
Iron	6	22700	37416.67	36200	40625	52700	**58150**	63600
Lanthanum	6	3	6.83	5.8	6.575	11.15	**13.375**	15.6
Lead	27	1.01	16.10	12.8	22.25	30.82	**39.97**	42.7
Magnesium	6	8700	19066.67	19450	26400	29000	**29700**	30400
Manganese	6	201	581.00	608.5	677	838	**916**	994
Mercury	27	0	0.04	0.05	0.06	0.072	**0.08**	0.08
Molybdenum	27	0.66	11.37	4.7	9.55	20.12	**30.98**	122.9
Nickel	27	4.2	32.43	30.3	44.4	50.22	**52.57**	55.4
Phosphorus	6	440	1263.33	1115	1187.5	1960	**2335**	2710
Potassium	6	400	1000.00	950	1425	1600	**1650**	1700
Scandium	6	2.1	5.12	5.6	6.575	6.75	**6.775**	6.8
Selenium	27	0.1	2.20	1.8	3	3.62	**4.54**	8.3
Silver	27	0.006	0.51	0.5	0.625	0.94	**1**	1.1
Sodium	6	310	415.00	360	467.5	575	**612.5**	650
Strontium	6	16.3	50.67	44.8	70.7	90.4	**96.85**	103.3
Sulfur	6	800	4616.67	2800	5425	10150	**12075**	14000
Tellurium	6	0.02	0.10	0.045	0.0575	0.23	**0.315**	0.4
Thallium	27	0.02	0.13	0.1	0.2	0.3	**0.3**	0.4
Thorium	6	0.6	1.15	1.15	1.275	1.55	**1.675**	1.8
Tin	21	0.2	0.32	0.3	0.3	0.46	**0.58**	0.7
Titanium	6	50	1093.33	1135	1285	1985	**2312.5**	2640
Tungsten	6	0.1	1.00	0.15	0.2	2.75	**4.025**	5.3
Uranium	27	0.1	0.57	0.5	0.58	1.108	**1.208**	1.92
Vanadium	27	11	71.82	70	82.6	97.26	**108.19**	115
Zinc	27	33.6	89.68	85	100	134.4	**143.67**	242

Units = mg/kg; Concentrations shown in bold were used in the calculations

Table C4: Summary Statistics of the Concentration of Inorganic Chemicals in Waste Rock (mg/kg)

Constituent	Count	Minimum	Mean	Median	75 Percentile	90 Percentile	95 Percentile	Maximum
Aluminum	367	4.80E+03	2.50E+04	1.91E+04	2.32E+04	3.28E+04	8.37E+04	9.27E+04
Antimony	296	2.50E+00	2.48E+01	2.00E+01	3.00E+01	3.50E+01	4.13E+01	8.85E+02
Arsenic	367	1.00E+00	3.25E+02	2.00E+02	4.13E+02	7.88E+02	9.91E+02	3.55E+03
Barium	367	1.00E+01	1.55E+02	6.50E+01	8.50E+01	2.26E+02	8.37E+02	4.20E+03
Beryllium	71	1.00E-01	5.77E-01	5.00E-01	8.00E-01	1.50E+00	1.50E+00	2.00E+00
Bismuth	365	1.00E+00	4.38E+00	2.50E+00	5.00E+00	1.00E+01	1.00E+01	2.00E+01
Boron	296	2.00E+00	3.61E+01	1.40E+01	2.60E+01	5.90E+01	1.07E+02	7.52E+02
Cadmium	367	1.00E-01	1.04E+01	4.00E+00	9.70E+00	2.64E+01	4.54E+01	2.53E+02
Calcium	367	7.10E+02	8.49E+03	7.30E+03	1.14E+04	1.74E+04	2.14E+04	5.47E+04
Chromium	367	1.00E+00	6.90E+01	4.90E+01	8.95E+01	1.49E+02	1.86E+02	4.25E+02
Cobalt	364	8.00E+00	2.14E+01	2.00E+01	2.40E+01	2.90E+01	3.20E+01	5.10E+01
Copper	367	5.00E+00	1.71E+02	1.47E+02	2.00E+02	2.69E+02	3.19E+02	1.83E+03
Iron	367	2.19E+04	6.61E+04	6.36E+04	7.26E+04	7.98E+04	8.67E+04	5.98E+05
Lanthanum	296	5.00E+00	5.49E+00	5.00E+00	5.00E+00	5.00E+00	1.00E+01	1.00E+01
Lead	367	1.00E+00	6.01E+01	3.40E+01	6.20E+01	1.18E+02	1.64E+02	1.76E+03
Magnesium	367	3.00E+03	2.00E+04	1.94E+04	2.32E+04	2.67E+04	2.88E+04	1.55E+05
Manganese	367	1.40E+02	8.69E+02	7.29E+02	1.15E+03	1.63E+03	1.80E+03	2.48E+03
Mercury	40	1.00E+00	6.59E+01	4.00E+01	6.10E+01	1.41E+02	2.15E+02	4.20E+02
Molybdenum	367	5.00E-01	2.44E+00	2.00E+00	3.00E+00	5.00E+00	5.70E+00	4.00E+01
Nickel	361	5.00E-01	2.66E+01	1.10E+01	3.40E+01	7.80E+01	9.20E+01	1.26E+02
Phosphorus	367	5.70E+02	1.32E+03	1.32E+03	1.51E+03	1.68E+03	1.75E+03	2.01E+03
Potassium	367	2.00E+02	4.63E+03	1.40E+03	2.10E+03	4.44E+03	3.57E+04	4.62E+04
Selenium	6	4.00E+00	7.35E+00	6.10E+00	8.50E+00	1.15E+01	1.28E+01	1.40E+01
Silver	367	1.00E-01	1.58E+00	2.00E-01	8.00E-01	2.94E+00	6.14E+00	1.00E+02
Sodium	367	5.00E+01	2.11E+03	3.00E+02	4.65E+02	1.19E+03	1.80E+04	5.03E+04
Strontium	367	8.00E+00	7.12E+01	4.40E+01	7.75E+01	1.51E+02	2.68E+02	5.88E+02
Tellurium	296	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01
Thallium	296	0.00E+00	1.35E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00
Tin	296	1.00E+01	1.32E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01	2.60E+02
Titanium	336	5.00E+01	7.94E+02	6.00E+02	1.00E+03	1.65E+03	2.80E+03	3.40E+03
Tungsten	365	1.00E+00	8.53E+00	5.00E+00	5.00E+00	1.00E+01	2.00E+01	4.50E+02
Uranium	296	5.00E+00	6.57E+00	5.00E+00	5.00E+00	1.00E+01	1.25E+01	6.00E+01
Vanadium	367	1.10E+01	1.29E+02	1.31E+02	1.60E+02	1.89E+02	2.16E+02	2.80E+02
Yttrium	296	5.00E-01	4.79E+00	5.00E+00	7.00E+00	9.00E+00	1.00E+01	1.30E+01
Zinc	367	5.00E-01	5.19E+02	9.20E+01	2.41E+02	1.63E+03	2.95E+03	8.49E+03

Units = mg/kg

Table C5: Summary Statistics of the Concentration of Inorganic Chemicals Ore Material (mg/kg)

Constituent	Count	Minimum	Mean	Median	75 Percentile	90 Percentile	95 Percentile	Maximum
Aluminum	52	4600	31126	15060	63800	**85800**	87700	93600
Antimony	10	20.000	72	55.000	91	**117**	148.5	180
Arsenic	52	1.000	357	262.000	510	**793**	906.5	1998
Barium	36	2.500	368	127.000	655	**984**	1436.0	1460
Beryllium	26	0.100	0.6	0.500	0.8	**1.4**	1.5	1.5
Bismuth	33	1.000	5.8	2.250	5.8	**19.2**	22.3	30
Boron	10	6.000	9	9.000	10.0	**10.2**	11.1	12
Cadmium	36	0.100	12.7	5.000	10.3	**22.8**	42.6	153
Calcium	36	4400	10490	7400	11030	**17584**	27500.0	40700
Chromium	52	1.000	54	43.000	77	**122**	166.0	204
Cobalt	34	9.000	19	19.000	21	**27**	28.8	33
Copper	36	51.000	439	233.000	346	**798**	2085.1	2540
Iron	36	50.000	70190	65400	82000	**112620**	143060.0	155000
Lanthanum	10	5.000	6	5.000	5	**10**	10.0	10
Lead	36	12.000	91	58.000	94	**184**	260.5	536
Magnesium	52	50.000	10816	8690.0	17300	**20800**	24040.0	27700
Manganese	52	31.000	605	462.0	865	**1275**	1474.0	2267
Mercury	42	1.000	25	1.0	10	**105**	150.0	210
Molybdenum	36	0.500	2.2	1.0	3.0	**4.0**	5.6	13
Nickel	34	1.000	25	12.0	34	**62**	79.8	84
Phosphorus	52	917.000	1484	1530.0	1660	**1830**	1840.0	2010
Potassium	48	300.000	13626	3610.0	31750	**39180**	40180.0	45000
Selenium	6	7.000	17	11.1	26	**32**	33.0	34
Silver	52	0.100	16	7.0	18	**29**	50.4	184
Sodium	52	50.000	1960	250.0	1390	**6900**	9650.0	18000
Strontium	51	8.000	54	26.0	67	**135**	158.4	285
Tellurium	10	25.000	25	25.0	25	**25**	25.0	25
Thallium	10	2.500	2.5	2.5	2.5	**2.5**	2.5	2.5
Tin	10	10.000	10	10.0	10	**10**	10.0	10
Titanium	24	50.000	1623	2100.0	2750	**3000**	3085.0	3300
Tungsten	49	1.000	3.8	2.0	5.0	**10.0**	10.0	20
Uranium	10	5.000	7.5	5.0	5.0	**7.5**	18.8	30
Vanadium	52	6.000	101	78.2	168	**234**	246.5	251
Yttrium	10	0.500	1.9	0.5	0.5	**7.1**	7.6	8
Zinc	52	30.000	987	236.0	718	**2597**	4729.0	10000

Units = mg/kg; Concentrations shown in bold were used in the calculations

Table C6: Summary Statistics for Future Road

Constituent	Count	Minimum	Mean	Median	75 Percentile	90 Percentile	95 Percentile	Maximum
Aluminum	19	3000.00	14415.79	15800.00	18250	19900	20750	28400.00
Antimony	33	0.55	2.34	1.88	2.4	2.6	5.717	12.17
Arsenic	33	0.90	65.95	17.10	20.8	27.6	76.9	1573.40
Barium	33	55.00	255.67	157.00	251.2	453.3	866.4	1238.80
Beryllium	14	0.20	0.39	0.35	0.475	0.57	0.6	0.60
Bismuth	19	0.03	0.71	0.16	0.185	0.546	2.193	9.60
Boron	19	20.00	20.00	20.00	20	20	20	20.00
Cadmium	33	0.03	0.91	0.50	0.78	0.82	0.924	13.97
Calcium	19	1300.00	8389.47	5100.00	11100	20460	24300	24300.00
Chromium	33	13.60	60.55	60.90	74.4	100.92	108.08	126.20
Cobalt	33	2.60	12.68	13.00	15.4	18.5	19.1	29.00
Copper	33	1.59	59.34	61.97	72	79.5	90.642	107.00
Gallium	19	0.90	5.18	5.50	5.75	6.2	6.84	12.60
Gold	19	0.00	0.01	0.00	0.0026	0.00702	0.01433	0.06
Iron	19	10700.00	30268.42	29500.00	35950	45100	46950	63600.00
Lanthanum	19	1.80	10.64	12.00	14	14.96	16.29	22.50
Lead	33	1.01	17.11	12.50	17.4	27.292	31.114	127.81
Magnesium	19	1300.00	10563.16	10000.00	14000	14500	17250	27600.00
Manganese	19	137.00	701.42	753.00	979	1068.4	1366	1366.00
Mercury	33	0.00	0.03	0.02	0.04	0.05	0.064	0.13
Molybdenum	33	0.87	9.26	2.89	4.5	14.04	34.88	122.90
Nickel	33	2.80	28.55	28.10	36	50.1	54.26	74.20
Phosphorus	19	390.00	1050.00	1010.00	1190	1358	1594	2710.00
Potassium	19	400.00	1842.11	1800.00	1900	2400	2600	4400.00
Scandium	19	1.30	4.75	4.80	6.2	7.42	9.9	9.90
Selenium	33	0.10	3.19	1.20	1.8	2.98	3.42	67.30
Silver	33	0.01	0.70	0.50	0.621	0.869	1.8084	5.90
Sodium	19	20.00	413.16	290.00	520	832	899	1070.00
Strontium	19	9.20	38.82	26.30	57.45	71.9	80.08	103.30
Sulfur	19	200.00	1763.16	800.00	1700	5660	6580	9100.00
Tellurium	19	0.02	0.10	0.04	0.08	0.128	0.335	0.83
Thallium	33	0.02	0.11	0.10	0.1	0.12	0.272	0.40
Thorium	19	0.30	3.40	1.30	2	10.4	13.39	15.10
Tin	14	0.20	0.24	0.20	0.3	0.3	0.3	0.30
Titanium	19	40.00	794.74	730.00	1085	1680	2172	2640.00
Tungsten	19	0.10	1.88	0.10	0.3	1.7	7.42	26.50
Uranium	33	0.10	0.84	0.50	0.6	1.364	3	5.50
Vanadium	33	11.00	66.92	68.70	80	97.58	99	115.00
Zinc	33	30.00	97.15	84.00	90.4	97.6	119.64	688.90

Table C7: Predicted Air Particulate Chemical Concentrations (ug/m^3)

Parameters	Background (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Background PM2.5 (ug/m^3)	Background PM10 (ug/m^3)	Annual PM2.5 Bitter Crk. Down Stream of Tailings Management Facility (ug/m^3)	Annual PM10 Bitter Creek Down Stream of Tailings Management Facility (ug/m^3)
Aluminum	29300	19900	85800	32800	3.81E-02	9.96E-02	5.91E-02	1.48E-01
Antimony	6.86	2.6	117	35	8.92E-06	2.33E-05	1.67E-05	4.18E-05
Arsenic	69.52	27.6	793	788.4	9.04E-05	2.36E-04	1.71E-04	4.26E-04
Barium	428.56	453.3	984	226.4	5.57E-04	1.46E-03	8.58E-04	2.14E-03
Beryllium	0.6	0.57	1.38	1.5	7.80E-07	2.04E-06	1.23E-06	3.07E-06
Bismuth	0.3275	0.546	19.2	10	4.26E-07	1.11E-06	1.33E-06	3.33E-06
Boron	20	10	10.2	59	2.60E-05	6.80E-05	4.00E-05	9.99E-05
Cadmium	1.097	0.82	22.78	26.4	1.43E-06	3.73E-06	3.28E-06	8.20E-06
Calcium	19650	20460	17584	17440	2.55E-02	6.68E-02	3.88E-02	9.71E-02
Chromium	99.08	100.92	122	148.6	1.29E-04	3.37E-04	1.98E-04	4.95E-04
Cobalt	22.27	18.5	26.6	29	2.90E-05	7.57E-05	4.42E-05	1.11E-04
Copper	106.1	79.5	798.4	269.4	1.38E-04	3.61E-04	2.30E-04	5.74E-04
Gallium	12.075	6.2			1.57E-05	4.11E-05	2.31E-05	5.79E-05
Gold	0.014425	0.00702			1.88E-08	4.90E-08	2.76E-08	6.91E-08
Iron	58150	45100	112620	79840	7.56E-02	1.98E-01	1.17E-01	2.91E-01
Lanthanum	13.375	14.96	10	5	1.74E-05	4.55E-05	2.63E-05	6.56E-05
Lead	39.97	27.292	183.6	118.4	5.20E-05	1.36E-04	8.40E-05	2.10E-04
Magnesium	29700	14500	20800	26720	3.86E-02	1.01E-01	5.80E-02	1.45E-01
Manganese	916	1068.4	1275	1632.4	1.19E-03	3.11E-03	1.84E-03	4.61E-03
Mercury	0.08	0.05	105	140.5	1.04E-07	2.72E-07	5.99E-06	1.50E-05
Molybdenum	30.98	14.04	4	5	4.03E-05	1.05E-04	5.95E-05	1.49E-04
Nickel	52.57	50.1	62.4	78	6.83E-05	1.79E-04	1.05E-04	2.62E-04
Phosphorus	2335	1358	1830	1680	3.04E-03	7.94E-03	4.56E-03	1.14E-02
Potassium	1650	2400	39180	4440	2.15E-03	5.61E-03	4.25E-03	1.06E-02
Scandium	6.775	7.42			8.81E-06	2.30E-05	1.31E-05	3.28E-05
Selenium	4.54	2.98	31.9	11.5	5.90E-06	1.54E-05	9.76E-06	2.44E-05
Silver	1	0.869	28.8	2.94	1.30E-06	3.40E-06	2.68E-06	6.71E-06
Sodium	612.5	832	6900	1194	7.96E-04	2.08E-03	1.38E-03	3.46E-03

Parameters	Background (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Background PM2.5 (ug/m^3)	Background PM10 (ug/m^3)	Annual PM2.5 Bitter Crk. Down Stream of Tailings Management Facility (ug/m^3)	Annual PM10 Bitter Creek Down Stream of Tailings Management Facility (ug/m^3)
Strontium	96.85	71.9	134.8	151.2	1.26E-04	3.29E-04	1.93E-04	4.83E-04
Sulfur	12075	5660			1.57E-02	4.11E-02	2.31E-02	5.78E-02
Tellurium	0.315	0.128	25	25	4.10E-07	1.07E-06	1.79E-06	4.48E-06
Thallium	0.3	0.12	2.5	2.5	3.90E-07	1.02E-06	6.93E-07	1.73E-06
Thorium	1.675	10.4			2.18E-06	5.70E-06	3.51E-06	8.78E-06
Tin	0.58	0.3	10	10	7.54E-07	1.97E-06	1.59E-06	3.97E-06
Titanium	2312.5	1680	3000	1650	3.01E-03	7.86E-03	4.56E-03	1.14E-02
Tungsten	4.025	1.7	10	10	5.23E-06	1.37E-05	8.18E-06	2.04E-05
Uranium	1.208	1.364	7.5	10	1.57E-06	4.11E-06	2.76E-06	6.89E-06
Vanadium	108.19	97.58	234	189	1.41E-04	3.68E-04	2.19E-04	5.47E-04
Yttrium			7.1	9	0.00E+00	0.00E+00	3.83E-07	9.56E-07
Zinc	143.67	97.6	2597	1633.6	1.87E-04	4.88E-04	3.77E-04	9.42E-04

* The screening level for magnesium is based on the reference concentration from the Michigan Department of Environmental Quality (MDEQ); ** Where the Ontario MOECC AACQs exceeded the British Columbia PM10 guideline of 50 ug/m3, 50 ug/m3was used as 24-hour particulate cutoff value; TCEQ - Texas Commission on Environmental Quality. 2018. http://www17.tceq.texas.gov/tamis/index.cfm?fuseaction=home.welcome; TCEQ. 2017. Download Effects Screening Levels (ESLs) Used in the Review of Air Permitting Data; ESL - Effects Screening Levels; Ontario Ministry of Environment and Climate Change (MOECC). 2017. Ontario’s Ambient Air Quality Criteria; AAQCs - Ambient Air Quality Criteria; PM10 - PM10 is particulate matter 10 micrometers or less in diameter

Table C8: Predicted Soil Chemical Concentrations (mg/kg)

Constituent	Background (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Deposition Road Between lower portal and Plant site Root Zone (mg/kg)	Deposition Between Lower Portal and Bitter Creek Root Zone (mg/kg)	Deposition Bitter Creek Downstream of TMF Root Zone (mg/kg)	Predicted Soil Concentration at Bitter Creek Down Stream of TMF (mg /kg soil)	Predicted Soil Concentration at Road Between Lower Portal and Plant site (mg /kg soil)	Predicted Soil Concentration Between Lower Portal and Bitter Creek (mg /kg soil)
Aluminum	29300	19900	85800	32800	158.1	159.3	173.1	29458.085	29459.281	**29473.136**
Antimony	6.86	2.6	117	35	0.04	0.04	0.04	6.905	6.900	**6.901**
Arsenic	69.52	27.6	793	788.4	0.46	0.41	0.42	69.976	69.928	**69.938**
Barium	428.56	453.3	984	226.4	2.29	2.36	2.69	430.853	430.923	**431.253**
Beryllium	0.6	0.57	1.38	1.5	0.003	0.003	0.004	0.603	0.603	**0.604**
Bismuth	0.3275	0.546	19.2	10	0.004	0.003	0.003	0.331	0.330	**0.330**
Boron	20	10	10.2	59	0.11	0.11	0.11	20.107	20.107	**20.114**
Cadmium	1.097	0.82	22.78	26.4	0.01	0.01	0.01	1.106	1.104	**1.105**
Calcium	19650	20460	17584	17440	103.8	107.7	122.7	19753.795	19757.706	**19772.695**
Chromium	99.08	100.92	122	148.6	0.53	0.54	0.62	99.609	99.625	**99.698**
Cobalt	22.27	18.5	26.6	29	0.12	0.12	0.13	22.388	22.391	**22.404**
Copper	106.1	79.5	798.4	269.4	0.61	0.60	0.65	106.714	106.696	**106.749**
Gallium	12.075	6.2	NA	NA	0.06	0.06	0.07	12.137	12.139	**12.143**
Gold	0.014425	0.00702	NA	NA	0.0001	0.0001	0.0001	0.014	0.015	**0.015**
Iron	58150	45100	112620	79840	311.5	316.6	348.6	58461.491	58466.598	**58498.628**
Lanthanum	13.375	14.96	10	5	0.07	0.07	0.08	13.445	13.448	**13.459**
Lead	39.97	27.292	183.6	118.4	0.22	0.22	0.24	40.195	40.191	**40.209**
Magnesium	29700	14500	20799.9	26720	155.2	157.8	167.9	29855.146	29857.788	**29867.902**
Manganese	916	1068.4	1275	1632.4	4.9	5.1	5.9	920.929	921.090	**921.869**
Mercury	0.08	0.05	105	140.5	0.02	0.01	0.01	0.096	0.087	**0.086**
Molybdenum	30.98	14.04	4	5	0.16	0.16	0.17	31.139	31.143	**31.153**
Nickel	52.57	50.1	62.4	78	0.28	0.29	0.32	52.850	52.858	**52.894**

Constituent	Background (mg/kg)	Road (mg/kg)	Ore (mg/kg)	Waste Rock (mg/kg)	Deposition Road Between lower portal and Plant site Root Zone (mg/kg)	Deposition Between Lower Portal and Bitter Creek Root Zone (mg/kg)	Deposition Bitter Creek Downstream of TMF Root Zone (mg/kg)	Predicted Soil Concentration at Bitter Creek Down Stream of TMF (mg /kg soil)	Predicted Soil Concentration at Road Between Lower Portal and Plant site (mg /kg soil)	Predicted Soil Concentration Between Lower Portal and Bitter Creek (mg /kg soil)
Phosphorus	2335	1358	1830	1680	12.20	12.4	13.4	2347.202	2347.464	**2348.427**
Potassium	1650	2400	39180	4440	11.3	10.3	11.9	1661.357	1660.359	**1661.910**
Scandium	6.775	7.42	NA	NA	0.04	0.04	0.04	6.810	6.812	**6.817**
Selenium	4.54	2.98	31.9	11.5	0.03	0.03	0.03	4.566	4.565	**4.567**
Silver	1	0.869	28.799	2.94	0.01	0.01	0.01	1.007	1.006	**1.007**
Sodium	612.5	832	6900	1193.99	3.7	3.6	4.2	616.196	616.106	**616.683**
Strontium	96.85	71.9	134.8	151.2	0.52	0.53	0.58	97.366	97.375	**97.426**
Sulfur	12075	5660	NA	NA	61.8	63.6	67.6	12136.830	12138.55	**12142.59**
Tellurium	0.315	0.128	25	25	0.00	0.005	0.003	0.320	0.318	**0.318**
Thallium	0.3	0.12	2.5	2.5	0.00	0.002	0.002	0.3019	0.302	**0.30177**
Thorium	1.675	10.4	NA	NA	0.01	0.009	0.012	1.684	1.687	**1.695**
Tin	0.58	0.3	10	10	0.00	0.004	0.004	0.584	0.584	**0.584**
Titanium	2312.5	1680	3000.000119	1650.0	12.2	12.5	13.7	2324.687	2324.975	**2326.178**
Tungsten	4.025	1.7	10	10	0.02	0.02	0.02	4.047	4.047	**4.048**
Uranium	1.208	1.364	7.5	10	0.01	0.01	0.01	1.215	1.215	**1.216**
Vanadium	108.19	97.58	234	189	0.022	0.022	0.023	108.775	108.785	**108.855**
Yttrium			7.1	9	0.007	0.007	0.008	0.00102	0.00044	**0.00035**
Zinc	143.67	97.6	2597	1633.6	1.01	0.88	0.93	144.677	144.551	**144.598**

Attachment D - Update
Detailed Country Food Concentration Calculations

Table D1. Exposure Media Concentrations Used to Estimate Tissue Concentrations in Country Foods – Baseline

COPCs	Soil 90th Percentile Baseline (mg/kg)	Surface Water (unfiltered) 90th Percentile Baseline (mg/L)	Terrestrial Plants (Wet Weight) (mg/kg)	Terrestrial Plants (Dry Weight) (mg/kg)	Soil Invertebrates (mg/kg)	Fish (mg/kg)
Aluminum	29300	5.89E+00	21.362	61.84	2198	35.35
Antimony	6.86	2.05E-03	0.011	0.031	0.34	0.062
Arsenic	69.52	8.45E-03	0.150	0.44	0.46	0.7358
Barium	428.56	1.13E-01	13	40.21	3	1.68
Bismuth	0.33	8.36E-03	0.0033	0.010	0.33	0.02
Boron	20.00	9.19E-02	10.2933	32.89	20.00	0.10
Cadmium	1.10	4.83E-04	1.277	3.88	12.1	0.85
Chromium	99.08	6.68E-03	0.109	0.32	3144.0	0.094
Cobalt	22.27	5.03E-03	0.251	0.74	990.8	0.29
Copper	106.10	3.01E-02	3.48	10.70	16.98	1.686
Iron	58150	9.17E+00	65.437	192.29	581500	128.80
Lead	39.97	6.83E-03	0.053	0.15	838.3	0.11
Manganese	916.00	2.94E-01	93.064	276.11	18.3	5.04
Mercury	0.08	1.21E-05	0.0036	0.011	0.027	0.0087
Nickel	52.57	2.06E-02	1.71	4.93	10.5	0.21
Selenium	4.54	2.30E-03	0.50	1.57	3.5	2.91
Strontium	95.85	2.69E-01	25.72	78.33	0.4	7.997
Tellurium	0.32	-	-	-	-	-
Thallium	0.30	1.84E-04	0.00047	0.0014	0.30	0.023
Titanium	2312.50	9.82E-02	0.807	2.35	2313	1.04
Uranium	1.21	5.0E-04	0.00146	0.0027	0.3624	0.0064
Vanadium	108.19	1.35E-02	0.070	0.20	14	0.19
Zinc	143.67	5.81E-02	57.256	171.14	2586.1	37.77
Aluminum	29300	5.89E+00	21.362	61.84	2198	35.35

Tissue concentrations are expressed in wet weight unless otherwise specified.

Table D2. Exposure Media Concentrations Used to Estimate Tissue Concentrations in Country Foods – Predicted Future

COPCs	Soil 90th Percentile (mg/kg)	Surface Water 90th Percentile Predicted (mg/L)	Terrestrial Plants Total (Wet Weight) (mg/kg)	Terrestrial Plants Total (Dry Weight) (mg/kg)	Terrestrial Plants from Deposition (Dry Weight) (mg/kg)	Terrestrial Plants from Root Uptake (Dry Weight) (mg/kg)	Soil Invertebrates (mg/kg)	Fish (mg/kg)
Aluminum	29473.14	6.15E+00	20.416	62.488	6.09E-01	61.879	2210	10.47
Antimony	6.90	5.74E-03	0.010	0.031	1.72E-04	0.031	0.35	0.034
Arsenic	69.94	9.79E-03	0.143	0.437	1.76E-03	0.435	0.46	0.6349
Barium	431.25	1.19E-01	13.149	40.25	8.83E-03	40.238	3.2	2.11
Bismuth	0.33	8.44E-03	0.003	0.01	1.37E-05	0.010	0.33	0.009
Boron	20.11	9.57E-02	10.751	32.91	4.12E-04	32.906	20.11	0.12
Cadmium	1.105	1.33E-03	1.2689	3.88	3.38E-05	3.884	12.1	0.66
Chromium	99.70	7.62E-03	0.106	0.324	2.04E-03	0.322	16.0	0.09
Cobalt	22.40	6.44E-03	0.241	0.74	4.56E-04	0.738	22.4	0.49
Copper	106.75	3.36E-02	3.498	10.71	2.36E-03	10.705	17	1.65
Iron	58499	9.66E+00	63.250	193.6	1.20E+00	192.40	58499	166.08
Lead	40.21	7.78E-03	0.051	0.16	8.65E-04	0.15	678.7	0.17
Manganese	921.9	5.38E-01	90.271	276.3	1.90E-02	276.29	18.4	20.98
Mercury	0.086	6.91E-05	0.004	0.011	6.17E-05	0.011	0.029	0.010
Nickel	52.89	2.72E-02	1.613	4.9	1.08E-03	4.94	12.2	0.22
Selenium	4.567	3.26E-03	0.513	1.57	1.00E-04	1.57	3.5	2.36
Strontium	97.43	2.96E-01	25.606	78	1.99E-03	78.38	0	6.63
Tellurium	0.318	NA	-	-	1.84E-05	-	0.32	
Thallium	0.3018	1.92E-04	0.00033	0.0010	7.14E-06	0.0010	0.30	0.02
Titanium	2326.12	1.01E-01	0.784	2.4	4.70E-02	2.35	2326	0.53
Uranium	1.22	5.00E-04	0.0010	0.0030	2.84E-05	0.0030	0.365	0.005
Vanadium	108.85	1.37E-02	0.067	0.20	2.25E-03	0.20	14	0.08
Zinc	144.60	1.13E-01	55.951	171.26	3.88E-03	171.26	260.3	84.89

Table D3. Bioconcentration and Biotransfer Factors Used to Estimate Tissue Concentrations in Country Foods – Baseline

COPCs	Soil Concentrations (mg/kg)	Soil to Soil Invertebrate BCFs (unit less)	Soil to Plant BCFs (dry) (Modelled from Baseline)	Soil to Rabbit BAFs	Soil to Moose BAFs	Soil to Grouse BAFs	Diet to Rabbit BAFs	Diet to Moose BAFs	Diet to Grouse BAFs	Diet (water) to Grouse BAFs	Diet (water) to Rabbit BAFs	Diet (water) to Moose BAFs	ORNL RAIS Beef Transfer (day/kg)
Aluminum	29300.00	7.50E-02	3.30E-03	3.87E-07	3.97E-05	2.24E-07	1.17E-04	1.20E-02	6.79E-05	6.83E-05	0.000195	3.00E-02	0.0015
Antimony	6.86	5.00E-02	1.02E-02	7.97E-07	8.17E-05	4.63E-07	7.80E-05	8.00E-03	4.53E-05	4.56E-05	0.00013	2.00E-02	0.001
Arsenic	69.52	6.60E-03	4.56E-03	7.11E-07	7.30E-05	4.13E-07	1.56E-04	1.60E-02	9.06E-05	9.11E-05	0.00026	4.00E-02	0.002
Barium	428.56	7.50E-03	2.11E-01	2.47E-06	2.53E-04	1.43E-06	1.17E-05	1.20E-03	6.79E-06	6.83E-06	1.95E-05	3.00E-03	0.00015
Bismuth	0.3275	1.00E+00	7.69E-02	2.40E-06	2.46E-04	1.39E-06	3.12E-05	3.20E-03	1.81E-05	1.82E-05	0.000052	8.00E-03	0.0004
Boron	20.00	1.00E+00	1.64E+00	7.70E-05	7.89E-03	4.47E-05	4.68E-05	4.80E-03	2.72E-05	2.73E-05	0.000078	1.20E-02	0.0006
Cadmium	1.097	1.10E+01	3.61E+00	1.55E-04	1.59E-02	8.99E-05	4.29E-05	4.40E-03	2.49E-05	2.51E-05	7.15E-05	1.10E-02	0.00055
Chromium	99.08	1.60E-01	6.77E-03	2.90E-06	2.98E-04	1.68E-06	4.29E-04	4.40E-02	2.49E-04	0.000251	0.000715	1.10E-01	0.0055
Cobalt	22.27	1.00E+00	5.15E-02	8.04E-05	8.24E-03	4.67E-05	1.56E-03	1.60E-01	9.06E-04	0.000911	0.0026	4.00E-01	0.02
Copper	106.10	1.60E-01	1.38E-01	1.07E-04	1.10E-02	6.24E-05	7.80E-04	8.00E-02	4.53E-04	0.000456	0.0013	2.00E-01	0.01
Iron	58150.00	1.00E+00	5.33E-03	8.31E-06	8.53E-04	4.83E-06	1.56E-03	1.60E-01	9.06E-04	0.000911	0.0026	4.00E-01	0.02
Lead	39.97	1.69E+01	7.42E-03	2.32E-07	2.38E-05	1.34E-07	3.12E-05	3.20E-03	1.81E-05	1.82E-05	0.000052	8.00E-03	0.0004
Manganese	916.00	2.00E-02	4.57E-01	1.43E-05	1.46E-03	8.27E-06	3.12E-05	3.20E-03	1.81E-05	1.82E-05	0.000052	8.00E-03	0.0004
Mercury	0.08	3.40E-01	2.57E-01	5.02E-03	5.15E-01	2.91E-03	1.95E-02	2.00E+00	1.13E-02	0.011391	0.0325	5.00E+00	0.25
Nickel	52.57	2.30E-01	1.46E-01	6.83E-05	7.00E-03	3.96E-05	4.68E-04	4.80E-02	2.72E-04	0.000273	0.00078	1.20E-01	0.006
Selenium	4.54	7.60E-01	6.67E-01	7.81E-04	8.01E-02	4.53E-04	1.17E-03	1.20E-01	6.79E-04	0.000683	0.00195	3.00E-01	0.015
Strontium	95.85	4.00E-03	1.75E+00	1.09E-03	1.12E-01	6.34E-04	6.24E-04	6.40E-02	3.62E-04	0.000365	0.00104	1.60E-01	0.008
Tellurium	0.32	1.00E+00	1.00E+00	5.46E-04	5.60E-02	3.17E-04	5.46E-04	5.60E-02	3.17E-04	0.000319	0.00091	1.40E-01	0.007
Thallium	0.30	1.00E+00	1.13E-02	3.52E-05	3.61E-03	2.05E-05	3.12E-03	3.20E-01	1.81E-03	0.001823	0.0052	8.00E-01	0.04
Titanium	2312.50	1.00E+00	2.17E-03	5.08E-06	5.21E-04	2.95E-06	2.34E-03	2.40E-01	1.36E-03	0.001367	0.0039	6.00E-01	0.03
Uranium	1.21	3.00E-01	5.09E-03	7.93E-08	8.14E-06	4.61E-08	1.56E-05	1.60E-03	9.06E-06	9.11E-06	0.000026	4.00E-03	0.0002
Vanadium	108.19	1.30E-01	2.74E-03	5.34E-07	5.47E-05	3.10E-07	1.95E-04	2.00E-02	1.13E-04	0.000114	0.000325	5.00E-02	0.0025
Zinc	143.67	1.80E+00	1.46E+00	1.14E-02	1.17E+00	6.62E-03	7.80E-03	8.00E-01	4.53E-03	0.004557	0.013	2.00E+00	0.1

Note: BCF = 1, when no literature values for dietary biotransfer factors were available.
BAF for soil to receptor = (BAF soil to plant) x (BAF plant to mammal) (USEPA 2007)
BAF for diet to receptor = Biotransfer Factor (cattle) x Receptor Ingestion Rate (USEPA 1998, 1999, 2005, 2007)

USEPA. 1998. *Guidelines for Ecological Risk Assessment*. Federal Register 63(93):26846-26942.
USEPA. 1999. *Ecological Risk Assessment and Risk Management Principles for Superfund Sites*. OSWER Directive 9285.7-28.P.
USEPA 2005. *Guidance for Developing Ecological Soil Screening Levels*. OSWER Directive 9285.7-55.
USEPA. 2007. *Attachment 4-1 Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs) Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLsd*.

Table D4. Bioconcentration and Biotransfer Factors Used to Estimate Tissue Concentrations in Country Foods - Predicted Future

COPCs	Soil Concentrations (mg/kg)	Soil to Soil Invertebrate BCFs (unit less)	Soil to Plant BCFs (dry) (Modelled from Baseline)	Soil to Rabbit BAFs	Soil to Moose BAFs	Soil to Grouse BAFs	Diet to Rabbit BAFs	Diet to Moose BAFs	Diet to Grouse BAFs	Diet (water) to Grouse BAFs	Diet (water) to Rabbit BAFs	Diet (water) to Moose BAFs	ORNL RAIS Beef Transfer Factor (day/kg)
Aluminum	29473	7.50E-02	3.30E-03	3.87E-07	3.97E-05	2.24E-07	1.17E-04	1.20E-02	6.79E-05	6.83E-05	1.95E-04	3.00E-02	0.0015
Antimony	6.90	5.00E-02	1.02E-02	7.97E-07	8.17E-05	4.63E-07	7.80E-05	8.00E-03	4.53E-05	4.56E-05	1.30E-04	2.00E-02	0.001
Arsenic	69.94	6.60E-03	4.56E-03	7.11E-07	7.30E-05	4.13E-07	1.56E-04	1.60E-02	9.06E-05	9.11E-05	2.60E-04	4.00E-02	0.002
Barium	431.25	7.50E-03	2.11E-01	2.47E-06	2.53E-04	1.43E-06	1.17E-05	1.20E-03	6.79E-06	6.83E-06	1.95E-05	3.00E-03	0.00015
Bismuth	0.3304	1.00E+00	7.69E-02	2.40E-06	2.46E-04	1.39E-06	3.12E-05	3.20E-03	1.81E-05	1.82E-05	5.20E-05	8.00E-03	0.0004
Boron	20.11	1.00E+00	1.64E+00	7.70E-05	7.89E-03	4.47E-05	4.68E-05	4.80E-03	2.72E-05	2.73E-05	7.80E-05	1.20E-02	0.0006
Cadmium	1.105	1.10E+01	3.61E+00	1.55E-04	1.59E-02	8.99E-05	4.29E-05	4.40E-03	2.49E-05	2.51E-05	7.15E-05	1.10E-02	0.00055
Chromium	99.70	1.60E-01	6.77E-03	2.90E-06	2.98E-04	1.68E-06	4.29E-04	4.40E-02	2.49E-04	2.51E-04	7.15E-04	1.10E-01	0.0055
Cobalt	22.40	1.00E+00	5.15E-02	8.04E-05	8.24E-03	4.67E-05	1.56E-03	1.60E-01	9.06E-04	9.11E-04	2.60E-03	4.00E-01	0.02
Copper	106.75	1.60E-01	1.38E-01	1.07E-04	1.10E-02	6.24E-05	7.80E-04	8.00E-02	4.53E-04	4.56E-04	1.30E-03	2.00E-01	0.01
Iron	58499	1.00E+00	5.33E-03	8.31E-06	8.53E-04	4.83E-06	1.56E-03	1.60E-01	9.06E-04	9.11E-04	2.60E-03	4.00E-01	0.02
Lead	40.21	1.69E+01	7.42E-03	2.32E-07	2.38E-05	1.34E-07	3.12E-05	3.20E-03	1.81E-05	1.82E-05	5.20E-05	8.00E-03	0.0004
Manganese	921.87	2.00E-02	4.57E-01	1.43E-05	1.46E-03	8.27E-06	3.12E-05	3.20E-03	1.81E-05	1.82E-05	5.20E-05	8.00E-03	0.0004
Mercury	0.086	3.40E-01	2.57E-01	5.02E-03	5.15E-01	2.91E-03	1.95E-02	2.00E+00	1.13E-02	1.14E-02	3.25E-02	5.00E+00	0.25
Nickel	52.89	2.30E-01	1.46E-01	6.83E-05	7.00E-03	3.96E-05	4.68E-04	4.80E-02	2.72E-04	2.73E-04	7.80E-04	1.20E-01	0.006
Selenium	4.57	7.60E-01	6.67E-01	7.81E-04	8.01E-02	4.53E-04	1.17E-03	1.20E-01	6.79E-04	6.83E-04	1.95E-03	3.00E-01	0.015
Strontium	97.43	4.00E-03	1.75E+00	1.09E-03	1.12E-01	6.34E-04	6.24E-04	6.40E-02	3.62E-04	3.65E-04	1.04E-03	1.60E-01	0.008
Tellurium	0.318	1.00E+00	1.00E+00	5.46E-04	5.60E-02	3.17E-04	5.46E-04	5.60E-02	3.17E-04	3.19E-04	9.10E-04	1.40E-01	0.007
Thallium	0.302	1.00E+00	1.13E-02	3.52E-05	3.61E-03	2.05E-05	3.12E-03	3.20E-01	1.81E-03	1.82E-03	5.20E-03	8.00E-01	0.04
Titanium	2326	1.00E+00	2.17E-03	5.08E-06	5.21E-04	2.95E-06	2.34E-03	2.40E-01	1.36E-03	1.37E-03	3.90E-03	6.00E-01	0.03
Uranium	1.216	3.00E-01	5.09E-03	7.93E-08	8.14E-06	4.61E-08	1.56E-05	1.60E-03	9.06E-06	9.11E-06	2.60E-05	4.00E-03	0.0002
Vanadium	108.85	1.30E-01	2.74E-03	5.34E-07	5.47E-05	3.10E-07	1.95E-04	2.00E-02	1.13E-04	1.14E-04	3.25E-04	5.00E-02	0.0025
Zinc	144.60	1.80E+00	1.46E+00	1.14E-02	1.17E+00	6.62E-03	7.80E-03	8.00E-01	4.53E-03	4.56E-03	1.30E-02	2.00E+00	0.1

Note: BAF and BCF = 1, when no literature values for dietary biotransfer factors were available.
BAF for soil to receptor = (BAF soil to plant) x (BAF plant to mammal) (ECO-SSL 2007 guidance document)
BAF for diet to receptor = Biotransfer Factor (cattle) x Receptor Ingestion Rate (ECO-SSL 2007 and USEPA guidance documents 1998, 1999, 2005)

USEPA. 1998. Guidelines for Ecological Risk Assessment. Federal Register 63(93):26846-26942.
USEPA. 1999. Ecological Risk Assessment and Risk Management Principles for Superfund Sites. OSWER Directive 9285.7-28.P.
USEPA 2005. Guidance for Developing Ecological Soil Screening Levels. OSWER Directive 9285.7-55.
USEPA. 2007. Attachment 4-1 Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs) Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs

Table D5. Rabbit Receptor Characteristics Used for Estimating Tissue Concentrations

Receptor Characteristics[a]	Snowshoe Hare	
Body weight (kg)	1.3	b
Food consumption rate (kg/day)	0.078	c
Water consumption rate (L/day)	0.13	d
Home range (hectares)	1.6	
Dietary Composition	**Percentages[e]**	
Soil ingestion (direct)	6%	a
Grasses, forbs, berries	38%	d
Shrubs	56%	d

a = Receptor characteristics for snowshoe hare (*Lepus americanus*) are from EC (2012).

b = Value selected is average of male and female.

c = food consumption rate based on 0.06 kg dry food / kg wet BW / day.

d = Percentages for diet composition for snowshoe hare foraging in western Canada, Ontario, and Alaska.

e = Diet percentages were normalized to 100% to include 6.3% soil ingestion.

EC (Environment Canada). 2012. *Federal Contaminated Sites Action Plan (FCSAP), Ecological Risk Assessment Guidance, Module 3: Standardization of Wildlife Receptor Characteristics*.

Table D6. Moose Receptor Characteristics Used for Estimating Tissue Concentrations

Receptor Characteristics[a]	Moose	
Body weight (kg)	400	b
Food consumption rate (kg/day)	8.0	c
Water consumption rate (L/day)	20.0	d
Home range (hectares)	460	
Dietary Composition	**Percentages[g]**	
Soil ingestion (direct)	2%	e
Aquatic plants	20%	f
Ferns, shrubs, trees, other	78%	f

a = Receptor characteristics for moose (*Alces alces*) (EC 2012).
b = Value selected is average of male and female reported literature values for moose.
c = Food consumption rate based on 0.02 kg dry food / kg wet BW / day.
d = Water consumption rate based on 0.05 L / kg wet BW / day.
e = BCMELP recommended percentage of soil ingestion for wildlife (BCMELP 2000)
f = Percentages for diet were taken from literature (EC 2012) values for two free-ranging moose foraging at Ministik Wildlife Research Station located 48 km southeast of Edmonton. The observations were made during continuous 24-hour period every 6-8 weeks for one year. Concentrations of substances in aquatic vegetation was assumed to be equal to concentrations in terrestrial vegetation.
g = Diet percentages were normalized to 100% to include 2% soil ingestion.

EC (Environment Canada). 2012. *Federal Contaminated Sites Action Plan (FCSAP), Ecological Risk Assessment Guidance, Module 3: Standardization of Wildlife Receptor Characteristics*.
BCMELP (British Columbia Ministry of Environment, Lands, and Parks). 2000. *Tier I Ecological Risk Assessment Policy Decision Summary*.

Table D7. Grouse Receptor Characteristics Used for Estimating Tissue Concentrations

Receptor Characteristics[a]	Ruffed Grouse	
Body weight (kg)	0.680	b
Food consumption rate (kg/day)	0.0453	c
Water consumption rate (L/day)	0.0456	d
Home range (hectares)	12	e
Dietary Composition[f]	**Percentages[j]**	
Soil (direct ingestion)	2%	h
Insects	1.4%	g
Grasses & Forbs	39%	
Shrubs & Trees (seeds)	58%	

a = General receptor characteristics and dietary consumption for *Bonassa umbellus* are from Connecticut Department of Environmental Protection.
b = Value selected is average of males and females for BWs reported for adults.
c = Based on USEPA (1993) - Allometric Equation 3-3.
d = Based on USEPA (1993) - Allometric Equation 3-16.
e = Home range based on average of hectares/bird reported values.
f = Dietary information from Missouri Department of Conservation (2002)
g = For modeling purposes, EECs in insects were based on soil invertebrates.
h = Direct ingestion of 2% soil is based on BCMOE recommended level (BCMELP 2000).
j = Diet percentages were normalized to 100% to include 2% soil ingestion.

USEPA. 1993. *Wildlife Exposure Factors Handbook*. EPA/600/R-93/187.
Missouri Department of Conservation. 2002. Ruffed Grouse (*Bonassa umbellus*). Online Resource.
BCMELP (British Columbia Ministry of Environment, Lands, and Parks). 2000. *Tier I Ecological Risk Assessment Policy Decision Summary*.

Table D8. Calculation of Rabbit Tissue Concentrations by Dietary Source – Baseline

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or (mg/L)	Body Burden or Tissue (mg/kg)
Aluminum	Soil ingestion (direct)	6%	2.93E+04	7.14E-04
	Grasses, forbs, berries	38%	6.18E+01	2.72E-03
	Shrubs	56%	6.18E+01	4.08E-03
	Water ingestion (direct)	NA	5.89E+00	1.15E-03
	Total	**100%**		**8.67E-03**
Antimony	Soil ingestion (direct)	6%	6.86E+00	3.44E-07
	Grasses, forbs, berries	38%	3.09E-02	9.06E-07
	Shrubs	56%	3.09E-02	1.36E-06
	Water ingestion (direct)	NA	2.05E-03	2.67E-07
	Total	**100%**		**2.88E-06**
Arsenic	Soil ingestion (direct)	6%	6.95E+01	3.12E-06
	Grasses, forbs, berries	38%	4.35E-01	2.55E-05
	Shrubs	56%	4.35E-01	3.83E-05
	Water ingestion (direct)	NA	8.45E-03	2.20E-06
	Total	**100%**		**6.92E-05**
Barium	Soil ingestion (direct)	6%	4.29E+02	6.67E-05
	Grasses, forbs, berries	38%	4.02E+01	1.77E-04
	Shrubs	56%	4.02E+01	2.66E-04
	Water ingestion (direct)	NA	1.13E-01	2.20E-06
	Total	**100%**		**5.11E-04**
Bismuth	Soil ingestion (direct)	6%	3.28E-01	4.95E-08
	Grasses, forbs, berries	38%	1.00E-02	1.17E-07
	Shrubs	56%	1.00E-02	1.76E-07
	Water ingestion (direct)	NA	8.36E-03	4.35E-07
	Total	**100%**		**7.78E-07**
Boron	Soil ingestion (direct)	6%	2.00E+01	9.70E-05
	Grasses, forbs, berries	38%	3.29E+01	5.79E-04
	Shrubs	56%	3.29E+01	8.69E-04
	Water ingestion (direct)	NA	9.19E-02	7.17E-06
	Total			**1.553E-03**
Cadmium	Soil ingestion (direct)	6%	1.10E+00	1.07E-05
	Grasses, forbs, berries	38%	3.88E+00	6.27E-05
	Shrubs	56%	3.88E+00	9.40E-05
	Water ingestion (direct)	NA	4.83E-04	3.45E-08
	Total	**100%**		**1.67E-04**
Chromium	Soil ingestion (direct)	6%	9.91E+01	1.81E-05
	Grasses, forbs, berries	38%	3.21E-01	5.19E-05
	Shrubs	56%	3.21E-01	7.78E-05
	Water ingestion (direct)	NA	6.68E-03	4.78E-06
	Total	**100%**		**1.53E-04**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or (mg/L)	Body Burden or Tissue (mg/kg)
Cobalt	Soil ingestion (direct)	6%	2.23E+01	1.13E-04
	Grasses, forbs, berries	38%	7.38E-01	4.33E-04
	Shrubs	56%	7.38E-01	6.50E-04
	Water ingestion (direct)	NA	5.03E-03	1.31E-05
	Total	**100%**		**1.21E-03**
Copper	Soil ingestion (direct)	6%	1.06E+02	7.18E-04
	Grasses, forbs, berries	38%	1.07E+01	3.14E-03
	Shrubs	56%	1.07E+01	4.71E-03
	Water Ingestion (direct)	NA	3.01E-02	3.92E-05
	Total	**100%**		**8.61E-03**
Iron	Soil ingestion (direct)	6%	5.82E+04	3.05E-02
	Grasses, forbs, berries	38%	1.92E+02	1.13E-01
	Shrubs	56%	1.92E+02	1.69E-01
	Water ingestion (direct)	NA	9.17E+00	2.38E-02
	Total	**100%**		**3.36E-01**
Lead	Soil ingestion (direct)	6%	4.00E+01	5.83E-07
	Grasses, forbs, berries	38%	1.55E-01	1.82E-06
	Shrubs	56%	1.55E-01	2.72E-06
	Water ingestion (direct)	NA	6.83E-03	3.55E-07
	Total	**100%**		**5.48E-06**
Manganese	Soil ingestion (direct)	6%	9.16E+02	8.22E-04
	Grasses, forbs, berries	38%	2.76E+02	3.24E-03
	Shrubs	56%	2.76E+02	4.86E-03
	Water ingestion (direct)	NA	2.94E-01	1.53E-05
	Total	**100%**		**8.94E-03**
Mercury	Soil ingestion (direct)	6%	8.00E-02	2.53E-05
	Grasses, forbs, berries	38%	1.11E-02	8.18E-05
	Shrubs	56%	1.11E-02	1.23E-04
	Water ingestion (direct)	NA	1.21E-05	3.95E-07
	Total	**100%**		**2.301E-04**
Nickel	Soil ingestion (direct)	6%	5.26E+01	2.26E-04
	Grasses, forbs, berries	38%	4.93E+00	8.69E-04
	Shrubs	56%	4.93E+00	1.30E-03
	Water ingestion (direct)	NA	2.06E-02	1.61E-05
	Total	**100%**		**2.41E-03**
Selenium	Soil ingestion (direct)	6%	4.54E+00	2.23E-04
	Grasses, forbs, berries	38%	1.57E+00	6.91E-04
	Shrubs	56%	1.57E+00	1.04E-03
	Water ingestion (direct)	NA	2.30E-03	4.48E-06
	Total	**100%**		**1.96E-03**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or (mg/L)	Body Burden or Tissue (mg/kg)
Strontium	Soil ingestion (direct)	6%	9.59E+01	6.60E-03
	Grasses, forbs, berries	38%	7.83E+01	1.84E-02
	Shrubs	56%	7.83E+01	2.76E-02
	Water ingestion (direct)	Na	2.69E-01	2.80E-04
	Total	**100%**		**5.29E-02**
Tellurium	Soil ingestion (direct)	6%	3.15E-01	1.08E-05
	Grasses, forbs, berries	38%	-	-
	Shrubs	56%	-	-
	Water ingestion (direct)	NA	-	-
	Total	**100%**		**1.08E-05**
Thallium	Soil ingestion (direct)	6%	3.00E-01	6.66E-07
	Grasses, forbs, berries	38%	1.43E-03	1.68E-06
	Shrubs	56%	1.43E-03	2.52E-06
	Water ingestion (direct)	NA	1.84E-04	9.58E-07
	Total	**100%**		**5.82E-06**
Titanium	Soil ingestion (direct)	6%	2.31E+03	7.40E-04
	Grasses, forbs, berries	38%	2.35E+00	2.07E-03
	Shrubs	56%	2.35E+00	3.11E-03
	Water ingestion (direct)	NA	9.82E-02	3.83E-04
	Total	**100%**		**6.30E-03**
Uranium	Soil ingestion (direct)	6%	1.21E+00	6.04E-09
	Grasses, forbs, berries	38%	2.71E-03	1.59E-08
	Shrubs	56%	2.71E-03	2.39E-08
	Water ingestion (direct)	NA	5.06E-04	1.31E-08
	Total	**100%**		**5.90E-08**
Vanadium	Soil ingestion (direct)	6%	1.08E+02	3.64E-06
	Grasses, forbs, berries	38%	2.01E-01	1.48E-05
	Shrubs	56%	2.01E-01	2.22E-05
	Water ingestion (direct)	NA	1.35E-02	4.37E-06
	Total	**100%**		**4.50E-05**
Zinc	Soil ingestion (direct)	6%	1.44E+02	1.03E-01
	Grasses, forbs, berries	38%	1.71E+02	5.02E-01
	Shrubs	56%	1.71E+02	7.53E-01
	Water ingestion (direct)	NA	5.81E-02	7.55E-04
	Total	**100%**		**1.360E+00**

Table D9. Calculation of Moose Tissue Concentrations by Dietary Source – Baseline

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or mg/L)	Body Burden or Tissue (mg/kg)
Aluminum	Soil ingestion (direct)	2%	2.93E+04	2.32E-02
	Aquatic plants	20%	6.18E+01	1.46E-01
	Ferns, shrubs, trees, other	78%	6.18E+01	5.82E-01
	Water ingestion (direct)	NA	5.89E+00	1.77E-01
	Total	**100%**		**9.28E-01**
Antimony	Soil ingestion (direct)	2%	6.86E+00	1.12E-05
	Aquatic plants	20%	3.09E-02	4.84E-05
	Ferns, shrubs, trees, other	78%	3.09E-02	1.94E-04
	Water ingestion (direct)	NA	2.05E-03	4.11E-05
	Total	**100%**		**2.94E-04**
Arsenic	Soil ingestion (direct)	2%	6.95E+01	1.01E-04
	Aquatic plants	20%	4.35E-01	1.37E-03
	Ferns, shrubs, trees, other	78%	4.35E-01	5.46E-03
	Water ingestion (direct)	NA	8.45E-03	3.38E-04
	Total muscle			7.27E-03
	Total (muscle, kidney, liver)	**100%**		**1.10E-02**
Barium	Soil ingestion (direct)	2%	4.29E+02	2.17E-03
	Aquatic plants	20%	4.02E+01	9.46E-03
	Ferns, shrubs, trees, other	78%	4.02E+01	3.78E-02
	Water ingestion (direct)	NA	1.13E-01	3.39E-04
	Total	**100%**		**4.98E-02**
Bismuth	Soil ingestion (direct)	2%	3.28E-01	1.61E-06
	Aquatic plants	20%	1.00E-02	6.27E-06
	Ferns, shrubs, trees, other	78%	1.00E-02	2.51E-05
	Water ingestion (direct)	NA	8.36E-03	6.69E-05
	Total	**100%**		**9.99E-05**
Boron	Soil ingestion (direct)	2%	2.00E+01	3.16E-03
	Aquatic plants	20%	3.29E+01	3.10E-02
	Ferns, shrubs, trees, other	78%	3.29E+01	1.24E-01
	Water ingestion (direct)	NA	9.19E-02	1.10E-03
	Total			**1.591E-01**
Cadmium	Soil ingestion (direct)	2%	1.10E+00	3.48E-04
	Aquatic plants	20%	3.88E+00	3.35E-03
	Ferns, shrubs, trees, other	78%	3.88E+00	1.34E-02
	Water ingestion (direct)	NA	4.83E-04	5.31E-06
	Total muscle			1.71E-02
	Total (muscle, kidney, liver)	**100%**		**5.28E-01**
Chromium	Soil ingestion (direct)	2%	9.91E+01	5.90E-04
	Aquatic plants	20%	3.21E-01	2.77E-03
	Ferns, shrubs, trees, other	78%	3.21E-01	1.11E-02
	Water ingestion (direct)	NA	6.68E-03	7.35E-04
	Total	**100%**		**1.52E-02**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or mg/L)	Body Burden or Tissue (mg/kg)
Cobalt	Soil ingestion (direct)	2%	2.23E+01	3.67E-03
	Aquatic plants	20%	7.38E-01	2.31E-02
	Ferns, shrubs, trees, other	78%	7.38E-01	9.26E-02
	Water ingestion (direct)	NA	5.03E-03	2.01E-03
	Total	**100%**		**1.21E-01**
Copper	Soil ingestion (direct)	2%	1.06E+02	2.34E-02
	Aquatic plants	20%	1.07E+01	1.68E-01
	Ferns, shrubs, trees, other	78%	1.07E+01	6.71E-01
	Water ingestion (direct)		3.01E-02	6.03E-03
	Total	**100%**		**8.69E-01**
Iron	Soil ingestion (direct)	2%	5.82E+04	9.92E-01
	Aquatic plants	20%	1.92E+02	6.03E+00
	Ferns, shrubs, trees, other	78%	1.92E+02	2.41E+01
	Water ingestion (direct)	NA	9.17E+00	3.67E+00
	Total	**100%**		**3.48E+01**
Lead	Soil ingestion (direct)	2%	4.00E+01	1.90E-05
	Aquatic plants	20%	1.55E-01	9.71E-05
	Ferns, shrubs, trees, other	78%	1.55E-01	3.88E-04
	Water ingestion (direct)	NA	6.83E-03	5.47E-05
	Total muscle			5.59E-04
	Total (muscle, kidney, liver)	**100%**		**5.57E-04**
Manganese	Soil ingestion (direct)	2%	9.16E+02	2.68E-02
	Aquatic plants	20%	2.76E+02	1.73E-01
	Ferns, shrubs, trees, other	78%	2.76E+02	6.93E-01
	Water ingestion (direct)	NA	2.94E-01	2.35E-03
	Total	**100%**		**8.95E-01**
Mercury	Soil ingestion (direct)	2%	8.00E-02	8.23E-04
	Aquatic plants	20%	1.11E-02	4.37E-03
	Ferns, shrubs, trees, other	78%	1.11E-02	1.75E-02
	Water ingestion (direct)	NA	1.21E-05	6.07E-05
	Total muscle			2.27E-02
	Total (muscle, kidney, liver)	**100%**		**2.68E-02**
Nickel	Soil ingestion (direct)	2%	5.26E+01	7.36E-03
	Aquatic plants	20%	4.93E+00	4.64E-02
	Ferns, shrubs, trees, other	78%	4.93E+00	1.86E-01
	Water ingestion (direct)	NA	2.06E-02	2.47E-03
	Total	**100%**		**2.42E-01**
Selenium	Soil ingestion (direct)	2%	4.54E+00	7.27E-03
	Aquatic plants	20%	1.57E+00	3.69E-02
	Ferns, shrubs, trees, other	78%	1.57E+00	1.48E-01
	Water ingestion (direct)	NA	2.30E-03	6.89E-04
	Total	**100%**		**1.93E-01**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or mg/L)	Body Burden or Tissue (mg/kg)
Strontium	Soil ingestion (direct)	2%	9.59E+01	2.15E-01
	Aquatic plants	20%	7.83E+01	9.83E-01
	Ferns, shrubs, trees, other	78%	7.83E+01	3.93E+00
	Water ingestion (direct)	NA	2.69E-01	4.30E-02
	Total	**100%**		**5.17E+00**
Tellurium	Soil ingestion (direct)	2%	3.15E-01	3.53E-04
	Aquatic plants	20%	1.43E-03	1.57E-05
	Ferns, shrubs, trees, other	78%	1.43E-02	6.27E-04
	Water ingestion (direct)	NA	NA	-
	Total	**100%**		**9.96E-04**
Thallium	Soil ingestion (direct)	2%	3.00E-01	2.17E-05
	Aquatic plants	20%	1.43E-03	8.96E-05
	Ferns, shrubs, trees, other	78%	1.43E-03	3.59E-04
	Water ingestion (direct)	NA	1.84E-04	1.47E-04
	Total	**100%**		**6.17E-04**
Titanium	Soil ingestion (direct)	2%	2.31E+03	2.41E-02
	Aquatic plants	20%	2.35E+00	1.11E-01
	Ferns, shrubs, trees, other	78%	2.35E+00	4.43E-01
	Water ingestion (direct)	NA	9.82E-02	5.89E-02
	Total	**100%**		**6.36E-01**
Uranium	Soil ingestion (direct)	2%	1.21E+00	1.97E-07
	Aquatic plants	20%	2.71E-03	8.52E-07
	Ferns, shrubs, trees, other	78%	2.71E-03	3.41E-06
	Water ingestion (direct)	NA	5.06E-04	2.02E-06
	Total	**100%**		**6.48E-06**
Vanadium	Soil ingestion (direct)	2%	1.08E+02	1.18E-04
	Aquatic plants	20%	2.01E-01	7.90E-04
	Ferns, shrubs, trees, other	78%	2.01E-01	3.16E-03
	Water ingestion (direct)	NA	1.35E-02	6.73E-04
	Total	**100%**		**4.74E-03**
Zinc	Soil ingestion (direct)	2%	1.44E+02	3.36E+00
	Aquatic plants	20%	1.71E+02	2.68E+01
	Ferns, shrubs, trees, other	78%	1.71E+02	1.07E+02
	Water ingestion (direct)	NA	5.81E-02	1.16E-01
	Total	**100%**		**1.377E+02**

Table D10. Calculation of Grouse Tissue Concentrations by Dietary Source – Baseline

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or mg/L)	Diet (mg/kg)
Aluminum	Soil (direct ingestion)	2%	2.93E+04	1.32E-04
	Insects	1%	2.20E+03	2.09E-03
	Grasses & Forbs	39%	6.18E+01	1.62E-03
	Shrubs & Trees (seeds)	58%	6.18E+01	2.43E-03
	Water ingestion (direct)	NA	5.89E+00	4.03E-04
	Total	**100%**		**6.68E-03**
Antimony	Soil (direct ingestion)	2%	6.86E+00	6.35E-08
	Insects	1%	3.43E-01	2.17E-07
	Grasses & Forbs	39%	3.09E-02	5.40E-07
	Shrubs & Trees (seeds)	58%	3.09E-02	8.10E-07
	Water ingestion (direct)	NA	2.05E-03	9.36E-08
	Total	**100%**		**1.72E-06**
Arsenic	Soil (direct ingestion)	2%	6.95E+01	5.74E-07
	Insects	1%	4.59E-01	5.82E-07
	Grasses & Forbs	39%	4.35E-01	1.52E-05
	Shrubs & Trees (seeds)	58%	4.35E-01	2.28E-05
	Water ingestion (direct)	NA	8.45E-03	7.70E-07
	Total	**100%**		**4.00E-05**
Barium	Soil (direct ingestion)	2%	4.29E+02	1.23E-05
	Insects	1%	3.21E+00	3.06E-07
	Grasses & Forbs	39%	4.02E+01	1.06E-04
	Shrubs & Trees (seeds)	58%	4.02E+01	1.58E-04
	Water ingestion (direct)	NA	1.13E-01	7.72E-07
	Total	**100%**		**2.77E-04**
Bismuth	Soil (direct ingestion)	2%	3.28E-01	9.13E-09
	Insects	1%	3.28E-01	8.30E-08
	Grasses & Forbs	39%	1.00E-02	7.00E-08
	Shrubs & Trees (seeds)	58%	1.00E-02	1.05E-07
	Water ingestion (direct)	NA	8.36E-03	1.52E-07
	Total	**100%**		**4.20E-07**
Boron	Soil (direct ingestion)	2%	2.00E+01	1.79E-05
	Insects	1%	2.00E+01	7.61E-06
	Grasses & Forbs	39%	3.29E+01	3.45E-04
	Shrubs & Trees (seeds)	58%	3.29E+01	5.18E-04
	Water ingestion (direct)	NA	9.19E-02	2.51E-06
	Total			**8.91E-04**
Cadmium	Soil (direct ingestion)	2%	1.10E+00	1.97E-06
	Insects	1%	1.21E+01	4.21E-06
	Grasses & Forbs	39%	3.88E+00	3.73E-05
	Shrubs & Trees (seeds)	58%	3.88E+00	5.60E-05
	Water ingestion (direct)	NA	4.83E-04	1.21E-08
	Total	**100%**		**9.96E-05**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or mg/L)	Diet (mg/kg)
Chromium	Soil (direct ingestion)	2%	9.91E+01	3.34E-06
	Insects	1%	1.59E+01	5.53E-05
	Grasses & Forbs	39%	3.21E-01	3.09E-05
	Shrubs & Trees (seeds)	58%	3.21E-01	4.64E-05
	Water ingestion (direct)	NA	6.68E-03	1.67E-06
	Total	**100%**		**1.38E-04**
Cobalt	Soil (direct ingestion)	2%	2.23E+01	2.08E-05
	Insects	1%	2.23E+01	2.82E-04
	Grasses & Forbs	39%	7.38E-01	2.58E-04
	Shrubs & Trees (seeds)	58%	7.38E-01	3.87E-04
	Water ingestion (direct)	NA	5.03E-03	4.58E-06
	Total	**100%**		**9.53E-04**
Copper	Soil (direct ingestion)	2%	1.06E+02	1.32E-04
	Insects	1%	1.70E+01	1.08E-04
	Grasses & Forbs	39%	1.07E+01	1.87E-03
	Shrubs & Trees (seeds)	58%	1.07E+01	2.81E-03
	Water ingestion (direct)	NA	3.01E-02	1.37E-05
	Total	**100%**		**4.93E-03**
Iron	Soil (direct ingestion)	2%	5.82E+04	5.61E-03
	Insects	1%	5.82E+04	7.37E-01
	Grasses & Forbs	39%	1.92E+02	6.73E-02
	Shrubs & Trees (seeds)	58%	1.92E+02	1.01E-01
	Water ingestion (direct)	NA	9.17E+00	8.35E-03
	Total	**100%**		**9.19E-01**
Lead	Soil (direct ingestion)	2%	4.00E+01	1.07E-07
	Insects	1%	6.75E+02	1.71E-04
	Grasses & Forbs	39%	1.55E-01	1.08E-06
	Shrubs & Trees (seeds)	58%	1.55E-01	1.62E-06
	Water ingestion (direct)	NA	6.83E-03	1.25E-07
	Total	**100%**		**1.74E-04**
Manganese	Soil (direct ingestion)	2%	9.16E+02	1.52E-04
	Insects	1%	1.83E+01	4.65E-06
	Grasses & Forbs	39%	2.76E+02	1.93E-03
	Shrubs & Trees (seeds)	58%	2.76E+02	2.90E-03
	Water ingestion (direct)	NA	2.94E-01	5.36E-06
	Total	**100%**		**4.99E-03**
Mercury	Soil (direct ingestion)	2%	8.00E-02	4.66E-06
	Insects	1%	2.72E-02	4.31E-06
	Grasses & Forbs	39%	1.11E-02	4.87E-05
	Shrubs & Trees (seeds)	58%	1.11E-02	7.31E-05
	Water ingestion (direct)	NA	1.21E-05	1.38E-07
	Total	**100%**		**1.31E-04**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or mg/L)	Diet (mg/kg)
Nickel	Soil (direct ingestion)	2%	5.26E+01	4.17E-05
	Insects	1%	1.21E+01	4.60E-05
	Grasses & Forbs	39%	4.93E+00	5.18E-04
	Shrubs & Trees (seeds)	58%	4.93E+00	7.77E-04
	Water ingestion (direct)	NA	2.06E-02	5.63E-06
	Total	**100%**		**1.39E-03**
Selenium	Soil (direct ingestion)	2%	4.54E+00	4.12E-05
	Insects	1%	3.45E+00	3.28E-05
	Grasses & Forbs	39%	1.57E+00	4.12E-04
	Shrubs & Trees (seeds)	58%	1.57E+00	6.18E-04
	Water ingestion (direct)	NA	2.30E-03	1.57E-06
	Total	**100%**		**1.11E-03**
Strontium	Soil (direct ingestion)	2%	9.59E+01	1.22E-03
	Insects	1%	3.83E-01	1.94E-06
	Grasses & Forbs	39%	7.83E+01	1.10E-02
	Shrubs & Trees (seeds)	58%	7.83E+01	1.64E-02
	Water ingestion (direct)	NA	2.69E-01	9.81E-05
	Total	**100%**		**2.87E-02**
Tellurium	Soil (direct ingestion)	2%	3.15E-01	2.00E-06
	Insects	1%	-	
	Grasses & Forbs	39%	-	-
	Shrubs & Trees (seeds)	58%	-	-
	Water ingestion (direct)	NA	-	-
	Total	**100%**		**2.00E-06**
Thallium	Soil (direct ingestion)	2%	3.00E-01	1.23E-07
	Insects	1%	3.00E-01	7.61E-06
	Grasses & Forbs	39%	1.43E-03	1.00E-06
	Shrubs & Trees (seeds)	58%	1.43E-03	1.50E-06
	Water ingestion (direct)	NA	1.84E-04	3.36E-07
	Total	**100%**		**1.06E-05**
Titanium	Soil (direct ingestion)	2%	2.31E+03	1.36E-04
	Insects	1%	2.31E+03	4.40E-02
	Grasses & Forbs	39%	2.35E+00	1.23E-03
	Shrubs & Trees (seeds)	58%	2.35E+00	1.85E-03
	Water ingestion (direct)	NA	9.82E-02	1.34E-04
	Total	**100%**		**4.73E-02**
Uranium	Soil (direct ingestion)	2%	1.21E+00	1.11E-09
	Insects	1%	3.62E-01	4.59E-08
	Grasses & Forbs	39%	2.71E-03	9.50E-09
	Shrubs & Trees (seeds)	58%	2.71E-03	1.42E-08
	Water ingestion (direct)	NA	5.06E-04	4.61E-09
	Total	**100%**		**7.54E-08**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg or mg/L)	Diet (mg/kg)
Vanadium	Soil (direct ingestion)	2%	1.08E+02	6.70E-07
	Insects	1%	1.41E+01	2.23E-05
	Grasses & Forbs	39%	2.01E-01	8.81E-06
	Shrubs & Trees (seeds)	58%	2.01E-01	1.32E-05
	Water ingestion (direct)	NA	1.35E-02	1.53E-06
	Total	**100%**		**4.65E-05**
Zinc	Soil (direct ingestion)	2%	1.44E+02	1.90E-02
	Insects	1%	2.59E+02	1.64E-02
	Grasses & Forbs	39%	1.71E+02	2.99E-01
	Shrubs & Trees (seeds)	58%	1.71E+02	4.49E-01
	Water ingestion (direct)	NA	5.81E-02	2.65E-04
	Total	**100%**		**7.84E-01**

Table D11. Arsenic, Cadmium, Mercury Moose Tissue Exposure Concentrations that Reflect Higher Uptake by the Kidney and Liver

Parameter	Total Country foods	Moose Kidney (Chan et al 2011)	Moose Liver (Chan et al 2011)	Moose Muscle (meat) (Chan et al 2011)	Modelled Concentration Baseline (muscle) (mg/kg)	Modelled Concentration Predicted (Muscle) (mg/kg)	Total Mass of Metal in Moose	Moose Concentration Baseline (mg/kg)	Moose Concentration Predicted (mg/kg)
Ingestion Rate (95 percentile) male age19-50 yrs, (g/day)	413.22	6.1	5.13	138.61	_	_	_	_	
Ingestion Rate normalized to 290 (95 percentile across genders and age groups, (g/day)	290	4.281	3.600	97.277	_	_		_	
Arsenic concentrations (mg/kg) in Moose Organs	_	0.03	0.04	0.004	0.007	0.0064			
Arsenic concentration adjusted so moose muscle (Chan et al 2011) =modelled concentration (mg/kg)		0.0525	0.07	0.007					
Arsenic Organ: Arsenic Muscle Ratio	_	7.5	10	1	_	_	_	_	
Arsenic Mass in each organ based on adjusted concentration (mg)	_	0.2247	0.2520	0.6809	_	_	1.1577		
Weighted Arsenic Concentration (mg/kg)								0.01109	0.01007
Cadmium concentrations (mg/kg) in Moose Organs	_	11.85	3.51	0.02	0.017	0.0156	_	_	
Cadmium concentration adjusted so moose muscle (Chan et al 2011) =modelled concentration (mg/kg)		10.0725	2.9835	0.017					
Cadmium Organ: Cadmium Muscle Ratio	_	592.5	175.5	1	_	_	_	_	
Cadmium mass in each organ and total mass based on adjusted concentration (mg).	_	43.1205	10.7414	1.6537	_	_	55.5156_		
Weighted cadmium concentration (mg/kg)								0.5279	0.4844
Lead concentrations (mg/kg) in Moose Organs	_	0.17	0.02	0.06	0.00053	0.00052		_	

Parameter	Total Country foods	Moose Kidney (Chan et al 2011)	Moose Liver (Chan et al 2011)	Moose Muscle (meat) (Chan et al 2011)	Modelled Concentration Baseline (muscle) (mg/kg)	Modelled Concentration Predicted (Muscle) (mg/kg)	Total Mass of Metal in Moose	Moose Concentration Baseline (mg/kg)	Moose Concentration Predicted (mg/kg)
Lead concentration adjusted so moose muscle (Chan et al 2011) =modelled concentration (mg/kg)	_	0.00150	0.00018	0.00053	_	_	_	_	
Lead Organ: Lead Muscle Ratio	_	2.833	0.3333	1	_	_	_	_	
Lead mass in each organ and total mass based on adjusted concentration (mg)	_	0.0064	0.0006	0.0516	_	_	0.0586_		
Weighted lead concentration (mg/kg)								0.000557	0.000547
Mercury concentrations (mg/kg) in Moose Organs	_	0.01	0.003	0.002	0.023	0.025		_	
Mercury concentration adjusted so moose muscle (Chan et al 2011) =modelled concentration (mg/kg)	_	0.115	0.0345	0.023	_	_		_	
Mercury Organ: Mercury Muscle Ratio	_	5	1.5	1	_	_		_	
Mercury mass in each organ and total mass based on adjusted concentration (mg)	_	0.4923	0.1242	2.2374			2.8167		
Weighted Mercury (mg/kg)	_	_	_	_	_	_		0.0268	0.0291

Information taken from Chan et. al. (2011) and modelled and measured plant concentrations.

Chan, L., O. Receveur, D. Sharp, H. Schwartz, A. Ing, and C. Tikhonov. 2011. First Nations Food, Nutrition & Environment Study (FNFNES): Results from British Columbia (2008/2009). University of Northern British Columbia: Prince George, BC.

Table D12. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Plants – Baseline

Parameter	Plant EEC (mg/kg)	RfD (mg/kg-day)	RAF	Hazard Quotient			
				Toddler	Child	Teen	Adult
Aluminum	2.14E+01	1.00E+00	NA	1.2E-01	8.7E-02	6.7E-02	8.8E-02
Antimony	1.10E-02	6.00E-03	NA	1.0E-02	7.5E-03	5.8E-03	7.5E-03
Arsenic	1.50E-01	1.00E-03	0.29	2.4E-01	1.8E-01	1.4E-01	1.8E-01
Barium	1.27E+01	2.00E-01	NA	3.5E-01	2.6E-01	2.0E-01	2.6E-01
Bismuth	3.27E-03	NA	NA	NA	NA	NA	NA
Boron	1.03E+01	2.00E-01	NA	2.9E-01	2.1E-01	1.6E-01	2.1E-01
Cadmium	1.277E+00	1.00E-03	NA	7.1E+00	5.2E+00	4.0E+00	5.2E+00
Chromium	1.09E-01	1.00E-03	NA	6.1E-01	4.5E-01	3.4E-01	4.5E-01
Cobalt	2.51E-01	1.40E-03	NA	9.9E-01	7.3E-01	5.7E-01	7.4E-01
Copper	3.48E+00	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	NA	2.1E-01	1.3E-01	8.7E-02	1.0E-01
Iron	6.54E+01	7.00E-01	NA	5.2E-01	3.8E-01	2.9E-01	3.8E-01
Lead	5.31E-02	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	NA	4.9E-01	3.6E-01	1.1E-01	1.5E-01
Manganese	9.31E+01	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	NA	3.8E+00	3.1E+00	2.1E+00	2.4E+00
Mercury	3.61E-03	3.00E-04	NA	6.7E-02	4.9E-02	3.8E-02	4.9E-02
Nickel	1.71E+00	1.10E-02	NA	8.6E-01	6.3E-01	4.9E-01	6.4E-01
Selenium	4.97E-01	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	NA	4.4E-01	3.2E-01	2.5E-01	3.6E-01
Stronium	2.69E-01	6.00E-01	NA	2.5E-03	1.8E-03	1.4E-03	1.8E-03

Parameter	Plant EEC (mg/kg)	RfD (mg/kg-day)	RAF	Hazard Quotient			
				Toddler	Child	Teen	Adult
Tellurium	NA	NA	NA	NA	NA	NA	NA
Thallium	4.70E-04	7.00E-05	NA	3.7E-02	2.7E-02	2.1E-02	2.8E-02
Titanium	8.07E-01	3.00E+00	NA	1.5E-03	1.1E-03	8.5E-04	1.1E-03
Uranium	1.46E-03	6.00E-04	NA	1.4E-02	1.0E-02	7.7E-03	1.0E-02
Vanadium	6.97E-02	5.00E-03	NA	7.7E-02	5.7E-02	4.4E-02	5.7E-02
Zinc	5.73E+01	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	NA	6.6E-01	4.9E-01	3.3E-01	4.1E-01
Max Hazard				**7.1E+00**	**5.2E+00**	**4.0E+00**	**5.2E+00**

Parameter	Plant EEC (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	RAF	Incremental Lifetime Cancer Risk			
				Toddler	Child	Teen	Adult
Arsenic	1.50E-01	1.80E+00	0.29	1E-04	8E-05	5E-05	2E-04

Table D13. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Fish – Baseline

Parameter	Fish EEC (mg/kg)	Fish EEC - Inorganic Arsenic[1] (mg/kg)	RfD (mg/kg-day)	RAF	Hazard Quotient			
					Toddler	Child	Teen	Adult
Aluminum	3.54E+01	NA	1.00E+00	1	2.0E-01	1.4E-01	1.1E-01	1.5E-01
Antimony	6.17E-02	NA	6.00E-03	1	5.7E-02	4.2E-02	3.2E-02	4.2E-02
Arsenic	7.36E-01	7.36E-02	1.00E-03	0.5	2.0E-01	1.5E-01	1.2E-01	1.5E-01
Barium	1.68E+00	NA	2.00E-01	1	4.7E-02	3.4E-02	2.7E-02	3.5E-02
Bismuth	2.00E-02	NA	NA	1	NA	NA	NA	NA
Boron	1.00E-01	NA	2.00E-01	1	2.8E-03	2.0E-03	1.6E-03	2.1E-03
Cadmium	8.48E-01	NA	1.00E-03	1	4.7E+00	3.5E+00	2.7E+00	3.5E+00
Chromium	9.40E-02	NA	1.00E-03	1	5.2E-01	3.8E-01	3.0E-01	3.9E-01
Cobalt	2.86E-01	NA	1.40E-03	1	1.1E+00	8.3E-01	6.4E-01	8.4E-01
Copper	1.69E+00	NA	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	1.0E-01	6.3E-02	4.2E-02	4.9E-02
Iron	1.29E+02	NA	7.00E-01	1	1.0E+00	7.5E-01	5.8E-01	7.6E-01
Lead	1.06E-01	NA	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	9.8E-01	7.2E-01	2.2E-01	2.9E-01
Manganese	5.04E+00	NA	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	2.1E-01	1.7E-01	1.1E-01	1.3E-01
Mercury (Methyl)	8.70E-03	NA	2.0E-04	1	2.4E-01	1.8E-01	1.4E-01	1.8E-01
Nickel	2.14E-01	NA	1.10E-02	1	1.1E-01	7.9E-02	6.1E-02	8.0E-02
Selenium	2.91E+00	NA	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	2.6E+00	1.9E+00	1.5E+00	2.1E+00
Strontium	8.00E+00	NA	6.00E-01	1	7.4E-02	5.4E-02	4.2E-02	5.5E-02
Tellurium	NA	NA	NA	1	NA	NA	NA	NA

Parameter	Fish EEC (mg/kg)	Fish EEC - Inorganic Arsenic[1] (mg/kg)	RfD (mg/kg-day)	RAF	Hazard Quotient			
					Toddler	Child	Teen	Adult
Thallium	2.34E-02	NA	7.00E-05	1	1.9E+00	1.4E+00	1.1E+00	1.4E+00
Titanium	1.04E+00	NA	3.00E+00	1	1.9E-03	1.4E-03	1.1E-03	1.4E-03
Uranium	6.40E-03	NA	6.00E-04	1	5.9E-02	4.4E-02	3.4E-02	4.4E-02
Vanadium	1.94E-01	NA	5.00E-03	1	2.1E-01	1.6E-01	1.2E-01	1.6E-01
Zinc	3.78E+01	NA	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	4.4E-01	3.2E-01	2.2E-01	2.7E-01
Max Hazard					**4.7E+00**	**3.5E+00**	**2.7E+00**	**3.5E+00**

Parameter	Fish EEC (mg/kg)	Fish EEC - Inorganic Arsenic (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	RAF	Incremental Lifetime Cancer Risk			
					Toddler	Child	Teen	Adult
Arsenic	7.36E-01	7.36E-02	1.80E+00	0.5	1.0E-04	7.1E-05	4.2E-05	2.0E-04

Table D14. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Rabbit – Baseline

Parameter	Snowshoe Hare EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Aluminum	8.67E-03	1.00E+00	4.8E-05	3.5E-05	2.7E-05	3.6E-05
Antimony	2.88E-06	6.00E-03	2.7E-06	2.0E-06	1.5E-06	2.0E-06
Arsenic	6.92E-05	1.00E-03	3.8E-04	2.8E-04	2.2E-04	2.8E-04
Barium	5.11E-04	2.00E-01	1.4E-05	1.0E-05	8.1E-06	1.1E-05
Bismuth	7.78E-07	NA	NA	NA	NA	NA
Boron	1.55E-03	2.00E-01	4.3E-05	3.2E-05	2.4E-05	3.2E-05
Cadmium	1.67E-04	1.00E-03	9.3E-04	6.8E-04	5.3E-04	6.9E-04
Chromium	1.53E-04	1.00E-03	8.5E-04	6.2E-04	4.8E-04	6.3E-04
Cobalt	1.21E-03	1.40E-03	4.8E-03	3.5E-03	2.7E-03	3.5E-03
Copper	8.61E-03	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	5.2E-04	3.2E-04	2.2E-04	2.5E-04
Iron	3.36E-01	7.00E-01	2.7E-03	2.0E-03	1.5E-03	2.0E-03
Lead	5.48E-06	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	5.1E-05	3.7E-05	1.2E-05	1.5E-05
Manganese	8.94E-03	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	3.6E-04	3.0E-04	2.0E-04	2.4E-04
Mercury	2.30E-04	3.00E-04	4.2E-03	3.1E-03	2.4E-03	3.1E-03
Nickel	2.41E-03	1.10E-02	1.2E-03	9.0E-04	6.9E-04	9.0E-04
Selenium	1.96E-03	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.7E-03	1.3E-03	9.9E-04	1.4E-03

Parameter	Snowshoe Hare EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Strontium	5.29E-02	6.00E-01	4.9E-04	3.6E-04	2.8E-04	3.6E-04
Tellurium	1.08E-05	NA	NA	NA	NA	NA
Thallium	5.82E-06	7.0E-05	4.6E-04	3.4E-04	2.6E-04	3.4E-04
Titanium	6.30E-03	3.00E+00	1.2E-05	8.6E-06	6.6E-06	8.6E-06
Uranium	5.90E-08	6.00E-04	5.4E-07	4.0E-07	3.1E-07	4.0E-07
Vanadium	4.50E-05	5.00E-03	5.0E-05	3.7E-05	2.8E-05	3.7E-05
Zinc	1.36E+00	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1.6E-02	1.2E-02	7.9E-03	9.8E-03
Max Hazard			**1.6E-02**	**1.2E-02**	**7.9E-03**	**9.8E-03**

Parameter	Snowshoe Hare EEC (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk			
			Toddler	Child	Teen	Adult
Arsenic	6.92E-05	1.80E+00	2E-07	1E-07	8E-08	4E-07

Table D15. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Moose – Baseline

Parameter	Moose EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Aluminum	9.28E-01	1.00E+00	5.1E-03	3.8E-03	2.9E-03	3.8E-03
Antimony	2.94E-04	6.00E-03	2.7E-04	2.0E-04	1.5E-04	2.0E-04
Arsenic	1.10E-02	1.00E-03	6.1E-02	4.5E-02	3.5E-02	4.5E-02
Barium	4.98E-02	2.00E-01	1.4E-03	1.0E-03	7.9E-04	1.0E-03
Bismuth	9.99E-05	NA	NA	NA	NA	NA
Boron	1.59E-01	2.00E-01	4.4E-03	3.2E-03	2.5E-03	3.3E-03
Cadmium	5.28E-01	1.00E-03	2.9E+00	2.2E+00	1.7E+00	2.2E+00
Chromium	1.52E-02	1.00E-03	8.4E-02	6.2E-02	4.8E-02	6.2E-02
Cobalt	1.21E-01	1.40E-03	4.8E-01	3.5E-01	2.7E-01	3.6E-01
Copper	8.69E-01	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	5.3E-02	3.2E-02	2.2E-02	2.5E-02
Iron	3.48E+01	7.00E-01	2.8E-01	2.0E-01	1.6E-01	2.0E-01
Lead	5.57E-04	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	5.1E-03	3.8E-03	1.2E-03	1.5E-03
Manganese	8.95E-01	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	3.6E-02	3.0E-02	2.0E-02	2.4E-02
Mercury	2.68E-02	3.00E-04	4.9E-01	3.6E-01	2.8E-01	3.7E-01
Nickel	2.42E-01	1.10E-02	1.2E-01	9.0E-02	6.9E-02	9.0E-02
Selenium	1.93E-01	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.7E-01	1.2E-01	9.8E-02	1.4E-01
Strontium	5.17E+00	6.00E-01	4.8E-02	3.5E-02	2.7E-02	3.5E-02
Tellurium	9.96E-04	NA	NA	NA	NA	NA

Parameter	Moose EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Thallium	6.17E-04	7.0E-05	4.9E-02	3.6E-02	2.8E-02	3.6E-02
Titanium	6.36E-01	3.00E+00	1.2E-03	8.7E-04	6.7E-04	8.7E-04
Uranium	6.48E-06	6.00E-04	6.0E-05	4.4E-05	3.4E-05	4.4E-05
Vanadium	4.74E-03	5.00E-03	5.3E-03	3.9E-03	3.0E-03	3.9E-03
Zinc	1.38E+02	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1.6E+00	1.2E+00	8.0E-01	9.9E-01
Max Hazard			**2.9E+00**	**2.2E+00**	**1.7E+00**	**2.2E+00**

Parameter	Moose EEC (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk			
			Toddler	Child	Teen	Adult
Arsenic	1.10E-02	1.80E+00	3E-05	2E-05	1E-05	6E-05

Table D16. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Grouse – Baseline

Parameter	Grouse EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Aluminum	6.68E-03	1.00E+00	3.7E-05	2.7E-05	2.1E-05	2.7E-05
Antimony	1.72E-06	6.00E-03	1.6E-06	1.2E-06	9.1E-07	1.2E-06
Arsenic	4.00E-05	1.00E-03	2.2E-04	1.6E-04	1.3E-04	1.6E-04
Barium	2.77E-04	2.00E-01	7.7E-06	5.7E-06	4.4E-06	5.7E-06
Bismuth	4.20E-07	NA	NA	NA	NA	NA
Boron	8.91E-04	2.00E-01	2.5E-05	1.8E-05	1.4E-05	1.8E-05
Cadmium	9.96E-05	1.00E-03	5.5E-04	4.1E-04	3.1E-04	4.1E-04
Chromium	1.38E-04	1.00E-03	7.6E-04	5.6E-04	4.3E-04	5.7E-04
Cobalt	9.53E-04	1.40E-03	3.8E-03	2.8E-03	2.1E-03	2.8E-03
Copper	4.93E-03	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	3.0E-04	1.8E-04	1.2E-04	1.4E-04
Iron	9.19E-01	7.00E-01	7.3E-03	5.4E-03	4.1E-03	5.4E-03
Lead	1.74E-04	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1.6E-03	1.2E-03	3.7E-04	4.8E-04
Manganese	4.99E-03	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	2.0E-04	1.7E-04	1.1E-04	1.3E-04
Mercury	1.31E-04	3.00E-04	2.4E-03	1.8E-03	1.4E-03	1.8E-03
Nickel	1.39E-03	1.10E-02	7.0E-04	5.2E-04	4.0E-04	5.2E-04
Selenium	1.11E-03	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	9.9E-04	7.2E-04	5.6E-04	8.0E-04
Strontium	2.87E-02	6.00E-01	2.7E-04	2.0E-04	1.5E-04	2.0E-04
Tellurium	2.00E-06	NA	NA	NA	NA	NA

Parameter	Grouse EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Thallium	1.06E-05	7.00E-05	8.4E-04	6.2E-04	4.8E-04	6.2E-04
Titanium	4.73E-02	3.00E+00	8.7E-05	6.4E-05	5.0E-05	6.5E-05
Uranium	7.54E-08	6.00E-04	7.0E-07	5.1E-07	4.0E-07	5.2E-07
Vanadium	4.65E-05	5.00E-03	5.2E-05	3.8E-05	2.9E-05	3.8E-05
Zinc	7.84E-01	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	9.0E-03	6.7E-03	4.6E-03	5.6E-03
Max Hazard			**9.0E-03**	**6.7E-03**	**4.6E-03**	**5.6E-03**

Parameter	Grouse EEC (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk			
			Toddler	Child	Teen	Adult
Arsenic	4.00E-05	1.80E+00	1E-07	8E-08	5E-08	2E-07

Table D17. Calculation of Rabbit Tissue Concentrations by Dietary Source – Predicted Future

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg Soil) or (mg/L Water)	Body Burden or Tissue (mg/kg)
Aluminum	Soil ingestion (direct)	6%	2.95E+04	7.18E-04
	Grasses, forbs, berries	38%	6.25E+01	2.75E-03
	Shrubs	56%	6.25E+01	4.13E-03
	Water ingestion (direct)	NA	6.15E+00	1.20E-03
	Total	**100%**		**8.79E-03**
Antimony	Soil ingestion (direct)	6%	6.90E+00	3.46E-07
	Grasses, forbs, berries	38%	3.12E-02	9.15E-07
	Shrubs	56%	3.12E-02	1.37E-06
	Water ingestion (direct)	NA	5.74E-03	7.47E-07
	Total	**100%**		**3.38E-06**
Arsenic	Soil ingestion (direct)	6%	6.99E+01	3.13E-06
	Grasses, forbs, berries	38%	4.37E-01	2.56E-05
	Shrubs	56%	4.37E-01	3.85E-05
	Water ingestion (direct)	NA	9.79E-03	2.54E-06
	Total	**100%**		**6.98E-05**
Barium	Soil ingestion (direct)	6%	4.31E+02	6.71E-05
	Grasses, forbs, berries	38%	4.02E+01	1.77E-04
	Shrubs	56%	4.02E+01	2.66E-04
	Water ingestion (direct)	NA	1.19E-01	2.31E-06
	Total	**100%**		**5.12E-04**
Bismuth	Soil ingestion (direct)	6%	3.30E-01	5.00E-08
	Grasses, forbs, berries	38%	1.00E-02	1.18E-07
	Shrubs	56%	1.00E-02	1.76E-07
	Water ingestion (direct)	NA	8.44E-03	4.39E-07
	Total	**100%**		**7.83E-07**
Boron	Soil ingestion (direct)	6%	2.01E+01	9.75E-05
	Grasses, forbs, berries	38%	3.29E+01	5.79E-04
	Shrubs	56%	3.29E+01	8.69E-04
	Water ingestion (direct)	NA	9.57E-02	7.46E-06
	Total	**100%**		**1.554E-03**
Cadmium	Soil ingestion (direct)	6%	1.10E+00	1.08E-05
	Grasses, forbs, berries	38%	3.88E+00	6.27E-05
	Shrubs	56%	3.88E+00	9.40E-05
	Water ingestion (direct)	NA	1.33E-03	9.54E-08
	Total	**100%**		**1.68E-04**
Chromium	Soil ingestion (direct)	6%	9.97E+01	1.82E-05
	Grasses, forbs, berries	38%	3.24E-01	5.23E-05
	Shrubs	56%	3.24E-01	7.85E-05
	Water ingestion (direct)	NA	7.62E-03	3.27E-06
	Total	**100%**		**1.52E-04**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg Soil) or (mg/L Water)	Body Burden or Tissue (mg/kg)
Cobalt	Soil ingestion (direct)	6%	2.24E+01	1.13E-04
	Grasses, forbs, berries	38%	7.38E-01	4.33E-04
	Shrubs	56%	7.38E-01	6.50E-04
	Water ingestion (direct)	NA	6.44E-03	1.67E-05
	Total	**100%**		**1.21E-03**
Copper	Soil ingestion (direct)	6%	1.07E+02	7.23E-04
	Grasses, forbs, berries	38%	1.07E+01	3.14E-03
	Shrubs	56%	1.07E+01	4.71E-03
	Water ingestion (direct)		3.36E-02	4.36E-05
	Total	**100%**		**8.62E-03**
Iron	Soil ingestion (direct)	6%	5.85E+04	3.06E-02
	Grasses, forbs, berries	38%	1.94E+02	1.14E-01
	Shrubs	56%	1.94E+02	1.70E-01
	Water ingestion (direct)	NA	9.66E+00	2.51E-02
	Total	**100%**		**3.40E-01**
Lead	Soil ingestion (direct)	6%	4.02E+01	5.87E-07
	Grasses, forbs, berries	38%	1.56E-01	1.83E-06
	Shrubs	56%	1.56E-01	2.74E-06
	Water ingestion (direct)	NA	7.78E-03	4.05E-07
	Total	**100%**		**5.57E-06**
Manganese	Soil ingestion (direct)	6%	9.22E+02	8.28E-04
	Grasses, forbs, berries	38%	2.76E+02	3.24E-03
	Shrubs	56%	2.76E+02	4.87E-03
	Water ingestion (direct)	NA	5.38E-01	2.80E-05
	Total	**100%**		**8.97E-03**
Mercury	Soil ingestion (direct)	6%	8.58E-02	2.71E-05
	Grasses, forbs, berries	38%	1.11E-02	8.12E-05
	Shrubs	56%	1.11E-02	1.22E-04
	Water ingestion (direct)	NA	6.91E-05	2.24E-06
	Total	**100%**		**2.323E-04**
Nickel	Soil ingestion (direct)	6%	5.29E+01	2.27E-04
	Grasses, forbs, berries	38%	4.94E+00	8.70E-04
	Shrubs	56%	4.94E+00	1.30E-03
	Water ingestion (direct)	NA	2.72E-02	2.12E-05
	Total	**100%**		**2.42E-03**
Selenium	Soil ingestion (direct)	6%	4.57E+00	2.25E-04
	Grasses, forbs, berries	38%	1.57E+00	6.92E-04
	Shrubs	56%	1.57E+00	1.04E-03
	Water ingestion (direct)	NA	3.26E-03	6.35E-06
	Total	**100%**		**1.96E-03**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg Soil) or (mg/L Water)	Body Burden or Tissue (mg/kg)
Strontium	Soil ingestion (direct)	6%	9.74E+01	6.70E-03
	Grasses, forbs, berries	38%	7.84E+01	1.84E-02
	Shrubs	56%	7.84E+01	2.76E-02
	Water ingestion (direct)		2.96E-01	3.08E-04
	Total	**100%**		**5.30E-02**
Tellurium	Soil ingestion (direct)	6%	3.18E-01	1.09E-05
	Grasses, forbs, berries	38%	-	-
	Shrubs	56%	-	-
	Water ingestion (direct)	NA	-	-
	Total	**100%**		**1.09E-05**
Thallium	Soil ingestion (direct)	6%	3.02E-01	6.70E-07
	Grasses, forbs, berries	38%	1.01E-03	1.18E-06
	Shrubs	56%	1.01E-03	1.77E-06
	Water ingestion (direct)	NA	1.92E-04	9.97E-07
	Total	**100%**		**4.62E-06**
Titanium	Soil ingestion (direct)	6%	2.33E+03	7.45E-04
	Grasses, forbs, berries	38%	2.40E+00	2.11E-03
	Shrubs	56%	2.40E+00	3.17E-03
	Water ingestion (direct)	NA	1.01E-01	3.92E-04
	Total	**100%**		**6.42E-03**
Uranium	Soil ingestion (direct)	6%	1.22E+00	6.08E-09
	Grasses, forbs, berries	38%	3.03E-03	1.78E-08
	Shrubs	56%	3.03E-03	2.67E-08
	Water ingestion (direct)	NA	5.00E-04	1.30E-08
	Total	**100%**		**6.35E-08**
Vanadium	Soil ingestion (direct)	6%	1.09E+02	3.66E-06
	Grasses, forbs, berries	38%	2.04E-01	1.50E-05
	Shrubs	56%	2.04E-01	2.25E-05
	Water ingestion (direct)	NA	1.37E-02	4.46E-06
	Total	**100%**		**4.56E-05**
Zinc	Soil ingestion (direct)	6%	1.45E+02	1.04E-01
	Grasses, forbs, berries	38%	1.71E+02	5.03E-01
	Shrubs	56%	1.71E+02	7.54E-01
	Water ingestion (direct)	NA	1.13E-01	1.47E-03
	Total	**100%**		**1.362E+00**

Table D18. Calculation of Moose Tissue Concentrations by Dietary Source – Predicted Future

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg)	Body Burden or Tissue (mg/kg)
Aluminum	Soil ingestion (direct)	2%	2.95E+04	2.34E-02
	Aquatic plants	20%	6.25E+01	1.47E-01
	Ferns, shrubs, trees, other	78%	6.25E+01	5.88E-01
	Water ingestion (direct)	NA	6.15E+00	1.84E-01
	Total	**100%**		**9.43E-01**
Antimony	Soil ingestion (direct)	2%	6.90E+00	1.13E-05
	Aquatic plants	20%	3.12E-02	4.89E-05
	Ferns, shrubs, trees, other	78%	3.12E-02	1.96E-04
	Water ingestion (direct)	NA	5.74E-03	1.15E-04
	Total	**100%**		**3.71E-04**
Arsenic	Soil ingestion (direct)	2%	6.99E+01	1.02E-04
	Aquatic plants	20%	4.37E-01	1.37E-03
	Ferns, shrubs, trees, other	78%	4.37E-01	5.48E-03
	Water ingestion (direct)	NA	9.79E-03	3.92E-04
	Total muscle			7.34E-03
	Total (muscle, kidney, liver)	**100%**		**9.16E-03**
Barium	Soil ingestion (direct)	2%	4.31E+02	2.18E-03
	Aquatic plants	20%	4.02E+01	9.47E-03
	Ferns, shrubs, trees, other	78%	4.02E+01	3.79E-02
	Water ingestion (direct)	NA	1.19E-04	3.56E-07
	Total	**100%**		**4.95E-02**
Bismuth	Soil ingestion (direct)	2%	3.30E-01	1.63E-06
	Aquatic plants	20%	1.00E-02	6.28E-06
	Ferns, shrubs, trees, other	78%	1.00E-02	2.51E-05
	Water ingestion (direct)	NA	8.44E-03	6.75E-05
	Total	**100%**		**1.01E-04**
Boron	Soil ingestion (direct)	2%	2.01E+01	3.18E-03
	Aquatic plants	20%	3.29E+01	3.10E-02
	Ferns, shrubs, trees, other	78%	3.29E+01	1.24E-01
	Water ingestion (direct)	NA	9.57E-02	1.15E-03
	Total			**1.593E-01**
Cadmium	Soil ingestion (direct)	2%	1.10E+00	3.51E-04
	Aquatic plants	20%	3.88E+00	3.35E-03
	Ferns, shrubs, trees, other	78%	3.88E+00	1.34E-02
	Water ingestion (direct)	NA	1.33E-03	1.47E-05
	Total muscle			1.71E-02
	Total (muscle, kidney, liver)	**100%**		**5.28E-01**
Chromium	Soil ingestion (direct)	2%	9.97E+01	5.94E-04
	Aquatic plants	20%	3.24E-01	2.80E-03
	Ferns, shrubs, trees, other	78%	3.24E-01	1.12E-02
	Water ingestion (direct)	NA	7.62E-03	8.38E-04
	Total	**100%**		**1.54E-02**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg)	Body Burden or Tissue (mg/kg)
Cobalt	Soil ingestion (direct)	2%	2.24E+01	3.69E-03
	Aquatic plants	20%	7.38E-01	2.32E-02
	Ferns, shrubs, trees, other	78%	7.38E-01	9.27E-02
	Water ingestion (direct)	NA	6.44E-03	2.58E-03
	Total	**100%**		**1.22E-01**
Copper	Soil ingestion (direct)	2%	1.07E+02	2.35E-02
	Aquatic plants	20%	1.07E+01	1.68E-01
	Ferns, shrubs, trees, other	78%	1.07E+01	6.72E-01
	Water ingestion (direct)		3.36E-02	6.71E-03
	Total	**100%**		**8.70E-01**
Iron	Soil ingestion (direct)	2%	5.85E+04	9.97E-01
	Aquatic plants	20%	1.94E+02	6.07E+00
	Ferns, shrubs, trees, other	78%	1.94E+02	2.43E+01
	Water ingestion (direct)	NA	9.66E+00	3.86E+00
	Total	**100%**		**3.52E+01**
Lead	Soil ingestion (direct)	2%	4.02E+01	1.91E-05
	Aquatic plants	20%	1.56E-01	9.78E-05
	Ferns, shrubs, trees, other	78%	1.56E-01	3.91E-04
	Water ingestion (direct)	NA	7.78E-03	6.23E-05
	Total muscle			5.70E-04
	Total (muscle, kidney, liver)	**100%**		**5.57E-04**
Manganese	Soil ingestion (direct)	2%	9.22E+02	2.70E-02
	Aquatic plants	20%	2.76E+02	1.73E-01
	Ferns, shrubs, trees, other	78%	2.76E+02	6.93E-01
	Water ingestion (direct)	NA	5.38E-01	4.30E-03
	Total	**100%**		**8.98E-01**
Mercury	Soil ingestion (direct)	2%	8.58E-02	8.83E-04
	Aquatic plants	20%	1.11E-02	4.34E-03
	Ferns, shrubs, trees, other	78%	1.11E-02	1.74E-02
	Water ingestion (direct)	NA	6.91E-05	3.45E-04
	Total muscle			2.29E-02
	Total (muscle, kidney, liver)	**100%**		**2.91E-02**
Nickel	Soil ingestion (direct)	2%	5.29E+01	7.41E-03
	Aquatic plants	20%	4.94E+00	4.65E-02
	Ferns, shrubs, trees, other	78%	4.94E+00	1.86E-01
	Water ingestion (direct)	NA	2.72E-02	3.27E-03
	Total	**100%**		**2.43E-01**
Selenium	Soil ingestion (direct)	2%	4.57E+00	7.32E-03
	Aquatic plants	20%	1.57E+00	3.70E-02
	Ferns, shrubs, trees, other	78%	1.57E+00	1.48E-01
	Water ingestion (direct)	NA	3.26E-03	9.77E-04
	Total	**100%**		**1.93E-01**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg)	Body Burden or Tissue (mg/kg)
Strontium	Soil ingestion (direct)	2%	9.74E+01	2.18E-01
	Aquatic plants	20%	7.84E+01	9.84E-01
	Ferns, shrubs, trees, other	78%	7.84E+01	3.93E+00
	Water ingestion (direct)		2.96E-01	4.74E-02
	Total	**100%**		**5.18E+00**
Tellurium	Soil ingestion (direct)	2%	3.18E-01	3.56E-04
	Aquatic plants	20%	1.01E-03	1.11E-05
	Ferns, shrubs, trees, other	78%	1.40E-02	6.15E-04
	Water ingestion (direct)	NA	NA	-
	Total	**100%**		**9.82E-04**
Thallium	Soil ingestion (direct)	2%	3.02E-01	2.18E-05
	Aquatic plants	20%	1.01E-03	6.32E-05
	Ferns, shrubs, trees, other	78%	1.01E-03	2.53E-04
	Water ingestion (direct)	NA	1.92E-04	1.53E-04
	Total	**100%**		**4.91E-04**
Titanium	Soil ingestion (direct)	2%	2.33E+03	2.42E-02
	Aquatic plants	20%	2.40E+00	1.13E-01
	Ferns, shrubs, trees, other	78%	2.40E+00	4.52E-01
	Water ingestion (direct)	NA	1.01E-01	6.03E-02
	Total	**100%**		**6.49E-01**
Uranium	Soil ingestion (direct)	2%	1.22E+00	1.98E-07
	Aquatic plants	20%	3.03E-03	9.50E-07
	Ferns, shrubs, trees, other	78%	3.03E-03	3.80E-06
	Water ingestion (direct)		5.00E-04	2.00E-06
	Total	**100%**		**6.95E-06**
Vanadium	Soil ingestion (direct)	2%	1.09E+02	1.19E-04
	Aquatic plants	20%	2.04E-01	8.01E-04
	Ferns, shrubs, trees, other	78%	2.04E-01	3.20E-03
	Water ingestion (direct)	NA	1.37E-02	6.86E-04
	Total	**100%**		**4.81E-03**
Zinc	Soil ingestion (direct)	2%	1.446E+02	3.38E+00
	Aquatic plants	20%	1.71E+02	2.69E+01
	Ferns, shrubs, trees, other	78%	1.71E+02	1.07E+02
	Water ingestion (direct)	NA	1.13E-01	2.26E-01
	Total	**100%**		**1.379E+02**

Table D19. Calculation of Grouse Tissue Concentrations by Dietary Source - Predicted Future

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg)	Body Burden or Tissue (mg/kg)
Aluminum	Soil (direct ingestion)	2%	2.95E+04	1.32E-04
	Insects	1%	2.21E+03	2.10E-03
	Grasses & Forbs	39%	6.25E+01	1.64E-03
	Shrubs & Trees (seeds)	58%	6.25E+01	2.46E-03
	Water ingestion (direct)	NA	6.15E+00	4.20E-04
	Total	**100%**		**6.75E-03**
Antimony	Soil (direct ingestion)	2%	6.90E+00	6.39E-08
	Insects	1%	3.45E-01	2.19E-07
	Grasses & Forbs	39%	3.12E-02	5.45E-07
	Shrubs & Trees (seeds)	58%	3.12E-02	8.18E-07
	Water ingestion (direct)	NA	5.74E-03	2.62E-07
	Total	**100%**		**1.91E-06**
Arsenic	Soil (direct ingestion)	2%	6.99E+01	5.78E-07
	Insects	1%	4.62E-01	5.85E-07
	Grasses & Forbs	39%	4.37E-01	1.53E-05
	Shrubs & Trees (seeds)	58%	4.37E-01	2.29E-05
	Water ingestion (direct)	NA	9.79E-03	8.92E-07
	Total	**100%**		**4.03E-05**
Barium	Soil (direct ingestion)	2%	4.31E+02	1.24E-05
	Insects	1%	3.23E+00	3.08E-07
	Grasses & Forbs	39%	4.02E+01	1.06E-04
	Shrubs & Trees (seeds)	58%	4.02E+01	1.58E-04
	Water ingestion (direct)	NA	1.19E-01	8.11E-07
	Total	**100%**		**2.78E-04**
Bismuth	Soil (direct ingestion)	2%	3.30E-01	9.21E-09
	Insects	1%	3.30E-01	8.38E-08
	Grasses & Forbs	39%	1.00E-02	7.01E-08
	Shrubs & Trees (seeds)	58%	1.00E-02	1.05E-07
	Water ingestion (direct)	NA	8.44E-03	1.54E-07
	Total	**100%**		**4.22E-07**
Boron	Soil (direct ingestion)	2%	2.01E+01	1.80E-05
	Insects	1%	0.00E+00	0.00E+00
	Grasses & Forbs	39%	3.29E+01	3.45E-04
	Shrubs & Trees (seeds)	58%	3.29E+01	5.18E-04
	Water ingestion (direct)	NA	9.57E-02	2.62E-06
	Total	**100%**		**8.84E-04**
Cadmium	Soil (direct ingestion)	2%	1.10E+00	1.99E-06
	Insects	1%	1.21E+01	4.24E-06
	Grasses & Forbs	39%	3.88E+00	3.74E-05
	Shrubs & Trees (seeds)	58%	3.88E+00	5.61E-05
	Water ingestion (direct)	NA	1.33E-03	3.34E-08
	Total	**100%**		**9.97E-05**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg)	Body Burden or Tissue (mg/kg)
Chromium	Soil (direct ingestion)	2%	9.97E+01	3.36E-06
	Insects	1%	1.60E+01	5.56E-05
	Grasses & Forbs	39%	3.24E-01	3.12E-05
	Shrubs & Trees (seeds)	58%	3.24E-01	4.68E-05
	Water ingestion (direct)	NA	7.62E-03	1.91E-06
	Total	**100%**		**1.39E-04**
Cobalt	Soil (direct ingestion)	2%	2.24E+01	2.09E-05
	Insects	1%	2.24E+01	2.84E-04
	Grasses & Forbs	39%	7.38E-01	2.58E-04
	Shrubs & Trees (seeds)	58%	7.38E-01	3.88E-04
	Water ingestion (direct)	NA	6.44E-03	5.87E-06
	Total	**100%**		**9.57E-04**
Copper	Soil (direct ingestion)	2%	1.07E+02	1.33E-04
	Insects	1%	1.71E+01	1.08E-04
	Grasses & Forbs	39%	1.07E+01	1.87E-03
	Shrubs & Trees (seeds)	58%	1.07E+01	2.81E-03
	Water ingestion (direct)		3.36E-02	1.53E-05
	Total	**100%**		**4.94E-03**
Iron	Soil (direct ingestion)	2%	5.85E+04	5.65E-03
	Insects	1%	5.85E+04	7.42E-01
	Grasses & Forbs	39%	1.94E+02	6.77E-02
	Shrubs & Trees (seeds)	58%	1.94E+02	1.02E-01
	Water ingestion (direct)	NA	9.66E+00	8.80E-03
	Total	**100%**		**9.25E-01**
Lead	Soil (direct ingestion)	2%	4.02E+01	1.08E-07
	Insects	1%	6.79E+02	1.72E-04
	Grasses & Forbs	39%	1.56E-01	1.09E-06
	Shrubs & Trees (seeds)	58%	1.56E-01	1.64E-06
	Water ingestion (direct)	NA	7.78E-03	1.42E-07
	Total	**100%**		**1.75E-04**
Manganese	Soil (direct ingestion)	2%	9.22E+02	1.53E-04
	Insects	1%	1.84E+01	4.67E-06
	Grasses & Forbs	39%	2.76E+02	1.93E-03
	Shrubs & Trees (seeds)	58%	2.76E+02	2.90E-03
	Water ingestion (direct)	NA	5.38E-01	9.80E-06
	Total	**100%**		**5.00E-03**
Mercury	Soil (direct ingestion)	2%	8.58E-02	5.00E-06
	Insects	1%	2.92E-02	4.62E-06
	Grasses & Forbs	39%	1.11E-02	4.84E-05
	Shrubs & Trees (seeds)	58%	1.11E-02	7.26E-05
	Water ingestion (direct)	NA	6.91E-05	7.87E-07
	Total	**100%**		**1.31E-04**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg)	Body Burden or Tissue (mg/kg)
Nickel	Soil (direct ingestion)	2%	5.29E+01	4.19E-05
	Insects	1%	1.22E+01	4.63E-05
	Grasses & Forbs	39%	4.94E+00	5.18E-04
	Shrubs & Trees (seeds)	58%	4.94E+00	7.78E-04
	Water ingestion (direct)	NA	2.72E-02	7.45E-06
	Total	**100%**		**1.39E-03**
Selenium	Soil (direct ingestion)	2%	4.57E+00	4.14E-05
	Insects	1%	3.47E+00	3.30E-05
	Grasses & Forbs	39%	1.57E+00	4.12E-04
	Shrubs & Trees (seeds)	58%	1.57E+00	6.18E-04
	Water ingestion (direct)	NA	3.26E-03	2.23E-06
	Total	**100%**		**1.11E-03**
Strontium	Soil (direct ingestion)	2%	9.74E+01	1.24E-03
	Insects	1%	3.90E-01	1.98E-06
	Grasses & Forbs	39%	7.84E+01	1.10E-02
	Shrubs & Trees (seeds)	58%	7.84E+01	1.65E-02
	Water ingestion (direct)		2.96E-01	1.08E-04
	Total	**100%**		**2.88E-02**
Tellurium	Soil (direct ingestion)	2%	3.18E-01	2.01E-06
	Insects	1%	-	-
	Grasses & Forbs	39%	-	-
	Shrubs & Trees (seeds)	58%	-	-
	Water ingestion (direct)	NA	-	-
	Total	**100%**		**2.01E-06**
Thallium	Soil (direct ingestion)	2%	3.02E-01	1.23E-07
	Insects	1%	3.02E-01	7.65E-06
	Grasses & Forbs	39%	1.01E-03	7.05E-07
	Shrubs & Trees (seeds)	58%	1.01E-03	1.06E-06
	Water ingestion (direct)	NA	1.92E-04	3.50E-07
	Total	**100%**		**9.89E-06**
Titanium	Soil (direct ingestion)	2%	2.33E+03	1.37E-04
	Insects	1%	2.33E+03	4.42E-02
	Grasses & Forbs	39%	2.40E+00	1.26E-03
	Shrubs & Trees (seeds)	58%	2.40E+00	1.89E-03
	Water ingestion (direct)	NA	1.01E-01	1.37E-04
	Total	**100%**		**4.77E-02**
Uranium	Soil (direct ingestion)	2%	1.22E+00	1.12E-09
	Insects	1%	3.65E-01	4.62E-08
	Grasses & Forbs	39%	3.03E-03	1.06E-08
	Shrubs & Trees (seeds)	58%	3.03E-03	1.59E-08
			5.00E-04	4.56E-09
	Total	**100%**		**7.84E-08**

Constituent	Media/Diet Consumed	Proportion of Medium Consumed (%)	Source (mg/kg)	Body Burden or Tissue (mg/kg)
Vanadium	Soil (direct ingestion)	2%	1.09E+02	6.74E-07
	Insects	1%	1.42E+01	2.24E-05
	Grasses & Forbs	39%	2.04E-01	8.93E-06
	Shrubs & Trees (seeds)	58%	2.04E-01	1.34E-05
	Water ingestion (direct)	NA	1.37E-02	1.56E-06
	Total	**100%**		**4.70E-05**
Zinc	Soil (direct ingestion)	2%	1.45E+02	1.92E-02
	Insects	1%	2.60E+02	1.65E-02
	Grasses & Forbs	39%	1.71E+02	3.00E-01
	Shrubs & Trees (seeds)	58%	1.71E+02	4.49E-01
	Water ingestion (direct)	NA	1.13E-01	5.15E-04
	Total	**100%**		**7.85E-01**

Table D20. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Plants – Predicted Future

Constituent	Plant EEC (mg/kg)	RfD (mg/kg-day)	RAF	Hazard Quotient			
				Toddler	Child	Teen	Adult
Aluminum	2.04E+01	1.00E+00	1	1.1E-01	8.3E-02	6.4E-02	8.4E-02
Antimony	1.02E-02	6.00E-03	1	9.4E-03	6.9E-03	5.3E-03	7.0E-03
Arsenic	1.43E-01	1.00E-03	2.90E-01	2.3E-01	1.7E-01	1.3E-01	1.7E-01
Barium	1.31E+01	2.00E-01	1	3.6E-01	2.7E-01	2.1E-01	2.7E-01
Bismuth	3.27E-03	NA	1	NA	NA	NA	NA
Boron	1.08E+01	2.00E-01	1	3.0E-01	2.2E-01	1.7E-01	2.2E-01
Cadmium	1.27E+00	1.00E-03	1	7.0E+00	5.2E+00	4.0E+00	5.2E+00
Chromium	1.06E-01	1.00E-03	1	5.9E-01	4.3E-01	3.3E-01	4.3E-01
Cobalt	2.41E-01	1.40E-03	1	9.5E-01	7.0E-01	5.4E-01	7.1E-01
Copper	3.50E+00	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	2.1E-01	1.3E-01	8.8E-02	1.0E-01
Iron	6.32E+01	7.00E-01	1	5.0E-01	3.7E-01	2.8E-01	3.7E-01
Lead	5.09E-02	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	4.7E-01	3.5E-01	1.1E-01	1.4E-01
Manganese	9.03E+01	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	3.7E+00	3.0E+00	2.0E+00	2.4E+00
Mercury	3.61E-03	3.00E-04	1	6.7E-02	4.9E-02	3.8E-02	4.9E-02
Nickel	1.61E+00	1.10E-02	1	8.1E-01	6.0E-01	4.6E-01	6.0E-01
Selenium	5.13E-01	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	4.6E-01	3.3E-01	2.6E-01	3.7E-01
Strontium	2.56E+01	6.00E-01	1	2.4E-01	1.7E-01	1.3E-01	1.8E-01
Tellurium	-	NA	1	-	-	-	-
Thallium	3.29E-04	7.00E-05	1	2.6E-02	1.9E-02	1.5E-02	1.9E-02

Constituent	Plant EEC (mg/kg)	RfD (mg/kg-day)	RAF	Hazard Quotient			
				Toddler	Child	Teen	Adult
Titanium	7.84E-01	3.00E+00	1	1.4E-03	1.1E-03	8.2E-04	1.1E-03
Uranium	9.89E-04	6.00E-04	1	9.1E-03	6.7E-03	5.2E-03	6.8E-03
Vanadium	6.67E-02	5.00E-03	1	7.4E-02	5.5E-02	4.2E-02	5.5E-02
Zinc	5.60E+01	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	6.5E-01	4.8E-01	3.3E-01	4.0E-01
Max Hazard				**7.0E+00**	**5.2E+00**	**4.0E+00**	**5.2E+00**

Constituent	Plant EEC (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	RAF	Incremental Lifetime Cancer Risk			
				Toddler	Child	Teen	Adult
Arsenic	1.43E-01	1.80E+00	2.90E-01	1.2E-04	8.0E-05	4.7E-05	2.3E-04

Table D21. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Fish – Predicted Future

Constituent	Fish EEC (mg/kg)	Fish EEC - Inorganic Arsenic[1] (mg/kg)	RfD (mg/kg-day)	RAF	Hazard Quotient			
					Toddler	Child	Teen	Adult
Aluminum	1.05E+01	NA	1.00E+00	1	5.8E-02	4.3E-02	3.3E-02	4.3E-02
Antimony	3.36E-02	NA	6.00E-03	1	3.1E-02	2.3E-02	1.8E-02	2.3E-02
Arsenic	6.35E-01	6.35E-02	1.00E-03	0.5	1.8E-01	1.3E-01	1.0E-01	1.3E-01
Barium	2.11E+00	NA	2.00E-01	1	5.8E-02	4.3E-02	3.3E-02	4.3E-02
Bismuth	8.59E-03	NA	NA	1	-	-	-	-
Boron	1.20E-01	NA	2.00E-01	1	3.3E-03	2.4E-03	1.9E-03	2.5E-03
Cadmium	6.64E-01	NA	1.00E-03	1	3.7E+00	2.7E+00	2.1E+00	2.7E+00
Chromium	9.21E-02	NA	1.00E-03	1	5.1E-01	3.8E-01	2.9E-01	3.8E-01
Cobalt	4.86E-01	NA	1.40E-03	1	1.9E+00	1.4E+00	1.1E+00	1.4E+00
Copper	1.65E+00	NA	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	1.0E-01	6.1E-02	4.1E-02	4.8E-02
Iron	1.66E+02	NA	7.00E-01	1	1.3E+00	9.7E-01	7.5E-01	9.7E-01
Lead	1.75E-01	NA	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	1.6E+00	1.2E+00	3.7E-01	4.8E-01
Manganese	2.10E+01	NA	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	8.5E-01	7.0E-01	4.7E-01	5.5E-01
Mercury	1.03E-02	NA	2.0E-04	1	2.9E-01	2.1E-01	1.6E-01	2.1E-01
Nickel	2.23E-01	NA	1.10E-02	1	1.1E-01	8.3E-02	6.4E-02	8.3E-02
Selenium	2.36E+00	NA	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	2.1E+00	1.5E+00	1.2E+00	1.7E+00
Strontium	6.63E+00	NA	6.00E-01	1	6.1E-02	4.5E-02	3.5E-02	4.5E-02
Tellurium	0.00E+00	NA	NA	1	-	-	-	-

Constituent	Fish EEC (mg/kg)	Fish EEC - Inorganic Arsenic[1] (mg/kg)	RfD (mg/kg-day)	RAF	Hazard Quotient			
					Toddler	Child	Teen	Adult
Thallium	1.61E-02	NA	7.00E-05	1	1.3E+00	9.4E-01	7.2E-01	9.4E-01
Titanium	5.28E-01	NA	3.00E+00	1	9.7E-04	7.2E-04	5.5E-04	7.2E-04
Uranium	5.16E-03	NA	6.00E-04	1	4.8E-02	3.5E-02	2.7E-02	3.5E-02
Vanadium	7.69E-02	NA	5.00E-03	1	8.5E-02	6.3E-02	4.8E-02	6.3E-02
Zinc	8.49E+01	NA	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	9.8E-01	7.2E-01	5.0E-01	6.1E-01
Max Hazard					**3.7E+00**	**2.7E+00**	**2.1E+00**	**2.7E+00**

Constituent	Fish EEC (mg/kg)	Fish EEC - Inorganic Arsenic[1] (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	RAF	Incremental Lifetime Cancer Risk			
					Toddler	Child	Teen	Adult
Arsenic	6.35E-01	6.35E-02	1.80E+00	5.00E-01	8.9E-05	6.1E-05	3.6E-05	1.8E-04

Table D22. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Rabbit – Predicted Future

Constituent	Snowshoe Hare EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Aluminum	8.79E-03	1.00E+00	4.9E-05	3.6E-05	2.8E-05	3.6E-05
Antimony	3.38E-06	6.00E-03	3.1E-06	2.3E-06	1.8E-06	2.3E-06
Arsenic	6.98E-05	1.00E-03	3.9E-04	2.9E-04	2.2E-04	2.9E-04
Barium	5.12E-04	2.00E-01	1.4E-05	1.0E-05	8.1E-06	1.1E-05
Bismuth	7.83E-07	NA	-	-	-	-
Boron	1.55E-03	2.00E-01	4.3E-05	3.2E-05	2.4E-05	3.2E-05
Cadmium	1.68E-04	1.00E-03	9.3E-04	6.8E-04	5.3E-04	6.9E-04
Chromium	1.52E-04	1.00E-03	8.4E-04	6.2E-04	4.8E-04	6.3E-04
Cobalt	1.21E-03	1.40E-03	4.8E-03	3.5E-03	2.7E-03	3.6E-03
Copper	8.62E-03	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	5.2E-04	3.2E-04	2.2E-04	2.5E-04
Iron	3.40E-01	7.00E-01	2.7E-03	2.0E-03	1.5E-03	2.0E-03
Lead	5.57E-06	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	5.1E-05	3.8E-05	1.2E-05	1.5E-05
Manganese	8.97E-03	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	3.7E-04	3.0E-04	2.0E-04	2.4E-04
Mercury	2.32E-04	3.00E-04	4.3E-03	3.2E-03	2.4E-03	3.2E-03
Nickel	2.42E-03	1.10E-02	1.2E-03	9.0E-04	6.9E-04	9.0E-04
Selenium	1.96E-03	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.8E-03	1.3E-03	1.0E-03	1.4E-03
Strontium	5.30E-02	6.00E-01	4.9E-04	3.6E-04	2.8E-04	3.6E-04
Tellurium	1.09E-05	NA	-	-	-	-
Thallium	4.62E-06	7.0E-05	3.7E-04	2.7E-04	2.1E-04	2.7E-04

Constituent	Snowshoe Hare EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Titanium	6.42E-03	3.00E+00	1.2E-05	8.7E-06	6.7E-06	8.8E-06
Uranium	6.35E-08	6.00E-04	5.9E-07	4.3E-07	3.3E-07	4.3E-07
Vanadium	4.56E-05	5.00E-03	5.1E-05	3.7E-05	2.9E-05	3.7E-05
Zinc	1.36E+00	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1.6E-02	1.2E-02	7.9E-03	9.8E-03
Max Hazard			**1.6E-02**	**1.2E-02**	**7.9E-03**	**9.8E-03**

Constituent	Snowshoe Hare EEC (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk			
			Toddler	Child	Teen	Adult
Arsenic	6.98E-05	1.80E+00	2.0E-07	1.3E-07	7.9E-08	3.9E-07

Table D23. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Moose – Predicted Future

Constituent	Moose EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Aluminum	9.43E-01	1.00E+00	5.2E-03	3.9E-03	3.0E-03	3.9E-03
Antimony	3.71E-04	6.00E-03	3.4E-04	2.5E-04	1.9E-04	2.5E-04
Arsenic	9.16E-03	1.00E-03	5.1E-02	3.7E-02	2.9E-02	3.8E-02
Barium	4.95E-02	2.00E-01	1.4E-03	1.0E-03	7.8E-04	1.0E-03
Bismuth	1.01E-04	NA	-	-	-	-
Boron	1.59E-01	2.00E-01	4.4E-03	3.3E-03	2.5E-03	3.3E-03
Cadmium	5.28E-01	1.00E-03	2.9E+00	2.2E+00	1.7E+00	2.2E+00
Chromium	1.54E-02	1.00E-03	8.5E-02	6.3E-02	4.9E-02	6.3E-02
Cobalt	1.22E-01	1.40E-03	4.8E-01	3.6E-01	2.7E-01	3.6E-01
Copper	8.70E-01	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	5.3E-02	3.2E-02	2.2E-02	2.5E-02
Iron	3.52E+01	7.00E-01	2.8E-01	2.1E-01	1.6E-01	2.1E-01
Lead	5.57E-04	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	5.1E-03	3.8E-03	1.2E-03	1.5E-03
Manganese	8.98E-01	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	3.7E-02	3.0E-02	2.0E-02	2.4E-02
Mercury	2.91E-02	3.00E-04	5.4E-01	4.0E-01	3.1E-01	4.0E-01
Nickel	2.43E-01	1.10E-02	1.2E-01	9.0E-02	7.0E-02	9.1E-02
Selenium	1.93E-01	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.7E-01	1.3E-01	9.8E-02	1.4E-01
Strontium	5.18E+00	6.00E-01	4.8E-02	3.5E-02	2.7E-02	3.5E-02
Tellurium	9.82E-04	NA	-	-	-	-
Thallium	4.91E-04	7.0E-05	3.9E-02	2.9E-02	2.2E-02	2.9E-02

Constituent	Moose EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Titanium	6.49E-01	3.00E+00	1.2E-03	8.8E-04	6.8E-04	8.9E-04
Uranium	6.95E-06	6.00E-04	6.4E-05	4.7E-05	3.6E-05	4.8E-05
Vanadium	4.81E-03	5.00E-03	5.3E-03	3.9E-03	3.0E-03	4.0E-03
Zinc	1.38E+02	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1.6E+00	1.2E+00	8.1E-01	9.9E-01
Max Hazard			**2.9E+00**	**2.2E+00**	**1.7E+00**	**2.2E+00**

Constituent	Moose EEC (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk			
			Toddler	Child	Teen	Adult
Arsenic	9.16E-03	1.80E+00	2.6E-05	1.8E-05	1.0E-05	5.1E-05

Table D24. Calculation of Non-Carcinogenic and Carcinogenic Hazards from Ingestion of Grouse – Predicted Future

Constituent	Grouse EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Aluminum	6.75E-03	1.00E+00	3.7E-05	2.8E-05	2.1E-05	2.8E-05
Antimony	1.91E-06	6.00E-03	1.8E-06	1.3E-06	1.0E-06	1.3E-06
Arsenic	4.03E-05	1.00E-03	2.2E-04	1.6E-04	1.3E-04	1.7E-04
Barium	2.78E-04	2.00E-01	7.7E-06	5.7E-06	4.4E-06	5.7E-06
Bismuth	4.22E-07	NA	-	-	-	-
Boron	8.84E-04	2.00E-01	2.4E-05	1.8E-05	1.4E-05	1.8E-05
Cadmium	9.97E-05	1.00E-03	5.5E-04	4.1E-04	3.1E-04	4.1E-04
Chromium	1.39E-04	3.00E-03	2.6E-04	1.9E-04	1.5E-04	1.9E-04
Cobalt	9.57E-04	1.40E-03	3.8E-03	2.8E-03	2.2E-03	2.8E-03
Copper	4.94E-03	toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	3.0E-04	1.8E-04	1.2E-04	1.4E-04
Iron	9.25E-01	7.00E-01	7.3E-03	5.4E-03	4.2E-03	5.4E-03
Lead	1.75E-04	toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1.6E-03	1.2E-03	3.7E-04	4.8E-04
Manganese	5.00E-03	toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	2.0E-04	1.7E-04	1.1E-04	1.3E-04
Mercury	1.31E-04	3.00E-04	2.4E-03	1.8E-03	1.4E-03	1.8E-03
Nickel	1.39E-03	1.10E-02	7.0E-04	5.2E-04	4.0E-04	5.2E-04
Selenium	1.11E-03	toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	9.9E-04	7.2E-04	5.6E-04	8.0E-04
Strontium	2.88E-02	6.00E-01	2.7E-04	2.0E-04	1.5E-04	2.0E-04
Tellurium	2.01E-06	NA	-	-	-	-
Thallium	9.89E-06	7.00E-05	7.8E-04	5.8E-04	4.5E-04	5.8E-04

Constituent	Grouse EEC (mg/kg)	RfD (mg/kg-day)	Hazard Quotient			
			Toddler	Child	Teen	Adult
Titanium	4.77E-02	3.00E+00	8.8E-05	6.5E-05	5.0E-05	6.5E-05
Uranium	7.84E-08	6.00E-04	7.2E-07	5.3E-07	4.1E-07	5.4E-07
Vanadium	4.70E-05	5.00E-03	5.2E-05	3.8E-05	3.0E-05	3.9E-05
Zinc	7.85E-01	toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	9.1E-03	6.7E-03	4.6E-03	5.7E-03
Max Hazard			**9.1E-03**	**6.7E-03**	**4.6E-03**	**5.7E-03**

Constituent	Grouse EEC (mg/kg)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Incremental Lifetime Cancer Risk			
			Toddler	Child	Teen	Adult
Arsenic	4.03E-05	1.80E+00	1.1E-07	7.8E-08	4.6E-08	2.2E-07

Attachment E
Toxicity Profile Summaries

1 TOXICITY PROFILE SUMMARIES

1.1 Aluminum

Aluminum (Al) is a silvery-white, malleable and ductile metal and the most abundant metal in the earth's crust (ATSDR 2008). It has a molecular weight of 26.98 g/mol and a density of 2.70 g/cm^3 (ATSDR 2008). Aluminum only occurs in one oxidation state: +3. Aluminum is highly reactive with water and is typically found in the environment as a constituent of inorganic and organic compounds. Human exposure to aluminum can occur through inhalation of air particles, ingestion of contaminated food, sediment or soil, and dermal contact with water, soil or sediment. The primary source of exposure to aluminum is typically from inhalation of dust in contaminated workplace and ingestion of food. The absorption of ingested aluminum in humans depends upon the solubility of the compound and is generally low (0.1 to 0.4%) (ATSDR 2008). Ingestion of more bioavailable forms such as organic aluminum compounds (i.e., aluminum citrate) have slightly higher absorption (0.5 to 5%), but are still considered to have low absorption (ATSDR 2008). The extent of absorption of inhaled aluminum depends on solubility of the compound and particle size. Dermal absorption of aluminum is considered to be negligible (ATSDR 2008). Exposure to excess aluminum has been shown to elicit a variety of toxic effects including neurotoxicity, bone disease, and lung disease (ATSDR 2008).

Due to important role kidneys play in removing aluminum from the body, people with kidneys that are not functioning properly can accumulate toxic concentrations of aluminum in the body resulting in bone disease and neurotoxicity (ATSDR 2008).

Aluminum has been shown to accumulate in plants and some animals; however, it does not appear to biomagnify in food chains (ATSDR 2008; BCMOE 1988).

Toxicity Reference Values

The oral toxicity value for aluminum, referred to as the reference dose (RfD), used in this risk assessment was developed by the USEPA (2006). The LOAEL of 100 mg Al/kg-day for minimal neurotoxicity in the offspring of mice (Donald et al., 1989, Golub et al., 1995) was selected as the basis for the provisional chronic 27 10-23-2006 RfD they developed The LOAEL is considered minimal because the results of the post-weaning neurobehavioral test battery indicate that performance deficits may be marginal. In particular, of the three observed effects (decreased forelimb and increased hindlimb grip strengths, increased hind-limb foot splay distance), one effect (increased grip strength) has unclear toxicological significance and two effects (increased grip strength and foot splay distance) did not persist after 2 weeks of no further exposure.

Application of an uncertainty factor (UF) of 100 (3 for use of a minimal LOAEL, 10 for interspecies extrapolation and 3 for intrahuman variability where the critical effects have been observed in a sensitive sub-group) results in a provisional RfD = **1E-0 mg Al/kg-day.**

The inhalation toxicity value for aluminum, referred to as the reference concentration (RfC), used in this risk assessment was developed by the USEPA (2006). In Hosovski et al. (1990) reports a study where workers were exposed to presumed time-weighted average (TWA) concentrations of 4.6-11.5 mg Al/m^3 magnitude for an average of 12 years. Using 4.6 mg Al/m^3 as the LOAEL for psychomotor and cognitive impairment for an 8-hour occupational exposure (Hosovski et al., 1990) and corrections for discontinuous exposure (10 m^3/20 m^3 and 5 days/7 days), the $LOAEL_{HEC}$ is 1.64 mg/m^3.

Applying an uncertainty factor of 300 for intrahuman variability (10), use of a LOAEL (10) and an incomplete database (3) yielded a provisional RfC of 1.64 mg/m^3/300 = **5E-3 mg/m^3**.

1.2 Antimony

Antimony (Sb) is a silvery-white metal with a molecular weight of 121.75 g/mol and a density of 6.684 g/cm^3. Antimony is considered insoluble in water and does not have a reported value for octanol–water partition coefficient (K_{ow}) (ATSDR 1992). Antimony does not occur as simple cations (i.e., Sb^{+3} and Sb^{+5}) in the environment. Antimony is typically found in the environment combined with oxygen, chlorine and/or sulphur to form inorganic compounds. Antimony can also combine with carbon and hydrogen to form organic compounds. Antimony in the environment typically exists in the +3 and +5 of its four oxidation states (-3, 0, +3, and +5). The majority of compounds containing antimony are non-volatile and therefore arsenic has no value for vapour pressure (P_{vap}) or Henry's constant (H); however, some forms of antimony are volatile, such as stibine (SbH_3) (ATSDR 1992). The chemical abstracts service registry number for antimony is 7440-36-0.

Human exposure to antimony can occur through inhalation of air particles, ingestion of contaminated food, water, sediment or soil, and dermal contact with water, soil or sediment. The primary source of exposure to arsenic is typically from food and water (ATSDR 1992). The absorption of ingested antimony in humans depends upon the solubility of the compound. The absorption of inhaled antimony depends on particle size and solubility. Absorption rates for antimony have been estimated between 1% and 10% (ATSDR 1992). Once absorbed, antimony is distributed widely throughout the body via blood and eliminated from the body in urine and feces (ATSDR 1992).

No association has been found between the occurrence of cancer in humans and occupational exposure to antimony (ATSDR 1992). Exposure to antimony may result in a wide-range of non-carcinogenic effects in a variety of organ systems, including cardiovascular, respiratory, developmental, gastrointestinal, hematological, musculoskeletal, ocular, and reproduction (ATSDR 1992). The primary target organs for antimony are the cardiovascular system (heart and vessels) and respiratory tract (ATSDR 1992).

Toxicity Reference Values

The BC MOE recommends using toxicological reference values (TRVs) from the US EPA Integrated Risk Information System (IRIS) for human health risk assessment. Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. An oral (ingestion) reference dose (RfD) derived from pathway-specific toxicological studies was available for antimony in IRIS; however, no dermal or inhalation TRVs were available. Therefore, the dermal TRV for antimony in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. The inhalation total daily intake (TDI) for antimony in this risk assessment is also based on the oral TRV, using an inhalation absorption factor of 100%. Table A below summarizes the TRVs used in HHRA calculations.

Table A Human Non-Carcinogenic TRVs for Exposure to Antimony

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Antimony	$4.00x10^{-4}$	IRIS	Use oral TRV	-	-	-
Antimony	$6.00x10^{-3}$	RIVM	Use oral TRV	-	$1.19x10^{-2}$	Derived from oral TRV

The principal study USEPA Integrated Risk Information System (IRIS) Schroeder et al. (1970) used to derive the USEPA oral reference dose (RfD) for antimony was based on the ingestion of drinking water by rats resulting in decreased longevity, decreased blood glucose levels and altered cholesterol levels. The LOAEL used in the derivation was 0.35 mg/kg-day. The uncertainty factor applied was 1000 to account for interspecies variation (10), intraspecific variation (10) (i.e., sensitive populations), and for using a LOAEL (10) (USEPA 2017).

Netherlands National Institute for Public Health and the Environment (RIVM) based its TDI on a NOAEL of 6 mg/kg-day for decreased body weight, food intake, and water intake observed in rats exposed to antimony potassium tartrate in drinking water for 90 days (Poon et al., 1998). Applying an uncertainty factor of 1000 (10 each for intra- and interspecies variation and use of a subchronic study), results in a TDI of 0.006 mg/kg-day. RIVM notes that the TDI especially accounts for soluble antimony compounds, but that insoluble compounds, such as antimony trioxide, are significantly less toxic.

No reference concentration was identified for antimony. The RfC for antimony was derived by dividing multiplying the RfD by 16.5/8.3 m^3 (or =1.99 =2.0).

Antimony does not appear to biomagnify in food chains (ATSDR 1992; HSDB 2017a).

1.3 Arsenic

Arsenic is a metalloid element with properties of both metallic and non-metallic elements. It has a molecular weight of 74.92 g/mol and a density of 5.73 g/cm^3. Arsenic typically exists in one of three oxidation states: -3, +3, and +5. Arsenic is considered insoluble in water and does not have a reported value for octanol–water partition coefficient (ATSDR 2007a). Arsenic is typically found in the environment combined with oxygen, chlorine and/or sulphur to form inorganic compounds. Arsenic can also combine with carbon and hydrogen to form organic compounds.

Numerous epidemiologic studies investigating occupational exposures to various forms of inorganic arsenic compounds have established a strong correlation between exposure and the incidence of cancer, including cancer in the bladder, kidneys, lungs, skin, and liver (CEPA 1993). Consequently, arsenic is classified as a Group I carcinogen by Health Canada, Group 1 carcinogen by the International Agency for Research on Cancer (IARC), and Group A carcinogen by the United States Environmental Protection Agency (USEPA).

In addition to carcinogenic effects, exposure to arsenic may also result in a wide-range of non-carcinogenic effects, including death. Regardless of the intake pathway, the most common symptoms of chronic arsenic exposure are non-cancerous dermal lesions, hyperkeratosis, and hyperpigmentation. Consequently, similar respiratory effects (i.e., inflammation and pulmonary edema) have been observed following inhalation of arsenic. Epidemiological studies have reported that arsenic exposure may result in gastrointestinal effects, neurological effects, and various cardiovascular effects such as blackfoot disease, which is characterized by the progressive loss of circulation in hands and feet (ATSDR 2007a).

Arsenic has been shown to accumulate in plants and some animals; however, it does not appear to biomagnify in food chains (ATSDR 2007a; CCME 2001a; CCME 2001b).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. For arsenic, separate oral (ingestion) and inhalation TRVs derived from pathway-specific toxicological studies were available; however, no dermal TRVs were available. Therefore, the dermal TRV for arsenic in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system.

Tables B and C below summarize the TRVs used in HHRA calculations.

Table B Human Carcinogenic TRVs for Exposure to Arsenic

COPC	Carcinogenic TRVs						
	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1-}$	Inhalation Unit Risk $(mg/m^3)^{-1}$	Source
Arsenic	1.5	IRIS	Use oral TRV	-	27	4.3	IRIS
Arsenic	1.8	Health Canada	Use Oral TRV	-	27	6.4	Health Canada

The principal studies (Tseng 1977; Tseng et al. 1968) used to derive the oral slope factor for arsenic for the USEPA was based on the ingestion of drinking water by humans resulting in skin cancer. The extrapolation method used to derive the oral slope factor was both time- and dose-related formulation of a multistage model (USEPA 2017).

The principal study used by Health Canada was Morales et al (2000), where 0.3 ug/L was considered to pose negligible risk (95th confidence interval of the lifetime risk is 1.9×10^{-6} to 13.9×10^{-6}) was the basis of the slope factor. Health Canada (2005) concluded that a Poisson model recommended by the US. EPA (2001) and fit by Morales et al (2000) with an external unexposed comparison population is the most appropriate for estimating the cancer risks associated with the ingestion of arsenic in drinking water. Health Canada (2005) adopted assumptions similar to those of the US EPA (2001) regarding the choice of risk metric, however, they also applied the use of a southwestern Taiwanese to Canadian conversion factor based on skin cancer.

The principal studies (Brown and Chu 1983; Lee-Feldstein 1983; Enterline and Marsh 1982) used to derive the inhalation unit risk/ slope factor for arsenic were based on the occupational inhalation of contaminated air resulting in lung cancer. The extrapolation method used to derive the inhalation unit risk was an absolute-risk linear model (USEPA 2017).

Table C Human Non-Carcinogenic TRVs for Exposure to Arsenic

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Source	Dermal RfD (mg/kg-day)	Source	Inhalation RfC (mg/m^3)	Source
Arsenic	1.0×10^{-3}	RIVM	Use oral TRV	-	1.0×10^{-3}	RIVM

RIVM (2001) derived a tolerable daily intake (TDI) of 0.001 mg/kg-day for critical effects on the skin in humans. This value is based on a NOAEL of 0.0021 mg/kg-day that was derived by Vermeire et al. (1991) from the World Health Organization provisional maximum tolerable weekly intake (PTWI) of organic arsenic of 15 mg/kg bw/week for adults of 70 kg of body weight. This PTWI was derived from a LOAEL of chronic intake of 100 ug arsenic/L in drinking water by humans, assuming a daily intake of drinking water of 1.5 L/day. RIVM used uncertainty factor of 2 to compensate for observation errors in an epidemiological study. Thus, the TDI is derived as follows: (100 ug arsenic/L x 1.5 L/day) / (70 kg) / (2) = 1 ug/kg-day (0.001 mg/kg-day).

RIVM notes that lung cancer occurs in humans at concentrations greater than 0.01 mg/m^3. However, RIVM indicates that the mechanism for tumors is not directly genotoxic, so a threshold exists for this effect. Therefore, RIVM elected to call the value a TCA, not a cancer risk value, and applied an uncertainty factor of 10 to account for intrahuman variability (Blom et al., 1985; Lagerkvist et al., 1984).

1.4 Barium

Barium (Ba) is a highly reactive alkaline earth metal that has one stable oxidation state (+2) and only occurs in a combined state in nature (ATSDR 2007b). It has a molecular weight of 137.327 g/mol and a density of 3.62 g/cm^3. Barium is highly reactive with water and is therefore considered insoluble in water. Due to its reactivity, barium is found in the environment combined with carbon, chlorine, oxygen, and/or sulphur to form inorganic and organic compounds. Human exposure to barium can occur through inhalation of soil particles in air, ingestion of contaminated food, sediment or soil, and dermal contact with water, soil or sediment. The primary source of exposure for the general population is typically from drinking water and food; however, soil particles in air are an important exposure route in mining operations and in the processing industry (ATSDR 2007b). The absorption of ingested inorganic arsenic in humans depends upon the solubility of the compound. Studies report barium absorption ranges from approximately 1 to 60% (ATSDR 2007b). Acid soluble barium compounds may be absorbed more readily than other forms. The absorption of inhaled barium depends upon the solubility and particle size. Animal studies indicate that 50 to 75% of barium chloride and barium sulphate is absorbed in the respiratory tract (ATSDR 2007b). Barium is not expected to be absorbed through the skin (ATSDR 2007b). Exposure to barium may result in a wide-range of non-carcinogenic effects in a variety of organ systems, including cardiovascular, respiratory, developmental, gastrointestinal, hematological, hepatic, and musculoskeletal (ATSDR 2007b). The primary target organs for barium are the cardiovascular (heart and vessels), gastrointestinal and reproductive systems (ATSDR 2007b).

Barium has been shown to accumulate in plants and some aquatic organisms; however, it is not expected to biomagnify in food chains (ATSDR 2007b; CCME 2013).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. Separate TRVs derived from pathway-specific toxicological studies were not available for barium in IRIS. The dermal TRV for barium in this risk assessment is based on the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. The inhalation TRV for barium in this risk assessment is also based on the oral TRV, using an inhalation absorption factor of 100%. Table D below summarize the TRVs used in HHRA calculations.

Table D Human Non-Carcinogenic TRVs for Exposure to Barium

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Barium	0.2	Health Canada	Use oral TRV	-	$1x10^{-3}$	RIVM
	0.2	USEPA	Use oral TRV	-	Use oral TRV	-

The principal study (USEPA 2005) used to derive the Health Canada oral reference dose was based on the chronic oral exposure of mice and rats to barium in drinking water resulting in renal lesions. A benchmark dose of 63 mg/kg-day was used for TRV derivation. The uncertainty factor applied was 300 to account for database deficiencies (3), interspecies differences (10), and intraspecies variation (10) (Health Canada 2010).

The principal study (Health and Safety Executive 1997) used to derive the RIVM inhalation reference concentration was based on the chronic inhalation exposure of rats to barium resulting in cardiovascular effects. A NOAEC of 0.11 mg/m^3 was used for TRV derivation. The uncertainty factor applied was 100 to account for interspecies differences (10) and intraspecific variation (10) (RIVM 2001).

The USEPA updated the barium oral RfD in 2005. The principal study (NTP 1994) used to derive the oral reference dose for barium was based on the ingestion of drinking water resulting in nephropathy (i.e., renal lesions) in mice. The benchmark dose predicted to affect 5% of the population (BMD_{05}) used in the derivation was 63 mg/kg-day. The uncertainty factor applied was 300 to account for database deficiencies (3) and to account for intraspecific variation (10) and interspecific variation (10) (i.e., sensitive populations) (USEPA 2017).

1.5 Bismuth

Bismuth (Bi) is a greyish-white, brittle, lustrous metal with a molecular weight of 208.98 g/mol and a density of 9.78 g/cm^3 (Fowler et al. 2015; HSDB 2017b). Bismuth occurs in two main oxidation states (+3 and +5) (Fowler et al. 2015; Salminen 2005). Elemental bismuth is reactive with and insoluble in water; however, in the presence of oxygen and water, bismuth is readily oxidized and generally exists as inorganic and organic compounds with a wide-range of water solubility (Fowler et al. 2015; HSDB 2017b; Salminen 2005).

The primary sources of exposure to bismuth is typically from cosmetics, pharmaceuticals and dust at workplaces where bismuth is processed or handled. The absorption of ingested bismuth in humans is considered to be poor (NRC 2005; HSDB 2017b). The extent of absorption of inhaled bismuth depends on solubility and particle size.

Bismuth compounds are poorly soluble and poorly absorbed with limited bioavailability, toxicity is likely to occur via the intake of pharmaceuticals containing bismuth (Fowler et al. 2005; NRC 2005). Exposure to elevated concentrations of bismuth may result in a neurological and renal toxicity (HSDB 2017b). The primary target organ for bismuth toxicity is the nervous system. Exposure to high doses of bismuth may result in death, encephalopathy, and kidney failure; whereas, chronic exposure to low doses may result in memory loss, depression, mucosal lesions, nausea, vomiting, diarrhea, and discoloration of skin (HSDB 2017b). People with kidney or liver disease may be susceptible to bismuth toxicity (HSDB 2017b).

Bismuth concentrations are low in the environment and in animal tissues and has been shown to not accumulate in laboratory studies; therefore, it is not considered to biomagnify in food chains (NRC 2005).

1.6 Boron

Boron is a metalloid with a molecular weight of 10.81 g/mol and a density of 2.31 to 2.46 g/cm^3 (ATSDR 2010; CCME 2009a). Boron occurs in two main oxidation states as elemental (0) and trivalent (+3) boron; however, elemental boron does not occur in nature (ATSDR 2010; CCME 2009a; HSDB 2017c). Inorganic and organic boron compounds have a wide-range of water solubility (ATSDR 2010; CCME 2009a; HSDB 2017c). Boron and most of its compounds have no reported octanol–water partition coefficients in ATSDR (2010), except for boric acid which has a value of 0.175. Most boron compounds are non-volatile with no reported vapour pressure and no Henry's constant (ATSDR 2010).

The primary sources of exposure to boron is typically from ingestion of food (boron is essential in plants), inhalation of contaminated workplace air, through damaged skin (ATSDR 2010). The absorption of ingested boron in humans depends upon the solubility of the compound (ATSDR 2010). The extent of absorption of inhaled boron depends on solubility and particle size. Dermal absorption of boron depends on the solubility of the compound and the absorption rate is considered to be very low for intact skin; however, boron is readily absorbed through damaged skin (ATSDR 2010).

No association has been found between the occurrence of cancer in humans and occupational exposure to boron (ATSDR 2010). Exposure to elevated concentrations of boron may a wide-range of non-carcinogenic effects to various organ systems, including gastrointestinal, nervous, hepatic, reproductive, renal, and cardiovascular (ATSDR 2010). The primary target organs for boron toxicity identified in animal studies were the respiratory tract and reproductive system (specifically with respect to fetal development) (ATSDR 2010). Exposure to high doses of boron may result in death, vomiting, diarrhea, dermatitis, erythema, respiratory failure, renal failure, and cardiac insufficiency; whereas, chronic exposure to low doses may result in irritation of nose, throat and eyes (ATSDR 2010).

Boron has been shown to accumulate in some plants; however, it does not appear to biomagnify in food chains (BCMOE 2003; CCME 2009a).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. Oral (ingestion) TRVs, derived from pathway-specific toxicological studies, were available for boron from Health Canada and USEPA IRIS; however, no inhalation or dermal TRVs were available. Therefore, the dermal TRV for boron in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. No reference concentration was identified for boron; therefore, the RfC for boron was derived by multiplying the TDI/RfD by 16.5/8.3 m^3 (or =1.99 =2.0).

Table E below summarizes the TRVs used in HHRA calculations.

Table E Human Non-Carcinogenic TRVs for Exposure to Boron

COPCs	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Boron	$1.75x10^{-2}$	Health Canada	Use oral TRV	-	-	-
Boron	$2.00x10^{-1}$	USEPA	Use oral TRV	-	$4.0x10^{-1}$	Derived from RfD

The principal study (Weir and Fisher 1972) used to derive the Health Canada oral reference dose for boron was based on testicular atrophy resulting in infertility and spermatogenic arrest. A NOAEL of 8.75 mg/kg-day was selected for TRV derivation. The uncertainty factor applied was 500 to account for study limitations (5), interspecies differences (10), and intraspecies variation (10) (Health Canada 2010).

The principal studies (Price et al., 1996; Heindel et al., 1992) used to derive the USEPA oral reference dose for boron were based on decreased fetal weight (development). Results from both studies were combined and a benchmark dose of 10.3 mg/kg-day was established. The uncertainty factor applied was 66 to account for variability and uncertainty in toxicokinetics and toxicodynamics (USEPA 2017).

The principal studies used in the development of the USEPA oral TRV were two decades newer than the principal study used by Health Canada. Studies used by Health Canada and the USEPA were based on sensitive endpoints; however, the USEPA relatively lower uncertainty factor used by the USEPA due to the use of a benchmark dose approach resulted in a less conservative TRV and therefore, the USEPA oral TRV was used in the risk assessment.

1.7 Cadmium

Cadmium is a soft, silver-white lustrous metal with a molecular weight of 112.41 g/mol and a density of 8.65 g/cm^3. Cadmium typically exists in one of two oxidation states: 0 and +2. Cadmium is typically found in the environment combined with oxygen, chlorine and/or sulphur to form inorganic compounds. Cadmium (elemental) is considered insoluble in water and does not have a reported value for octanol–water partition coefficient; however, some cadmium salts are soluble with water solubility ranging from 0.00013 to 140 g/mL (CCME 2014).

Numerous rat laboratory studies on cadmium compounds have established shown a correlation between exposure and the incidence of cancer, including cancer in the prostate, testes, and lungs (CEPA 1994). Limited evidence from epidemiologic studies investigating occupational exposures has established a correlation between inhalation exposure and the incidence of lung cancer (ATSDR 2012a). Consequently, cadmium is classified as a Group II carcinogen by Health Canada, Group 1 carcinogen by the International Agency for Research on Cancer, and Group B1 probable carcinogen by the United States Environmental Protection Agency (USEPA).

In addition to carcinogenic effects, exposure to cadmium may also result in a wide-range of non-carcinogenic effects, including death. Regardless of the intake pathway, chronic cadmium exposure may lead to kidney disease and fragile bones. Respiratory effects (i.e., inflammation and pulmonary edema) have been observed following inhalation of cadmium. Epidemiological studies have reported that cadmium exposure may result in adverse effects to the reproductive, skeletal, hepatic, hematological, and immune systems (ATSDR 2012a; CEPA 1994).

Cadmium has been shown to accumulate in some plants and animals; however, it does not biomagnify in food chains (BCMOE 2015).

Toxicity Reference Values

The BC MOE recommends using toxicological reference values (TRVs) from the US EPA Integrated Risk Information System (IRIS) for human health risk assessment. Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. Separate oral (ingestion) and inhalation TRVs derived from pathway-specific toxicological studies were available for cadmium in USEPA IRIS; however, no dermal TRVs were available. Therefore, the dermal TRV for cadmium in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. Tables F and G below summarize the TRVs used in HHRA calculations.

Table F Human Carcinogenic TRVs for Exposure to Cadmium

COPCs	Carcinogenic TRVs		
	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Unit Risk $(mg/m^3)^{-1}$	Ref.
Cadmium		1.8	USEPA
	42	9.8	Health Canada

The principal study for USEPA 2017 was Thun et al (1985). This study was used to derive the inhalation unit risk for cadmium was based on the occupational inhalation of contaminated air resulting in lung and bronchus cancer. A two-stage extrapolation method was used to derive the inhalation unit risk (USEPA 2017).

The principal studies for the Health Canada 2010 Inhalation slope factor was Takenaka et al. (1983); and Oldiges et al. (1984). The estimated cadmium dose found to induce a 5% increase in the incidence of tumours (TD05), based on exposure to cadmium chloride was calculated by first fitting the multistage model to the lung tumour incidences observed by Takenaka et al. (1983; Oldiges et al., 1984), which yields a TD05 for the rat of 2.9 µg of Cd/m^3. This value was subsequently amortized to be constant over the lifetime of the rat (the exposure was 23 hours/day for 72 weeks), adjusted for the longer than standard lifetime duration of the experiment (130 weeks), and converted to an equivalent concentration in humans using standard values for the breathing volumes and body weights of rats and humans. The resultant TD05 estimated for humans is 5.1 µg of Cd/m^3. It should be noted that TD05 values derived from the lung tumour incidences observed in rats inhaling cadmium chloride, cadmium oxide dust, cadmium sulphate, and cadmium sulphide (Oldiges et al., 1989; Glaser et al., 1990) are similar, ranging from 2.7 to 12.7 µg/m^3. Health Canada derived the slope factor by dividing the TD05 by 5000.

Table G Human Non-Carcinogenic TRVs for Exposure to Cadmium

COPCs	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Cadmium	$1.00x10^{-3}$	USEPA	Use oral TRV	-	-	
	$1.00x10^{-3}$	Health Canada	Use oral TRV	-	$3.5x10^{-3}$	Derived from RfD

The principal study used to derive the oral reference dose for cadmium the USEPA (1985) was based on a toxicokinetic model predicting tissue concentrations in which proteinuria will not occur. The highest renal concentrations not associated with proteinuria is 200 ug/g wet human renal cortex. The model predicts that a NOAEL of 0.005 and 0.01 mg/kg-day from water and food, respectively. The uncertainty factor applied was 10 to account for intraspecific variation (i.e., sensitive populations) (USEPA 2017).

The principal study for Health Canada was based on Friberg et al. (1971). Oral administration of cadmium has produced hypertension in animals; the dose-response curve, however, is not monotonic. The greatest effects are observed with oral doses of 0.01 mg/day or intra-peritoneal injections of 0.0001 to 0.001 mg/kg. Doses an order of magnitude higher have little effect. Chronic exposure to airborne cadmium results in a number of toxic effects; the two main symptoms are lung emphysema and proteinuria. Emphysema appears after approximately 20 years of exposure; levels of exposure that result in disability have not been systematically determined. In one study, exposure to cadmium concentrations of 3 to 15 mg/m^3 produced emphysema. A renal disturbance that includes the excretion of low-molecular-weight proteins in the urine and an increase in amino acids, calcium, and glucose accompanies the emphysema. Study at autopsy has revealed that the principal renal effects of chronic cadmium poisoning are seen in the tubules but are pronounced only in the most severe cases. It has been proposed that the minimum critical level of cadmium in the kidney required to produce renal tubular damage is approximately 0.2 mg/g.

No reference concentration was identified for cadmium; therefore, the TC for cadmium was derived by multiplying the TDI/RfD by 16.5/8.3 m^3 (or =1.99 =2.0).

1.8 Chromium

Chromium (Cr) is a grey lustrous metal with a MW of 52.0 g/mol and a density of 7.14 g/cm^3. Chromium occurs in nine different oxidation states of which +3 and +6 are the most common (CCME 1999a). Chromium is typically found in the environment combined with oxygen, iron or chromium, such as chromite (FeOCr2O3), chromitite (Fe2O3•2Cr2O3), and crocitite (PbCrO4). Chromium can also combine carbon and hydrogen to form organic compounds. Trivalent chromium (Cr[III]) and hexavalent chromium (Cr[VI]) are the most common of nine oxidation (valence) states that chromium may have (ATSDR 2012b). Trivalent chromium is ubiquitous in the environment and the most dominant form of chromium, since it's the most thermodynamically stable form in ambient conditions (CCME 1999a). Hexavalent chromium is a strong oxidizing agent and primarily originates from anthropogenic sources (ATSDR 2012b; CEPA 1993). Hexavalent chromium is rare in nature because it's highly reactive with organic matter and other reducing substances (CCME 1999a). Chromium compounds may be highly soluble (i.e., chromic acid) or insoluble (i.e., chromium oxide) in water and generally do not have octanol–water partition coefficients (ATSDR 2012b).

The general population is predominantly exposed to chromium via inhalation pathway; whereas, occupational populations are predominantly exposed to chromium via ingestion of food. Chromium [III] is an essential nutrient and plays a role in various body functions such as enhancing absorption and metabolism of sugars, protein and fat (CEPA 1993). The absorption of ingested chromium [VI] compounds is generally more efficient (2 to 10% of dose) than chromium [III] compounds (0.5 to 3%). Absorption in the lungs appears to be more efficient than in the digestive tract, with the absorption of 12% of inhaled chromium [III] and 30% of inhaled chromium [VI] by lung tissues (ATSDR 2012b; CCME 1999a).

No association has been identified between exposure to chromium (+3) compounds and increased incidence of cancer. However, numerous epidemiologic studies investigating occupational exposures to chromium (+6) compounds have established a strong correlation between exposure and the incidence of stomach, intestinal tract and lung cancer (ATSDR 2012b). Consequently, chromium (+6) compounds are classified as a Group I carcinogen by Health Canada and Group A carcinogen (inhalation route only) by the United States Environmental Protection Agency (USEPA). Exposure to chromium may result in a wide-range of non-carcinogenic effects in a variety of organ systems. The primary target systems for chromium are the immune, renal, and respiratory (ATSDR 2012b).

Chromium has been shown to accumulate in some plants and animals; however, it does not biomagnify in food chains (BCMOE 2015; HSDB 2017d).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. An oral (ingestion) TRVs derived from pathway-specific toxicological studies was available for chromium in IRIS; however, no dermal and inhalation TRVs were not available. Therefore, the dermal TRV for chromium in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. The carcinogenic and non-carcinogenic inhalation TRVs were obtained from Health Canada and RIVM, respectively.Tables H and I below summarize the TRVs used in HHRA calculations.

Table H Human Carcinogenic TRVs for Exposure to Chromium

COPC	Carcinogenic TRVs					
	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Ref.	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Ref.	Inhalation Slope Factor $(mg/kg\text{-}d)^{-1}$	Ref.
Chromium (total)	None	NA	None	NA	46	Health Canada
Chromium (VI)	None	NA	None	NA	320	Health Canada

The principal study (Mancuso 1975) used to derive the inhalation slope factors for chromium (total and hexavalent) were based on the occupational inhalation of contaminated air resulting in lung cancer. No extrapolation method was used to derive the inhalation unit risk (Health Canada 2010).

Table I Human Non-Carcinogenic TRVs for Exposure to Chromium

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Chromium (III)	1.5	USEPA	Use oral TRV	-	$6x10^{-2}$	RIVM
Chromium (VI)	$3x10^{-3}$	USEPA	Use oral TRV	-	$1x10^{-4}$	USEPA
Chromium (total)	$1x10^{-3}$	Health Canada	Use oral TRV	-	$6x10^{-2}$	RIVM

The principal study (Ivankovic and Preussmann 1975) used to derive the oral reference dose for chromium (III) was based on a rat chronic feeding study resulting in reductions to liver and spleen weights. The NOAEL used in the derivation was 1468 mg/kg-day. The uncertainty factor applied was 100 to account for interspecies variation (10) and intraspecific variation (10) (i.e., sensitive populations) (USEPA 2017). An additional modifying factor of 10 was applied to account for database deficiencies (USEPA 2017).

The principal study used to derive the inhalation reference concentration was not specified in the source document (RIVM 2001); however, RIVM (2001) stated that the principal studies were obtained from ATSDR (1998). The studies used to derive the inhalation reference concentration for chromium (III) were based on a study involving human exposure to chromium (III) via inhalation. The NOAEC used in the derivation was 0.6 mg/m^3. The uncertainty factor applied was 10 to account for the intraspecies variation (i.e., sensitive populations) (RIVM 2001).

The principal study (MacKenzie et al 1958) used to derive the oral reference dose for chromium (VI) was based on rats ingesting chromium (VI) via drinking water resulting in reduced water consumption and elevated tissue concentrations. The NOAEL used in the derivation was 2.5 mg/kg-day. The uncertainty factor applied was 300 to account for the interspecies variation (10) (extrapolation from rats to humans), intraspecific variation (10) (i.e., sensitive populations), and for the less-than-lifetime exposure duration (3) (USEPA 2017). An additional modifying factor of 3 was applied as a result of concerns raised by another study (USEPA 2017).

The principal study (Glaser et al., 1990; Malsch et al., 1994) used to derive the inhalation reference concentration for chromium (VI) particulates was based on rat subchronic exposure to chromium (VI) via inhalation. The time-adjusted benchmark dose used in the derivation was 0.034 mg/m^3. The uncertainty factor applied was 300 to account for interspecies differences (10), the intraspecific variation (10) (i.e., sensitive populations), and the extrapolation from subchronic to chronic exposure (3) (USEPA 2017).

The principal source used to derive the Health Canada oral reference dose was the Canadian Drinking Water Quality Guidelines (Health Canada 1979; updated in 1986). Health Canada (2010) provides limited information regarding the principal studies, besides that a weight of evidence approach was used, and the mode of administration was drinking water. Details regarding laboratory conditions, species, dose regime, duration and applicable uncertainty factors were not available.

Total chromium was identified as a contaminant of potential concern for the Project; therefore, where possible TRVs derived from studies investigating total chromium or chromium (III) were preferred. Hexavalent chromium was not identified as a contaminant of potential concern for the Project. When multiple sources of TRVs were available, the Health Canada TRVs were preferentially used over values from other jurisdictions. Therefore, the Health Canada oral reference dose for total chromium was preferentially used in the risk assessment. As non-cancer inhalation TRVs was not available from Health Canada, values from other jurisdictions were considered and the RIVM inhalation reference concentration for chromium (III) were used in the risk assessment.

1.9 Cobalt

Cobalt (Co) is a silvery grey, hard metal and occurs naturally in the earth's crust (ATSDR 2004). It has a molecular weight of 58.93 g/mol and a density of 8.9 g/cm^3 (ATSDR 2004). Cobalt commonly occurs in three oxidation states: 0, +2 and +3. Cobalt occurs in a variety of inorganic and organic compounds with a wide-range of water solubility (ATSDR 2004).

Cobalt is ubiquitous in the environment at low concentrations and thus people may come into contact with it as dust in air, in drinking water, and in food. The primary source of exposure to cobalt for most people is in food (ATSDR 2004). The absorption of ingested cobalt is about 18 to 97% depending on the bioavailability of the ingested cobalt compound and body burden (ATSDR 2004). The extent of absorption of inhaled cobalt depends on bioavailability and particle size. Dermal absorption of cobalt compounds is considered to be very small (less than 1 %) (ATSDR 2004). The most bioavailable forms of cobalt are soluble compounds (ATSDR 2004).

Cobalt is an essential nutrient as it is part of vitamin B_{12} which is necessary to maintain human health (ATSDR 2004). Exposure to elevated concentrations of cobalt may result in a cardiovascular, developmental, hematological and respiratory toxicity (ATSDR 2004). The primary target organ for cobalt toxicity is the cardiovascular system. Exposure to high doses of cobalt may result in death, lung damage, liver damage, and kidney impairment and failure; whereas, chronic exposure to low doses may result in impaired vision, asthma, nausea, and vomiting (ATSDR 2004).

Cobalt has been shown to accumulate in plants and animals; however, it is not known to biomagnify in food chains (ATSDR 2004).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. An oral (ingestion) TRV, derived from pathway-specific toxicological studies, was available for cobalt from RIVM; however, no inhalation or dermal TRVs were available. Therefore, the dermal TRV for cobalt in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system.

Table J below summarizes the TRVs used in HHRA calculations.

Table J Human Non-Carcinogenic TRVs for Exposure to Cobalt

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Cobalt	$1.40x10^{-3}$	RIVM	Use oral TRV	-	$5x10^{-4}$	RIVM

The value of 1.4 µg/kg-day was derived based on a migration limit for packaging materials (RIVM 2001). Subsequent review of available toxicological information indicated that the lowest LOAEL for cobalt exposure was 0.04 mg/kg-day based on intermediate oral exposure resulting in cardiomyopathy. The uncertainty factor applied was 30 to account for using a LOAEL and for intraspecific variation (3) (i.e., sensitive populations) (RIVM 2001).

The principal study (ATSDR 1992) used to derive the inhalation reference concentration for cobalt was based on the occupational inhalation exposure resulting in interstitial lung disease. No NOAEL was observed; therefore, the LOAEL of 50 $\mu g/m^3$ was used in the derivation. The uncertainty factor applied was 100 to account for intraspecific variation (i.e., sensitive populations) (RIVM 2001).

1.10 Copper

Copper (Cu) is a noble and can be found in nature in its elemental form. Copper has four oxidation states (Cu, Cu^{+}, Cu^{+2} and Cu^{+3}) with Cu^{+2} being the most common. The molecular weight of copper is 63.546 and the density is 8.96 g/cm^3 (ATSDR 2004b Copper in its elemental form is considered insoluble in water; however, the most common forms of copper are soluble in water (i.e., copper sulphate). Copper has no reported octanol–water partition coefficients (K_{ow}). The majority of copper and its compounds are non-volatile and therefore have low or no values for vapour pressure (P_{vap}) and Henry's constant (H) (ATSDR 2004b). The Chemical abstracts service registry number for copper is 7440-50-8.

Exposure and Toxicokinetics (Absorption, Distribution, Metabolism, and Excretion)
Human exposure to barium can occur through inhalation of soil particles in air, ingestion of contaminated food, sediment or soil, and dermal contact with water, soil or sediment. The primary source of exposure for the general population is typically from drinking water (ATSDR 2004b). Copper is readily absorbed in the gastrointestinal tract and transported throughout the body as a conjugate with metallothionein (ATSDR 2004b). Absorption of copper in the lungs is not well understood; however, copper absorption in across the skin is considered to be poor (ATSDR 2004b).

Toxicity
Copper is an essential nutrient and is incorporated in enzymes responsible for hemoglobin formation, biotransformation, energy metabolism, and antioxidant defense. No association has been found between the occurrence of cancer in humans and occupational exposure to copper (ATSDR 2004b). Exposure to antimony may result in a wide-range of non-carcinogenic effects in a variety of organ systems, including, respiratory, developmental, gastrointestinal, hematological, and reproduction (ATSDR 2004b). The primary targets systems for copper toxicity are the gastrointestinal, hematological and hepatic (ATSDR 2004b).

Toxicity Reference Values
The BC MOE recommends using toxicological reference values (TRVs) from the US EPA Integrated Risk Information System (IRIS) for human health risk assessment. Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. Separate TRVs derived

from pathway-specific toxicological studies were not available for lead in IRIS; therefore, oral TRVs were obtained from Health Canada (HC) and Netherland's National Institute of Public Health and the Environment (RIVM). The dermal TRV for copper in this risk assessment is based on the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. The inhalation TRV for copper in this risk assessment is also based on the oral TRV, using an inhalation absorption factor of 100%.

Table K below summarize the TRVs used in HHRA calculations.

Table K Human Non-Carcinogenic TRVs for Exposure to Copper

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Copper	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	Health Canada	Use oral TRV	-	1.00E-03	Derived from RfD

The principal study (Vermeire et al. 1991) used to derive the oral reference dose for copper was based on oral exposure in mice resulting in decreased body weight in mice. The LOAEL used in the derivation was 4.2 mg/kg-day. A margin of safety of 30 was applied, since the typical uncertainty factors accounting for interspecies and intraspecies variation resulted in a lower TDI than the recommended essential nutrient dose (RIVM 2001).

RIVM derived a tolerable concentration in air (TC) of 0.001 (1E-3) mg/cu.m based on a NOAEC of 0.6 mg/cu.m for lung and immune system effects in rabbits from a short-term toxicity study (Johansson et al., 1984, as cited in ATSDR, 1990). RIVM used an uncertainty factor of 100 (10 each for intra- and interspecies variability), and a factor of 6 (5/7 x 6/24) to adjust for continuous exposure.

1.11 Iron

Iron (Fe) is a white or grey, soft, malleable and ductile metal and the fourth most abundant element in the earth's crust (HSDB 2017e). It has a molecular weight of 55.85 g/mol and a density of 7.86 g/cm^3 (BCMOE 2008a; HSDB 2017e). Iron occurs in three oxidation states: 0, +2 and +3; however, pure iron is highly reactive with water and generally occurs in a variety of inorganic and organic compounds with a wide-range of water solubility (BCMOE 2008a).

The primary source of exposure to iron is typically from food. Iron is an essential nutrient and thus, its uptake, storage, and excretion are highly regulated (HSDB 2017e). The absorption of ingested iron is about 2 to 15% depending on the bioavailability of the ingested iron compound and body burden (HSDB 2017e). The extent of absorption of inhaled iron depends on bioavailability and particle size. No information was available regarding dermal absorption of iron compounds. The most bioavailable forms of iron are soluble compounds such as ferrous sulfate (HSDB 2017e). Once absorbed, iron is distributed throughout the body, stored in the blood, macrophage (reticuloendothelial) system, liver and muscle, and primarily excreted in urine and feces (HSDB 2017e).

Iron is an essential nutrient that plays a vital role in the function of numerous proteins and enzymes such as hemoglobin in red blood cells (HSDB 2017e). Nutrient deficiency may also exhibit toxic effects, such as anemia in which the iron content in red blood cells is low resulting in reduced oxygen uptake and numerous symptoms including fatigue, weakness, shortness of breath, confusion, thirst, impaired immune system, and loss of consciousness (HSDB 2017e).

Exposure to elevated concentrations of iron may a wide-range of non-carcinogenic effects to various organ systems, including gastrointestinal, cardiovascular, nervous, hepatic, and reproductive systems (HSDB 2017e). The primary target organs for iron toxicity include the lungs, gastrointestinal tract and reproductive system (specifically with respect to fetal development) (HSDB 2017e).

As iron is an essential nutrient to plants and animals, it is highly regulated and will accumulate in tissues; however, excess iron is readily excreted in healthy organisms and thus, it does not appear to biomagnify in food chains (BCMOE 2008a; HSDB 2017e; USEPA 2003).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. An oral (ingestion) TRV, derived from pathway-specific toxicological studies, was available for iron from Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV); however, no inhalation or dermal TRVs were available. Therefore, the dermal TRV for iron in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. No reference concentration was identified for iron; therefore, the RfC for iron was derived by multiplying the TDI or RfD by 16.5 kg/8.3 m^3 (or 2.0). In many jurisdictions the adult body weight and inhalation is employed however; to better capture all age groups the toddler body weight and inhalation rate was used. This resulted in a TC that was approximately 2 times more conservative.

Table L below summarizes the TRVs used in HHRA calculations.

Table L Human Non-Carcinogenic TRVs for Exposure to Iron

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Iron	$7.00x10^{-1}$	PPRTV	Use oral TRV	PPRTV	2.45	Derived from RfD

The principal study (Frykman et al. 1994) used to derive the PPRTV oral reference dose for iron was based on human subchronic oral exposure resulting in gastrointestinal effects. The LOAEL of 1 mg/kg-day was used in the derivation. The uncertainty factor applied was 1.5 to account for use of a LOAEL (USEPA 2006).

No reference concentration was identified for iron; therefore, the TC for cadmium was derived by multiplying the TDI/RfD by 16.5/8.3 m^3 (or =1.99 =2.0).

1.12 Lead

Lead (Pb) is a soft, dense, lustrous bluish-grey metal that occurs naturally in earth's crust (HSDB 2017f). It is rarely found in its elemental form in nature. The molecular weight of lead is 207.20 and the density is 11.34 g/cm^3 (ATSDR 2007c). Lead has three oxidation states (0, +2, and +4) with the divalent (+2) form being the most common. Lead rarely exists in its elemental form and is to be considered insoluble in water; however, most lead compounds are soluble in water (i.e., lead nitrate). Lead and its compounds have no reported octanol–water partition coefficients in ATSDR (2007c).

No association has been found between the occurrence of cancer in humans and occupational exposure to lead (ATSDR 2007c). Exposure to lead may result in a wide-range of non-carcinogenic effects in a variety of organ systems, including cardiovascular, developmental, gastrointestinal, hematological, musculoskeletal, neurological, ocular, urinary, and reproduction (ATSDR 2007c). The primary target organ for lead is the nervous system. Children are particularly sensitive to lead toxicity. Exposure to high doses of lead may result in death and severe brain and kidney damage; whereas, chronic exposure to low doses may result in decreased cognitive and musculoskeletal performance (ATSDR 2007c).

Lead has been shown to bioaccumulate in plants and animals; however, it has not been reported to biomagnify in food chains (ATSDR 2007c; Wixson and Davis 1993; Eisler 1988). The primary uptake route for lead in plants is through roots where it generally remains bound, as the translocation of lead in plants is limited. The highest lead concentrations in aquatic organisms are usually observed in lower trophic level benthic organisms and algae; whereas, the lowest lead concentrations are observed in the upper trophic level organisms such as carnivorous fishes (Eisler 1988). Lead tends to concentrate in bone tissue rather than soft tissue, which minimizes the movement to higher trophic levels in the food chain and thus, lead is not considered to biomagnify (ATSDR 2007c; Stansley and Roscoe 1996).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. Separate TRVs derived from pathway-specific toxicological studies were not available for lead in IRIS or Health Canada; therefore, an oral TRV was obtained from Netherland's National Institute of Public Health and the Environment (RIVM). The dermal TRV for lead in this risk assessment is based on the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. No inhalation TRV was identified for lead; therefore, the RfC for lead was derived by dividing multiplying the RfD by 70 kg/20 m^3 (or 3.5).

Table M below summarizes the TRVs used in HHRA calculations.

Table M Human Non-Carcinogenic TRVs for Exposure to Lead

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Lead	Infants, Toddlers & Children: $6.0x10^{-4}$ Teens & Adults: $1.5x10^{-3}$	Wilson and Richardson 2012	Use oral TRV	Wilson and Richardson 2012	$2.10x10^{-3}$ $5.25x10^{-3}$	Derived from RfD
Lead	$3.60x10^{-3}$	RIVM	Use oral TRV	RIVM	-	-

The principal source (WHO 2011) used to derive the Wilson and Richardson oral reference dose for lead was based on measured blood lead levels resulting in a one intelligence quotient point decrement. The risk specific dose used in the derivation was 0.6 µg/kg-day based on infants, toddlers and children. A modified risk specific dose for teens and adults was obtained by taking into account the fact that adults oral absorption of lead is approximately 40% of children, which produces a risk specific dose of 1.5 µg/kg-day. Information regarding the application of uncertainty factors was not available (Wilson and Richardson 2012).

The RIVM tolerable daily intake, used as the reference dose, was directly derived from the World Health Organization (WHO) recommendation of 25 mg/kg per week for lead, which is based on a threshold value of 50 µg/L in blood (RIVM 2001). This value is based on the protection of fetuses and children. In 1997, the Health Council of the Netherlands estimated the background exposure of lead was 2.0 µg/kg per day resulting from intake of food, water, soil, soil dust and air for children aged 1 to 4 year(s) of age (RIVM 2001).

No reference concentration was identified for lead; therefore, the TC for lead was derived by multiplying the TDI/RfD by the (receptor specific body weight)/(receptor specific inhalation rate).

1.13 Manganese

Manganese (Mn) is a grey-white solid with no odour that dissolves readily in mineral acids. It has a molecular formula of manganese, a molecular weight of 54.94 g/mol and a density of 7.47 g/cm^3 (at 20ºC). Manganese is non-volatile and insoluble (ATSDR 2012c). Manganese is ubiquitous in the environment, and human exposure arises from both natural and anthropogenic activities. The chemical abstracts service registry number for manganese is 7439-96-5.

Human exposure to manganese can occur through inhalation of air particles, ingestion of contaminated food, sediment or soil, and dermal contact with water, soil or sediment. The primary source of exposure to manganese is typically from food and water (ATSDR 2012c; Health Canada 1979). The manganese ingested from food and drinking water is easily absorbed in the gastrointestinal tract (ATSDR 2012c; Health Canada 1979). The absorption of inhaled manganese depends upon the solubility and particle size. Once absorbed, manganese is distributed widely throughout the body. Homeostatic mechanisms are in place that control the amount of manganese in the body. The primary means of elimination is via the liver bile (ATSDR 2012c; Health Canada 1979).

Manganese is an essential nutrient and is incorporated in enzymes responsible for carbohydrate metabolism, lipid and sterol metabolism and oxidative phosphorylation. Manganese deficiencies can result in central nervous system effects (ATSDR 2012c; Health Canada 1979). No association has been found between the occurrence of cancer in humans and exposure to most forms of selenium (ATSDR 2012c; Health Canada 1979). Manganese is regarded as one of the least toxic elements; however, exposure to excess manganese, such as the inhalation of dust from industrial sources, may result in reduction of iron into hemoglobin, neurological effects and pneumonitis (ATSDR 2012c; Health Canada 1979).

As manganese is an essential nutrient to plants and animals, it is highly regulated and will accumulate in tissues; however, excess manganese is readily excreted in healthy organisms and thus, it does not appear to biomagnify in food chains (WHO 2004).

Toxicity Reference Values

The BC MOE recommends using toxicological reference values (TRVs) from the US EPA Integrated Risk Information System (IRIS) for human health risk assessment. Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. An oral (ingestion) TRVs was available in IRIS derived from pathway-specific (assumed based on primary route of exposure) toxicological epidemiological studies were available for manganese from Health Canada. No dermal TRVs were available; therefore, the dermal TRV for manganese in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system.

Table N below summarize the TRVs used in HHRA calculations.

Table N Human Non-Carcinogenic TRVs for Exposure to Manganese

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Manganese	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	Health Canada 2010	Use oral TRV	-	infant = 5.03E-01 toddler = 2.70E-01 child = 2.77E-01 teen = 5.43E-01 adult = 6.64E-01	Derived from RfD

The principal study (Greger 1999) used to derive the oral reference dose for manganese was based on human epidemiological studies involving elevated manganese exposures from food and water. The primary toxic effect in these studies was Parkinsonian-like neurotoxicity (Health Canada 2010). The NOAEL (food) used in the derivation was 11 mg/kg-day. No uncertainty factors were applied (Health Canada 2010).

No reference concentration was identified for manganese; therefore, the TC for manganese was derived by multiplying the TDI/RfD by the (receptor specific body weight)/(receptor specific inhalation rate).

1.14 Mercury

Mercury (Hg) is a metal with silver-white colour as a liquid (at room temperature). It has a molecular weight of 200.59 g/mol and a density of 13.534 g/cm^3. Mercury exists in one of three stable oxidation states: 0, +1 and +2. Mercury has a low water solubility (0.28 moles/L) and a log octanol–water partition coefficient of 5.95 (ATSDR 1999). Mercury is typically found in the environment combined with oxygen, chlorine and/or sulphur to form inorganic compounds.

Exposure to elemental mercury has not been shown to result in cancer (ATSDR 1999; USEPA 2017). Numerous epidemiologic studies investigating occupational exposures to various forms of inorganic and organic mercury compounds have established a correlation between exposure and the incidence of cancer in laboratory studies; however, insufficient evidence is available for humans (ATSDR 1999; USEPA 2017). Consequently, inorganic and organic mercury compounds are classified as Group 3 (inorganic mercury) or Group 2B (methylmercury) carcinogen by the International Agency for Research on Cancer (IARC), and Group C, a possible human carcinogen, by the United States Environmental Protection Agency (USEPA). Health Canada has no classified mercury as to its potential carcinogenicity.

Exposure to mercury may result in a wide-range of non-carcinogenic effects on the nervous system, kidneys, stomach, intestines, development, immune system, reproductive system, cardiovascular system and death (ATSDR 1999).

Mercury has been shown to accumulate in plants and animals and biomagnify in food chains (BCMOE 1989; CCME 1999).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. Separate oral (ingestion) and inhalation TRVs derived from pathway-specific toxicological studies were available for mercury in IRIS; however, no dermal TRVs were available. Therefore, the dermal TRV for mercury in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. No inhalation TRVs were identified for mercury; therefore, the RfC for mercury was derived by dividing multiplying the RfD by 70 kg/20 m^3 (or 3.5).

Table O below summarizes the TRVs used in HHRA calculations.

Table O Human Non-Carcinogenic TRVs for Exposure to Mercury

COPCs	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	**Ref.**	**Dermal RfD (mg/kg-day)**	**Ref.**	**Inhalation RfC (mg/m^3)**	**Ref.**
Mercury, inorganic	$3x10^{-4}$	Health Canada 2010	Use oral TRV	USEPA IRIS	-	-
Mercury, inorganic	$3x10^{-4}$	USEPA IRIS	Use oral TRV	USEPA IRIS	$3x10^{-4}$	IRIS
Methylmercury	infant = $2.0x10^{-4}$ toddler = $2.0x10^{-4}$ child = $2.0x10^{-4}$ teen = $4.7x10^{-4}$ adult = $4.7x10^{-4}$	Health Canada 2010	Use oral TRV	Health Canada 2010	Use oral TRV	-
Methylmercury	$1x10^{-4}$	IRIS	Use oral TRV	-		

The principal studies (Fawer et al 1983; Piikivi and Tolonen 1989; Piikivi and Hanninen 1989; Piikivi 1989; Ngim et al 1992; Liang et al 1993) used to derive the inhalation reference concentration for elemental mercury was based on occupation inhalation resulting in hand tremors, increases in memory disturbance, and automatic dysfunction (USEPA 2017). No NOAEL was observed; therefore, the LOAEL of 0.009 mg/m^3 (based on LOAEL of 0.025 mg/m^3) was used in the derivation. The uncertainty factor applied was 30 to account for database deficiencies (3) and intraspecific variation (10) (i.e., sensitive populations) (USEPA 2017).

The principal studies (Druet et al. 1978; Bernaudin et al. 1981; Andres 1984) used to derive the Health Canada oral reference dose for inorganic mercury was based on ingestion and subcutaneous rat exposures resulting in nephrotoxicity and neurotoxicity. The LOAEL values used in the derivation were 0.226, 0.317, and 0.633 mg/kg-day. The uncertainty factor applied was 1000 to account for the use of subchronic studies (10), interspecies differences (10), and the use of LOAEL (10) (Health Canada 2010).

The principal studies (US EPA 1987) used to derive the USEPA oral reference dose for inorganic mercury was based on ingestion and subcutaneous rat exposures resulting in autoimmune effects. No NOAEL values were available. The LOAEL values used in the derivation were 0.226, 0.317, and 0.633 mg/kg-day. The uncertainty factor applied was 1000 to account for extrapolating from subchronic to chronic exposures (10), interspecies differences (10) and intraspecific variation (i.e., sensitive populations) (USEPA 2017).

The principal source (Health Canada Food Directorate 2007) used to derive the oral reference dose for methylmercury was based on epidemiological studies where accidental poisoning and chronic low-level exposures of methylmercury occurred in populations with high consumption of fish. The approximate threshold of 10 ppm in maternal hair, equivalent to 0.001 mg/kg-day, was used in the derivation of the oral reference dose. The uncertainty factor applied was 5 to account for intraspecies variation (i.e., to protect women of child-bearing age and young children) (Health Canada 2010).

The principal study (Grandjean et al 1997; Budtz-Jorgensen et al 1999) used to derive the oral reference dose for methylmercury was based on epidemiological studies involving the ingestion of methylmercury resulting in developmental neuropsychological impairment. The benchmark dose range of 46 to 79 ppb was used in the derivation, which corresponded to daily intakes ranging from 0.857 to 1.472 µg/kg-day. The uncertainty factor applied was 10 to account for intraspecific variation (i.e., sensitive populations) (USEPA 2017).

1.15 Nickel

Nickel (Ni) is a hard, silvery white, lustrous metal that occurs naturally in earth's crust. It has a molecular weight of 58.69 g/mol and a density of 8.91 g/cm^3. Nickel has six oxidation states (-1, 0, +1, +2, +3, and +4); however, the most relevant oxidation state in the environment is +2 (CCME 2015). Nickel compounds have a wide-range of water solubility, including insoluble compounds such as nickel cyanide, and highly soluble compounds such as nickel chloride (CCME 2015).

The primary source of exposure to nickel is typically from food (ATSDR 2005a). The absorption of ingested nickel in humans ranges from 3% to 40% depending on the form and solubility of the compound. The absorption of inhaled nickel ranges from 20% to 35%, varying with particle size and solubility.

Numerous epidemiologic studies investigating occupational exposures to nickel refinery dust has established a strong correlation between exposure and the incidence of lung cancer and nasal tumours (USEPA 2017). Consequently, nickel refinery dust is classified as a Group I carcinogen by Health Canada (HC), Group 1 carcinogen by the International Agency for Research on Cancer (IARC), and Group A carcinogen by the United States Environmental Protection Agency (US EPA).

Non-carcinogenic effects resulting from exposure to nickel vary with the uptake route, since nickel and its compounds often elicit contact dermatitis (allergic reaction which is thought to affect 10% to 20% of the general public); moreover, lung inflammation may follow inhalation of nickel and its compounds (ATSDR 2005a). A wide-range of non-carcinogenic adverse effects have been documented in association with human oral ingestion of nickel compounds, including gastrointestinal upset and neurological symptoms. Animal studies have shown that nickel oral exposure may result in adverse effects to development, growth, reproduction and survival (ATSDR 2005a).

Nickel has been shown to accumulate in plants and some animals; however, it does not appear to biomagnify in food chains (ATSDR 2005a; CCME 2015).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. An oral (ingestion) TRV derived from pathway-specific toxicological studies was available for nickel in IRIS; however, no dermal or inhalation TRVs were available. Therefore, the dermal TRV for nickel in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. The oral TRV was used as the inhalation TRV, conservatively assuming 100% absorption. Tables P and Q below summarize the TRVs used in HHRA calculations.

Table P Carcinogenic TRVs for Exposure to Nickel

COPC	Carcinogenic TRVs					
	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Ref.	Dermal Slope Factor (mg/kg-day)	Ref.	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Ref.
Nickel	-	-	-	-	3.0	Health Canada 2010

The principal study used to derive the inhalation slope factor for nickel, involved the occupational and cohort inhalation of nickel resulting in lung, nasal, kidney, prostate and mouth cavity cancers. The extrapolation method used was not provided by Health Canada (2010).

Table Q Human Non-Carcinogenic TRVs for Exposure to Nickel

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Nickel	2.00×10^{-2}	IRIS	Use oral TRV	IRIS	1.4×10^{-5}	CalEPA
Nickel	1.10×10^{-2}	Health Canada 2010	Use oral TRV	Health Canada 2010	2.00×10^{-5}	Health Canada 2010

The principal study (Ambrose et al. 1976) used to derive the oral reference dose for nickel was based rat exposed to soluble nickel salts in their diet resulting in decreased body and organ weight. The NOAEL used in the derivation was 8×10^{-4} mg/kg-day. The uncertainty factor applied was 300 to account for the lack of database deficiencies (3) and to account for interspecific (10) and intraspecific variation (10) (i.e., sensitive populations) (USEPA 2017).

The principal study (WHO 2005) used to derive the oral reference dose for nickel was based on rats exposed to nickel in drinking water resulting in post-implantation perinatal lethality. The NOAEL used in the derivation was 1.1 mg/kg-day. The uncertainty factor applied was 100 to account for interspecific (10) and intraspecific variation (10) (i.e., sensitive populations) (Health Canada 2010).

The principal studies (Benson et al. 1990; Dunnick et al. 1989) used to derive the inhalation reference concentration for nickel was based on rats and mice exposed to nickel in air. The NOEL (mice) and LOAEL (rats) was 0.1 mg/m^3. The uncertainty factor applied was 1000 to account for using less than subchronic exposure (10), interspecific (10) and intraspecific variation (10) (i.e., sensitive populations) (Health Canada 2010).

1.16 Selenium

Selenium (Se) is a black, grey or red non-metal solid element with chemical properties similar to sulphur (ATSDR 2003). It has a molecular weight of 72.96 g/mol and a density of 4.39 g/cm^3 (red), 4.81 g/cm^3 (grey), or 4.28 g/cm^3 (black) g/cm^3. Selenium typically exists in one of four oxidation states: -2, 0, +4 and +6.

Selenium is an essential nutrient and is incorporated in enzymes responsible for antioxidant defense (ATSDR 2003; BCMOE 2014). The margin between toxicity and essentiality of selenium is very narrow (BCMOE 2014). Selenium deficiencies can result in cardiovascular disease (i.e., enlarged heart, congestive heart failure), muscle pain, Kashin-Beck disease (atrophy, degeneration and necrosis of cartilage), loss of immunocompetence, and risk of miscarriage

(ATSDR 2003; BCMOE 2014). No association has been found between the occurrence of cancer in humans and exposure to most forms of selenium; moreover, studies have shown that exposure to selenium may reduce the risk of cancer (ATSDR 2003). One selenium compound, selenium sulphide, has been shown to cause cancer in animals and is considered to be a probable human carcinogen by the US EPA; however, selenium is not considered to be a carcinogen by Health Canada (ATSDR 2003; CCME 2009b). Selenium sulphide does not occur in food, does not dissolve in water and is considered to be safe for dermal exposure (i.e., commonly used in anti-dandruff shampoo) (ATSDR 2003). Exposure to excess selenium may result in non-carcinogenic effects to the respiratory and reproduction systems (ATSDR 2003).

Selenium has been shown to accumulate in plants and animals and biomagnify in food chains (ATSDR 2003; BCMOE 2014).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. An oral (ingestion) TRVs was available in IRIS derived from pathway-specific (assumed based on primary route of exposure) toxicological studies. No dermal TRVs were available; therefore, the dermal TRV for selenium in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. No inhalation TRVs were identified for selenium; therefore, the RfC for selenium was derived by dividing multiplying the RfD by 70 kg/20 m^3 (or 3.5). Tables R below summarize the TRVs used in HHRA calculations.

Table R Human Non-Carcinogenic TRVs for Exposure to Selenium

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	**Ref.**	**Dermal RfD (mg/kg-day)**	**Ref.**	**Inhalation RfC (mg/m^3)**	**Ref.**
Selenium	infant = 5.5 $x10^{-3}$ toddler = 6.2 $x10^{-3}$ child = 6.3 $x10^{-3}$ teen = 6.2 $x10^{-3}$ adult = 5.7 $x10^{-3}$	Health Canada 2010	Use oral TRV		infant = $2.1x10^{-2}$ toddler = 1.2 $x10^{-2}$ child = 1.4 $x10^{-2}$ teen = 2.4 $x10^{-2}$ adult = 2.4 $x10^{-2}$	Derived from RfD

The principal study (Yang 1989) used to derive the oral reference dose for selenium was based on the blood tissue level of individuals living in an area with unusually high environmental concentrations of selenium. The selenium dose was estimated based on environmental, food and blood tissue concentrations. Toxic effects of selenosis included liver dysfunction, loss of hair and nails, and morphological changes of nails. The NOAEL used in the derivation was 0.015 mg/kg-day. The uncertainty factor applied was 3 to account for intraspecific variation (i.e., sensitive populations) (IRIS 2015).

No reference concentration was identified for selenium; therefore, the TC for selenium was derived by multiplying the TDI/RfD by the (receptor specific body weight)/(receptor specific inhalation rate).

1.17 Strontium

Strontium is a natural and commonly occurring element. Strontium can exist in two oxidation states: 0 and +2. Under normal environmental conditions, only the +2 oxidation state is stable enough to be important. Pure strontium is a hard, white-colored metal, but this form is not found in the environment (ATSDR 2004). Strontium is found nearly everywhere in small amounts, and you can be exposed to low levels of strontium by breathing air, eating food, drinking water, or accidentally eating soil or dust that contains strontium. Food and drinking water are the largest sources of exposure to strontium (ATSDR 2004). Because of the nature of strontium, some of it gets into fish, vegetables, and livestock. Grain, leafy vegetables, and dairy products contribute the greatest percentage of dietary strontium to humans (ATSDR 2004).

Problems with bone growth may occur in children eating or drinking unusually high levels of strontium, especially if the diet is low in calcium and protein (ATSDR 2004). Ordinary strontium salts are not harmful when inhaled or placed on the skin (ATSDR 2004).

Animal studies showed that eating or drinking very large amounts of stable strontium can be lethal, but the public is not likely to encounter such high levels of strontium. In these unusually high amounts, so much strontium was taken into bone instead of calcium that growing bones were weakened. Strontium had more severe effects on bone growth in young animals than in adults (ATSDR 2004).

Toxicity Reference Values

USEPA have evaluated the noncancer oral toxicity data for strontium. EPA derived a reference dose (RfD) of 0.6 mg/kg-day based on a NOAEL of 190 mg/kg-day for rachitic bone observed in oral studies in rats (Storey, 1961; Marie et al., 1985; Skoryna, 1981). EPA used an uncertainty factor of 300 [10 for species-to-species extrapolation, 10 for an incomplete database (including a lack of developmental and reproductive data) and to account for uncertainties in using data for strontium carbonate to derive a risk estimate that may apply to other salts of strontium, and 3 for sensitive subpopulations]. NSF International has adopted the U.S. EPA RfD of 0.6 mg/kg-day for strontium (U.S. EPA, 1992).

No reference concentration was identified for strontium. The RfC for strontium was derived by dividing multiplying the RfD by 16.5/8.3 m^3 (or =1.99 =2.0).

1.18 Tellurium

Tellurium (Te) is a lustrous greyish-white metalloid that occurs naturally in earth’s crust. The molecular weight of tellurium is 127.60 and the density is 6.11 to 6.27 g/cm^3 (HSDB 2017g; Salminen 2005). Tellurium has four main oxidation states (-2, +2, +4 and +6). Elemental tellurium does not occur in nature and is insoluble in water; however, some tellurium compounds are soluble in water (i.e., telluric acids).

No association has been found between the occurrence of cancer in humans and occupational exposure to tellurium (HSDB 2017g). Exposure to tellurium may result in a wide-range of non-carcinogenic effects in a variety of organ systems, including skin, gastrointestinal, hematological, musculoskeletal, neurological, urinary, and respiratory systems (HSDB 2017g). The primary target organs for tellurium are the organ with first contact (i.e., lungs, gastrointestinal tract, skin) and the nervous system (HSDB 2017g). Exposure to high doses of tellurium may result in blue-black skin discolouration, headache, gastritis, somnolence, dizziness, fatigue, and lung irritation upon inhalation; whereas, chronic exposure to low doses may result in garlic breath, metallic taste, decreased sweating, dry mouth, fatigue, anorexia, and nausea (HSDB 2017g).

Tellurium is a rare earth metal and its concentration is low in the environment (HSDB 2017g). Tellurium has not been shown to not accumulate or biomagnify in food chains; however, limited studies are available investigating the fate of tellurium in food chains (HSDB 2017g).

1.19 Thallium

Thallium (Tl) is a greyish-white, soft, malleable heavy metal with a molecular weight of 204.38 g/mol and a density of 11.85 g/cm^3 (ATSDR 1992b; CCME 1999a). Thallium occurs in three main oxidation states (+1, +2 and +3) with the monovalent (+1) and trivalent (+3) being the most common (CCME 1999a). Thallium occurs naturally as inorganic and organic compounds with a wide-range of water solubility (ATSDR 1992b; CCME 1999a).

No association has been found between the occurrence of cancer in humans and occupational exposure to thallium (ATSDR 1992b). Exposure to elevated concentrations of thallium may a wide-range of non-carcinogenic effects to fetal development and various organ systems, including nervous, cardiovascular, gastrointestinal, hepatic, respiratory, ocular, and renal systems (ATSDR 1992b). The primary target organs for thallium toxicity were the nervous and cardiovascular systems, and fetal development (ATSDR 1992b). Exposure to high doses (e.g., over one gram) of thallium may result in death, blindness, vomiting, diarrhea, hair loss, muscle fiber necrosis, bradycardia, and myocardial necrosis; whereas, chronic exposure to low doses may result in birth defects, failing eye sight, neural degeneration, and myelin sheath delamination (ATSDR 1992b).

Thallium has been shown to accumulate in plants and some animals; however, it does not appear to biomagnify in food chains (ATSDR 1992b; HSDB 2017h).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. An oral (ingestion) TRVs was available in Health Canada (2011); however, the source does not indicate whether the TRV was based on pathway-specific (assumed based on primary route of exposure) toxicological studies. No dermal TRVs were available; therefore, the dermal TRV for thallium in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. No inhalation TRVs were identified for thallium; therefore, the RfC for thallium was derived by dividing multiplying the RfD by 70 kg/20 m^3 (or 3.5). Tables S below summarize the TRVs used in HHRA calculations.

Table S Human Non-Carcinogenic TRVs for Exposure to Thallium

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Thallium	$7x10^{-5}$	Health Canada 2010	Use oral TRV	-	$2.45x10^{-4}$	Derived from RfD

The principal source (Health Canada 2011) used to derive the oral reference dose for thallium does not provide a rationale for its derivation.

No reference concentration was identified for thallium. The RfC for thallium was derived by dividing multiplying the RfD by 16.5/8.3 m^3 (or =1.99 =2.0).

1.20 Titanium

Titanium (Ti) is a dark grey lustrous metal with a molecular weight of 47.90 g/mol and a density of 4.506 g/cm^3 (HSDB 2017i). Titanium exist in four main oxidation states (0, +2, +3, and +4); however, the tetravalent (+4) form is the principal form in the environment (HSDB 2017i; Salminen 2005). Elemental titanium does not occur in nature (HSDB 2017i). Elemental titanium is considered insoluble in water and does not have a reported value for octanol–water partition coefficient; however, some titanium compounds are soluble in water (i.e., titanium oxides and hydroxides) (HSDB 2017i; Salminen 2005).

Numerous animal studies investigating exposures to titanium dioxide have provided sufficient evidence for a correlation between exposure and the incidence of cancer; however, there is insufficient evidence in humans for carcinogenicity (CCOHS 2013; IARC 2010). Consequently, titanium dioxide is classified as a Group 2B carcinogen (possibly carcinogenic to humans) by the International Agency for Research on Cancer (IARC) and Class D2A (carcinogenic) by the Canadian Centre for Occupational Health and Safety in the Workplace Hazardous Materials Information System (CCOHS 2013; CCOHS 2017; IARC 2010). The United States Environmental Protection Agency and National Institute for Occupational Safety and Health (NIOSH) do not classify titanium dioxide as a carcinogen (USEPA 2010; NIOSH 2011). No association has been found between the occurrence of cancer in humans and occupational exposure to titanium compounds, including titanium dioxide (HSDB 2017i; IARC 2010; NIOSH 2011). Exposure to elevated concentrations of naturally occurring titanium may result a wide-range of non-carcinogenic effects to various organ systems, including gastrointestinal, nervous, hepatic, reproductive, renal, and cardiovascular (HSDB 2017i). The primary target organ for naturally occurring titanium compounds is the lung (HSDB 2017i). Limited human data is available; however, animal studies indicate that exposure to high doses of naturally occurring titanium may result in strong immune response, pulmonary inflammation, enhanced proliferation of pulmonary cells, atherosclerosis, disturbances in energy and amino acid metabolism, and liver and heart damage (HSDB 2017i; HSDB 2017j; Shi et al. 2013). Chronic exposure to low doses may result in irritation of respiratory tract, defects in macrophage function, enhanced proliferation of pulmonary cells, metaplasia, pulmonary inflammation, pneumonia, and lesions in the kidney, lungs and spleen (HSDB 2017i; HSDB 2017j; Shi et al. 2013).

Limited studies have investigated bioaccumulation of titanium compounds; however, they are not expected to accumulate in plants or animals and thus, they are not considered to biomagnify in food chains (Doyle et al., 2015; HSDB 2017i; Oliver et al., 2015).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. An oral (ingestion) TRVs was available from the National Sanitation Foundation International (NSF) derived from pathway-specific (assumed based on primary route of exposure) toxicological studies. No dermal TRVs were available; therefore, the dermal TRV for titanium in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. No inhalation TRVs were identified for titanium; therefore, the RfC for titanium was derived by dividing multiplying the RfD by 70 kg/20 m^3 (or 3.5). Tables T below summarize the TRVs used in HHRA calculations.

Table T Human Non-Carcinogenic TRVs for Exposure to Titanium

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Titanium	3.0	NSF	Use oral TRV	NSF	10.5	Derived from oral TRV

The principal study (NCI 1978) used to derive the oral reference dose for titanium was based on the oral exposure of rats and mice to titanium resulting in reduced reproduction and survival in a 3-generation study. The NOAEL used in the derivation was 2680 mg/kg-day. The uncertainty factor applied was 1000 to account for database deficiencies (10), interspecies differences (10), intraspecific variation (10) (i.e., sensitive populations) (IRIS 2015).

No reference concentration was identified for titanium. The RfC for titanium was derived by dividing multiplying the RfD by 16.5/8.3 m^3 (or =1.99 =2.0).

1.21 Uranium

Uranium (U) is a silvery-white, dense, hard, lustrous radioactive metal (CCME 2007). It has a molecular weight of 238.03 g/mol and a density of 18.06-19.1 g/cm^3 (ATSDR 2013; CCME 2007). Uranium occurs in five oxidation states: +2, +3, +4, +5 and +6; however, tetravalent (+4) and hexavalent (+6) are the most common and the only species considered stable for practical importance (ATSDR 2013; CCME 2007). Uranium comprises three isotopes in natural conditions: ^{234}U, ^{235}U, and ^{238}U (CCME 2007). Most natural uranium radioactivity comes from the parent of the uranium series, ^{238}U, and its decay product, ^{234}U (ATSDR 2013; CCME 2007). Uranium generally occurs as inorganic and organic compounds with a wide-range of water solubility (ATSDR 2013; CCME 2007). Most uranium compounds are non-volatile with no reported vapour pressure and no Henry's constant (ATSDR 2013; CCME 2007). The primary source of exposure to uranium is typically from food, water, and contaminated workplaces. The absorption of ingested uranium depends upon the solubility of the compound and the absorption rate ranges from 0.1% to 6% (ATSDR 2013). The extent of absorption of inhaled uranium depends on solubility and particle size; the absorption rate ranges from 0.76% to 5% (ATSDR 2013). Dermal absorption of uranium depends on compound solubility and the absorption rate is considered to be very low (0.1%) (ATSDR 2013).

Uranium has been shown to accumulate in plants and some animals; however, it does not biomagnify in food chains (ATSDR 2013; CCME 2007; CCME 2011).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. Oral (ingestion) and inhalation TRVs were available from the Health Canada and ATSDR, respectively, which were derived from pathway-specific (assumed based on primary route of exposure) toxicological studies. No dermal TRVs were available; therefore, the dermal TRV for uranium in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. Tables U below summarize the TRVs used in HHRA calculations.

Table U Human Non-Carcinogenic TRVs for Exposure to Uranium

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Uranium	$6.00x10^{-4}$	Health Canada 2010	Use oral TRV		$8.00x10^{-4}$	ATSDR

The principal study (Gilman 1998) used to derive the oral reference dose for uranium was based on the oral exposure (via drinking water) of rats resulting in nephrotoxic and hepatotoxic effects. The LOAEL used in the derivation was 0.06 mg/kg-day. The uncertainty factor applied was 100 to account for interspecies differences (10) and intraspecies variation (10) Health Canada 2010).

The principal study (Leach 1973 et al. 1973) used to derive the inhalation reference concentration for uranium was based on the inhalation exposure of monkeys to uranium resulting in histological alterations. The LOAEL used in the derivation was 0.82 mg/m^3. The uncertainty factor applied was 1000 to account for data deficiencies (10), interspecies differences (10), and intraspecies variation (10) (ATSDR 2013).

1.22 Vanadium

Vanadium (V) is a grey metal with a molecular weight of 50.9415 g/mol and a density of 6.11 g/cm^3 (ATSDR 2012d). Vanadium may exist in six oxidation states (-2, -1, +2, +3, +4, +5); however, it is commonly found as +3, +4 and +5 (ATSDR 2012d). Elemental vanadium does not occur in nature. Elemental vanadium is considered insoluble in water and does not have a reported value for octanol–water partition coefficient; however, some vanadium compounds are soluble in water (i.e., vanadium pentoxide) (ATSDR 2012d).

There is an insufficient amount of evidence to determine if exposure to vanadium may result in an increased incidence of cancer (ATSDR 2012d). Exposure to excess vanadium has been shown to elicit a variety of toxic effects including dermal irritation on contact, stomach irritation upon ingestion, and haematological effects (ATSDR 2012d).

Vanadium has been shown to accumulate in plants and some animals; however, there is no evidence of biomagnification in food chains (ATSDR 2012d). Human studies suggest that biomagnification is unlikely due to the rapid and complete excretion of absorbed vanadium, with no evidence of long-term accumulation (ATSDR 2012d).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. No TRVs were available for vanadium in IRIS; however, a TRV was available for vanadium pentoxide. The oral (ingestion) TRV for vanadium pentoxide was derived from pathway-specific toxicological studies. No dermal TRVs were available in IRIS. Therefore, the dermal TRV for vanadium in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system.

Table V below summarizes the TRVs used in HHRA calculations.

Table V Human Non-Carcinogenic TRVs for Exposure to Vanadium

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	Ref.	Dermal RfD (mg/kg-day)	Ref.	Inhalation RfC (mg/m^3)	Ref.
Vanadium	$9.0x10^{-3}$	USEPA IRIS	Use oral TRV	-	$1x10^{-4}$	ATSDR
Vanadium	$5.0x10^{-3}$	ORNL RAIS	Use oral TRV	-	-	-

The principal study (Stonkinger et al 1953) used to derive the USEPA oral reference dose for vanadium was based on the ingestion (diet) of vanadium by rats resulting in decreased hair cystine. The NOAEL used in the derivation was 17.85 ppm (converted to 0.89 mg/kg-day). The uncertainty factor applied was 100 to account for the interspecies differences (10) and intraspecific variation (10) (i.e., sensitive populations) (USEPA 2017).

The Oakridge National Laboratory (ORNL 2017) oral reference dose is based on the USEPA value but has been adjusted to account for the molecular weight contribution of the pentoxide portion of the compound. This TRV was deemed more appropriate for the Project since vanadium and not vanadium pentoxide is the contaminant of potential concern.

The principal study (NTP 2002) used to derive the ATSDR inhalation reference concentration was based on the inhalation of vanadium by rats resulting in respiratory tract (ATSDR 2012c).
The adjusted benchmark concentration used in the derivation was 0.003 mg/m^3. The uncertainty factor applied was 30 to account for interspecies differences (3) and intraspecies variation (10) (ATSDR 2012d).

1.23 Zinc

Zinc (Zn) is a bluish-white, shiny metal and one of the most common elements in the earth's crust. It has a molecular weight of 65.38 g/mol and a density of 7.14 g/cm^3 (ATSDR 2005b). Zinc exists in one of three oxidation states: +2, +1, and 0. Pure zinc is highly reactive with water and may spontaneously combust in damp areas. Consequently, zinc predominantly exists in a variety of inorganic and organic compounds. Zinc compounds have a wide-range of water solubility; however, pure zinc is considered to be insoluble in water (ASTDR 2005b).

Exposure to excess zinc has been shown to elicit a variety of toxic effects including infertility, decreased birth weight, pancreatic damage, anaemia, nausea, vomiting and skin irritation. Zinc deficiency can result in a wide range of adverse effects including decreased immune response, birth defects, slow wound healing, and slow growth (CCME 1999).

Zinc has been shown to accumulate in some plants and animals; however, it does biomagnify in food chains (ATSDR 2005b).

Toxicity Reference Values

Separate TRVs are sometimes available for ingestion, inhalation, and dermal contact; however, due to limitations in available toxicological studies, studies from one exposure pathway may sometimes be extrapolated to provide TRVs for another exposure pathway. A separate oral (ingestion) TRV derived from pathway-specific toxicological studies was available for zinc in IRIS; however, no inhalation or dermal TRVs were available. Therefore, the dermal TRV for zinc in this risk assessment is based the oral TRV, using dermal absorption factors to account for the different absorptive properties of skin versus the digestive system. The oral TRV was used as the inhalation TRV, conservatively assuming 100% absorption.

Table W below summarizes the TRVs used in HHRA calculations.

Table W Human Non-Carcinogenic TRVs for Exposure to Zinc

COPC	Non-Carcinogenic TRVs					
	Oral RfD (mg/kg-day)	**Ref.**	**Dermal RfD (mg/kg-day)**	**Ref.**	**Inhalation RfC (mg/m^3)**	**Ref.**
Zinc	infant = 0.49 toddler = 0.48 child = 0.48 teen = 0.54 adult = 0.57	Health Canada 2010	Use oral TRV	-	infant = 1.8 toddler = 0.95 child = 1.1 teen = 2.1 adult = 2.4	Derived from oral TRV
Zinc	0.3	USEPA IRIS	Use oral TRV	USEPA IRIS	Use oral TRV	IRIS

The principal study (Yadrick et al 1989) used to derive the Health Canada oral reference dose was based on the ingestion of zinc via dietary supplements resulting in reduced iron and copper status (Health Canada 2010). The LOAEL (adult) used in the derivation was 60 mg/d. The uncertainty factor applied was 1.5 to account for extrapolation from LOAEL to NOAEL and intraspecies variation (Health Canada 2010).

The four principal studies (Yadrick et al 1989, Fischer et al 1984, Davis et al 2000, Milne et al 2001) used to derive the oral reference dose for zinc were based on the ingestion of zinc dietary supplements resulting in a decreased blood enzyme (i.e., erythrocyte copper, zinc-superoxide dismutase (ESOD)) activity. The LOAEL used in the derivation was 0.91 mg/kg-day. The uncertainty factor applied was 3 to account for intraspecific variation (i.e., sensitive populations) (IRIS 2014).

No reference concentration was identified for zinc; therefore, the TC for zinc was derived by multiplying the TDI/RfD by the (receptor specific body weight)/(receptor specific inhalation rate).

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Attachment F
Detailed Risk Estimates for Soil, Air, and Surface Water

Table F1: Constituent Concentrations Used in the HHRA

Constituent	Soil Baseline mg/kg	Soil Predicted mg/kg	Surface Water Baseline mg/L	Predicted Surface Water mg/L	Air Baseline (PM10) mg/m^3	Predicted Air (PM10) mg/m^3
Aluminum	2.93E+04	2.947E+04	5.89E+00	6.15E+00	9.96E-05	1.48E-04
Antimony	6.86E+00	6.901E+00	2.05E-03	5.74E-03	2.33E-08	4.18E-08
Arsenic	6.95E+01	6.994E+01	8.45E-03	9.79E-03	2.36E-07	4.26E-07
Barium	*4.29E+02*	4.313E+02	1.13E-01	1.19E-01	1.46E-06	2.14E-06
Bismuth	3.28E-01	3.304E-01	8.36E-03	8.44E-03	1.11E-09	3.33E-09
Boron	2.00E+01	2.011E+01	9.19E-02	9.57E-02	6.80E-08	9.99E-08
Cadmium	1.10E+00	1.105E+00	4.83E-04	1.33E-03	3.73E-09	8.20E-09
Chromium	1.97E+04	1.977E+04	4.75E+01	5.84E+01	6.68E-05	9.71E-05
Cobalt	9.91E+01	9.970E+01	6.68E-03	7.62E-03	3.37E-07	4.95E-07
Copper	2.23E+01	2.240E+01	5.03E-03	6.44E-03	7.57E-08	1.11E-07
Iron	1.44E-02	1.451E-02	NA	NA	4.90E-11	6.91E-11
Lead	5.82E+04	5.850E+04	9.17E+00	9.66E+00	1.98E-04	2.91E-04
Manganese	4.00E+01	4.021E+01	6.83E-03	7.78E-03	1.36E-07	2.10E-07
Mercury, inorganic	9.16E+02	9.219E+02	2.94E-01	5.38E-01	3.11E-06	4.61E-06
Molybdenum	8.00E-02	8.579E-02	1.21E-05	6.91E-05	2.72E-10	1.50E-08
Nickel	5.257E+01	5.289E+01	2.06E-02	2.72E-02	1.79E-07	2.62E-07
Selenium	4.54E+00	4.567E+00	2.30E-03	3.26E-03	1.54E-08	2.44E-08
Strontium	9.685E+01	9.743E+01	2.69E-01	2.96E-01	3.29E-07	4.83E-07
Tellurium	3.15E-01	3.178E-01	NA	NA	1.07E-09	4.48E-09
Thallium	3.00E-01	3.018E-01	1.84E-04	1.92E-04	1.02E-09	1.73E-09
Titanium	2.31E+03	2.326E+03	9.82E-02	1.01E-01	7.86E-06	1.14E-05
Uranium	1.208E+00	1.216E+00	5.00E-04	5.00E-04	4.11E-09	6.89E-09
Vanadium	1.08E+02	1.089E+02	1.35E-02	1.37E-02	3.68E-07	5.47E-07
Zinc	1.44E+02	1.446E+02	5.81E-02	1.13E-01	4.88E-07	9.42E-07

Table F2. Calculation of Non-Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Hunter/Trapper/Fisher – Baseline

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Hunter/Trapper/Fisher - Incidental Soil Ingestion					
Aluminum	2.93E+04	1.0E+00	1	6.5E-03	5.5E-03
Antimony	6.86E+00	6.0E-03	1	2.6E-04	2.2E-04
Arsenic	6.95E+01	1.0E-03	0.33	5.1E-03	4.3E-03
Barium	4.29E+02	2.0E-01	1	4.8E-04	4.0E-04
Bismuth	3.28E-01	N/A	1	N/A	N/A
Boron	2.00E+01	2.0E-01	1	2.2E-05	1.9E-05
Cadmium	1.10E+00	1.0E-03	1	2.5E-04	2.1E-04
Chromium	9.91E+01	1.0E-03	1	2.2E-02	1.9E-02
Cobalt	2.23E+01	1.4E-03	1	3.6E-03	3.0E-03
Copper	1.06E+02	teen = 1.26E-01 adult = 1.41E-01	1	1.9E-04	1.4E-04
Iron	5.82E+04	7.0E-01	1	1.9E-02	1.6E-02
Lead	4.00E+01	1.5E-03	1	6.0E-03	5.0E-03
Manganese	9.16E+02	teen = 0.142 adult = 0.156	1	1.4E-03	1.1E-03
Mercury	8.00E-02	3.0E-04	1	6.0E-05	5.0E-05
Nickel	5.26E+01	1.10E-02	1	1.1E-03	9.0E-04
Selenium	4.54E+00	teen = 6.2E-3 adult = 5.7E-3	1	1.6E-04	1.5E-04
Strontium	9.69E+01	6.0E-01	1	3.6E-05	3.0E-05
Tellurium	3.15E-01	N/A	1	N/A	N/A
Thallium	3.00E-01	7.0E-05	1	9.6E-04	8.1E-04
Titanium	2.31E+03	3.0E+00	1	1.7E-04	1.5E-04
Uranium	1.21E+00	6.0E-04	1	4.5E-04	3.8E-04
Vanadium	1.08E+02	5.0E-03	1	4.8E-03	4.1E-03

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Zinc	1.44E+02	teen = 5.4E-01 adult = 5.7E-01	1	5.9E-05	4.8E-05
Hunter/Trapper/Fisher - Dermal Contact with Soil					
Aluminum	2.93E+04	1.0E+00	1.0E-02	5.0E-04	4.7E-04
Antimony	6.86E+00	6.0E-03	1.0E-02	1.9E-05	1.8E-05
Arsenic	6.95E+01	1.0E-03	3.0E-02	3.5E-03	3.4E-03
Barium	4.29E+02	2.0E-01	1.0E-01	3.6E-04	3.5E-04
Bismuth	3.28E-01	N/A	N/A	N/A	N/A
Boron	2.00E+01	0.2	1.0E-02	1.7E-06	1.6E-06
Cadmium	1.10E+00	1.0E-03	1.0E-02	1.9E-05	1.8E-05
Chromium	9.91E+01	1.0E-03	1.0E-01	1.7E-02	1.6E-02
Cobalt	2.23E+01	1.4E-03	1.0E-02	2.7E-04	2.6E-04
Copper	1.06E+02	teen = 1.26E-01 adult = 1.41E-01	6.0E-02	8.6E-05	7.3E-05
Iron	5.82E+04	7.0E-01	1.0E-02	1.4E-03	1.3E-03
Lead	4.00E+01	1.5E-03	1.0E-02	4.5E-04	4.3E-04
Manganese	9.16E+02	teen = 1.42E-01 adult = 1.56E-01	1.0E-02	1.1E-04	9.5E-05
Mercury	8.00E-02	3.0E-04	1.0E+00	4.5E-04	4.3E-04
Nickel	5.26E+01	1.10E-02	9.1E-02	7.4E-04	7.0E-04
Selenium	4.54E+00	teen = 6.2E-3 adult = 5.7E-3	1.0E-02	1.2E-05	1.3E-05
Strontium	9.685E+01	6.0E-01	1.0E-02	2.7E-06	2.6E-06
Tellurium	3.15E-01	N/A	N/A	N/A	N/A
Thallium	3.00E-01	7.0E-05	1.0E-02	7.3E-05	6.9E-05
Titanium	2.31E+03	3.0E+00	1.0E-02	1.3E-05	1.2E-05
Uranium	1.21E+00	6.0E-04	1.0E-01	3.4E-04	3.3E-04
Vanadium	1.08E+02	5.0E-03	1.0E-02	3.7E-04	3.5E-04

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Zinc	1.44E+02	teen = 5.4E-01 adult = 5.7E-01	1.0E-01	4.5E-05	4.1E-05
Hunter/Trapper/Fisher - Inhalation of Particulate					
	Air Concentration (mg/m^3)				
Aluminum	9.96E-05	5.0E-03	1	1.3E-02	1.3E-02
Antimony	2.33E-08	1.2E-02	1	1.3E-06	1.3E-06
Arsenic	2.36E-07	1.0E-03	1	1.6E-04	1.6E-04
Barium	1.46E-06	1.0E-03	1	9.7E-04	9.7E-04
Bismuth	1.11E-09	N/A	1	N/A	N/A
Boron	6.80E-08	4.0E-01	1	1.1E-07	1.1E-07
Cadmium	3.73E-09	2.0E-03	1	1.3E-06	1.3E-06
Chromium	3.37E-07	6.0E-02	1	3.7E-06	3.7E-06
Cobalt	7.57E-08	5.0E-04	1	1.0E-04	1.0E-04
Copper	3.61E-07	1.00E-03	1	2.4E-04	2.4E-04
Iron	1.98E-04	1.4E+00	1	9.5E-05	9.5E-05
Lead	1.36E-07	teen = 0057 adult = 0064	1	1.6E-05	1.4E-05
Manganese	3.11E-06	teen = 5.4E-01 adult = 6.6E-01	1	3.8E-06	3.1E-06
Mercury	2.72E-10	3.00E-04	1	6.0E-07	6.0E-07
Nickel	1.79E-07	2.00E-05	1	6.0E-03	6.0E-03
Selenium	1.54E-08	teen = 2.37E-02 adult = 2.43E-02	1	4.3E-07	4.2E-07
Strontium	3.29E-07	1.2E+00	1	1.8E-07	1.8E-07
Tellurium	1.07E-09	N/A	1	N/A	N/A
Thallium	1.02E-09	1.4E-04	1	4.9E-06	4.9E-06
Titanium	7.86E-06	6.0E+00	1	8.8E-07	8.8E-07

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Uranium	4.11E-09	8.0E-04	1	3.4E-06	3.4E-06
Vanadium	3.68E-07	1.0E-04	1	2.5E-03	2.5E-03
Zinc	4.88E-07	teen = 2.1E+00 adult = 2.4E+00	1	1.6E-07	1.3E-07

Table F3. Calculation of Non-Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Hunter/Trapper/Fisher – Predicted

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Hunter/Trapper/Fisher - Incidental Soil Ingestion					
Aluminum	2.95E+04	1.0E+00	1	6.6E-03	5.6E-03
Antimony	6.90E+00	6.0E-03	1	2.6E-04	2.2E-04
Arsenic	6.99E+01	1.0E-03	0.33	5.2E-03	4.4E-03
Barium	4.31E+02	2.0E-01	1	4.8E-04	4.1E-04
Bismuth	3.30E-01	N/A	1	N/A	N/A
Boron	2.01E+01	2.0E-01	1	2.2E-05	1.9E-05
Cadmium	1.10E+00	1.0E-03	1	2.5E-04	2.1E-04
Chromium	9.97E+01	1.0E-03	1	2.2E-02	1.9E-02
Cobalt	2.24E+01	1.4E-03	1	3.6E-03	3.0E-03
Copper	1.07E+02	teen = 1.26E-01 adult = 1.41E-01	1	1.9E-04	1.4E-04
Iron	5.85E+04	7.0E-01	1	1.9E-02	1.6E-02
Lead	4.02E+01	1.5E-03	1	6.0E-03	5.1E-03
Manganese	9.22E+02	teen = 1.42E-01 adult = 1.56E-01	1	1.4E-03	1.1E-03
Mercury	8.58E-02	3.0E-04	1	6.4E-05	5.4E-05
Nickel	5.29E+01	1.10E-02	1	1.1E-03	9.1E-04
Selenium	4.57E+00	teen = 6.2E-3 adult = 5.7E-3	1	1.65E-04	1.5E-04
Strontium	9.74E+01	6.0E-01	1	3.6E-05	3.1E-05
Tellurium	3.18E-01	N/A	1	N/A	N/A
Thallium	3.02E-01	7.0E-05	1	9.6E-04	8.1E-04
Titanium	2.33E+03	3.0E+00	1	1.7E-04	1.5E-04
Uranium	1.22E+00	6.0E-04	1	4.5E-04	3.8E-04

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Vanadium	1.09E+02	5.0E-03	1	4.9E-03	4.1E-03
Zinc	1.45E+02	teen = 5.4E-01 adult = 5.7E-01	1	6.0E-05	4.8E-05
Hunter/Trapper/Fisher - Dermal Contact with Soil					
Aluminum	2.9473E+04	1.0E+00	1.0E-02	5.0E-04	4.8E-04
Antimony	6.90E+00	6.0E-03	1.0E-02	2.0E-05	1.9E-05
Arsenic	6.99E+01	1.0E-03	3.0E-02	3.6E-03	3.4E-03
Barium	4.31E+02	2.0E-01	1.0E-01	3.7E-04	3.5E-04
Bismuth	3.30E-01	N/A	N/A	N/A	N/A
Boron	2.01E+01	0.2	1.0E-02	1.7E-06	1.6E-06
Cadmium	1.10E+00	1.0E-03	1.0E-02	1.9E-05	1.8E-05
Chromium	9.97E+01	1.0E-03	1.0E-01	1.7E-02	1.6E-02
Cobalt	2.24E+01	1.4E-03	1.0E-02	2.7E-04	2.6E-04
Copper	1.07E+02	teen = 1.26E-01 adult = 1.41E-01	6.0E-02	8.6E-05	7.33E-05
Iron	5.85E+04	7.0E-01	1.0E-02	1.4E-03	1.3E-03
Lead	4.02E+01	1.5E-03	1.0E-02	4.6E-04	4.3E-04
Manganese	9.22E+02	teen = 1.42E-01 adult = 1.56E-01	1.0E-02	1.1E-04	9.5E-05
Mercury	8.58E-02	3.0E-04	1.0E+00	4.9E-04	4.6E-04
Nickel	5.29E+01	1.10E-02	9.1E-02	7.4E-04	7.1E-04
Selenium	4.57E+00	teen = 6.2E-3 adult = 5.7E-3	1.0E-02	1.3E-05	1.3E-05
Strontium	9.74E+01	6.0E-01	1.0E-02	2.8E-06	2.6E-06
Tellurium	3.18E-01	N/A	N/A	N/A	N/A
Thallium	3.02E-01	7.0E-05	1.0E-02	7.3E-05	7.0E-05
Titanium	2.33E+03	3.0E+00	1.0E-02	1.3E-05	1.3E-05
Uranium	1.22E+00	6.0E-04	1.0E-01	3.4E-04	3.3E-04

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Vanadium	1.09E+02	5.0E-03	1.0E-02	3.7E-04	3.5E-04
Zinc	1.45E+02	teen = 5.4E-01 adult = 5.7E-01	1.0E-01	4.5E-05	4.1E-05
Hunter/Trapper/Fisher - Inhalation of Particulate					
	Air Concentration (mg/m^3)				
Aluminum	1.48E-04	5.0E-03	1	2.0E-02	2.0E-02
Antimony	4.18E-08	1.2E-02	1	2.3E-06	2.3E-06
Arsenic	4.26E-07	1.0E-03	1	2.8E-04	2.8E-04
Barium	2.14E-06	1.0E-03	1	1.4E-03	1.4E-03
Bismuth	3.33E-09	N/A	1	N/A	N/A
Boron	9.99E-08	4.0E-01	1	1.7E-07	1.7E-07
Cadmium	8.20E-09	2.0E-03	1	2.7E-06	2.7E-06
Chromium	4.95E-07	6.0E-02	1	5.5E-06	5.5E-06
Cobalt	1.11E-07	5.0E-04	1	1.5E-04	1.5E-04
Copper	5.74E-07	1.0E-03	1	3.8E-04	3.8E-04
Iron	2.91E-04	1.4E+00	1	1.4E-04	1.4E-04
Lead	2.10E-07	teen = 0057 adult = 0064	1	2.4E-05	2.2E-05
Manganese	4.61E-06	teen = 5.43E-01 adult = 6.64E-01	1	5.7E-06	4.6E-06
Mercury	1.50E-08	3.00E-04	1	3.3E-05	3.3E-05
Nickel	2.62E-07	2.00E-05	1	8.7E-03	8.7E-03
Selenium	2.44E-08	teen = 2.37E-02 adult = 2.43E-02	1	6.9E-07	6.7E-07
Strontium	4.83E-07	1.2E+00	1	2.7E-07	2.7E-07
Tellurium	4.48E-09	N/A	1	N/A	N/A
Thallium	1.73E-09	1.4E-04	1	8.3E-06	8.3E-06
Titanium	1.14E-05	6.0E+00	1	1.3E-06	1.3E-06

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Uranium	6.89E-09	8.0E-04	1	5.7E-06	5.7E-06
Vanadium	5.47E-07	1.0E-04	1	3.6E-03	3.6E-03
Zinc	9.42E-07	teen = 2.1E+00 adult = 2.4E+00	1	3.0E-07	2.6E-07

Table F4. Calculation of Carcinogenic Risk from Direct Contact with Soil and Inhalation of Air Particulate by the Hunter/Trapper/Fisher – Baseline

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Cancer Risk	
				Teen	Adult
Hunter/Trapper/Fisher - Incidental Soil Ingestion					
Arsenic	6.95E+01	1.8E+00	0.33	4.3E-07	1.348E-06
Hunter/Trapper/Fisher - Dermal Contact with Soil					
Arsenic	6.95E+01	1.8E+00	3.0E-02	2.9E-07	1.049E-06
Hunter/Trapper/Fisher - Inhalation of Particulate					
Arsenic	2.36E-07	2.7E+01	1	5.1E-08	1.7E-07
Cadmium	3.73E-09	4.2E+01	1	1.3E-09	4.2E-09
Chromium	3.37E-07	4.6E+01	1	1.2E-07	4.2E-07
Nickel	1.79E-07	3.0E+00	1	4.3E-09	1.5E-08

Table F5 Calculation of Carcinogenic Risk from Direct Contact with Soil and Inhalation of Air Particulate by the Hunter/Trapper/Fisher – Predicted

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Cancer Risk	
				Teen	Adult
Hunter/Trapper/Fisher - Incidental Soil Ingestion					
Arsenic	6.99E+01	1.8E+00	3.3E-01	4.28E-07	1.356E-06
Hunter/Trapper/Fisher - Dermal Contact with Soil					
Arsenic	6.99E+01	1.8E+00	3.0E-02	3.0E-07	1.0552E-06
Hunter/Trapper/Fisher - Inhalation of Particulate					
	Air Concentration (mg/m^3)				
Arsenic	4.26E-07	2.7E+01	1	9.3E-08	3.120E-07
Cadmium	8.20E-09	4.2E+01	1	2.8E-09	9.3E-09
Chromium	4.95E-07	4.6E+01	1	1.8E-07	6.2E-07
Nickel	2.62E-07	3.0E+00	1	6.3E-09	2.1E-08

Table F6. Calculation of Non-Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Recreational User – Baseline

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Recreational User - Incidental Soil Ingestion								
Aluminum	2.93E+04	1.0E+00	1	1.8E-02	3.6E-02	4.5E-03	2.5E-03	2.1E-03
Antimony	6.86E+00	6.0E-03	1	7.0E-04	1.4E-03	1.7E-04	9.6E-05	8.1E-05
Arsenic	6.95E+01	1.0E-03	0.33	1.4E-02	2.8E-02	3.5E-03	1.9E-03	1.6E-03
Barium	4.29E+02	2.0E-01	1	1.3E-03	2.6E-03	3.3E-04	1.8E-04	1.5E-04
Bismuth	3.28E-01	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	2.00E+01	2.0E-01	1	6.1E-05	1.2E-04	1.5E-05	8.4E-06	7.1E-06
Cadmium	1.10E+00	1.0E-03	1	6.7E-04	1.3E-03	1.7E-04	9.2E-05	7.8E-05
Chromium	9.91E+01	1.0E-03	1	6.0E-02	1.2E-01	1.5E-02	8.3E-03	7.0E-03
Cobalt	2.23E+01	1.4E-03	1	9.7E-03	1.9E-02	2.4E-03	1.3E-03	1.1E-03
Copper	1.06E+02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	7.1E-04	1.41E-03	1.47E-04	7.05E-05	5.32E-05
Iron	5.82E+04	7.0E-01	1	5.1E-02	1.0E-01	1.3E-02	7.0E-03	5.9E-03
Lead	4.00E+01	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	4.1E-02	8.1E-02	1.0E-02	2.2E-03	1.9E-03
Manganese	9.16E+02	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	4.1E-03	8E-03	1.1E-03	5.4E-04	4.2E-04
Mercury	8.00E-02	3.0E-04	1	1.6E-04	3.2E-04	4.1E-05	2.2E-05	1.9E-05

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Nickel	5.26E+01	1.10E-02	1	2.9E-03	5.8E-03	7.3E-04	4.0E-04	3.4E-04
Selenium	4.54E+00	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	5.0E-04	8.9E-04	1.10E-04	6.1E-05	5.6E-05
Strontium	9.69E+01	6.0E-01	1	9.8E-05	2.0E-04	2.5E-05	1.4E-05	1.1E-05
Tellurium	3.15E-01	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	3.00E-01	7.0E-05	1	2.6E-03	5.2E-03	6.5E-04	3.6E-04	3.0E-04
Titanium	2.31E+03	3.0E+00	1	4.7E-04	9.3E-04	1.2E-04	6.5E-05	5.5E-05
Uranium	1.21E+00	6.0E-04	1	1.2E-03	2.4E-03	3.1E-04	1.7E-04	1.4E-04
Vanadium	1.08E+02	5.0E-03	1	1.3E-02	2.6E-02	3.3E-03	1.8E-03	1.5E-03
Zinc	1.44E+02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	1.8E-04	3.6E-04	4.5E-05	2.2E-05	1.8E-05
Recreational User - Dermal Contact with Soil								
Aluminum	2.93E+04	1.0E+00	1.0E-02	4.16E-04	3.1E-04	2.3E-04	1.9E-04	1.8E-04
Antimony	6.86E+00	6.0E-03	1.0E-02	1.6E-05	1.2E-05	9.1E-06	7.3E-06	6.9E-06
Arsenic	6.95E+01	1.0E-03	3.0E-02	3.0E-03	2.2E-03	1.7E-03	1.3E-03	1.3E-03
Barium	4.29E+02	2.0E-01	1.0E-01	3.0E-04	2.2E-04	1.7E-04	1.4E-04	1.3E-04
Bismuth	3.28E-01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boron	2.00E+01	0.2	1.0E-02	1.4E-06	1.0E-06	7.9E-07	6.4E-07	6.1E-07
Cadmium	1.10E+00	1.0E-03	1.0E-02	1.6E-05	1.1E-05	8.7E-06	7.0E-06	6.6E-06
Chromium	9.91E+01	1.0E-03	1.0E-01	1.4E-02	1.0E-02	7.9E-03	6.3E-03	6.0E-03
Cobalt	2.23E+01	1.4E-03	1.0E-02	2.3E-04	1.7E-04	1.3E-04	1.0E-04	9.6E-05

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Copper	1.06E+02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	6.0E-02	9.9E-05	7.3E-05	5.1E-05	3.2E-05	2.7E-05
Iron	5.82E+04	7.0E-01	1.0E-02	1.2E-03	8.7E-04	6.6E-04	5.3E-04	5.0E-04
Lead	4.00E+01	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1.0E-02	9.5E-04	6.9E-04	5.3E-04	1.7E-04	1.6E-04
Manganese	9.16E+02	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1.0E-02	9.57E-05	7.02E-05	6.0E-05	4.1E-05	3.6E-05
Mercury	8.00E-02	3.0E-04	1.0E+00	3.8E-04	2.8E-04	2.1E-04	1.7E-04	1.6E-04
Nickel	5.26E+01	1.10E-02	9.1E-02	6.2E-04	4.5E-04	3.5E-04	2.8E-04	2.6E-04
Selenium	4.54E+00	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.0E-02	1.2E-05	7.6E-06	5.7E-06	4.7E-06	4.8E-06
Strontium	9.69E+01	6.0E-01	1.0E-02	2.3E-06	1.7E-06	1.3E-06	1.0E-06	9.8E-07
Tellurium	3.15E-01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	3.00E-01	7.0E-05	1.0E-02	6.1E-05	4.5E-05	3.4E-05	2.7E-05	2.6E-05
Titanium	2.31E+03	3.0E+00	1.0E-02	1.1E-05	8.0E-06	6.1E-06	4.9E-06	4.7E-06
Uranium	1.21E+00	6.0E-04	1.0E-01	2.9E-04	2.1E-04	1.6E-04	1.3E-04	1.2E-04
Vanadium	1.08E+02	5.0E-03	1.0E-02	3.1E-04	2.3E-04	1.7E-04	1.4E-04	1.3E-04

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Zinc	1.44E+02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1.0E-01	4.2E-05	3.1E-05	2.4E-05	1.7E-05	1.5E-05
Recreational User - Inhalation of Particulate								
	Air Concentration (mg/m^3)							
Aluminum	9.96E-05	5.0E-03	1	5.0E-03	5.0E-03	5.0E-03	5.0E-03	5.0E-03
Antimony	2.33E-08	1.2E-02	1	4.9E-07	4.9E-07	4.9E-07	4.9E-07	4.9E-07
Arsenic	2.36E-07	1.0E-03	1	5.9E-05	5.9E-05	5.9E-05	5.9E-05	5.9E-05
Barium	1.46E-06	1.0E-03	1	3.6E-04	3.6E-04	3.6E-04	3.6E-04	3.6E-04
Bismuth	1.11E-09	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	6.80E-08	4.0E-01	1	4.3E-08	4.3E-08	4.3E-08	4.3E-08	4.3E-08
Cadmium	3.73E-09	2.0E-03	1	4.7E-07	4.7E-07	4.7E-07	4.7E-07	4.7E-07
Chromium	3.37E-07	6.0E-02	1	1.4E-06	1.4E-06	1.4E-06	1.4E-06	1.4E-06
Cobalt	7.57E-08	5.0E-04	1	3.8E-05	3.8E-05	3.8E-05	3.8E-05	3.8E-05
Copper	3.61E-07	1.00E-03	1	9.0E-05	9.0E-05	9.0E-05	9.0E-05	9.0E-05
Iron	1.98E-04	1.4E+00	1	3.6E-05	3.6E-05	3.6E-05	3.6E-05	3.6E-05
Lead	1.36E-07	infant = 2.24E-03 toddler = 1.19E-03 child = 1.36E-03 teen = 4.98E-03 adult = 5.54E-03	1	1.5E-05	2.8E-05	2.5E-05	5.9E-06	5.3E-06
Manganese	3.11E-06	infant = 5.03E-01 toddler = 2.70E-01 child = 2.77E-01 teen = 5.43E-01 adult = 6.64E-01	1	1.5E-06	2.9E-06	2.8E-06	1.4E-06	1.2E-06

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Mercury	2.72E-10	3.00E-04	1	2.3E-07	2.3E-07	2.3E-07	2.3E-07	2.3E-07
Nickel	1.79E-07	2.00E-05	1	2.2E-03	2.2E-03	2.2E-03	2.2E-03	2.2E-03
Selenium	1.54E-08	infant = 2.1E-02 toddler = 1.2E-02 child = 1.4E-02 teen = 2.4E-02 adult = 2.4E-02	1	1.9E-07	3.1E-07	2.7E-07	1.6E-07	1.6E-07
Strontium	3.29E-07	1.2E+00	1	6.9E-08	6.9E-08	6.9E-08	6.9E-08	6.9E-08
Tellurium	1.07E-09	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	1.02E-09	1.4E-04	1	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06
Titanium	7.86E-06	6.0E+00	1	3.3E-07	3.3E-07	3.3E-07	3.3E-07	3.3E-07
Uranium	4.11E-09	8.0E-04	1	1.3E-06	1.3E-06	1.3E-06	1.3E-06	1.3E-06
Vanadium	3.68E-07	1.0E-04	1	9.2E-04	9.2E-04	9.2E-04	9.2E-04	9.2E-04
Zinc	4.88E-07	infant = 1.8E+00 toddler = 9.5E-01 child = 1.1E-00 teen = 2.1E+00 adult = 2.4E+00	1	6.7E-08	1.3E-07	1.1E-07	5.9E-08	5.0E-08

Table F7. Calculation of Non-Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Recreational User – Predicted

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Recreational User - Incidental Soil Ingestion								
Aluminum	2.95E+04	1.0E+00	1	1.8E-02	3.6E-02	4.5E-03	2.5E-03	2.1E-03
Antimony	6.90E+00	6.0E-03	1	7.0E-04	1.4E-03	1.7E-04	9.6E-05	8.1E-05
Arsenic	6.99E+01	1.0E-03	0.33	1.4E-02	2.8E-02	3.5E-03	1.9E-03	1.6E-03
Barium	4.31E+02	2.0E-01	1	1.3E-03	2.6E-03	3.3E-04	1.8E-04	1.5E-04
Bismuth	3.30E-01	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	2.01E+01	2.0E-01	1	6.1E-05	1.2E-04	1.5E-05	8.4E-06	7.1E-06
Cadmium	1.10E+00	1.0E-03	1	6.7E-04	1.3E-03	1.7E-04	9.3E-05	7.8E-05
Chromium	9.97E+01	1.0E-03	1	6.1E-02	1.2E-01	1.5E-02	8.3E-03	7.1E-03
Cobalt	2.24E+01	1.4E-03	1	9.8E-03	1.9E-02	2.4E-03	1.3E-03	1.1E-03
Copper	1.07E+02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	7.2E-04	1.4E-03	1.5E-04	7.1E-05	5.4E-05
Iron	5.85E+04	7.0E-01	1	5.1E-02	1.0E-01	1.3E-02	7.0E-03	5.9E-03
Lead	4.02E+01	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	4.1E-02	8.1E-02	1.0E-02	2.2E-03	1.9E-03
Manganese	9.22E+02	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	4.1E-03	8.2E-03	1.1E-03	5.4E-04	4.2E-04
Mercury	8.58E-02	3.0E-04	1	1.7E-04	3.5E-04	4.3E-05	2.4E-05	2.0E-05

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Nickel	5.29E+01	1.10E-02	1	2.9E-03	5.8E-03	7.3E-04	4.0E-04	3.4E-04
Selenium	4.57E+00	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	5.06E-04	8.9E-04	1.1E-04	6.2E-05	5.7E-05
Strontium	9.74E+01	6.0E-01	1	9.9E-05	2.0E-04	2.5E-05	1.4E-05	1.1E-05
Tellurium	3.18E-01	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	3.02E-01	7.0E-05	1	2.6E-03	5.2E-03	6.6E-04	3.6E-04	3.0E-04
Titanium	2.33E+03	3.0E+00	1	4.7E-04	9.4E-04	1.2E-04	6.5E-05	5.5E-05
Uranium	1.22E+00	6.0E-04	1	1.2E-03	2.5E-03	3.1E-04	1.7E-04	1.4E-04
Vanadium	1.09E+02	5.0E-03	1	1.3E-02	2.6E-02	3.3E-03	1.8E-03	1.5E-03
Zinc	1.45E+02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	1.8E-04	3.7E-04	4.6E-05	2.2E-05	1.8E-05
Recreational User - Dermal Contact with Soil								
Aluminum	2.95E+04	1.0E+00	1E-02	4.2E-04	3.1E-04	2.3E-04	1.9E-04	1.8E-04
Antimony	6.90E+00	6.0E-03	1E-02	1.6E-05	1.2E-05	9.1E-06	7.3E-06	7.0E-06
Arsenic	6.99E+01	1.0E-03	3E-02	3.0E-03	2.2E-03	1.7E-03	1.3E-03	1.3E-03
Barium	4.31E+02	2.0E-01	1E-01	3.1E-04	2.2E-04	1.7E-04	1.4E-04	1.3E-04
Bismuth	3.30E-01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boron	2.01E+01	0.2	1E-02	1.4E-06	1.0E-06	8.0E-07	6.4E-07	6.1E-07
Cadmium	1.10E+00	1.0E-03	1E-02	1.6E-05	1.2E-05	8.8E-06	7.0E-06	6.7E-06
Chromium	9.97E+01	1.0E-03	1E-01	1.4E-02	1.0E-02	7.9E-03	6.3E-03	6.0E-03
Cobalt	2.24E+01	1.4E-03	1E-02	2.3E-04	1.7E-04	1.3E-04	1.0E-04	9.7E-05

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Copper	1.07E+02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	6E-02	1.0E-04	7.34E-05	4.62E-05	3.24E-05	2.75E-05
Iron	5.85E+04	7.0E-01	1E-02	1.2E-03	8.7E-04	6.6E-04	5.3E-04	5.1E-04
Lead	4.02E+01	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1E-02	9.5E-04	7.0E-04	5.3E-04	1.7E-04	1.6E-04
Manganese	9.22E+02	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1E-02	9.6E-05	7.1E-05	6.0E-05	4.1E-05	3.6E-05
Mercury	8.58E-02	3.0E-04	1E+00	4.1E-04	3.0E-04	2.3E-04	1.8E-04	1.7E-04
Nickel	5.29E+01	1.10E-02	9E-02	6.2E-04	4.6E-04	3.5E-04	2.8E-04	2.6E-04
Selenium	4.57E+00	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1E-02	1.2E-05	7.7E-06	5.8E-06	4.7E-06	4.9E-06
Strontium	9.74E+01	6.0E-01	1E-02	2.3E-06	1.7E-06	1.3E-06	1.0E-06	9.8E-07
Tellurium	3.18E-01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	3.02E-01	7.0E-05	1E-02	6.1E-05	4.5E-05	3.4E-05	2.7E-05	2.6E-05
Titanium	2.33E+03	3.0E+00	1E-02	1.1E-05	8.1E-06	6.2E-06	4.9E-06	4.7E-06
Uranium	1.22E+00	6.0E-04	1E-01	2.9E-04	2.1E-04	1.6E-04	1.3E-04	1.2E-04
Vanadium	1.09E+02	5.0E-03	1E-02	3.1E-04	2.3E-04	1.7E-04	1.4E-04	1.3E-04

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Zinc	1.45E+02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1E-01	4.2E-05	3.1E-05	2.4E-05	1.7E-05	1.5E-05
Recreational User - Inhalation of Particulate								
	Air Concentration (mg/m^3)							
Aluminum	1.48E-04	5.0E-03	1	7.4E-03	7.4E-03	7.4E-03	7E-03	7.4E-03
Antimony	4.18E-08	1.2E-02	1	8.8E-07	8.8E-07	8.8E-07	9E-07	8.8E-07
Arsenic	4.26E-07	1.0E-03	1	1.1E-04	1.1E-04	1.1E-04	1E-04	1.1E-04
Barium	2.14E-06	1.0E-03	1	5.4E-04	5.4E-04	5.4E-04	5E-04	5.4E-04
Bismuth	3.33E-09	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	9.99E-08	4.0E-01	1	6.3E-08	6.3E-08	6.3E-08	6E-08	6.3E-08
Cadmium	8.20E-09	2.0E-03	1	1.0E-06	1.0E-06	1.0E-06	1E-06	1.0E-06
Chromium	4.95E-07	6.0E-02	1	2.1E-06	2.1E-06	2.1E-06	2E-06	2.1E-06
Cobalt	1.11E-07	5.0E-04	1	5.5E-05	5.5E-05	5.5E-05	6E-05	5.5E-05
Copper	5.74E-07	1.0E-03	1	1.4E-04	1.4E-04	1.4E-04	1E-04	1.4E-04
Iron	2.91E-04	1.4E+00	1	5.2E-05	5.2E-05	5.2E-05	5E-05	5.2E-05
Lead	2.10E-07	infant = 2.24E-03 toddler = 1.19E-03 child = 1.36E-03 teen = 5.74E-03 adult = 6.4E-03	1	2E-05	4E-05	4E-05	9E-06	8.2E-06
Manganese	4.61E-06	infant = 5.03E-01 toddler = 2.70E-01 child = 2.77E-01 teen = 5.43E-01 adult = 6.64E-01	1	2E-06	4E-06	4E-06	2E-06	1.7E-06
Mercury	1.50E-08	3.00E-04	1	1E-05	1E-05	1E-05	1E-05	1.2E-05

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Nickel	2.62E-07	2.00E-05	1	3E-03	3E-03	3E-03	3E-03	3.3E-03
Selenium	2.44E-08	infant = 2.1E-02 toddler = 1.2E-02 child = 1.4E-02 teen = 2.4E-02 adult = 2.4E-02	1	3E-07	5E-07	4E-07	3E-07	2.5E-07
Strontium	4.83E-07	1.2E+00	1	1E-07	1E-07	1E-07	1E-07	1.0E-07
Tellurium	4.48E-09	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	1.73E-09	1.4E-04	1	3E-06	3E-06	3E-06	3E-06	3.1E-06
Titanium	1.14E-05	6.0E+00	1	5E-07	5E-07	5E-07	5E-07	4.8E-07
Uranium	6.89E-09	8.0E-04	1	2E-06	2E-06	2E-06	2E-06	2.2E-06
Vanadium	5.47E-07	1.0E-04	1	1E-03	1E-03	1E-03	1E-03	1.4E-03
Zinc	9.42E-07	infant = 1.8E+00 toddler = 9.5E-01 child = 1.1E-00 teen = 2.1E+00 adult = 2.4E+00	1	1E-07	2.5E-07	2.2E-07	1E-07	9.7E-08

Table F8. Calculation of Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Recreational User – Baseline

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Cancer Risk				
				Infant	Toddler	Child	Teen	Adult
Recreational User - Incidental Soil Ingestion								
Arsenic	6.95E+01	1.8E+00	3.3E-01	3.63E-07	3.25E-06	3.80E-07	1.60E-07	5.05E-07
Recreational User - Dermal Contact with Soil								
Arsenic	6.95E+01	1.8E+00	3.0E-02	7.7E-08	2.5E-07	1.8E-07	1.1E-07	3.93E-07
Recreational User - Inhalation of Particulate								
	Air Concentration (mg/m^3)							
Arsenic	2.36E-07	2.7E+01	1	6.2E-09	5.2E-08	4.3E-08	1.9E-08	6.5E-08
Cadmium	3.73E-09	4.2E+01	1	1.5E-10	1.3E-09	1.0E-09	4.7E-10	1.6E-09
Chromium	3.37E-07	4.6E+01	1	1.5E-08	1.3E-07	1.0E-07	4.7E-08	1.6E-07
Nickel	1.79E-07	3.0E+00	1	5.2E-10	4.4E-09	3.6E-09	1.6E-09	5.4E-09

Table F9. Calculation of Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Recreational User – Predicted

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Cancer Risk				
				Infant	Toddler	Child	Teen	Adult
Recreational - Incidental Soil Ingestion								
Arsenic	6.99E+01	1.8E+00	3.3E-01	3.65E-07	3.27E-06	3.82E-07	1.61E-07	5.08E-07
Recreational - Dermal Contact with Soil								
Arsenic	6.99E+01	1.8E+00	3.0E-02	7.7E-08	2.6E-07	1.8E-07	1.1E-07	3.96E-07
Recreational - Inhalation of Particulate								
	Air Concentration (mg/m^3)							
Arsenic	4.26E-07	2.7E+01	1	1.1E-08	9.4E-08	7.7E-08	3.5E-08	1.2E-07
Cadmium	8.20E-09	4.2E+01	1	3.3E-10	2.8E-09	2.3E-09	1.0E-09	3.5E-09
Chromium	4.95E-07	4.6E+01	1	2.2E-08	1.9E-07	1.5E-07	6.9E-08	2.3E-07
Nickel	2.62E-07	3.0E+00	1	7.6E-10	6.4E-09	5.2E-09	2.4E-09	8.0E-09

Table F10. Calculation of Non-Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Summer Resident – Baseline

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Summer Resident - Incidental Soil Ingestion								
Aluminum	2.93E+04	1.0E+00	1	3.6E-02	7.1E-02	8.9E-03	4.9E-03	4.1E-03
Antimony	6.86E+00	6.0E-03	1	1.4E-03	2.8E-03	3.5E-04	1.9E-04	1.6E-04
Arsenic	6.95E+01	1.0E-03	0.33	2.8E-02	5.6E-02	7.0E-03	3.8E-03	3.2E-03
Barium	4.29E+02	2.0E-01	1	2.6E-03	5.2E-03	6.5E-04	3.6E-04	3.0E-04
Bismuth	3.28E-01	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	2.00E+01	2.0E-01	1	1.2E-04	2.4E-04	3.0E-05	1.7E-05	1.4E-05
Cadmium	1.10E+00	1.0E-03	1	1.3E-03	2.7E-03	3.3E-04	1.8E-04	1.6E-04
Chromium	9.91E+01	1.0E-03	1	1.2E-01	2.4E-01	3.0E-02	1.7E-02	1.4E-02
Cobalt	2.23E+01	1.4E-03	1	1.9E-02	3.9E-02	4.8E-03	2.7E-03	2.2E-03
Copper	1.06E+02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	1.4E-03	2.83E-03	2.93E-04	1.41E-04	1.06E-04
Iron	5.82E+04	7.0E-01	1	1.0E-01	2.0E-01	2.5E-02	1.4E-02	1.2E-02
Lead	4.00E+01	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	8.1E-02	1.6E-01	2.0E-02	4.5E-03	3.8E-03
Manganese	9.16E+02	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	8.2E-03	2E-02	2.3E-03	1.1E-03	8.3E-04
Mercury	8.00E-02	3.0E-04	1	3.3E-04	6.5E-04	8.1E-05	4.5E-05	3.8E-05

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Nickel	5.26E+01	1.10E-02	1	5.8E-03	1.2E-02	1.5E-03	8.0E-04	6.8E-04
Selenium	4.54E+00	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	1.0E-03	1.8E-03	2.19E-04	1.2E-04	1.1E-04
Strontium	9.69E+01	6.0E-01	1	2.0E-04	3.9E-04	4.9E-05	2.7E-05	2.3E-05
Tellurium	3.15E-01	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	3.00E-01	7.0E-05	1	5.2E-03	1.0E-02	1.3E-03	7.2E-04	6.1E-04
Titanium	2.31E+03	3.0E+00	1	9.4E-04	1.9E-03	2.3E-04	1.3E-04	1.1E-04
Uranium	1.21E+00	6.0E-04	1	2.5E-03	4.9E-03	6.1E-04	3.4E-04	2.8E-04
Vanadium	1.08E+02	5.0E-03	1	2.6E-02	5.2E-02	6.6E-03	3.6E-03	3.1E-03
Zinc	1.44E+02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	3.6E-04	7.3E-04	9.1E-05	4.5E-05	3.6E-05
Summer Resident - Dermal Contact with Soil								
Aluminum	2.93E+04	1.0E+00	1.0E-02	8.3E-04	6.1E-04	4.7E-04	3.7E-04	3.5E-04
Antimony	6.86E+00	6.0E-03	1.0E-02	3.2E-05	2.4E-05	1.8E-05	1.5E-05	1.4E-05
Arsenic	6.95E+01	1.0E-03	3.0E-02	5.9E-03	4.3E-03	3.3E-03	2.7E-03	2.5E-03
Barium	4.29E+02	2.0E-01	1.0E-01	6.1E-04	4.5E-04	3.4E-04	2.7E-04	2.6E-04
Bismuth	3.28E-01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boron	2.00E+01	2.0E-01	1.0E-02	2.8E-06	2.1E-06	1.6E-06	1.3E-06	1.2E-06
Cadmium	1.10E+00	1.0E-03	1.0E-02	3.1E-05	2.3E-05	1.7E-05	1.4E-05	1.3E-05
Chromium	9.91E+01	1.0E-03	1.0E-01	2.8E-02	2.1E-02	1.6E-02	1.3E-02	1.2E-02
Cobalt	2.23E+01	1.4E-03	1.0E-02	4.5E-04	3.3E-04	2.5E-04	2.0E-04	1.9E-04

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Copper	1.06E+02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	6.0E-02	2.0E-04	1.46E-04	9.19E-05	6.43E-05	5.47E-05
Iron	5.82E+04	7.0E-01	1.0E-02	2.4E-03	1.7E-03	1.3E-03	1.1E-03	1.0E-03
Lead	4.00E+01	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1.0E-02	1.9E-03	1.4E-03	1.1E-03	3.4E-04	3.2E-04
Manganese	9.16E+02	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1.0E-02	1.91E-04	1.40E-04	1.2E-04	8.2E-05	7.1E-05
Mercury	8.00E-02	3.0E-04	1.0E+00	7.6E-04	5.6E-04	4.2E-04	3.4E-04	3.2E-04
Nickel	5.26E+01	1.10E-02	9.1E-02	1.2E-03	9.1E-04	6.9E-04	5.5E-04	5.3E-04
Selenium	4.54E+00	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.0E-02	2.3E-05	1.5E-05	1.1E-05	9.3E-06	9.6E-06
Strontium	9.69E+01	6.0E-01	1.0E-02	4.6E-06	3.4E-06	2.6E-06	2.1E-06	2.0E-06
Tellurium	3.15E-01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	3.00E-01	7.0E-05	1.0E-02	1.2E-04	8.9E-05	6.8E-05	5.5E-05	5.2E-05
Titanium	2.31E+03	3.0E+00	1.0E-02	2.2E-05	1.6E-05	1.2E-05	9.8E-06	9.3E-06
Uranium	1.21E+00	6.0E-04	1.0E-01	5.7E-04	4.2E-04	3.2E-04	2.6E-04	2.4E-04
Vanadium	1.08E+02	5.0E-03	1.0E-02	6.1E-04	4.5E-04	3.4E-04	2.8E-04	2.6E-04

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Zinc	1.44E+02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1.0E-01	8.3E-05	6.2E-05	4.8E-05	3.4E-05	3.1E-05
Summer Resident - Inhalation of Particulate								
	Air Concentration (mg/m^3)							
Aluminum	9.96E-05	5.0E-03	1	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Antimony	2.33E-08	1.2E-02	1	9.8E-07	9.8E-07	9.8E-07	9.8E-07	9.8E-07
Arsenic	2.36E-07	1.0E-03	1	1.2E-04	1.2E-04	1.2E-04	1.2E-04	1.2E-04
Barium	1.46E-06	1.0E-03	1	7.3E-04	7.3E-04	7.3E-04	7.3E-04	7.3E-04
Bismuth	1.11E-09	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	6.80E-08	4.0E-01	1	8.6E-08	8.6E-08	8.6E-08	8.6E-08	8.6E-08
Cadmium	3.73E-09	2.0E-03	1	9.4E-07	9.4E-07	9.4E-07	9.4E-07	9.4E-07
Chromium	3.37E-07	6.0E-02	1	2.8E-06	2.8E-06	2.8E-06	2.8E-06	2.8E-06
Cobalt	7.57E-08	5.0E-04	1	7.6E-05	7.6E-05	7.6E-05	7.6E-05	7.6E-05
Copper	3.61E-07	1.0E-03	1	1.8E-04	1.8E-04	1.8E-04	1.8E-04	1.8E-04
Iron	1.98E-04	1.4E+00	1	7.1E-05	7.1E-05	7.1E-05	7.1E-05	7.1E-05
Lead	1.36E-07	infant = 2.24E-03 toddler = 1.19E-03 child = 1.36E-03 teen = 4.98E-03 adult = 5.54E-03	1	3.0E-05	5.7E-05	5.0E-05	1.2E-05	1.1E-05
Manganese	3.11E-06	infant = 5.03E-01 toddler = 2.70E-01 child = 2.77E-01 teen = 5.43E-01 adult = 6.64E-01	1	3.1E-06	5.8E-06	5.6E-06	2.9E-06	2.3E-06

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Mercury	2.72E-10	3.00E-04	1	4.5E-07	4.5E-07	4.5E-07	4.5E-07	4.5E-07
Nickel	1.79E-07	2.00E-05	1	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03
Selenium	1.54E-08	infant = 2.1E-02 toddler = 1.2E-02 child = 1.4E-02 teen = 2.4E-02 adult = 2.4E-02	1	3.8E-07	6.3E-07	5.4E-07	3.3E-07	3.2E-07
Strontium	3.29E-07	1.2E+00	1	1.4E-07	1.4E-07	1.4E-07	1.4E-07	1.4E-07
Tellurium	1.07E-09	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	1.02E-09	1.4E-04	1	3.7E-06	3.7E-06	3.7E-06	3.7E-06	3.7E-06
Titanium	7.86E-06	6.0E+00	1	6.6E-07	6.6E-07	6.6E-07	6.6E-07	6.6E-07
Uranium	4.11E-09	8.0E-04	1	2.6E-06	2.6E-06	2.6E-06	2.6E-06	2.6E-06
Vanadium	3.68E-07	1.0E-04	1	1.8E-03	1.8E-03	1.8E-03	1.8E-03	1.8E-03
Zinc	4.88E-07	infant = 1.8E+00 toddler = 9.5E-01 child = 1.1E-00 teen = 2.1E+00 adult = 2.4E+00	1	1.3E-07	2.6E-07	2.2E-07	1.2E-07	1.0E-07

Table F11. Calculation of Non-Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Summer Resident – Predicted

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Summer Resident - Incidental Soil Ingestion								
Aluminum	2.95E+04	1.0E+00	1	3.6E-02	7.1E-02	9.0E-03	4.9E-03	4.2E-03
Antimony	6.90E+00	6.0E-03	1	1.4E-03	2.8E-03	3.5E-04	1.9E-04	1.6E-04
Arsenic	6.99E+01	1.0E-03	3.3E-01	2.8E-02	5.6E-02	7.0E-03	3.9E-03	3.3E-03
Barium	4.31E+02	2.0E-01	1	2.6E-03	5.2E-03	6.6E-04	3.6E-04	3.0E-04
Bismuth	3.30E-01	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	2.01E+01	2.0E-01	1	1.2E-04	2.4E-04	3.1E-05	1.7E-05	1.4E-05
Cadmium	1.10E+00	1.0E-03	1	1.3E-03	2.7E-03	3.4E-04	1.9E-04	1.6E-04
Chromium	9.97E+01	1.0E-03	1	1.2E-01	2.4E-01	3.0E-02	1.7E-02	1.4E-02
Cobalt	2.24E+01	1.4E-03	1	2.0E-02	3.9E-02	4.9E-03	2.7E-03	2.3E-03
Copper	1.07E+02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	1.4E-03	2.8E-03	2.9E-04	1.4E-04	1.1E-04
Iron	5.85E+04	7.0E-01	1	1.0E-01	2.0E-01	2.5E-02	1.4E-02	1.2E-02
Lead	4.02E+01	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	8.2E-02	1.6E-01	2.0E-02	4.5E-03	3.8E-03
Manganese	9.22E+02	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	8.3E-03	1.6E-02	2.3E-03	1.1E-03	8.4E-04
Mercury	8.58E-02	3.0E-04	1	3.5E-04	6.9E-04	8.7E-05	4.8E-05	4.0E-05

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Nickel	5.29E+01	1.10E-02	1	5.9E-03	1.2E-02	1.5E-03	8.1E-04	6.8E-04
Selenium	4.57E+00	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	1.0E-03	1.8E-03	2.20E-04	1.2E-04	1.1E-04
Strontium	9.74E+01	6.0E-01	1	2.0E-04	3.9E-04	4.9E-05	2.7E-05	2.3E-05
Tellurium	3.18E-01	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	3.02E-01	7.0E-05	1	5.3E-03	1.0E-02	1.3E-03	7.2E-04	6.1E-04
Titanium	2.33E+03	3.0E+00	1	9.5E-04	1.9E-03	2.4E-04	1.3E-04	1.1E-04
Uranium	1.22E+00	6.0E-04	1	2.5E-03	4.9E-03	6.2E-04	3.4E-04	2.9E-04
Vanadium	1.09E+02	5.0E-03	1	2.7E-02	5.3E-02	6.6E-03	3.6E-03	3.1E-03
Zinc	1.45E+02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	3.6E-04	7.3E-04	9.2E-05	4.5E-05	3.6E-05
Summer Resident - Dermal Contact with Soil								
Aluminum	2.95E+04	1.0E+00	1.0E-02	8.4E-04	6.1E-04	4.7E-04	3.8E-04	3.6E-04
Antimony	6.90E+00	6.0E-03	1.0E-02	3.3E-05	2.4E-05	1.8E-05	1.5E-05	1.4E-05
Arsenic	6.99E+01	1.0E-03	3.0E-02	6.0E-03	4.4E-03	3.3E-03	2.7E-03	2.5E-03
Barium	4.31E+02	2.0E-01	1.0E-01	6.1E-04	4.5E-04	3.4E-04	2.7E-04	2.6E-04
Bismuth	3.30E-01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boron	2.01E+01	2.0E-01	1.0E-02	2.9E-06	2.1E-06	1.6E-06	1.3E-06	1.2E-06
Cadmium	1.10E+00	1.0E-03	1.0E-02	3.1E-05	2.3E-05	1.8E-05	1.4E-05	1.3E-05
Chromium	9.97E+01	1.0E-03	1.0E-01	2.8E-02	2.1E-02	1.6E-02	1.3E-02	1.2E-02
Cobalt	2.24E+01	1.4E-03	1.0E-02	4.5E-04	3.3E-04	2.5E-04	2.0E-04	1.9E-04

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Copper	1.07E+02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	6.0E-02	2.0E-04	1.47E-04	9.25E-05	6.47E-05	5.50E-05
Iron	5.85E+04	7.0E-01	1.0E-02	2.4E-03	1.7E-03	1.3E-03	1.1E-03	1.0E-03
Lead	4.02E+01	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1.0E-02	1.9E-03	1.4E-03	1.1E-03	3.4E-04	3.2E-04
Manganese	9.22E+02	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1.0E-02	1.93E-04	1.41E-04	1.2E-04	8.3E-05	7.2E-05
Mercury	8.58E-02	3.0E-04	1.0E+00	8.1E-04	6.0E-04	4.5E-04	3.6E-04	3.5E-04
Nickel	5.29E+01	1.10E-02	9.1E-02	1.2E-03	9.1E-04	6.9E-04	5.6E-04	5.3E-04
Selenium	4.57E+00	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.0E-02	2.4E-05	1.5E-05	1.2E-05	9.4E-06	9.7E-06
Strontium	9.74E+01	6.0E-01	1.0E-02	4.6E-06	3.4E-06	2.6E-06	2.1E-06	2.0E-06
Tellurium	3.18E-01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	3.02E-01	7.0E-05	1.0E-02	1.2E-04	9.0E-05	6.8E-05	5.5E-05	5.2E-05
Titanium	2.33E+03	3.0E+00	1.0E-02	2.2E-05	1.6E-05	1.2E-05	9.9E-06	9.4E-06
Uranium	1.22E+00	6.0E-04	1.0E-01	5.8E-04	4.2E-04	3.2E-04	2.6E-04	2.5E-04
Vanadium	1.09E+02	5.0E-03	1.0E-02	6.2E-04	4.5E-04	3.5E-04	2.8E-04	2.6E-04

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Zinc	1.45E+02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1.0E-01	8.4E-05	6.3E-05	4.8E-05	3.4E-05	3.1E-05
Summer Resident - Inhalation of Particulate								
	Air Concentration (mg/m^3)							
Aluminum	1.48E-04	5.0E-03	1	1.5E-02	1.5E-02	1.5E-02	1.5E-02	1.5E-02
Antimony	4.18E-08	1.2E-02	1	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06
Arsenic	4.26E-07	1.0E-03	1	2.1E-04	2.1E-04	2.1E-04	2.1E-04	2.1E-04
Barium	2.14E-06	1.0E-03	1	1.1E-03	1.1E-03	1.1E-03	1.1E-03	1.1E-03
Bismuth	3.33E-09	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	9.99E-08	4.0E-01	1	1.3E-07	1.3E-07	1.3E-07	1.3E-07	1.3E-07
Cadmium	8.20E-09	2.0E-03	1	2.1E-06	2.1E-06	2.1E-06	2.1E-06	2.1E-06
Chromium	4.95E-07	6.0E-02	1	4.1E-06	4.1E-06	4.1E-06	4.1E-06	4.1E-06
Cobalt	1.11E-07	5.0E-04	1	1.1E-04	1.1E-04	1.1E-04	1.1E-04	1.1E-04
Copper			1					
Iron	2.91E-04	1.4E+00	1	1.0E-04	1.0E-04	1.0E-04	1.0E-04	1.0E-04
Lead	2.10E-07	infant = 2.24E-03 toddler = 1.19E-03 child = 1.36E-03 teen = 4.98E-03 adult = 5.54E-03	1	4.7E-05	8.8E-05	7.7E-05	1.8E-05	1.6E-05
Manganese	4.61E-06	infant = 5.03E-01 toddler = 2.70E-01 child = 2.77E-01 teen = 5.43E-01 adult = 6.64E-01	1	4.5E-06	8.5E-06	8.3E-06	4.2E-06	3.5E-06

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Mercury	1.50E-08	3.00E-04	1	2.5E-05	2.5E-05	2.5E-05	2.5E-05	2.5E-05
Nickel	2.62E-07	2.00E-05	1	6.6E-03	6.6E-03	6.6E-03	6.6E-03	6.6E-03
Selenium	2.44E-08	infant = 2.1E-02 toddler = 1.2E-02 child = 1.4E-02 teen = 2.4E-02 adult = 2.4E-02	1	5.9E-07	9.9E-07	8.5E-07	5.1E-07	5.0E-07
Strontuim	4.83E-07	1.2E+00	1	2.0E-07	2.0E-07	2.0E-07	2.0E-07	2.0E-07
Tellurium	4.48E-09	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	1.73E-09	1.4E-04	1	6.2E-06	6.2E-06	6.2E-06	6.2E-06	6.2E-06
Titanium	1.14E-05	6.0E+00	1	9.6E-07	9.6E-07	9.6E-07	9.6E-07	9.6E-07
Uranium	6.89E-09	8.0E-04	1	4.3E-06	4.3E-06	4.3E-06	4.3E-06	4.3E-06
Vanadium	5.47E-07	1.0E-04	1	2.7E-03	2.7E-03	2.7E-03	2.7E-03	2.7E-03
Zinc	9.42E-07	infant = 1.8E+00 toddler = 9.5E-01 child = 1.1E-00 teen = 2.1E+00 adult = 2.4E+00	1	2.6E-07	4.9E-07	4.3E-07	2.3E-07	1.9E-07

Table F12. Calculation of Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Summer Resident - Baseline

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Cancer Risk				
				Infant	Toddler	Child	Teen	Adult
Summer Resident - Incidental Soil Ingestion								
Arsenic	6.95E+01	1.8E+00	3.3E-01	1.57E-06	1E-05	1.65E-06	6.92E-07	8.03E-07
Summer Resident - Dermal Contact with Soil								
Arsenic	6.95E+01	1.8E+00	3.0E-02	3.3E-07	1.1E-06	7.8E-07	4.8E-07	1.70E-06
Summer Resident - Inhalation of Particulate								
	Air Concentration (mg/m^3)							
Arsenic	2.36E-07	2.7E+01	1	2.7E-08	2.3E-07	1.8E-07	8.3E-08	2.8E-07
Cadmium	3.73E-09	4.2E+01	1	6.6E-10	5.5E-09	4.5E-09	2.0E-09	6.9E-09
Chromium	3.37E-07	4.6E+01	1	6.5E-08	5.5E-07	4.5E-07	2.0E-07	6.8E-07
Nickel	1.79E-07	3.0E+00	1	2.2E-09	1.9E-08	1.6E-08	7.0E-09	2.4E-08

Table F13. Calculation of Carcinogenic Hazard from Direct Contact with Soil and Inhalation of Air Particulate by the Summer Resident – Predicted

Constituent	Soil Concentration (mg/kg)	TRV	RAF	Cancer Risk				
				Infant	Toddler	Child	Teen	Adult
Summer Resident - Incidental Soil Ingestion								
Arsenic	6.99E+01	1.8E+00	3.3E-01	1.58E-06	1E-05	1.66E-06	6.96E-07	8.08E-07
Summer Resident - Dermal Contact with Soil								
Arsenic	6.99E+01	1.8E+00	3.0E-02	3.4E-07	1.1E-06	7.9E-07	4.8E-07	1.71E-06
Summer Resident - Inhalation of Particulate								
	Air Concentration (mg/m^3)							
Arsenic	4.26E-07	2.7E+01	1	4.8E-08	4.1E-07	3.3E-07	1.5E-07	5.1E-07
Cadmium	8.20E-09	4.2E+01	1	1.4E-09	1.2E-08	1.0E-08	4.5E-09	1.5E-08
Chromium	4.95E-07	4.6E+01	1	9.5E-08	8.1E-07	6.6E-07	3.0E-07	1.0E-06
Nickel	2.62E-07	3.0E+00	1	3.3E-09	2.8E-08	2.3E-08	1.0E-08	3.5E-08

Table F14. Calculation of Non-Carcinogenic Hazard from Direct Contact with Surface Water by the Hunter/Trapper/Fisher – Baseline

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Hunter/Trapper/Fisher - Ingestion Surface Water					
Aluminum	5.89E+00	1.0E+00	1	6.6E-02	8.3E-02
Antimony	2.05E-03	6.0E-03	1	3.8E-03	4.8E-03
Arsenic	8.45E-03	1.0E-03	1	9.4E-02	1.2E-01
Barium	1.13E-01	2.0E-01	1	6.3E-03	8.0E-03
Bismuth	8.36E-03	N/A	1	N/A	N/A
Boron	9.19E-02	2.0E-01	1	5.1E-03	6.5E-03
Cadmium	4.83E-04	1.0E-03	1	5.4E-03	6.8E-03
Chromium	6.68E-03	1.0E-03	1	7.5E-02	9.5E-02
Cobalt	5.03E-03	1.4E-03	1	4.0E-02	5.1E-02
Copper	3.01E-02	teen = 1.26E-01 adult = 1.41E-01	1	2.7E-03	3.0E-03
Iron	9.17E+00	7.0E-01	1	1.5E-01	1.9E-01
Lead	6.83E-03	1.5E-03	1	5.1E-02	6.4E-02
Manganese	2.94E-01	teen = 1.42E-01 adult = 1.56E-01	1	2.3E-02	2.7E-02
Mercury	1.21E-05	3.0E-04	1	4.5E-04	5.7E-04
Nickel	2.06E-02	1.10E-02	1	2.1E-02	2.6E-02
Selenium	2.30E-03	teen = 6.2E-3 adult = 5.7E-3	1	4.1E-03	5.7E-03
Strontium	2.69E-01	6.0E-01	1	5.0E-03	6.3E-03
Tellurium	N/A	N/A	1	N/A	N/A
Thallium	1.84E-04	7.0E-05	1	2.9E-02	3.7E-02
Titanium	9.82E-02	3.0E+00	1	3.7E-04	4.6E-04
Uranium	5.00E-04	6.0E-04	1	9.3E-03	1.2E-02
Vanadium	1.35E-02	5.0E-03	1	3.0E-02	3.8E-02

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Zinc	5.81E-02	teen = 5.4E-01 adult = 5.7E-01	1	1.2E-03	1.4E-03
Hunter/Trapper/Fisher - Dermal Contact with Surface Water					
Aluminum	5.89E+00	1.0E+00	1.0E-03	2.0E-04	1.9E-04
Antimony	2.05E-03	6.0E-03	1.0E-03	1.2E-05	1.1E-05
Arsenic	8.45E-03	1.0E-03	1.0E-03	2.9E-04	2.7E-04
Barium	1.13E-01	2.0E-01	1.0E-03	1.9E-05	1.8E-05
Bismuth	8.36E-03	N/A	N/A	N/A	N/A
Boron	9.19E-02	2.0E-01	1.0E-03	1.6E-05	1.5E-05
Cadmium	4.83E-04	1.0E-03	1.0E-03	1.6E-05	1.5E-05
Chromium	6.68E-03	1.0E-03	2.0E-03	4.5E-04	4.3E-04
Cobalt	5.03E-03	1.4E-03	1.0E-03	1.2E-04	1.1E-04
Copper	3.01E-02	teen = 1.26E-01 adult = 1.41E-01	1.0E-03	8.1E-06	6.8E-06
Iron	9.17E+00	7.0E-01	1.0E-03	4.4E-04	4.2E-04
Lead	6.83E-03	1.5E-03	1.0E-04	1.5E-05	1.5E-05
Manganese	2.94E-01	teen = 1.42E-01 adult = 1.56E-01	1.0E-03	7.0E-05	6.0E-05
Mercury	1.21E-05	3.0E-04	2.5E-03	3.4E-06	3.2E-06
Nickel	2.06E-02	1.10E-02	2.0E-04	1.3E-05	1.2E-05
Selenium	2.30E-03	teen = 6.2E-3 adult = 5.7E-3	1.0E-03	1.3E-05	1.3E-05
Strontium	2.69E-01	6.0E-01	1.0E-03	1.5E-05	1.4E-05
Tellurium	N/A	N/A	N/A	N/A	N/A
Thallium	1.84E-04	7.0E-05	1.0E-03	8.9E-05	8.4E-05
Titanium	9.82E-02	3.0E+00	1.0E-03	1.1E-06	1.0E-06
Uranium	5.00E-04	6.0E-04	1.0E-03	2.8E-05	2.7E-05
Vanadium	1.35E-02	5.0E-03	1.0E-03	9.1E-05	8.6E-05
Zinc	5.81E-02	teen = 5.4E-01 adult = 5.7E-01	6.0E-04	2.2E-06	2.0E-06

Table F15. Calculation of Non-Carcinogenic Hazard from Direct Contact with Surface Water by the Hunter/Trapper/Fisher - Predicted Future

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Hunter/Trapper/Fisher - Ingestion Surface Water					
Aluminum	6.15E+00	1.0E+00	1	6.9E-02	8.7E-02
Antimony	5.74E-03	6.0E-03	1	1.1E-02	1.4E-02
Arsenic	9.79E-03	1.0E-03	1	1.1E-01	1.38E-01
Barium	1.19E-01	2.0E-01	1	6.6E-03	8.4E-03
Bismuth	8.44E-03	N/A	1	N/A	N/A
Boron	9.57E-02	2.0E-01	1	5.3E-03	6.8E-03
Cadmium	1.33E-03	1.0E-03	1	1.5E-02	1.9E-02
Chromium	7.62E-03	1.0E-03	1	8.5E-02	1.1E-01
Cobalt	6.44E-03	1.4E-03	1	5.1E-02	6.5E-02
Copper	3.36E-02	teen = 1.26E-01 adult = 1.41E-01	1	3.0E-03	3.37E-03
Iron	9.66E+00	7.0E-01	1	1.5E-01	2.0E-01
Lead	7.78E-03	1.5E-03	1	5.8E-02	7.3E-02
Manganese	5.38E-01	teen = 1.42E-01 adult = 1.56E-01	1	4.2E-02	4.9E-02
Mercury	6.91E-05	3.0E-04	1	2.6E-03	3.3E-03
Nickel	2.72E-02	1.10E-02	1	2.8E-02	3.5E-02
Selenium	3.26E-03	teen = 6.2E-3 adult = 5.7E-3	1	5.9E-03	8.1E-03
Strontium	2.96E-01	6.0E-01	1	5.5E-03	7.0E-03
Tellurium	N/A	N/A	1	N/A	N/A
Thallium	1.92E-04	7.0E-05	1	3.1E-02	3.9E-02
Titanium	1.01E-01	3.0E+00	1	3.7E-04	4.7E-04
Uranium	5.00E-04	6.0E-04	1	9.3E-03	1.2E-02
Vanadium	1.37E-02	5.0E-03	1	3.1E-02	3.9E-02

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient	
				Teen	Adult
Zinc	1.13E-01	teen = 5.4E-01 adult = 5.7E-01	1	2.3E-03	2.8E-03
Hunter/Trapper/Fisher - Dermal Contact with Surface Water					
Aluminum	6.15E+00	1.0E+00	1.0E-03	2.1E-04	2.0E-04
Antimony	5.74E-03	6.0E-03	1.0E-03	3.2E-05	3.1E-05
Arsenic	9.79E-03	1.0E-03	1.0E-03	3.3E-04	3.1E-04
Barium	1.19E-01	2.0E-01	1.0E-03	2.0E-05	1.9E-05
Bismuth	8.44E-03	N/A	N/A	N/A	N/A
Boron	9.57E-02	2.0E-01	1.0E-03	1.6E-05	1.5E-05
Cadmium	1.33E-03	1.0E-03	1.0E-03	4.5E-05	4.3E-05
Chromium	7.62E-03	1.0E-03	2.0E-03	5.2E-04	4.9E-04
Cobalt	6.44E-03	1.4E-03	1.0E-03	1.6E-04	1.5E-04
Copper	3.36E-02	teen = 1.26E-01 adult = 1.41E-01	1.0E-03	9.0E-06	7.6E-06
Iron	9.66E+00	7.0E-01	1.0E-03	4.7E-04	4.4E-04
Lead	7.78E-03	1.5E-03	1.0E-04	1.8E-05	1.7E-05
Manganese	5.38E-01	teen = 1.42E-01 adult = 1.56E-01	1.0E-03	1.3E-04	1.1E-04
Mercury	6.91E-05	3.0E-04	2.5E-03	1.9E-05	1.8E-05
Nickel	2.72E-02	1.10E-02	2.0E-04	1.7E-05	1.6E-05
Selenium	3.26E-03	teen = 6.2E-3 adult = 5.7E-3	1.0E-03	1.8E-05	1.8E-05
Strontium	2.96E-01	6.0E-01	1.0E-03	1.7E-05	1.6E-05
Tellurium	N/A	N/A	N/A	N/A	N/A
Thallium	1.92E-04	7.0E-05	1.0E-03	9.3E-05	8.8E-05
Titanium	1.01E-01	3.0E+00	1.0E-03	1.1E-06	1.1E-06
Uranium	5.00E-04	6.0E-04	1.0E-03	2.8E-05	2.7E-05
Vanadium	1.37E-02	5.0E-03	1.0E-03	9.3E-05	8.8E-05
Zinc	1.13E-01	teen = 5.4E-01 adult = 5.7E-01	6.0E-04	4.3E-06	3.8E-06

Table F16. Calculation of Carcinogenic Hazard from Direct Contact with Surface Water by the Hunter/Trapper/Fisher – Baseline

Constituent	Surface Water (mg/L)	TRV	RAF	Cancer Risk	
				Teen	Adult
Hunter/Trapper/Fisher - Ingestion Surface Water					
Arsenic	8.45E-03	1.8E+00	N/A	7.8E-06	3.7E-05
Hunter/Trapper/Fisher - Dermal Contact with Surface Water					
Arsenic	8.45E-03	1.8E+00	1.0E-03	2.4E-08	8.4E-08

Table F17. Calculation of Carcinogenic Hazard from Direct Contact with Surface Water by the Hunter/Trapper/Fisher - Predicted Future

Constituent	Surface Water (mg/L)	TRV	RAF	Cancer Risk	
				Teen	Adult
Hunter/Trapper/Fisher - Ingestion Surface Water					
Arsenic	9.79E-03	1.8E+00	N/A	9.1E-06	4.3E-05
Hunter/Trapper/Fisher - Dermal Contact with Surface Water					
Arsenic	9.79E-03	1.8E+00	1.0E-03	2.8E-08	9.7E-08

Table F18. Calculation of Non-Carcinogenic Hazard from Direct Contact with Surface Water by the Recreational User – Baseline

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Recreational - Ingestion Surface Water								
Aluminum	5.89E+00	1.0E+00	1	5.4E-02	5.4E-02	3.6E-02	2.5E-02	3.1E-02
Antimony	2.05E-03	6.0E-03	1	3.1E-03	3.1E-03	2.1E-03	1.4E-03	1.8E-03
Arsenic	8.45E-03	1.0E-03	1	7.7E-02	7.7E-02	5.1E-02	3.5E-02	4.5E-02
Barium	1.13E-01	2.0E-01	1	5.2E-03	5.1E-03	3.4E-03	2.4E-03	3.0E-03
Bismuth	8.36E-03	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	9.19E-02	2.0E-01	1	4.2E-03	4.2E-03	2.8E-03	1.9E-03	2.4E-03
Cadmium	4.83E-04	1.0E-03	1	4.4E-03	4.4E-03	2.9E-03	2.0E-03	2.6E-03
Chromium	6.68E-03	1.0E-03	1	6.1E-02	6.1E-02	4.1E-02	2.8E-02	3.5E-02
Cobalt	5.03E-03	1.4E-03	1	3.3E-02	3.3E-02	2.2E-02	1.5E-02	1.9E-02
Copper	3.01E-02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	3.0E-03	3.01E-03	1.7E-03	1.0E-03	1.1E-03
Iron	9.17E+00	7.0E-01	1	1.2E-01	1.2E-01	8.0E-02	5.5E-02	6.9E-02
Lead	6.83E-03	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	1.0E-01	1.0E-01	6.9E-02	1.9E-02	2.4E-02
Manganese	2.94E-01	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	2.0E-02	2.0E-02	1.5E-02	8.7E-03	1.0E-02
Mercury	1.21E-05	3.0E-04	1	3.7E-04	3.7E-04	2.5E-04	1.7E-04	2.1E-04
Nickel	2.06E-02	1.10E-02	1	1.7E-02	1.7E-02	1.1E-02	7.8E-03	9.9E-03

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Selenium	2.30E-03	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	3.8E-03	3.4E-03	2.2E-03	1.6E-03	2.1E-03
Strontium	2.69E-01	6.0E-01	1	4.1E-03	4.1E-03	2.7E-03	1.9E-03	2.4E-03
Tellurium	N/A	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	1.84E-04	7.0E-05	1	2.4E-02	2.4E-02	1.6E-02	1.1E-02	1.4E-02
Titanium	9.82E-02	3.0E+00	1	3.0E-04	3.0E-04	2.0E-04	1.4E-04	1.7E-04
Uranium	5.00E-04	6.0E-04	1	7.6E-03	7.6E-03	5.1E-03	3.5E-03	4.4E-03
Vanadium	1.35E-02	5.0E-03	1	2.5E-02	2.4E-02	1.6E-02	1.1E-02	1.4E-02
Zinc	5.81E-02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	1.1E-03	1.1E-03	7.4E-04	4.5E-04	5.4E-04
Recreational - Dermal Contact with Surface Water								
Aluminum	5.89E+00	1.0E+00	1.0E-03	1.6E-04	1.2E-04	9.3E-05	7.5E-05	7.1E-05
Antimony	2.05E-03	6.0E-03	1.0E-03	9.1E-06	6.8E-06	5.4E-06	4.3E-06	4.1E-06
Arsenic	8.45E-03	1.0E-03	1.0E-03	2.2E-04	1.7E-04	1.3E-04	1.1E-04	1.0E-04
Barium	1.13E-01	2.0E-01	1.0E-03	1.5E-05	1.1E-05	8.9E-06	7.2E-06	6.8E-06
Bismuth	8.36E-03	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boron	9.19E-02	2.0E-01	1.0E-03	1.2E-05	9.2E-06	7.2E-06	5.8E-06	5.5E-06
Cadmium	4.83E-04	1.0E-03	1.0E-03	1.3E-05	9.7E-06	7.6E-06	6.1E-06	5.8E-06
Chromium	6.68E-03	1.0E-03	2.0E-03	3.5E-04	2.7E-04	2.1E-04	1.7E-04	1.6E-04
Cobalt	5.03E-03	1.4E-03	1.0E-03	9.5E-05	7.2E-05	5.7E-05	4.6E-05	4.3E-05
Copper	3.01E-02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1.0E-03	8.8E-06	6.6E-06	4.3E-06	3.0E-06	2.6E-06

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Iron	9.17E+00	7.0E-01	1.0E-03	3.5E-04	2.6E-04	2.1E-04	1.7E-04	1.6E-04
Lead	6.83E-03	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1.0E-04	3.0E-05	2.3E-05	1.8E-05	5.8E-06	5.5E-06
Manganese	2.94E-01	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1.0E-03	5.7E-05	4.3E-05	3.8E-05	2.6E-05	2.3E-05
Mercury	1.21E-05	3.0E-04	2.5E-03	2.6E-06	2.0E-06	1.6E-06	1.3E-06	1.2E-06
Nickel	2.06E-02	1.10E-02	2.0E-04	9.9E-06	7.5E-06	5.9E-06	4.7E-06	4.5E-06
Selenium	2.30E-03	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.0E-03	1.1E-05	7.4E-06	5.7E-06	4.7E-06	4.8E-06
Strontium	2.69E-01	6.0E-01	1.0E-03	1.2E-05	9.0E-06	7.1E-06	5.7E-06	5.4E-06
Tellurium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	1.84E-04	7.0E-05	1.0E-03	7.0E-05	5.3E-05	4.1E-05	3.3E-05	3.2E-05
Titanium	9.82E-02	3.0E+00	1.0E-03	8.7E-07	6.5E-07	5.1E-07	4.2E-07	3.9E-07
Uranium	5.00E-04	6.0E-04	1.0E-03	2.2E-05	1.7E-05	1.3E-05	1.1E-05	1.0E-05
Vanadium	1.35E-02	5.0E-03	1.0E-03	7.1E-05	5.4E-05	4.2E-05	3.4E-05	3.2E-05
Zinc	5.81E-02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	6.0E-04	1.9E-06	1.5E-06	1.1E-06	8.2E-07	7.3E-07

Table F19. Calculation of Non-Carcinogenic Hazard from Direct Contact with Surface Water by the Recreational User - Predicted Future

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Recreational - Ingestion Surface Water								
Aluminum	6.15E+00	1.0E+00	1	5.6E-02	5.6E-02	3.7E-02	2.6E-02	3.3E-02
Antimony	5.74E-03	6.0E-03	1	8.8E-03	8.7E-03	5.8E-03	4.0E-03	5.1E-03
Arsenic	9.79E-03	1.0E-03	1	9.0E-02	8.9E-02	6.0E-02	4.1E-02	5.2E-02
Barium	1.19E-01	2.0E-01	1	5.4E-03	5.4E-03	3.6E-03	2.5E-03	3.1E-03
Bismuth	8.44E-03	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	9.57E-02	2.0E-01	1	4.4E-03	4.4E-03	2.9E-03	2.0E-03	2.5E-03
Cadmium	1.33E-03	1.0E-03	1	1.2E-02	1.2E-02	8.1E-03	5.6E-03	7.1E-03
Chromium	7.62E-03	1.0E-03	1	7.0E-02	6.9E-02	4.6E-02	3.2E-02	4.0E-02
Cobalt	6.44E-03	1.4E-03	1	4.2E-02	4.2E-02	2.8E-02	1.9E-02	2.4E-02
Copper	3.36E-02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	3.4E-03	3.4E-03	1.9E-03	1.1E-03	1.3E-03
Iron	9.66E+00	7.0E-01	1	1.3E-01	1.3E-01	8.4E-02	5.8E-02	7.3E-02
Lead	7.78E-03	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	1.19E-01	1.18E-01	7.9E-02	2.2E-02	2.8E-02
Manganese	5.38E-01	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	3.6E-02	3.6E-02	2.7E-02	1.6E-02	1.8E-02
Mercury	6.91E-05	3.0E-04	1	2.1E-03	2.1E-03	1.4E-03	9.6E-04	1.2E-03
Nickel	2.72E-02	1.10E-02	1	2.3E-02	2.3E-02	1.5E-02	1.0E-02	1.3E-02

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Selenium	3.26E-03	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	5.4E-03	4.8E-03	3.1E-03	2.2E-03	3.0E-03
Strontium	2.96E-01	6.0E-01	1	4.5E-03	4.5E-03	3.0E-03	2.1E-03	2.6E-03
Tellurium	N/A	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	1.92E-04	7.0E-05	1	2.5E-02	2.5E-02	1.7E-02	1.1E-02	1.5E-02
Titanium	1.01E-01	3.0E+00	1	3.1E-04	3.0E-04	2.0E-04	1.4E-04	1.8E-04
Uranium	5.00E-04	6.0E-04	1	7.6E-03	7.6E-03	5.1E-03	3.5E-03	4.4E-03
Vanadium	1.37E-02	5.0E-03	1	2.5E-02	2.5E-02	1.7E-02	1.1E-02	1.5E-02
Zinc	1.13E-01	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	2.1E-03	2.1E-03	1.4E-03	8.8E-04	1.1E-03
Recreational - Dermal Contact with Surface Water								
Aluminum	6.15E+00	1.0E+00	1.0E-03	1.6E-04	1.2E-04	9.7E-05	7.8E-05	7.4E-05
Antimony	5.74E-03	6.0E-03	1.0E-03	2.5E-05	1.9E-05	1.5E-05	1.2E-05	1.1E-05
Arsenic	9.79E-03	1.0E-03	1.0E-03	2.6E-04	2.0E-04	1.5E-04	1.2E-04	1.2E-04
Barium	1.19E-01	2.0E-01	1.0E-03	1.6E-05	1.2E-05	9.3E-06	7.5E-06	7.1E-06
Bismuth	8.44E-03	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boron	9.57E-02	2.0E-01	1.0E-03	1.3E-05	9.6E-06	7.5E-06	6.1E-06	5.7E-06
Cadmium	1.33E-03	1.0E-03	1.0E-03	3.5E-05	2.7E-05	2.1E-05	1.7E-05	1.6E-05
Chromium	7.62E-03	1.0E-03	2.0E-03	4.0E-04	3.0E-04	2.4E-04	1.9E-04	1.8E-04
Cobalt	6.44E-03	1.4E-03	1.0E-03	1.2E-04	9.2E-05	7.2E-05	5.8E-05	5.5E-05
Copper	3.36E-02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1.0E-03	9.8E-06	7.4E-06	4.8E-06	3.4E-06	2.9E-06
Iron	9.66E+00	7.0E-01	1.0E-03	3.7E-04	2.8E-04	2.2E-04	1.8E-04	1.7E-04

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Lead	7.78E-03	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1.0E-04	3.4E-05	2.6E-05	2.0E-05	6.6E-06	6.2E-06
Manganese	5.38E-01	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1.0E-03	1.0E-04	7.9E-05	6.9E-05	4.8E-05	4.1E-05
Mercury	6.91E-05	3.0E-04	2.5E-03	1.5E-05	1.1E-05	8.9E-06	7.2E-06	6.8E-06
Nickel	2.72E-02	1.10E-02	2.0E-04	1.3E-05	9.9E-06	7.8E-06	6.3E-06	5.9E-06
Selenium	3.26E-03	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.0E-03	1.6E-05	1.1E-05	8.1E-06	6.7E-06	6.9E-06
Strontium	2.96E-01	6.0E-01	1.0E-03	1.3E-05	9.9E-06	7.8E-06	6.3E-06	5.9E-06
Tellurium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	1.92E-04	7.0E-05	1.0E-03	7.3E-05	5.5E-05	4.3E-05	3.5E-05	3.3E-05
Titanium	1.01E-01	3.0E+00	1.0E-03	8.9E-07	6.7E-07	5.3E-07	4.3E-07	4.0E-07
Uranium	5.00E-04	6.0E-04	1.0E-03	2.2E-05	1.7E-05	1.3E-05	1.1E-05	1.0E-05
Vanadium	1.37E-02	5.0E-03	1.0E-03	7.3E-05	5.5E-05	4.3E-05	3.5E-05	3.3E-05
Zinc	1.13E-01	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	6.0E-04	3.7E-06	2.8E-06	2.2E-06	1.6E-06	1.4E-06

Table F20. Calculation of Carcinogenic Hazard from Direct Contact with Surface Water by the Recreational User – Baseline

Constituent	Surface Water (mg/L)	TRV	RAF	Cancer Risk				
				Infant	Toddler	Child	Teen	Adult
Recreational - Ingestion Surface Water								
Arsenic	8.45E-03	1.8E+00	N/A	2.0E-06	9.0E-06	5.6E-06	2.9E-06	1.4E-05
Recreational - Dermal Contact with Surface Water								
Arsenic	8.45E-03	1.8E+00	1.0E-03	5.8E-09	2.0E-08	1.4E-08	8.9E-09	3.2E-08

Table F21. Calculation of Carcinogenic Hazard from Direct Contact with Surface Water by the Recreational User - Predicted Future

Constituent	Surface Water (mg/L)	TRV	RAF	Cancer Risk				
				Infant	Toddler	Child	Teen	Adult
Recreational - Ingestion Surface Water								
Arsenic	9.79E-03	1.8E+00	N/A	2.3E-06	1.0E-05	6.5E-06	3.4E-06	1.6E-05
Recreational - Dermal Contact with Surface Water								
Arsenic	9.79E-03	1.8E+00	1.0E-03	6.7E-09	2.3E-08	1.7E-08	1.0E-08	3.7E-08

Table F22. Calculation of Non-Carcinogenic Hazard from Direct Contact with Surface Water by the Summer Resident – Baseline

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Summer Resident - Ingestion Surface Water								
Aluminum	5.89E+00	1.0E+00	1	1.1E-01	1.1E-01	7.2E-02	4.9E-02	6.2E-02
Antimony	2.05E-03	6.0E-03	1	6.3E-03	6.2E-03	4.2E-03	2.9E-03	3.6E-03
Arsenic	8.45E-03	1.0E-03	1	1.5E-01	1.5E-01	1.0E-01	7.1E-02	9.0E-02
Barium	1.13E-01	2.0E-01	1	1.0E-02	1.0E-02	6.9E-03	4.7E-03	6.0E-03
Bismuth	8.36E-03	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	9.19E-02	2.0E-01	1	8.4E-03	8.4E-03	5.6E-03	3.8E-03	4.9E-03
Cadmium	4.83E-04	1.0E-03	1	8.8E-03	8.8E-03	5.9E-03	4.0E-03	5.1E-03
Chromium	6.68E-03	1.0E-03	1	1.2E-01	1.2E-01	8.1E-02	5.6E-02	7.1E-02
Cobalt	5.03E-03	1.4E-03	1	6.6E-02	6.5E-02	4.4E-02	3.0E-02	3.8E-02
Copper	3.01E-02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	6.1E-03	6.0E-03	3.3E-03	2.0E-03	2.3E-03
Iron	9.17E+00	7.0E-01	1	2.4E-01	2.4E-01	1.6E-01	1.1E-01	1.4E-01
Lead	6.83E-03	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	2.1E-01	2.1E-01	1.4E-01	3.8E-02	4.8E-02
Manganese	2.94E-01	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	4.0E-02	3.9E-02	2.9E-02	1.7E-02	2.0E-02
Mercury	1.21E-05	3.0E-04	1	7.4E-04	7.4E-04	4.9E-04	3.4E-04	4.3E-04
Nickel	2.06E-02	1.10E-02	1	3.4E-02	3.4E-02	2.3E-02	1.6E-02	2.0E-02

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Selenium	2.30E-03	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	7.6E-03	6.7E-03	4.4E-03	3.1E-03	4.3E-03
Strontium	2.69E-01	6.0E-01	1	8.2E-03	8.2E-03	5.5E-03	3.8E-03	4.8E-03
Tellurium	N/A	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	1.84E-04	7.0E-05	1	4.8E-02	4.8E-02	3.2E-02	2.2E-02	2.8E-02
Titanium	9.82E-02	3.0E+00	1	6.0E-04	6.0E-04	4.0E-04	2.7E-04	3.5E-04
Uranium	5.00E-04	6.0E-04	1	1.5E-02	1.5E-02	1.0E-02	7.0E-03	8.8E-03
Vanadium	1.35E-02	5.0E-03	1	4.9E-02	4.9E-02	3.3E-02	2.3E-02	2.9E-02
Zinc	5.81E-02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	2.2E-03	2.2E-03	1.5E-03	9.0E-04	1.1E-03
Summer Resident - Dermal Contact with Surface Water								
Aluminum	5.89E+00	1.0E+00	1.0E-03	3.1E-04	2.4E-04	1.9E-04	1.5E-04	1.4E-04
Antimony	2.05E-03	6.0E-03	1.0E-03	1.8E-05	1.4E-05	1.1E-05	8.7E-06	8.2E-06
Arsenic	8.45E-03	1.0E-03	1.0E-03	4.5E-04	3.4E-04	2.7E-04	2.1E-04	2.0E-04
Barium	1.13E-01	2.0E-01	1.0E-03	3.0E-05	2.3E-05	1.8E-05	1.4E-05	1.4E-05
Bismuth	8.36E-03	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boron	9.19E-02	2.0E-01	1.0E-03	2.4E-05	1.8E-05	1.4E-05	1.2E-05	1.1E-05
Cadmium	4.83E-04	1.0E-03	1.0E-03	2.6E-05	1.9E-05	1.5E-05	1.2E-05	1.2E-05
Chromium	6.68E-03	1.0E-03	2.0E-03	7.1E-04	5.3E-04	4.2E-04	3.4E-04	3.2E-04
Cobalt	5.03E-03	1.4E-03	1.0E-03	1.9E-04	1.4E-04	1.1E-04	9.1E-05	8.6E-05
Copper	3.01E-02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1.0E-03	1.8E-05	1.3E-05	8.6E-06	6.1E-06	5.1E-06
Iron	9.17E+00	7.0E-01	1.0E-03	6.9E-04	5.2E-04	4.1E-04	3.3E-04	3.1E-04

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Lead	6.83E-03	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1.0E-04	6.0E-05	4.6E-05	3.6E-05	1.2E-05	1.1E-05
Manganese	2.94E-01	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1.0E-03	1.1E-04	8.7E-05	7.6E-05	5.3E-05	4.5E-05
Mercury	1.21E-05	3.0E-04	2.5E-03	5.3E-06	4.0E-06	3.1E-06	2.5E-06	2.4E-06
Nickel	2.06E-02	1.10E-02	2.0E-04	2.0E-05	1.5E-05	1.2E-05	9.5E-06	9.0E-06
Selenium	2.30E-03	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.0E-03	2.2E-05	1.5E-05	1.1E-05	9.4E-06	9.7E-06
Strontium	2.69E-01	6.0E-01	1.0E-03	2.4E-05	1.8E-05	1.4E-05	1.1E-05	1.1E-05
Tellurium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	1.84E-04	7.0E-05	1.0E-03	1.4E-04	1.1E-04	8.3E-05	6.7E-05	6.3E-05
Titanium	9.82E-02	3.0E+00	1.0E-03	1.7E-06	1.3E-06	1.0E-06	8.3E-07	7.8E-07
Uranium	5.00E-04	6.0E-04	1.0E-03	4.4E-05	3.3E-05	2.6E-05	2.1E-05	2.0E-05
Vanadium	1.35E-02	5.0E-03	1.0E-03	1.4E-04	1.1E-04	8.5E-05	6.8E-05	6.5E-05
Zinc	5.81E-02	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	6.0E-04	3.8E-06	2.9E-06	2.3E-06	1.6E-06	1.5E-06

Table F23. Calculation of Non-Carcinogenic Hazard from Direct Contact with Surface Water by the Summer Resident - Predicted Future

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Summer Resident - Ingestion Surface Water								
Aluminum	6.15E+00	1.0E+00	1	1.1E-01	1.1E-01	7.5E-02	5.1E-02	6.5E-02
Antimony	5.74E-03	6.0E-03	1	1.8E-02	1.7E-02	1.2E-02	8.0E-03	1.0E-02
Arsenic	9.79E-03	1.0E-03	1	1.8E-01	1.8E-01	1.2E-01	8.2E-02	1.0E-01
Barium	1.19E-01	2.0E-01	1	1.1E-02	1.1E-02	7.2E-03	5.0E-03	6.3E-03
Bismuth	8.44E-03	N/A	1	N/A	N/A	N/A	N/A	N/A
Boron	9.57E-02	2.0E-01	1	8.8E-03	8.7E-03	5.8E-03	4.0E-03	5.1E-03
Cadmium	1.33E-03	1.0E-03	1	2.4E-02	2.4E-02	1.6E-02	1.1E-02	1.4E-02
Chromium	7.62E-03	1.0E-03	1	1.4E-01	1.4E-01	9.3E-02	6.4E-02	8.1E-02
Cobalt	6.44E-03	1.4E-03	1	8.4E-02	8.4E-02	5.6E-02	3.9E-02	4.9E-02
Copper	3.36E-02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1	6.7E-03	6.70E-03	3.71E-03	2.23E-03	2.52E-03
Iron	9.66E+00	7.0E-01	1	2.5E-01	2.5E-01	1.7E-01	1.2E-01	1.5E-01
Lead	7.78E-03	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1	2.4E-01	2.4E-01	1.6E-01	4.3E-02	5.5E-02
Manganese	5.38E-01	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1	7.2E-02	7.2E-02	5.4E-02	3.2E-02	3.7E-02
Mercury	6.91E-05	3.0E-04	1	4.2E-03	4.2E-03	2.8E-03	1.9E-03	2.4E-03
Nickel	2.72E-02	1.10E-02	1	4.5E-02	4.5E-02	3.0E-02	2.1E-02	2.6E-02

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Selenium	3.26E-03	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1	1.1E-02	9.6E-03	6.3E-03	4.4E-03	6.1E-03
Strontium	2.96E-01	6.0E-01	1	9.0E-03	9.0E-03	6.0E-03	4.1E-03	5.2E-03
Tellurium	N/A	N/A	1	N/A	N/A	N/A	N/A	N/A
Thallium	1.92E-04	7.0E-05	1	5.0E-02	5.0E-02	3.3E-02	2.3E-02	2.9E-02
Titanium	1.01E-01	3.0E+00	1	6.1E-04	6.1E-04	4.1E-04	2.8E-04	3.6E-04
Uranium	5.00E-04	6.0E-04	1	1.5E-02	1.5E-02	1.0E-02	7.0E-03	8.8E-03
Vanadium	1.37E-02	5.0E-03	1	5.0E-02	5.0E-02	3.3E-02	2.3E-02	2.9E-02
Zinc	1.13E-01	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	1	4.2E-03	4.3E-03	2.9E-03	1.8E-03	2.1E-03
Summer Resident - Dermal Contact with Surface Water								
Aluminum	6.15E+00	1.0E+00	1.0E-03	3.3E-04	2.5E-04	1.9E-04	1.6E-04	1.5E-04
Antimony	5.74E-03	6.0E-03	1.0E-03	5.1E-05	3.8E-05	3.0E-05	2.4E-05	2.3E-05
Arsenic	9.79E-03	1.0E-03	1.0E-03	5.2E-04	3.9E-04	3.1E-04	2.5E-04	2.3E-04
Barium	1.19E-01	2.0E-01	1.0E-03	3.1E-05	2.4E-05	1.9E-05	1.5E-05	1.4E-05
Bismuth	8.44E-03	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boron	9.57E-02	2.0E-01	1.0E-03	2.5E-05	1.9E-05	1.5E-05	1.2E-05	1.1E-05
Cadmium	1.33E-03	1.0E-03	1.0E-03	7.1E-05	5.3E-05	4.2E-05	3.4E-05	3.2E-05
Chromium	7.62E-03	1.0E-03	2.0E-03	8.1E-04	6.1E-04	4.8E-04	3.9E-04	3.7E-04
Cobalt	6.44E-03	1.4E-03	1.0E-03	2.4E-04	1.8E-04	1.4E-04	1.2E-04	1.1E-04
Copper	3.36E-02	infant = 0.091 toddler = 0.091 child = 0.110 teen = 0.126 adult = 0.141	1.0E-03	2.0E-05	1.48E-05	9.60E-06	6.76E-06	5.71E-06
Iron	9.66E+00	7.0E-01	1.0E-03	7.3E-04	5.5E-04	4.3E-04	3.5E-04	3.3E-04

Constituent	Surface Water (mg/L)	TRV	RAF	Hazard Quotient				
				Infant	Toddler	Child	Teen	Adult
Lead	7.78E-03	infant = 6.0E-04 toddler = 6.0E-04 child = 6.0E-04 teen = 1.5E-03 adult = 1.5E-03	1.0E-04	6.9E-05	5.2E-05	4.1E-05	1.3E-05	1.2E-05
Manganese	5.38E-01	infant = 1.36E-01 toddler = 1.36E-01 child = 1.22E-01 teen = 1.42E-01 adult = 1.56E-01	1.0E-03	2.1E-04	1.6E-04	1.4E-04	9.6E-05	8.3E-05
Mercury	6.91E-05	3.0E-04	2.5E-03	3.0E-05	2.3E-05	1.8E-05	1.4E-05	1.4E-05
Nickel	2.72E-02	1.10E-02	2.0E-04	2.6E-05	2.0E-05	1.6E-05	1.3E-05	1.2E-05
Selenium	3.26E-03	infant = 5.5E-03 toddler = 6.2E-03 child = 6.3E-03 teen = 6.2E-03 adult = 5.7E-03	1.0E-03	3.1E-05	2.1E-05	1.6E-05	1.3E-05	1.4E-05
Strontium	2.96E-01	6.0E-01	1.0E-03	2.6E-05	2.0E-05	1.6E-05	1.3E-05	1.2E-05
Tellurium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	1.92E-04	7.0E-05	1.0E-03	1.5E-04	1.1E-04	8.6E-05	7.0E-05	6.6E-05
Titanium	1.01E-01	3.0E+00	1.0E-03	1.8E-06	1.3E-06	1.1E-06	8.5E-07	8.0E-07
Uranium	5.00E-04	6.0E-04	1.0E-03	4.4E-05	3.3E-05	2.6E-05	2.1E-05	2.0E-05
Vanadium	1.37E-02	5.0E-03	1.0E-03	1.5E-04	1.1E-04	8.6E-05	7.0E-05	6.6E-05
Zinc	1.13E-01	infant = 4.9E-01 toddler = 4.8E-01 child = 4.8E-01 teen = 5.4E-01 adult = 5.7E-01	6.0E-04	7.3E-06	5.7E-06	4.4E-06	3.2E-06	2.9E-06

Table F24. Calculation of Carcinogenic Hazard from Direct Contact with Surface Water by the Summer Resident – Baseline

Constituent	Surface Water (mg/L)	TRV	RAF	Cancer Risk				
				Infant	Toddler	Child	Teen	Adult
Summer Resident - Ingestion Surface Water								
Arsenic	8.45E-03	1.8E+00	N/A	8.7E-06	3.9E-05	2.4E-05	1.3E-05	6.1E-05
Summer Resident - Dermal Contact with Surface Water								
Arsenic	8.45E-03	1.8E+00	1.0E-03	2.5E-08	8.6E-08	6.3E-08	3.9E-08	1.4E-07

Table F25. Calculation of Carcinogenic Hazard from Direct Contact with Surface Water by the Summer Resident - Predicted Future

Constituent	Surface Water (mg/L)	TRV	RAF	Cancer Risk				
				Infant	Toddler	Child	Teen	Adult
Summer Resident - Ingestion Surface Water								
Arsenic	9.79E-03	1.8E+00	N/A	1.0E-05	4.5E-05	2.8E-05	1.5E-05	7.0E-05
Summer Resident - Dermal Contact with Surface Water								
Arsenic	9.79E-03	1.8E+00	1.0E-03	2.9E-08	9.9E-08	7.3E-08	4.5E-08	1.6E-07

Attachment G
Detailed Risk Estimates for Sum of All Exposure Pathways

Table G1: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Hunter/Trapper/Fisher Teen

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.1	0.2	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.2	0.2	0.0	Bladder-Liver-Lung	Lung
Barium	0.1	0.1	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.1	0.1	0.0	Fetal Development	
Cadmium	2.7	2.7	0.0	Kidney	
Chromium	0.3	0.3	0.0	Reproductive organs	Lung
Cobalt	0.5	0.8	0.3	Blood	Lung
Copper	0.1	0.1	0.0	Liver	
Iron	0.6	0.7	0.1	Gastrointestinal	
Lead	0.2	0.3	0.1	Neurological	
Manganese	1.4	1.4	0.0	Neurological	
Mercury	0.2	0.2	0.0	Kidney	
Nickel	0.3	0.3	0.0	Fetal Development	Lung
Selenium	1.0	1.0	0.0	Selenosis	
Strontium	0.0	0.1	0.1	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.7	0.7	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.1	0.1	0.0	Gastrointestinal	Lung
Zinc	0.5	0.5	0.0	Increased growth	

Table G2: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Hunter/Trapper/Fisher Teen

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	2.5	2.6	0.1
Longevity	0.03	0.03	0.0
Bladder	0.2	0.2	0.0
Kidney	3.0	3.0	0.0
Fetal Development	0.5	0.4	0.0
Reproductive organs	0.3	0.3	0.0
Blood	0.5	0.8	0.3
Gastrointestinal	0.6	0.6	0.0
Selenosis	1.0	1.0	0.0
Musculoskeletal	0.03	0.10	0.1
Increased growth	0.5	0.5	0.0
Liver	0.06	0.06	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G3: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Hunter/Trapper/Fisher Teen

Constituent	Baseline ILCR	Predicted ILCR	Project Hazard
Arsenic	1.7E-05	1.8E-05	1.3E-06
Cadmium	1.3E-09	2.8E-09	1.5E-09
Chromium	1.2E-07	1.8E-07	5.8E-08
Nickel	4.3E-09	6.3E-09	2.0E-09

Table G4: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Hunter/Trapper/Fisher Adult

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.2	0.1	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.2	0.3	0.0	Bladder-Liver-Lung	Lung
Barium	0.2	0.2	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.1	0.2	0.0	Fetal Development	
Cadmium	3.5	3.5	0.0	Kidney	
Chromium	0.4	0.4	0.0	Reproductive organs	Lung
Cobalt	0.6	1.0	0.4	Blood	Lung
Copper	0.1	0.1	0.0	Liver	
Iron	0.7	0.9	0.2	Gastrointestinal	
Lead	0.3	0.4	0.1	Neurological	
Manganese	1.7	1.7	0.0	Neurological	
Mercury	0.2	0.2	0.0	Kidney	
Nickel	0.5	0.5	0.0	Fetal Development	Lung
Selenium	1.4	1.4	0.0	Selenosis	
Strontium	0.0	0.1	0.1	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	1.0	1.0	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.1	0.1	0.0	Gastrointestinal	Lung
Zinc	0.7	0.7	0.0	Increased growth	

Table G5: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Hunter/Trapper/Fisher Adult

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	3.1	3.2	0.1
Longevity	0.03	0.03	0.0
Bladder	0.2	0.3	0.0
Kidney	4.0	4.0	0.0
Fetal Development	0.6	0.6	0.0
Reproductive organs	0.4	0.4	0.0
Blood	0.6	1.0	0.4
Gastrointestinal	0.9	0.9	0.0
Selenosis	1.4	1.4	0.0
Musculoskeletal	0.04	0.12	0.1
Increased growth	0.7	0.7	0.0
Liver	0.07	0.07	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G6: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Hunter/Trapper/Fisher Adult

Constituent	Baseline ILCR	Predicted ILCR	Project Hazard
Arsenic	8.0E-05	8.6E-05	6.1E-06
Cadmium	4.2E-09	9.3E-09	5.1E-09
Chromium	4.2E-07	6.2E-07	2.0E-07
Nickel	1.5E-08	2.1E-08	6.8E-09

Table G7: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Recreational User Infant

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.1	0.1	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.1	0.1	0.0	Bladder-Liver-Lung	Lung
Barium	0.0	0.0	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.0	0.0	0.0	Fetal Development	
Cadmium	0.0	0.0	0.0	Kidney	
Chromium	0.1	0.1	0.0	Reproductive organs	Lung
Cobalt	0.0	0.1	0.0	Blood	Lung
Copper	0.0	0.0	0.0	Liver	
Iron	0.2	0.2	0.0	Gastrointestinal	
Lead	0.1	0.2	0.0	Neurological	
Manganese	0.0	0.0	0.0	Neurological	
Mercury	0.0	0.0	0.0	Kidney	
Nickel	0.0	0.0	0.0	Fetal Development	Lung
Selenium	0.0	0.0	0.0	Selenosis	
Strontium	0.0	0.0	0.0	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.0	0.0	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.0	0.0	0.0	Gastrointestinal	Lung
Zinc	0.0	0.0	0.0	Increased growth	

Table G8: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Recreational User Infant

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	0.3	0.3	0.0
Longevity	0.00	0.0	0.0
Bladder	0.1	0.1	0.0
Kidney	0.0	0.0	0.0
Fetal Development	0.0	0.0	0.0
Reproductive organs	0.1	0.1	0.0
Blood	0.0	0.1	0.0
Gastrointestinal	0.2	0.2	0.0
Selenosis	0.0	0.0	0.0
Musculoskeletal	0.00	0.00	0.0
Increased growth	0.0	0.0	0.0
Liver	0.00	0.00	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G9: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Recreational User Infant

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	2.5E-06	2.8E-06	3.3E-07
Cadmium	1.5E-10	3.3E-10	1.8E-10
Chromium	1.5E-08	2.2E-08	7.0E-09
Nickel	5.2E-10	7.6E-10	2.4E-10

Table G10: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Recreational User Toddler

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.1	0.1	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.2	0.2	0.0	Bladder-Liver-Lung	Lung
Barium	0.1	0.1	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.1	0.1	0.0	Fetal Development	
Cadmium	1.6	1.6	0.0	Kidney	
Chromium	0.3	0.3	0.0	Reproductive organs	Lung
Cobalt	0.3	0.5	0.2	Blood	Lung
Copper	0.1	0.1	0.0	Liver	
Iron	0.5	0.5	0.1	Gastrointestinal	
Lead	0.4	0.6	0.2	Neurological	
Manganese	0.9	0.9	0.0	Neurological	
Mercury	0.1	0.1	0.0	Kidney	
Nickel	0.2	0.2	0.0	Fetal Development	Lung
Selenium	0.6	0.6	0.0	Selenosis	
Strontium	0.0	0.1	0.0	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.5	0.5	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.1	0.1	0.0	Gastrointestinal	Lung
Zinc	0.4	0.4	0.0	Increased growth	

Table G11: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Recreational User Toddler

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	1.9	2.0	0.1
Longevity	0.02	0.02	0.0
Bladder	0.2	0.2	0.0
Kidney	1.9	1.9	0.0
Fetal Development	0.3	0.3	0.0
Reproductive organs	0.3	0.3	0.0
Blood	0.3	0.5	0.2
Gastrointestinal	0.5	0.5	0.0
Selenosis	0.6	0.6	0.0
Musculoskeletal	0.02	0.06	0.0
Increased growth	0.4	0.4	0.0
Liver	0.05	0.05	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G12: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Recreational User Toddler

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	2.0E-05	2.11E-05	1.5E-06
Cadmium	1.3E-09	2.8E-09	1.5E-09
Chromium	1.3E-07	1.9E-07	5.9E-08
Nickel	4.4E-09	6.4E-09	2.0E-09

Table G13: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Recreational User Child

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.1	0.1	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.1	0.1	0.0	Bladder-Liver-Lung	Lung
Barium	0.1	0.1	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.1	0.1	0.0	Fetal Development	
Cadmium	1.2	1.2	0.0	Kidney	
Chromium	0.2	0.2	0.0	Reproductive organs	Lung
Cobalt	0.2	0.4	0.1	Blood	Lung
Copper	0.0	0.0	0.0	Liver	
Iron	0.3	0.3	0.1	Gastrointestinal	
Lead	0.2	0.4	0.1	Neurological	
Manganese	0.7	0.7	0.0	Neurological	
Mercury	0.1	0.1	0.0	Kidney	
Nickel	0.2	0.2	0.0	Fetal Development	Lung
Selenium	0.4	0.4	0.0	Selenosis	
Strontium	0.0	0.0	0.0	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.3	0.3	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.1	0.1	0.0	Gastrointestinal	Lung
Zinc	0.3	0.3	0.0	Increased growth	

Table G14: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Recreational User Child

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	1.4	1.5	0.1
Longevity	0.01	0.01	0.0
Bladder	0.1	0.1	0.0
Kidney	1.4	1.4	0.0
Fetal Development	0.2	0.2	0.0
Reproductive organs	0.2	0.2	0.0
Blood	0.2	0.4	0.1
Gastrointestinal	0.3	0.3	0.0
Selenosis	0.4	0.4	0.0
Musculoskeletal	0.02	0.04	0.0
Increased growth	0.3	0.3	0.0
Liver	0.03	0.03	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G15: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Recreational User Child

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	1.1E-05	1.2E-05	9.3E-07
Cadmium	1.0E-09	2.3E-09	1.3E-09
Chromium	1.0E-07	1.5E-07	4.9E-08
Nickel	3.6E-09	5.2E-09	1.7E-09

Table G16: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Recreational User Teen

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.1	0.1	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.1	0.1	0.0	Bladder-Liver-Lung	Lung
Barium	0.0	0.1	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.0	0.0	0.0	Fetal Development	
Cadmium	0.9	0.9	0.0	Kidney	
Chromium	0.1	0.1	0.0	Reproductive organs	Lung
Cobalt	0.2	0.3	0.1	Blood	Lung
Copper	0.0	0.0	0.0	Liver	
Iron	0.2	0.2	0.0	Gastrointestinal	
Lead	0.1	0.1	0.0	Neurological	
Manganese	0.5	0.5	0.0	Neurological	
Mercury	0.1	0.1	0.0	Kidney	
Nickel	0.1	0.1	0.0	Fetal Development	Lung
Selenium	0.3	0.3	0.0	Selenosis	
Strontium	0.0	0.0	0.0	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.3	0.3	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.0	0.0	0.0	Gastrointestinal	Lung
Zinc	0.2	0.2	0.0	Increased growth	

Table G17: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Recreational User Teen

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	0.9	0.9	0.0
Longevity	0.01	0.01	0.0
Bladder	0.1	0.1	0.0
Kidney	1.1	1.1	0.0
Fetal Development	0.2	0.2	0.0
Reproductive organs	0.1	0.1	0.0
Blood	0.2	0.3	0.1
Gastrointestinal	0.2	0.2	0.0
Selenosis	0.3	0.3	0.0
Musculoskeletal	0.01	0.03	0.0
Increased growth	0.2	0.2	0.0
Liver	0.02	0.02	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G18: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Recreational User Teen

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	6.1E-06	6.6E-06	4.8E-07
Cadmium	4.7E-10	1.0E-09	5.7E-10
Chromium	4.7E-08	6.9E-08	2.2E-08
Nickel	1.6E-09	2.4E-09	7.5E-10

Table G19: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Recreational User Adult

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.1	0.1	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.1	0.1	0.0	Bladder-Liver-Lung	Lung
Barium	0.1	0.1	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.1	0.0	0.0	Fetal Development	
Cadmium	1.2	1.2	0.0	Kidney	
Chromium	0.2	0.2	0.0	Reproductive organs	Lung
Cobalt	0.2	0.2	0.0	Blood	Lung
Copper	0.0	0.0	0.0	Liver	
Iron	0.3	0.3	0.0	Gastrointestinal	
Lead	0.1	0.1	0.0	Neurological	
Manganese	0.6	0.6	0.0	Neurological	
Mercury	0.1	0.1	0.0	Kidney	
Nickel	0.2	0.2	0.0	Fetal Development	Lung
Selenium	0.5	0.5	0.0	Selenosis	
Strontium	0.0	0.0	0.0	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.3	0.3	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.1	0.1	0.0	Gastrointestinal	Lung
Zinc	0.2	0.2	0.0	Increased growth	

Table G20: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Recreational User Adult

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	1.1	1.0	0.0
Longevity	0.01	0.01	0.0
Bladder	0.1	0.1	0.0
Kidney	1.4	1.4	0.0
Fetal Development	0.2	0.2	0.0
Reproductive organs	0.2	0.2	0.0
Blood	0.2	0.2	0.0
Gastrointestinal	0.3	0.3	0.0
Selenosis	0.5	0.5	0.0
Musculoskeletal	0.02	0.02	0.0
Increased growth	0.2	0.2	0.0
Liver	0.02	0.02	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G21: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Recreational User Adult

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	2.9E-05	3.1E-05	2.3E-06
Cadmium	1.6E-09	3.5E-09	1.9E-09
Chromium	1.6E-07	2.3E-07	7.4E-08
Nickel	5.4E-09	8.0E-09	2.5E-09

Table G22: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Summer Resident Infant

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.1	0.1	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.2	0.2	0.0	Bladder-Liver-Lung	Lung
Barium	0.0	0.0	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.0	0.0	0.0	Fetal Development	
Cadmium	0.0	0.0	0.0	Kidney	
Chromium	0.3	0.3	0.0	Reproductive organs	Lung
Cobalt	0.1	0.1	0.0	Blood	Lung
Copper	0.0	0.0	0.0	Liver	
Iron	0.3	0.4	0.0	Gastrointestinal	
Lead	0.3	0.3	0.0	Neurological	
Manganese	0.0	0.1	0.0	Neurological	
Mercury	0.0	0.0	0.0	Kidney	
Nickel	0.0	0.1	0.0	Fetal Development	Lung
Selenium	0.0	0.0	0.0	Selenosis	
Strontium	0.0	0.0	0.0	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.1	0.1	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.1	0.1	0.0	Gastrointestinal	Lung
Zinc	0.0	0.0	0.0	Increased growth	

Table G23: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Summer Resident Infant

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	0.5	0.6	0.1
Longevity	0.01	0.01	0.0
Bladder	0.2	0.2	0.0
Kidney	0.0	0.0	0.0
Fetal Development	0.0	0.1	0.0
Reproductive organs	0.3	0.3	0.0
Blood	0.1	0.1	0.0
Gastrointestinal	0.4	0.4	0.0
Selenosis	0.0	0.0	0.0
Musculoskeletal	0.01	0.01	0.0
Increased growth	0.0	0.0	0.0
Liver	0.01	0.01	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G24: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Summer Resident Infant

Constituent	Baseline ILCR	Predicted ILCR	Project Hazard
Arsenic	1.1E-05	1.2E-05	1.4E-06
Cadmium	6.6E-10	1.4E-09	7.9E-10
Chromium	6.5E-08	9.5E-08	3.0E-08
Nickel	2.2E-09	3.3E-09	1.0E-09

Table G25: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Summer Resident Toddler

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.3	0.3	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.3	0.4	0.0	Bladder-Liver-Lung	Lung
Barium	0.2	0.2	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.2	0.2	0.0	Fetal Development	
Cadmium	3.5	3.6	0.0	Kidney	
Chromium	0.7	0.7	0.0	Reproductive organs	Lung
Cobalt	0.7	1.1	0.4	Blood	Lung
Copper	0.1	0.1	0.0	Liver	
Iron	1.0	1.1	0.2	Gastrointestinal	
Lead	0.9	1.2	0.3	Neurological	
Manganese	2.0	2.0	0.0	Neurological	
Mercury	0.2	0.3	0.0	Kidney	
Nickel	0.5	0.5	0.0	Fetal Development	Lung
Selenium	1.3	1.3	0.0	Selenosis	
Strontium	0.0	0.1	0.1	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	1.0	1.0	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.1	0.1	0.0	Kidney	
Vanadium	0.2	0.2	0.0	Gastrointestinal	Lung
Zinc	0.8	0.8	0.0	Increased growth	

Table G26: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Summer Resident Toddler

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	4.1	4.4	0.4
Longevity	0.04	0.04	0.0
Bladder	0.3	0.4	0.0
Kidney	4.0	4.0	0.0
Fetal Development	0.6	0.6	0.0
Reproductive organs	0.7	0.7	0.0
Blood	0.7	1.1	0.4
Gastrointestinal	1.2	1.2	0.0
Selenosis	1.3	1.3	0.0
Musculoskeletal	0.05	0.13	0.1
Increased growth	0.8	0.8	0.0
Liver	0.11	0.12	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G27: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Summer Resident Toddler

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	8.5E-05	9.1E-05	6.4E-06
Cadmium	5.5E-09	1.2E-08	6.6E-09
Chromium	5.5E-07	8.1E-07	2.6E-07
Nickel	1.9E-08	2.8E-08	8.8E-09

Table G28: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Summer Resident Child

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.2	0.2	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.2	0.2	0.0	Bladder-Liver-Lung	Lung
Barium	0.1	0.1	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.1	0.1	0.0	Fetal Development	
Cadmium	2.6	2.6	0.0	Kidney	
Chromium	0.4	0.4	0.0	Reproductive organs	Lung
Cobalt	0.5	0.8	0.3	Blood	Lung
Copper	0.1	0.1	0.0	Liver	
Iron	0.6	0.7	0.1	Gastrointestinal	
Lead	0.5	0.8	0.3	Neurological	
Manganese	1.6	1.6	0.0	Neurological	
Mercury	0.2	0.2	0.0	Kidney	
Nickel	0.3	0.3	0.0	Fetal Development	Lung
Selenium	0.9	0.9	0.0	Selenosis	
Strontium	0.0	0.1	0.1	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.7	0.7	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.1	0.1	0.0	Gastrointestinal	Lung
Zinc	0.6	0.6	0.0	Increased growth	

Table G29: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Summer Resident Child

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	3.0	3.2	0.2
Longevity	0.03	0.03	0.0
Bladder	0.2	0.2	0.0
Kidney	3.0	3.0	0.0
Fetal Development	0.4	0.4	0.0
Reproductive organs	0.4	0.4	0.0
Blood	0.5	0.8	0.3
Gastrointestinal	0.7	0.7	0.0
Selenosis	0.9	0.9	0.0
Musculoskeletal	0.03	0.09	0.1
Increased growth	0.6	0.6	0.0
Liver	0.07	0.07	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G30: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Summer Resident Child

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	4.8E-05	5.2E-05	4.0E-06
Cadmium	4.5E-09	1.0E-08	5.4E-09
Chromium	4.5E-07	6.6E-07	2.1E-07
Nickel	1.6E-08	2.3E-08	7.2E-09

Table G31: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Summer Resident Teen

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.1	0.1	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.1	0.2	0.0	Bladder-Liver-Lung	Lung
Barium	0.1	0.1	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.1	0.1	0.0	Fetal Development	
Cadmium	2.0	2.0	0.0	Kidney	
Chromium	0.3	0.3	0.0	Reproductive organs	Lung
Cobalt	0.4	0.6	0.2	Blood	Lung
Copper	0.0	0.0	0.0	Liver	
Iron	0.4	0.5	0.1	Gastrointestinal	
Lead	0.2	0.2	0.1	Neurological	
Manganese	1.1	1.0	0.0	Neurological	
Mercury	0.1	0.2	0.0	Kidney	
Nickel	0.3	0.3	0.0	Fetal Development	Lung
Selenium	0.7	0.7	0.0	Selenosis	
Strontium	0.0	0.1	0.0	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.5	0.6	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.1	0.1	0.0	Gastrointestinal	Lung
Zinc	0.4	0.4	0.0	Increased growth	

Table G32: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Summer Resident Teen

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	1.9	1.9	0.1
Longevity	0.02	0.02	0.0
Bladder	0.1	0.2	0.0
Kidney	2.3	2.3	0.0
Fetal Development	0.3	0.3	0.0
Reproductive organs	0.3	0.3	0.0
Blood	0.4	0.6	0.2
Gastrointestinal	0.5	0.5	0.0
Selenosis	0.7	0.7	0.0
Musculoskeletal	0.02	0.07	0.0
Increased growth	0.4	0.4	0.0
Liver	0.05	0.05	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G33: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Summer Resident Teen

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	2.6E-05	2.8E-05	2.1E-06
Cadmium	2.0E-09	4.5E-09	2.5E-09
Chromium	2.0E-07	3.0E-07	9.5E-08
Nickel	7.0E-09	1.0E-08	3.3E-09

Table G34: Calculation of Non-Carcinogenic Hazard Index and Project Hazard for the Summer Resident Adult

Constituent	Baseline HI	Predicted HI	Project Hazard	Target Organ (Ingestion)	Target Organ (Inhalation)
Aluminum	0.1	0.1	0.0	Neurological	Neurological
Antimony	0.0	0.0	0.0	Longevity	
Arsenic	0.2	0.2	0.0	Bladder-Liver-Lung	Lung
Barium	0.1	0.1	0.0	Kidney	Cardiovascular
Bismuth	N/A	N/A	N/A		
Boron	0.1	0.1	0.0	Fetal Development	
Cadmium	2.6	2.6	0.0	Kidney	
Chromium	0.3	0.3	0.0	Reproductive organs	Lung
Cobalt	0.5	0.8	0.3	Blood	Lung
Copper	0.1	0.1	0.0	Liver	
Iron	0.5	0.6	0.1	Gastrointestinal	
Lead	0.2	0.3	0.1	Neurological	
Manganese	1.2	1.2	0.0	Neurological	
Mercury	0.2	0.2	0.0	Kidney	
Nickel	0.3	0.3	0.0	Fetal Development	Lung
Selenium	1.1	1.1	0.0	Selenosis	
Strontium	0.0	0.1	0.1	Musculoskeletal	
Tellurium	N/A	N/A	N/A		
Thallium	0.7	0.7	0.0	Neurological	
Titanium	0.0	0.0	0.0	Gastrointestinal	
Uranium	0.0	0.0	0.0	Kidney	
Vanadium	0.1	0.1	0.0	Gastrointestinal	Lung
Zinc	0.5	0.5	0.0	Increased growth	

Table G35: Calculation of Non-Carcinogenic Target Organ Hazard Index for the Summer Resident Adult

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	2.3	2.4	0.1
Longevity	0.02	0.02	0.0
Bladder	0.2	0.2	0.0
Kidney	3.0	3.0	0.0
Fetal Development	0.4	0.4	0.0
Reproductive organs	0.3	0.3	0.0
Blood	0.5	0.8	0.3
Gastrointestinal	0.6	0.6	0.0
Selenosis	1.1	1.1	0.0
Musculoskeletal	0.03	0.09	0.1
Increased growth	0.5	0.5	0.0
Liver	0.05	0.05	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G36: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Project Hazard for the Summer Resident Adult

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	1.2E-04	1.3E-04	9.8E-06
Cadmium	6.9E-09	1.5E-08	8.3E-09
Chromium	6.8E-07	1.0E-06	3.2E-07
Nickel	2.4E-08	3.5E-08	1.1E-08

Table G37: Calculation of Non-Carcinogenic Hazard Index for the Year Round Resident Toddler

Constituent	Baseline HI	Predicted HI	Project Hazard
Aluminum	0.6	0.6	0.0
Antimony	0.1	0.1	0.0
Arsenic	0.7	0.7	0.0
Barium	0.4	0.4	0.0
Bismuth	NA	NA	NA
Boron	0.3	0.3	0.0
Cadmium	7.1	7.1	0.0
Chromium	1.4	1.4	0.0
Cobalt	1.3	2.2	0.8
Copper	0.2	0.2	0.0
Iron	1.9	2.2	0.3
Lead	1.7	2.4	0.7
Manganese	3.9	4.0	0.1
Mercury	0.5	0.5	0.1
Nickel	1.0	1.0	0.0
Selenium	2.6	2.6	0.0
Strontium	0.1	0.3	0.2
Tellurium	NA	NA	NA
Thallium	2.0	2.0	0.0
Titanium	0.0	0.0	0.0
Uranium	0.1	0.1	0.0
Vanadium	0.4	0.4	0.0
Zinc	1.6	1.6	0.0

Table G38: Non-Carcinogenic Target Organ Hazard Index for the Year Round Resident Toddler

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	8.1	8.9	0.8
Longevity	0.1	0.1	0.0
Bladder	0.7	0.7	0.0
Kidney	8.1	8.1	0.0
Fetal Development	1.2	1.3	0.0
Reproductive organs	1.4	1.4	0.0
Blood	1.3	2.2	0.8
Gastrointestinal	2.3	2.3	0.0
Selenosis	2.6	2.6	0.0
Musculoskeletal	0.1	0.3	0.2
Increased growth	1.6	1.6	0.0
Liver	0.2	0.2	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G39: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Hazard for the Year Round Resident Toddler

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	3.40E-04	3.65E-04	2.58E-05
Cadmium	2.22E-08	4.87E-08	2.66E-08
Chromium	2.19E-06	3.22E-06	1.03E-06
Nickel	7.59E-08	1.11E-07	3.54E-08

Table G40: Calculation of Non-Carcinogenic Hazard Index for the Year Round Resident Adult

Constituent	Baseline HI	Predicted HI	Project Hazard
Aluminum	0.3	0.3	0.0
Antimony	0.0	0.1	0.0
Arsenic	0.4	0.4	0.0
Barium	0.3	0.3	0.0
Bismuth	NA	NA	NA
Boron	0.2	0.2	0.0
Cadmium	5.3	5.2	0.0
Chromium	0.6	0.6	0.0
Cobalt	0.9	1.5	0.6
Copper	0.1	0.1	0.0
Iron	1.1	1.3	0.2
Lead	0.4	0.6	0.2
Manganese	2.5	2.5	0.0
Mercury	0.4	0.4	0.0
Nickel	0.7	0.7	0.0
Selenium	2.1	2.1	0.0
Strontium	0.1	0.2	0.1
Tellurium	NA	NA	NA
Thallium	1.4	1.4	0.0
Titanium	0.0	0.0	0.0
Uranium	0.1	0.1	0.0
Vanadium	0.2	0.2	0.0
Zinc	1.0	1.0	0.0

Table G41: Non-Carcinogenic Target Organ Hazard Index for the Year Round Resident Adult

Target Organ (Ingestion)	Baseline HI	Predicted HI	Project Hazard
Neurological	4.6	4.7	0.2
Longevity	0.0	0.0	0.0
Bladder	0.4	0.4	0.0
Kidney	6.0	6.0	0.0
Fetal Development	0.9	0.9	0.0
Reproductive organs	0.6	0.6	0.0
Blood	0.9	1.5	0.6
Gastrointestinal	1.3	1.3	0.0
Selenosis	2.1	2.1	0.0
Musculoskeletal	0.1	0.2	0.1
Increased growth	1.0	1.0	0.0
Liver	0.1	0.1	0.0
Target Organ (Inhalation)	**Baseline HI**	**Predicted HI**	**Project Hazard**
Neurological	0.0	0.0	0.0
Lung	0.0	0.0	0.0
Cardiovascular	0.0	0.0	0.0

Table G42: Calculation of Carcinogenic Incremental Lifetime Cancer Risk and Hazard for the Year Round Resident Adult

Constituent	Baseline ILCR	Predicted ILCR	Project ILCR
Arsenic	4.95E-04	5.34E-04	3.94E-05
Cadmium	2.76E-08	6.06E-08	3.31E-08
Chromium	2.73E-06	4.01E-06	1.28E-06
Nickel	9.44E-08	1.38E-07	4.40E-08

Table G43. Country Food Basket Risk Calculations – Cobalt

Exposure Source		COPC Concentration - Baseline (mg/kg)	COPC Concentration - Future (mg/kg)	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Toddler Exposure Dose (mg/kg bw/d) - Future
Large Mammal	Moose Meat	1.33E-01	1.33E-01	1.05E+02	3.52E-01	1.95E-03	2.59E-04	2.59E-04
	Moose Liver	1.33E-01	1.33E-01	4.39E+00	1.47E-02	8.13E-05	1.08E-05	1.08E-05
	Moose Kidney	1.33E-01	1.33E-01	3.66E+00	1.22E-02	6.77E-05	9.01E-06	9.01E-06
	Deer Meat	1.33E-01	1.33E-01	2.60E+01	8.69E-02	4.81E-04	6.40E-05	6.40E-05
	Elk Meat	1.33E-01	1.33E-01	8.78E+00	2.93E-02	1.63E-04	2.16E-05	2.16E-05
	Caribou	1.33E-01	1.33E-01	1.67E+00	5.58E-03	3.09E-05	4.11E-06	4.11E-06
	Beaver	1.33E-01	1.33E-01	1.46E+00	4.88E-03	2.70E-05	3.59E-06	3.59E-06
Small Mammal	Rabbit	1.59E-03	1.59E-03	2.93E+00	9.79E-03	5.42E-05	8.62E-08	8.62E-08
Birds	Grouse	1.33E-02	1.33E-02	1.64E+00	5.48E-03	3.04E-05	4.04E-07	4.04E-07
	Duck	1.33E-02	1.33E-02	2.10E-01	7.02E-04	3.89E-06	5.17E-08	5.17E-08
	Geese	1.33E-02	1.33E-02	2.10E-01	7.02E-04	3.89E-06	5.17E-08	5.17E-08
Fish	Salmon any - NA	0.00E+00	0.00E+00	6.86E+01	2.29E-01	1.27E-03	0.00E+00	0.00E+00
	Trout any	2.90E-01	5.15E-01	1.14E+01	3.82E-02	2.12E-04	6.14E-05	1.09E-04
	Halibut - NA	0.00E+00	0.00E+00	1.05E+01	3.50E-02	1.94E-04	0.00E+00	0.00E+00
	Ling Cod - NA	0.00E+00	0.00E+00	3.49E+00	1.17E-02	6.46E-05	0.00E+00	0.00E+00
	Eulachon - NA	0.00E+00	0.00E+00	2.89E+00	9.66E-03	5.35E-05	0.00E+00	0.00E+00
	Dolly Varden	2.90E-01	5.15E-01	1.91E+00	6.38E-03	3.54E-05	1.03E-05	1.82E-05
	Pacific/Gery Cod - NA	0.00E+00	0.00E+00	1.59E+00	5.31E-03	2.94E-05	0.00E+00	0.00E+00
Plants	Soapberries	2.51E-01	2.51E-01	6.64E+00	2.22E-02	1.23E-04	3.08E-05	3.08E-05
	Blue huckleberries	2.51E-01	2.51E-01	5.81E+00	1.94E-02	1.08E-04	2.70E-05	2.70E-05
	Blackberries, large	2.51E-01	2.51E-01	6.64E+00	2.22E-02	1.23E-04	3.08E-05	3.08E-05
	Raspberries	2.51E-01	2.51E-01	5.81E+00	1.94E-02	1.08E-04	2.70E-05	2.70E-05
	Wild strawberry	2.51E-01	2.51E-01	3.32E+00	1.11E-02	6.15E-05	1.54E-05	1.54E-05
	Salmonberries	2.51E-01	2.51E-01	2.77E+00	9.26E-03	5.13E-05	1.29E-05	1.29E-05
	Saskatoon berries	2.51E-01	2.51E-01	2.77E+00	9.26E-03	5.13E-05	1.29E-05	1.29E-05
	Red huckleberries	2.51E-01	2.51E-01	1.94E+00	6.48E-03	3.59E-05	9.01E-06	9.01E-06
	Blackberries, trailing	2.51E-01	2.51E-01	1.66E+00	5.55E-03	3.07E-05	7.71E-06	7.71E-06
	Thimbleberries	2.51E-01	2.51E-01	1.66E+00	5.55E-03	3.07E-05	7.71E-06	7.71E-06
	Low bush cranberries	2.51E-01	2.51E-01	1.11E+00	3.71E-03	2.05E-05	5.16E-06	5.16E-06

Exposure Source		COPC Concentration - Baseline (mg/kg)	COPC Concentration - Future (mg/kg)	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Toddler Exposure Dose (mg/kg bw/d) - Future
	Highbush cranberries	2.51E-01	2.51E-01	9.60E-01	3.21E-03	1.78E-05	4.46E-06	4.46E-06
	Salal berries	2.51E-01	2.51E-01	8.30E-01	2.77E-03	1.54E-05	3.86E-06	3.86E-06
	Chokecherries	2.51E-01	2.51E-01	3.20E-01	1.07E-03	5.92E-06	1.49E-06	1.49E-06
	Gooseberries	2.51E-01	2.51E-01	2.80E-01	9.36E-04	5.18E-06	1.30E-06	1.30E-06
			Total Intake	**2.99E+02**		**Total Country Food Exposure**	**6.42E-04**	**6.98E-04**
						RFD	**1.40E-03**	**1.40E-03**
						Year Round Resident		
						HQ Country food	**0.5**	**0.5**
						HQ Soil	**0.1**	**0.1**
						HQ Surface Water	**0.1**	**0.2**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.7**	**0.7**
						Project HQ		**0.08**
						Summer Resident		
						HQ Country food	**0.2**	**0.2**
						HQ Soil	**0.0**	**0.0**
						HQ Surface Water	**0.1**	**0.1**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.3**	**0.4**
						Project HQ		**0.0**

1 - When the predicted concentration was less than the baseline concentration the predicted concentration was set equal to the baseline concentration

NA - as these fish are marine fish there tissue concentration are not a result of the project thus there tissue residue was set to zero.

Table G44. Country Food Basket Risk Calculations – Iron

Exposure Source		COPC Concentration - Baseline	COPC Concentration - Future	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
Large Mammal	Moose Meat	3.26E+01	3.29E+01	1.05E+02	3.52E-01	1.95E-03	6.40E-02	6.42E-02
	Moose Liver	3.26E+01	3.29E+01	4.39E+00	1.47E-02	8.13E-05	2.65E-03	2.67E-03
	Moose Kidney	3.26E+01	3.29E+01	3.66E+00	1.22E-02	6.77E-05	2.21E-03	2.23E-03
	Deer Meat	3.26E+01	3.29E+01	2.60E+01	8.69E-02	4.81E-04	1.57E-02	1.58E-02
	Elk Meat	3.26E+01	3.29E+01	8.78E+00	2.93E-02	1.63E-04	5.30E-03	5.35E-03
	Caribou	3.26E+01	3.29E+01	1.67E+00	5.58E-03	3.09E-05	1.01E-03	1.02E-03
	Beaver	3.26E+01	3.29E+01	1.46E+00	4.88E-03	2.70E-05	8.82E-04	8.89E-04
Small Mammal	Rabbit	3.27E-01	3.30E-01	2.93E+00	9.79E-03	5.42E-05	1.77E-05	1.79E-05
Birds	Grouse	9.19E-01	7.60E+00	1.64E+00	5.48E-03	3.04E-05	2.79E-05	2.31E-04
	Duck	9.19E-01	7.60E+00	2.10E-01	7.02E-04	3.89E-06	3.57E-06	2.95E-05
	Geese	9.19E-01	7.60E+00	2.10E-01	7.02E-04	3.89E-06	3.57E-06	2.95E-05
Fish	Salmon any - NA	0.00E+00	0.00E+00	6.86E+01	2.29E-01	1.27E-03	0.00E+00	0.00E+00
	Trout any	1.29E+02	1.63E+02	1.14E+01	3.82E-02	2.12E-04	2.72E-02	3.45E-02
	Halibut - NA	0.00E+00	0.00E+00	1.05E+01	3.50E-02	1.94E-04	0.00E+00	0.00E+00
	Ling Cod - NA	0.00E+00	0.00E+00	3.49E+00	1.17E-02	6.46E-05	0.00E+00	0.00E+00
	Eulachon - NA	0.00E+00	0.00E+00	2.89E+00	9.66E-03	5.35E-05	0.00E+00	0.00E+00
	Dolly Varden	1.29E+02	1.63E+02	1.91E+00	6.38E-03	3.54E-05	4.55E-03	5.77E-03
	Pacific/Gery Cod - NA	0.00E+00	0.00E+00	1.59E+00	5.31E-03	2.94E-05	0.00E+00	0.00E+00
Plants	Soapberries	6.54E+01	6.54E+01	6.64E+00	2.22E-02	1.23E-04	8.04E-03	8.04E-03
	Blue huckleberries	6.54E+01	6.54E+01	5.81E+00	1.94E-02	1.08E-04	7.04E-03	7.04E-03
	Blackberries, large	6.54E+01	6.54E+01	6.64E+00	2.22E-02	1.23E-04	8.04E-03	8.04E-03
	Raspberries	6.54E+01	6.54E+01	5.81E+00	1.94E-02	1.08E-04	7.04E-03	7.04E-03
	Wild strawberry	6.54E+01	6.54E+01	3.32E+00	1.11E-02	6.15E-05	4.02E-03	4.02E-03
	Salmonberries	6.54E+01	6.54E+01	2.77E+00	9.26E-03	5.13E-05	3.36E-03	3.36E-03
	Saskatoon berries	6.54E+01	6.54E+01	2.77E+00	9.26E-03	5.13E-05	3.36E-03	3.36E-03
	Red huckleberries	6.54E+01	6.54E+01	1.94E+00	6.48E-03	3.59E-05	2.35E-03	2.35E-03
	Blackberries, trailing	6.54E+01	6.54E+01	1.66E+00	5.55E-03	3.07E-05	2.01E-03	2.01E-03
	Thimbleberries	6.54E+01	6.54E+01	1.66E+00	5.55E-03	3.07E-05	2.01E-03	2.01E-03

Exposure Source		COPC Concentration - Baseline	COPC Concentration - Future	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
	Low bush cranberries	6.54E+01	6.54E+01	1.11E+00	3.71E-03	2.05E-05	1.34E-03	1.34E-03
	Highbush cranberries	6.54E+01	6.54E+01	9.60E-01	3.21E-03	1.78E-05	1.16E-03	1.16E-03
	Salal berries	6.54E+01	6.54E+01	8.30E-01	2.77E-03	1.54E-05	1.01E-03	1.01E-03
	Chokecherries	6.54E+01	6.54E+01	3.20E-01	1.07E-03	5.92E-06	3.88E-04	3.88E-04
	Gooseberries	6.54E+01	6.54E+01	2.80E-01	9.36E-04	5.18E-06	3.39E-04	3.39E-04
			Total Intake	**2.99E+02**		**Total Country Food Exposure**	**1.75E-01**	**1.84E-01**
						RFD	**7.00E-01**	**7.00E-01**
						Year Round Resident		
						HQ Country food	**0.3**	**0.3**
						HQ Soil	**0.4**	**0.4**
						HQ Surface Water	**0.5**	**0.5**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**1.1**	**1.2**
						Project HQ		**0.0**
						Summer Resident		
						HQ Country food	**0.1**	**0.1**
						HQ Soil	**0.2**	**0.2**
						HQ Surface Water	**0.2**	**0.3**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.6**	**0.6**
						Project HQ		**0.0**

1 - When the predicted concentration was less than the baseline concentration the predicted concentration was set equal to the baseline concentration

NA - as these fish are marine fish there tissue concentration are not a result of the project thus there tissue residue was set to zero.

Table G45. Country Food Basket Risk Calculations – Lead

Exposure Source		COPC Concentration - Baseline	COPC Concentration - Future	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
Large Mammal	Moose Meat	5.57E-04	5.57E-04	1.05E+02	3.52E-01	1.95E-03	1.09E-06	1.09E-06
	Moose Liver	5.57E-04	5.57E-04	4.39E+00	1.47E-02	8.13E-05	4.53E-08	4.53E-08
	Moose Kidney	5.57E-04	5.57E-04	3.66E+00	1.22E-02	6.77E-05	3.78E-08	3.78E-08
	Deer Meat	5.57E-04	5.57E-04	2.60E+01	8.69E-02	4.81E-04	2.68E-07	2.68E-07
	Elk Meat	5.57E-04	5.57E-04	8.78E+00	2.93E-02	1.63E-04	9.06E-08	9.06E-08
	Caribou	5.57E-04	5.57E-04	1.67E+00	5.58E-03	3.09E-05	1.72E-08	1.72E-08
	Beaver	5.57E-04	5.57E-04	1.46E+00	4.88E-03	2.70E-05	1.51E-08	1.51E-08
Small Mammal	Rabbit	5.34E-06	5.34E-06	2.93E+00	9.79E-03	5.42E-05	2.89E-10	2.89E-10
Birds	Grouse	2.16E-04	2.17E-04	1.64E+00	5.48E-03	3.04E-05	6.54E-09	6.59E-09
	Duck	2.16E-04	2.17E-04	2.10E-01	7.02E-04	3.89E-06	8.38E-10	8.43E-10
	Geese	2.16E-04	2.17E-04	2.10E-01	7.02E-04	3.89E-06	8.38E-10	8.43E-10
Fish	Salmon any - NA	0.00E+00	0.00E+00	6.86E+01	2.29E-01	1.27E-03	0.00E+00	0.00E+00
	Trout any	1.06E-01	1.89E-01	1.14E+01	3.82E-02	2.12E-04	2.25E-05	4.00E-05
	Halibut - NA	0.00E+00	0.00E+00	1.05E+01	3.50E-02	1.94E-04	0.00E+00	0.00E+00
	Ling Cod - NA	0.00E+00	0.00E+00	3.49E+00	1.17E-02	6.46E-05	0.00E+00	0.00E+00
	Eulachon - NA	0.00E+00	0.00E+00	2.89E+00	9.66E-03	5.35E-05	0.00E+00	0.00E+00
	Dolly Varden	1.06E-01	1.89E-01	1.91E+00	6.38E-03	3.54E-05	3.76E-06	6.68E-06
	Pacific/Gery Cod - NA	0.00E+00	0.00E+00	1.59E+00	5.31E-03	2.94E-05	0.00E+00	0.00E+00
Plants	Soapberries	5.31E-02	5.31E-02	6.64E+00	2.22E-02	1.23E-04	6.53E-06	6.53E-06
	Blue huckleberries	5.31E-02	5.31E-02	5.81E+00	1.94E-02	1.08E-04	5.71E-06	5.71E-06
	Blackberries, large	5.31E-02	5.31E-02	6.64E+00	2.22E-02	1.23E-04	6.53E-06	6.53E-06
	Raspberries	5.31E-02	5.31E-02	5.81E+00	1.94E-02	1.08E-04	5.71E-06	5.71E-06
	Wild strawberry	5.31E-02	5.31E-02	3.32E+00	1.11E-02	6.15E-05	3.26E-06	3.26E-06
	Salmonberries	5.31E-02	5.31E-02	2.77E+00	9.26E-03	5.13E-05	2.72E-06	2.72E-06
	Saskatoon berries	5.31E-02	5.31E-02	2.77E+00	9.26E-03	5.13E-05	2.72E-06	2.72E-06
	Red huckleberries	5.31E-02	5.31E-02	1.94E+00	6.48E-03	3.59E-05	1.91E-06	1.91E-06
	Blackberries, trailing	5.31E-02	5.31E-02	1.66E+00	5.55E-03	3.07E-05	1.63E-06	1.63E-06
	Thimbleberries	5.31E-02	5.31E-02	1.66E+00	5.55E-03	3.07E-05	1.63E-06	1.63E-06

Exposure Source		COPC Concentration - Baseline	COPC Concentration - Future	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
	Low bush cranberries	5.31E-02	5.31E-02	1.11E+00	3.71E-03	2.05E-05	1.09E-06	1.09E-06
	Highbush cranberries	5.31E-02	5.31E-02	9.60E-01	3.21E-03	1.78E-05	9.43E-07	9.43E-07
	Salal berries	5.31E-02	5.31E-02	8.30E-01	2.77E-03	1.54E-05	8.16E-07	8.16E-07
	Chokecherries	5.31E-02	5.31E-02	3.20E-01	1.07E-03	5.92E-06	3.14E-07	3.14E-07
	Gooseberries	5.31E-02	5.31E-02	2.80E-01	9.36E-04	5.18E-06	2.75E-07	2.75E-07
			Total Intake	**2.99E+02**		**Total Country Food Exposure**	**6.96E-05**	**9.00E-05**
						RFD	**6.00E-04**	**6.00E-04**
						Year Round Resident		
						HQ Country food	**0.1**	**0.2**
						HQ Soil	**0.3**	**0.3**
						HQ Surface Water	**0.4**	**0.5**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.9**	**0.9**
						Project HQ		**0.09**
						Summer Resident		
						HQ Country food	**0.1**	**0.1**
						HQ Soil	**0.2**	**0.2**
						HQ Surface Water	**0.2**	**0.2**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.4**	**0.5**
						Project HQ		**0.0**

1 - When the predicted concentration was less than the baseline concentration the predicted concentration was set equal to the baseline concentration

NA - as these fish are marine fish their tissue concentration are not a result of the project thus there tissue residue was set to zero.

Table G46. Country Food Basket Risk Calculations – Manganese

Exposure Source		COPC Concentration - Baseline	COPC Concentration - Future	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
Large Mammal	Moose Meat	8.94E-01	8.96E-01	1.05E+02	3.52E-01	1.95E-03	1.74E-03	1.75E-03
	Moose Liver	8.94E-01	8.96E-01	4.39E+00	1.47E-02	8.13E-05	7.26E-05	7.28E-05
	Moose Kidney	8.94E-01	8.96E-01	3.66E+00	1.22E-02	6.77E-05	6.06E-05	6.07E-05
	Deer Meat	8.94E-01	8.96E-01	2.60E+01	8.69E-02	4.81E-04	4.30E-04	4.31E-04
	Elk Meat	8.94E-01	8.96E-01	8.78E+00	2.93E-02	1.63E-04	1.45E-04	1.46E-04
	Caribou	8.94E-01	8.96E-01	1.67E+00	5.58E-03	3.09E-05	2.76E-05	2.77E-05
	Beaver	8.94E-01	8.96E-01	1.46E+00	4.88E-03	2.70E-05	2.42E-05	2.42E-05
Small Mammal	Rabbit	8.94E-03	8.95E-03	2.93E+00	9.79E-03	5.42E-05	4.85E-07	4.86E-07
Birds	Grouse	4.99E-03	5.00E-03	1.64E+00	5.48E-03	3.04E-05	1.52E-07	1.52E-07
	Duck	4.99E-03	5.00E-03	2.10E-01	7.02E-04	3.89E-06	1.94E-08	1.94E-08
	Geese	4.99E-03	5.00E-03	2.10E-01	7.02E-04	3.89E-06	1.94E-08	1.94E-08
Fish	Salmon any - NA	0.00E+00	0.00E+00	6.86E+01	2.29E-01	1.27E-03	0.00E+00	0.00E+00
	Trout any	5.04E+00	1.88E+01	1.14E+01	3.82E-02	2.12E-04	1.07E-03	3.97E-03
	Halibut - NA	0.00E+00	0.00E+00	1.05E+01	3.50E-02	1.94E-04	0.00E+00	0.00E+00
	Ling Cod - NA	0.00E+00	0.00E+00	3.49E+00	1.17E-02	6.46E-05	0.00E+00	0.00E+00
	Eulachon - NA	0.00E+00	0.00E+00	2.89E+00	9.66E-03	5.35E-05	0.00E+00	0.00E+00
	Dolly Varden	5.04E+00	1.88E+01	1.91E+00	6.38E-03	3.54E-05	1.78E-04	6.63E-04
	Pacific/Gery Cod - NA	0.00E+00	0.00E+00	1.59E+00	5.31E-03	2.94E-05	0.00E+00	0.00E+00
Plants	Soapberries	9.31E+01	9.31E+01	6.64E+00	2.22E-02	1.23E-04	1.14E-02	1.14E-02
	Blue huckleberries	9.31E+01	9.31E+01	5.81E+00	1.94E-02	1.08E-04	1.00E-02	1.00E-02
	Blackberries, large	9.31E+01	9.31E+01	6.64E+00	2.22E-02	1.23E-04	1.14E-02	1.14E-02
	Raspberries	9.31E+01	9.31E+01	5.81E+00	1.94E-02	1.08E-04	1.00E-02	1.00E-02
	Wild strawberry	9.31E+01	9.31E+01	3.32E+00	1.11E-02	6.15E-05	5.72E-03	5.72E-03
	Salmonberries	9.31E+01	9.31E+01	2.77E+00	9.26E-03	5.13E-05	4.77E-03	4.77E-03
	Saskatoon berries	9.31E+01	9.31E+01	2.77E+00	9.26E-03	5.13E-05	4.77E-03	4.77E-03
	Red huckleberries	9.31E+01	9.31E+01	1.94E+00	6.48E-03	3.59E-05	3.34E-03	3.34E-03
	Blackberries, trailing	9.31E+01	9.31E+01	1.66E+00	5.55E-03	3.07E-05	2.86E-03	2.86E-03
	Thimbleberries	9.31E+01	9.31E+01	1.66E+00	5.55E-03	3.07E-05	2.86E-03	2.86E-03

Exposure Source		COPC Concentration - Baseline	COPC Concentration - Future	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
	Low bush cranberries	9.31E+01	9.31E+01	1.11E+00	3.71E-03	2.05E-05	1.91E-03	1.91E-03
	Highbush cranberries	9.31E+01	9.31E+01	9.60E-01	3.21E-03	1.78E-05	1.65E-03	1.65E-03
	Salal berries	9.31E+01	9.31E+01	8.30E-01	2.77E-03	1.54E-05	1.43E-03	1.43E-03
	Chokecherries	9.31E+01	9.31E+01	3.20E-01	1.07E-03	5.92E-06	5.51E-04	5.51E-04
	Gooseberries	9.31E+01	9.31E+01	2.80E-01	9.36E-04	5.18E-06	4.82E-04	4.82E-04
			Total Intake	**2.99E+02**		**Total Country Food Exposure**	**7.70E-02**	**8.04E-02**
						RFD	**1.36E-01**	**1.36E-01**
						Year Round Resident		
						HQ Country food	**0.6**	**0.6**
						HQ Soil	**0.0**	**0.0**
						HQ Surface Water	**0.1**	**0.1**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.7**	**0.8**
						Project HQ		**0.09**
						Summer Resident		
						HQ Country food	**0.3**	**0.3**
						HQ Soil	**0.0**	**0.0**
						HQ Surface Water	**0.0**	**0.1**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.3**	**0.4**
						Project HQ		**0.0**

1 - When the predicted concentration was less than the baseline concentration the predicted concentration was set equal to the baseline concentration

NA - as these fish are marine fish there tissue concentration are not a result of the project thus there tissue residue was set to zero.

Table G47. Country Food Basket Risk Calculations – Mercury

Exposure Source		COPC Concentration - Baseline (mg/kg)	COPC Concentration - Future[1] (mg/kg)	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
Large Mammal	Moose Meat	2.68E-02	2.95E-02	1.05E+02	3.52E-01	1.95E-03	5.23E-05	5.75E-05
	Moose Liver	2.68E-02	2.95E-02	4.39E+00	1.47E-02	8.13E-05	2.18E-06	2.40E-06
	Moose Kidney	2.68E-02	2.95E-02	3.66E+00	1.22E-02	6.77E-05	1.81E-06	2.00E-06
	Deer Meat	2.68E-02	2.95E-02	2.60E+01	8.69E-02	4.81E-04	1.29E-05	1.42E-05
	Elk Meat	2.68E-02	2.95E-02	8.78E+00	2.93E-02	1.63E-04	4.35E-06	4.79E-06
	Caribou	2.68E-02	2.95E-02	1.67E+00	5.58E-03	3.09E-05	8.28E-07	9.12E-07
	Beaver	2.68E-02	2.95E-02	1.46E+00	4.88E-03	2.70E-05	7.24E-07	7.97E-07
Small Mammal	Rabbit	2.30E-04	2.30E-04	2.93E+00	9.79E-03	5.42E-05	1.25E-08	1.25E-08
Birds	Grouse	1.31E-04	1.31E-04	1.64E+00	5.48E-03	3.04E-05	3.98E-09	3.98E-09
	Duck	1.31E-04	1.31E-04	2.10E-01	7.02E-04	3.89E-06	5.09E-10	5.09E-10
	Geese	1.31E-04	1.31E-04	2.10E-01	7.02E-04	3.89E-06	5.09E-10	5.09E-10
Fish	Salmon any - NA	0.00E+00	0.00E+00	6.86E+01	2.29E-01	1.27E-03	0.00E+00	0.00E+00
	Trout any	8.70E-03	9.98E-03	1.14E+01	3.82E-02	2.12E-04	1.84E-06	2.11E-06
	Halibut - NA	0.00E+00	0.00E+00	1.05E+01	3.50E-02	1.94E-04	0.00E+00	0.00E+00
	Ling Cod - NA	0.00E+00	0.00E+00	3.49E+00	1.17E-02	6.46E-05	0.00E+00	0.00E+00
	Eulachon - NA	0.00E+00	0.00E+00	2.89E+00	9.66E-03	5.35E-05	0.00E+00	0.00E+00
	Dolly Varden	8.70E-03	9.98E-03	1.91E+00	6.38E-03	3.54E-05	3.08E-07	3.53E-07
	Pacific/Gery Cod - NA	0.00E+00	0.00E+00	1.59E+00	5.31E-03	2.94E-05	0.00E+00	0.00E+00
Plants	Soapberries	3.61E-03	3.61E-03	6.64E+00	2.22E-02	1.23E-04	4.43E-07	4.43E-07
	Blue huckleberries	3.61E-03	3.61E-03	5.81E+00	1.94E-02	1.08E-04	3.88E-07	3.88E-07
	Blackberries, large	3.61E-03	3.61E-03	6.64E+00	2.22E-02	1.23E-04	4.43E-07	4.43E-07
	Raspberries	3.61E-03	3.61E-03	5.81E+00	1.94E-02	1.08E-04	3.88E-07	3.88E-07
	Wild strawberry	3.61E-03	3.61E-03	3.32E+00	1.11E-02	6.15E-05	2.22E-07	2.22E-07
	Salmonberries	3.61E-03	3.61E-03	2.77E+00	9.26E-03	5.13E-05	1.85E-07	1.85E-07
	Saskatoon berries	3.61E-03	3.61E-03	2.77E+00	9.26E-03	5.13E-05	1.85E-07	1.85E-07
	Red huckleberries	3.61E-03	3.61E-03	1.94E+00	6.48E-03	3.59E-05	1.29E-07	1.29E-07
	Blackberries, trailing	3.61E-03	3.61E-03	1.66E+00	5.55E-03	3.07E-05	1.11E-07	1.11E-07
	Thimbleberries	3.61E-03	3.61E-03	1.66E+00	5.55E-03	3.07E-05	1.11E-07	1.11E-07

Exposure Source		COPC Concentration - Baseline (mg/kg)	COPC Concentration - Future[1] (mg/kg)	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
	Low bush cranberries	3.61E-03	3.61E-03	1.11E+00	3.71E-03	2.05E-05	7.41E-08	7.41E-08
	Highbush cranberries	3.61E-03	3.61E-03	9.60E-01	3.21E-03	1.78E-05	6.41E-08	6.41E-08
	Salal berries	3.61E-03	3.61E-03	8.30E-01	2.77E-03	1.54E-05	5.54E-08	5.54E-08
	Chokecherries	3.61E-03	3.61E-03	3.20E-01	1.07E-03	5.92E-06	2.14E-08	2.14E-08
	Gooseberries	3.61E-03	3.61E-03	2.80E-01	9.36E-04	5.18E-06	1.87E-08	1.87E-08
			Total Intake	**2.99E+02**		**Total Country Food Exposure**	**8.00E-05**	**8.80E-05**
						RFD	**3.00E-04**	**3.00E-04**
						Year Round Resident		
						HQ Country food	**0.3**	**0.3**
						HQ Soil	**0.0**	**0.0**
						HQ Surface Water	**0.0**	**0.0**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.3**	**0.3**
						Project HQ		**0.0**
						Summer Resident		
						HQ Country food	**0.1**	**0.1**
						HQ Soil	**0.0**	**0.0**
						HQ Surface Water	**0.0**	**0.0**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.1**	**0.2**
						Project HQ		**0.0**

1 - When the predicted concentration was less than the baseline concentration the predicted concentration was set equal to the baseline concentration

NA - as these fish are marine fish there tissue concentration are not a result of the project thus there tissue residue was set to zero.

Table G48. Country Food Basket Risk Calculations – Strontium

Exposure Source		COPC Concentration - Baseline	COPC Concentration - Future	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
Large Mammal	Moose Meat	2.35E-02	2.42E-02	1.05E+02	3.52E-01	1.95E-03	4.6E-05	4.7E-05
	Moose Liver	2.35E-02	2.42E-02	4.39E+00	1.47E-02	8.13E-05	1.9E-06	2.0E-06
	Moose Kidney	2.35E-02	2.42E-02	3.66E+00	1.22E-02	6.77E-05	1.6E-06	1.6E-06
	Deer Meat	2.35E-02	2.42E-02	2.60E+01	8.69E-02	4.81E-04	1.1E-05	1.2E-05
	Elk Meat	2.35E-02	2.42E-02	8.78E+00	2.93E-02	1.63E-04	3.8E-06	3.9E-06
	Caribou	2.35E-02	2.42E-02	1.67E+00	5.58E-03	3.09E-05	7.2E-07	7.5E-07
	Beaver	2.35E-02	2.42E-02	1.46E+00	4.88E-03	2.70E-05	6.3E-07	6.5E-07
Small Mammal	Rabbit	2.32E-02	2.54E-02	2.93E+00	9.79E-03	5.42E-05	1.3E-06	1.4E-06
Birds	Grouse	2.31E-02	2.41E-02	1.64E+00	5.48E-03	3.04E-05	7.0E-07	7.3E-07
	Duck	2.31E-02	2.41E-02	2.10E-01	7.02E-04	3.89E-06	9.0E-08	9.4E-08
	Geese	2.31E-02	2.41E-02	2.10E-01	7.02E-04	3.89E-06	9.0E-08	9.4E-08
Fish	Salmon any - NA	0.00E+00	0.00E+00	6.86E+01	2.29E-01	1.27E-03	0.0E+00	0.0E+00
	Trout any	8.00E+00	8.00E+00	1.14E+01	3.82E-02	2.12E-04	1.7E-03	1.7E-03
	Halibut - NA	0.00E+00	0.00E+00	1.05E+01	3.50E-02	1.94E-04	0.0E+00	0.0E+00
	Ling Cod - NA	0.00E+00	0.00E+00	3.49E+00	1.17E-02	6.46E-05	0.0E+00	0.0E+00
	Eulachon - NA	0.00E+00	0.00E+00	2.89E+00	9.66E-03	5.35E-05	0.0E+00	0.0E+00
	Dolly Varden	8.00E+00	8.00E+00	1.91E+00	6.38E-03	3.54E-05	2.8E-04	2.8E-04
	Pacific/Gery Cod - NA	0.00E+00	0.00E+00	1.59E+00	5.31E-03	2.94E-05	0.0E+00	0.0E+00
Plants	Soapberries	2.57E+01	2.57E+01	6.64E+00	2.22E-02	1.23E-04	3.2E-03	3.2E-03
	Blue huckleberries	2.57E+01	2.57E+01	5.81E+00	1.94E-02	1.08E-04	2.8E-03	2.8E-03
	Blackberries, large	2.57E+01	2.57E+01	6.64E+00	2.22E-02	1.23E-04	3.2E-03	3.2E-03
	Raspberries	2.57E+01	2.57E+01	5.81E+00	1.94E-02	1.08E-04	2.8E-03	2.8E-03
	Wild strawberry	2.57E+01	2.57E+01	3.32E+00	1.11E-02	6.15E-05	1.6E-03	1.6E-03
	Salmonberries	2.57E+01	2.57E+01	2.77E+00	9.26E-03	5.13E-05	1.3E-03	1.3E-03
	Saskatoon berries	2.57E+01	2.57E+01	2.77E+00	9.26E-03	5.13E-05	1.3E-03	1.3E-03
	Red huckleberries	2.57E+01	2.57E+01	1.94E+00	6.48E-03	3.59E-05	9.2E-04	9.2E-04
	Blackberries, trailing	2.57E+01	2.57E+01	1.66E+00	5.55E-03	3.07E-05	7.9E-04	7.9E-04
	Thimbleberries	2.57E+01	2.57E+01	1.66E+00	5.55E-03	3.07E-05	7.9E-04	7.9E-04

Exposure Source		COPC Concentration - Baseline	COPC Concentration - Future	Source Intake Rate (g/day)	Intake Proportion for Toddler	Toddler Unit Exposure Dose (mg/kg bw/d)	Toddler Exposure Dose (mg/kg bw/d) - Baseline	Exposure Dose (mg/kg bw/d) - Future
	Low bush cranberries	2.57E+01	2.57E+01	1.11E+00	3.71E-03	2.05E-05	5.3E-04	5.3E-04
	Highbush cranberries	2.57E+01	2.57E+01	9.60E-01	3.21E-03	1.78E-05	4.6E-04	4.6E-04
	Salal berries	2.57E+01	2.57E+01	8.30E-01	2.77E-03	1.54E-05	4.0E-04	4.0E-04
	Chokecherries	2.57E+01	2.57E+01	3.20E-01	1.07E-03	5.92E-06	1.5E-04	1.5E-04
	Gooseberries	2.57E+01	2.57E+01	2.80E-01	9.36E-04	5.18E-06	1.3E-04	1.3E-04
			Total Intake	**2.99E+02**		**Total Country Food Exposure**	**2.2E-02**	**2.2E-02**
						RFD	**6.0E-01**	**6.0E-01**
						Year Round Resident		
						HQ Country food	**0.0**	**0.0**
						HQ Soil	**0.0**	**0.0**
						HQ Surface Water	**0.0**	**0.0**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.1**	**0.1**
						Project HQ		**0.00**
						Summer Resident		
						HQ Country food	**0.0**	**0.0**
						HQ Soil	**0.0**	**0.0**
						HQ Surface Water	**0.0**	**0.0**
						HQ Air	**0.0**	**0.0**
						Total HQ (Not Including Air)	**0.0**	**0.0**
						Project HQ		**0.00**

1 - When the predicted concentration was less than the baseline concentration the predicted concentration was set equal to the baseline concentration

NA - as these fish are marine fish there tissue concentration are not a result of the project thus there tissue residue was set to zero.

Attachment H
Example Calculations

DOSE

This section provides worked calculations for each of the models used to estimate arsenic exposure from soil and country food for the adult hunter, trapper, fisher receptor during baseline.

Ingestion of Soil

The baseline intake of each constituent via ingestion of soil was calculated as:

$$\text{Dose}\ (mg/kg-day) = \frac{C_s \times IR_s \times RAF_{Oral} \times D_2 \times D_3 (\times D_4)}{BW (\times LE)}$$

Where:

- Dose = chronic daily intake (mg/kg-day)
- C_S = concentration of contaminant in soil (arsenic 95th percentile = 69.52 mg/kg)
- IR_S = receptor ingestion rate for soil (0.00002 kg/d)
- RAF_{Oral} = relative absorption factor from the gastrointestinal tract (0.33) (unit-less)
- D_2 = days per week exposed (7 days/7-day week)
- D_3 = weeks per year exposed (8 weeks per 12-week for assessment of non-carcinogens)
- D_3 = weeks per year exposed (8 weeks per 52-week for assessment of carcinogens)
- D_4 = total years exposed to site (60 years) (for assessment of carcinogens only)
- BW = body weight (70.7 kg)
- LE = life expectancy (80 years) (for assessment of carcinogens only)

$$Dose_{non-carcinogen} = \frac{(69.52mg/kg \times 0.00002kg/d \ \times 0.33 \times \frac{7d}{7d} \times \frac{8w}{12w})}{(70.7kg)}$$

$$Dose_{non-carcinogen} = 4.3 \times 10^{-6}\ mg/kg - day$$

$$Dose_{carcinogen} = \frac{(69.52mg/kg \times 0.00002kg/d \ \times 0.33 \times \frac{7d}{7d} \times \frac{8w}{52w} \times \frac{60}{80y})}{(70.7kg)}$$

$$Dose_{carcinogen} = 7.5 \times 10^{-7}\ mg/kg - day$$

Inhalation of Particulates

The baseline intake of each constituent via inhalation of soil particulate was calculated as:

Noncarcinogenic

$$TADC_A\ (\text{mg}/m^3) = C_{Air} \times RAF_{Inh} \times D_1 \times D_2 \times D_3$$

Where:

$TADC_A$	= time-adjusted average daily air concentration (mg/m^3)
CAir	= concentration of COPC in airborne dust (2.36 x 10^{-7} mg/m^3)
RAF_{Inh}	= relative absorption factor from the respiratory tract (unit-less, assumed to be 1)
D1	= hours per day exposed (24 hours/24-hours)
D2	= days per week exposed (7 days/7-day week)
D3	= weeks per year exposed (weeks/52-week year)

Carcinogenic

$$\text{Dose (mg/kg-day)} = \frac{C_{Air} \times IR_A \times RAF_{INH} D_1 \times D_2 \times D_3 \times D_4}{BW \times LE}$$

Where:

Dose	= chronic daily intake (mg/kg-day)
C_{Air}	= concentration of COPC in airborne dust (2.36 x 10^{-7} mg/m^3)
IR_A	= ROC inhalation rate for fugitive dust (16.6 m^3/day)
RAF_{Inh}	= relative absorption factor from the respiratory tract (unit-less, assumed to be 1)
D1	= hours per day exposed (24 hours/24-hour)
D2	= days per week exposed (7days/7-day week)
D3	= weeks per year exposed (8 weeks/52-week year)
D4	= total years exposed (60 year)(for assessment of carcinogens only)
BW	= body weight (70.7 kg)
LE	= life expectancy (80 years) (for assessment of carcinogens only)

$$Dose_{non-carcinogen} = (2.36 \times 10^{-7}\ mg/m^3\ \times 1.0 \times \frac{24h}{24h} \times \frac{7d}{7d}\ \times \frac{8w}{12w})$$

$$Dose_{non-carcinogen} = 1.57 \times 10^{-7}\ mg/m^3$$

$$Dose_{carcinogen} = \frac{(2.36 \times 10^{-7}\ mg/m^3\ \times 16.6m^3/day \times 1.0 \times \frac{24h}{24h} \times \frac{7d}{7d}\ \times \frac{8w}{52w} \times \frac{60}{80y})}{(70.7kg)}$$

$$Dose_{carcinogen} = 6.4 \times 10^{-9}\ mg/kg - day$$

Dermal Contact with Soil

The baseline intake of each constituent via dermal contact with soil was calculated as:

$$Dose(mg/kg-day) = \frac{\left((C_S \times SA_H \times SL_H) + (C_S \times SA_O \times SL_O)\right) \times RAF_{Derm} \times D_1 \times D_2 \times D_3 (\times D_4)}{BW (\times LE)}$$

Where:

Dose	= chronic daily intake (mg/kg-day)
C_S	= concentration of contaminant in soil (arsenic 95th percentile = 69.52 mg/kg)
S_{AH}	= surface area of hands exposed for soil loading (890 cm^2)
S_{LH}	= soil loading rate to exposed skin of hands (1x10^{-7} kg/cm^2-event)
S_{AO}	= surface area exposed other than hands for soil loading (arms + legs; 8220 cm^2)
S_{LO}	= soil loading rate to exposed skin other than hands (1x10^{-8} kg/cm^2-event)
RAF_{Derm}	= relative absorption factor from the gastrointestinal tract (the chemical specific RAF for arsenic is 0.03) (unit-less)
D1	= events per day, assumed to be 1 (events/day)
D2	= days per week exposed (7 days/7-day week)
D3	= weeks per year exposed (8 weeks per 12-week for assessment of non-carcinogens)
D_3	= weeks per year exposed (8 weeks per 52-week for assessment of carcinogens)
D_4	= total years exposed to Site (60 years) (for assessment of carcinogens only)
BW	= body weight (70.7 kg)
LE	= life expectancy (80 years) (for assessment of carcinogens only)

$$Dose_{non-carcinogen} = \frac{(69.52mg/kg \times ((890cm^2 \times 1 \times 10^{-7}\frac{kg}{cm^2} - event) + (8220cm^2 \times 1 \times 10^{-8}\frac{kg}{cm^2} - event)) \times 0.03 \times \frac{7d}{7d} \times \frac{8w}{12w})}{(70.7kg)}$$

$$Dose_{non-carcinogen} = 3.4 \times 10^{-9}\ mg/kg - day$$

$$Dose_{carcinogen} = \frac{(69.52mg/kg \times (890cm^2 \times 1 \times 10^{-7}\frac{kg}{cm^2} - event + 8220cm^2 \times 1 \times 10^{-8}\frac{kg}{cm^2} - event\ ) \times 0.03 \times \frac{7d}{7d} \times \frac{8w}{52w} \times \frac{60y}{80y})}{(70.7kg)}$$

$$Dose_{carcinogen} = 5.8 \times 10^{-7}\ mg/kg - day$$

Ingestion of Country Foods

The baseline intake of each constituent via ingestion of fish was calculated as:

$$\text{Dose (mg/kg} - \text{day)} = \frac{C_{\text{Foodi}} \times IR_{\text{Foodi}} \times RAF_{\text{Orali}} \times D_i (\times D_4)}{BW \times 365 (\times LE)}$$

This is the dose formula for all country foods.

Where:

Dose	= chronic daily intake (mg/kg-day)
C_{Foodi}	= baseline concentration of contaminant in country food such as fish (e.g., inorganic arsenic in fish = 0.7358 x 10% (%inorganic arsenic) = 0.07358 mg/kg);
IR_{Foodi}	= receptor ingestion rate for country food (0.290 kg/d)
RAF_{Oral}	= relative absorption factor from the gastrointestinal tract (RAF=0.5 for arsenic only for all other chemicals the fish RAF = 1) (unit-less)
D_i	= days per year exposed (365 days/365-day year)
D_4	= total years exposed to site (60 years) (for assessment of carcinogens only)
BW	= body weight (70.7 kg)
LE	= life expectancy (80 years) (for assessment of carcinogens only)

Amortization of the dose from country foods was not included in the calculations reported in Appendix D (i.e., these calculations assumed 0.290 mg/day consumption for each country food for 365 days per year).

$$Dose_{non-carcinogen,not\ amortized\ for\ receptor} = \frac{(0.0736\ mg/kg \times 0.290 kg/d\ \times 0.5 \times 365\ d)}{(70.7 kg) x\ 365\ d}$$

$$Dose_{non-carcinogen,not\ amortized\ for\ receptor} = 1.5 \times 10^{-4}\ mg/kg - day$$

Amortization for country foods consumption was applied to the calculations shown for receptors in Appendix G by multiplying the concentrations in Appendix D with the ratio representing the exposure period described for each receptor in Table 5 of the HHRA (e.g., 8 weeks/12 weeks for non-carcinogens or 2 months/12 months carcinogens for the hunter-trapper-fisher receptor).

$$Dose_{non-carcinogen,amortized\ for\ receptor} = 1.5 \times 10^{-4}\ mg/kg - day \times \frac{8\ weeks}{12\ weeks}$$

$$Dose_{non-carcinogen,amortized\ for\ receptor} = 1.0 \times 10^{-4}\ mg/kg - day$$

The following calculations for dose of inorganic arsenic from fish ingestion for adult hunter-trapper-fisher receptors shows both the amortized and non-amortized doses:

$$Dose_{carcinogen,not\ amortized\ for\ receptor} = \frac{(0.0736\ mg/kg \times 0.290kg/d\ \times 0.5 \times \frac{60y}{80y})}{(70.7kg)}$$

$$Dose_{carcinogen,not\ amortized\ for\ receptor} = 1.13 \times 10^{-4}\ mg/kg - day$$

$$Dose_{carcinogen,amortized\ for\ receptor} = 1.13 \times 10^{-7}\ mg/kg - day \times \frac{2\ months}{12\ months}$$

$$Dose_{carcinogen,amortized\ for\ receptor} = 1.9 \times 10^{-5}\ mg/kg - day$$

HQ/ILCR

Soil, Air, and Water

Non-Carcinogenic Constituents

Non-carcinogens are considered to be threshold chemicals where a specific dose must be exceeded before a health effects is observed. The likelihood of a potential adverse health effect is represented by a Hazard Quotient (HQ), which is calculated as the ratio of a given chemical dose to the chemical's corresponding non-carcinogenic TRV:

$$HQ = \frac{Dose}{TRV}$$

Where:

HQ	= non-carcinogenic hazard quotient
Dose	= dose for each constituent (mg/kg-day)
TRV	= non-carcinogenic toxicity reference value (mg/kg-day)

The following calculation was used to estimate the baseline HQ for the adult hunter, trapper, fisher receptor group as a result of exposure to arsenic in soil:

Inadvertent soil ingestion

$$HQ_1 = \frac{4.3 \times 10^{-6}\ mg/kg - day}{1 \times 10^{-3} mg/kg - day} = 0.0043$$

Inhalation of soil particulate

$$HQ_2 = \frac{1.6 \times 10^{-7}\ mg/m^3}{1 \times 10^{-3} mg/m^3} = 0.00016$$

Dermal Contact with soil

$$HQ_3 = \frac{3.4 \times 10^{-6}\, mg/kg - day}{1 \times 10^{-3} mg/kg - day} = 0.0034$$

Total (one significant figure)

$$HQ = HI = HQ_1 + HQ_3 = 0.008$$

Carcinogenic Constituents

For carcinogens, the risk of cancer is assumed to be proportional to dose and exposure results in a given probability of risk. Carcinogenic risk probabilities for the ingestion pathway were calculated by multiplying the EEC in soil by the cancer unit risk factor for each carcinogen.

The following formula was used to calculate risk estimates for carcinogenic adverse health effects (i.e., incremental lifetime cancer risk or ILCR) for arsenic:

$$ILCR_{Lifestage\ i} = Dose_i\ (mg/kg - day) \times Slope\ Factor (mg/kg - day)^{-1} \times ADAF_i$$

Where:

$Dose_i$	= carcinogenic dose received during lifestage i averaged over a lifetime (mg/kg-day)
Slope Factor	= Route- and chemical-specific cancer slope factor (1.8 mg/kg-day)$^{-1}$
$ADAF_i$	= Age-dependent adjustment factor for lifestage I (1 for adults)

The following calculation/s was used to estimate the baseline ILCR for the adult hunter, trapper, fisher receptor as a result of exposure to arsenic:

Incidental soil ingestion ILCR

$$ILCR_1 = (7.5 \times 10^{-7}\ m \frac{mg}{kg - day})\ \times (1.8 \frac{mg}{kg - day})^{-1} \times 1 = 1.4 \times 10^{-6}$$

Inhalation of soil particulate ILCR

$$ILCR_2 = (6.4 \times 10^{-9} \frac{mg}{kg - day})\ \times (27 \frac{mg}{kg - day})^{-1} \times 1 = 1.7 \times 10^{-7}$$

Dermal Contact with soil ILCR

$$ILCR_3 = (5.8 \times 10^{-7}\ mg/kg - day)\ \times (1.8 \frac{mg}{kg} - day)^{-1} \times 1 = 1.0 \times 10^{-6}$$

Total ILCR

$$ILCR_{total} = ILCR_1 + ILCR_3 + ILCR_3 = 2.569 \times 10^{-6} = 2.6 \times 10^{-6}$$

Country Foods

Non-Carcinogenic Hazard (Ingestion of Inorganic Arsenic in Fish – Hunter/ Trapper/ Fisher)

Baseline Hazard, using the amortized dose for non-carcinogens from the previous "Ingestion of Country Foods" sample calculation:

$$HQ_1 = \frac{1.0 \times 10^{-4}\ mg/kg - day}{1 \times 10^{-3} mg/kg - day}$$

$$HQ_{Baseline} = 0.1$$

Carcinogenic Risk (Ingestion of Inorganic Arsenic in Fish – Hunter/ Trapper/ Fisher)

Baseline ILCR, using the amortized dose for carcinogens from the previous "Ingestion of Country Foods" sample calculation for carcinogens:

$$ILCR_1 = (1.9 \times 10^{-5}\ mg/kg - day)\ \times (1.8 \frac{mg}{kg} - day)^{-1} \times 1$$

$$ILCR_1 = 3.4 \times 10^{-5}$$