APPENDIX 22-B: SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

RED MOUNTAIN UNDERGROUND GOLD PROJECT

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Acronyms and Abbreviations

BCEAO	British Columbia Environmental Assessment Office
BCMOE	British Columbia Ministry of Environment
CCME	Canadian Council of Ministers of the Environment
CIL	Carbon-in-Leach
COPC	Constituents of Potential Concern
Core6	Core6 Environmental Ltd
CSEM	Conceptual Site Exposure Model
CSR	*Contaminated Sites Regulation*
D	Dissolved
EA	Environmental Assessment
EEC	Estimated Environmental Concentration
HQ	Hazard Quotient
LSA	Local Study Area
masl	metres above sea level
NFA	Nisga'a Final Agreement
PFSA	Project Footprint Study Area
PL	Parkland
Project, the	Red Mountain Underground Gold Project, the
RL	Residential Land
RSA	Regional Study Area
SLERA	Screening Level Ecological Risk Assessment
T	Total

TMF	Tailings Management Facility
tpd	tonnes per day
TRV	Toxicity Reference Value
USEPA	United States Environmental Protection Agency
VC	Valued Component

Statement of Limitations

This report was prepared by Core6 Environmental Ltd ("Core6") for IDM Mining Ltd ("IDM") who has been party to the development of the scope-of-work and objectives for this report and understand its limitations. This report is intended to provide information to IDM to support Project permitting efforts through the British Columbia Environmental Assessment Office (BCEAO). 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, modifications to this report may be necessary.

1 INTRODUCTION

This Screening Level Ecological Risk Assessment (SLERA) was completed by Core6 Environmental Ltd (Core6) to provide information for use in an Environmental Assessment (EA) initiated by IDM Mining Ltd (IDM) in relation to their interest in developing the Red Mountain Underground Gold Project (the Project) near the town of Stewart, in northwestern British Columbia (Figure 1).

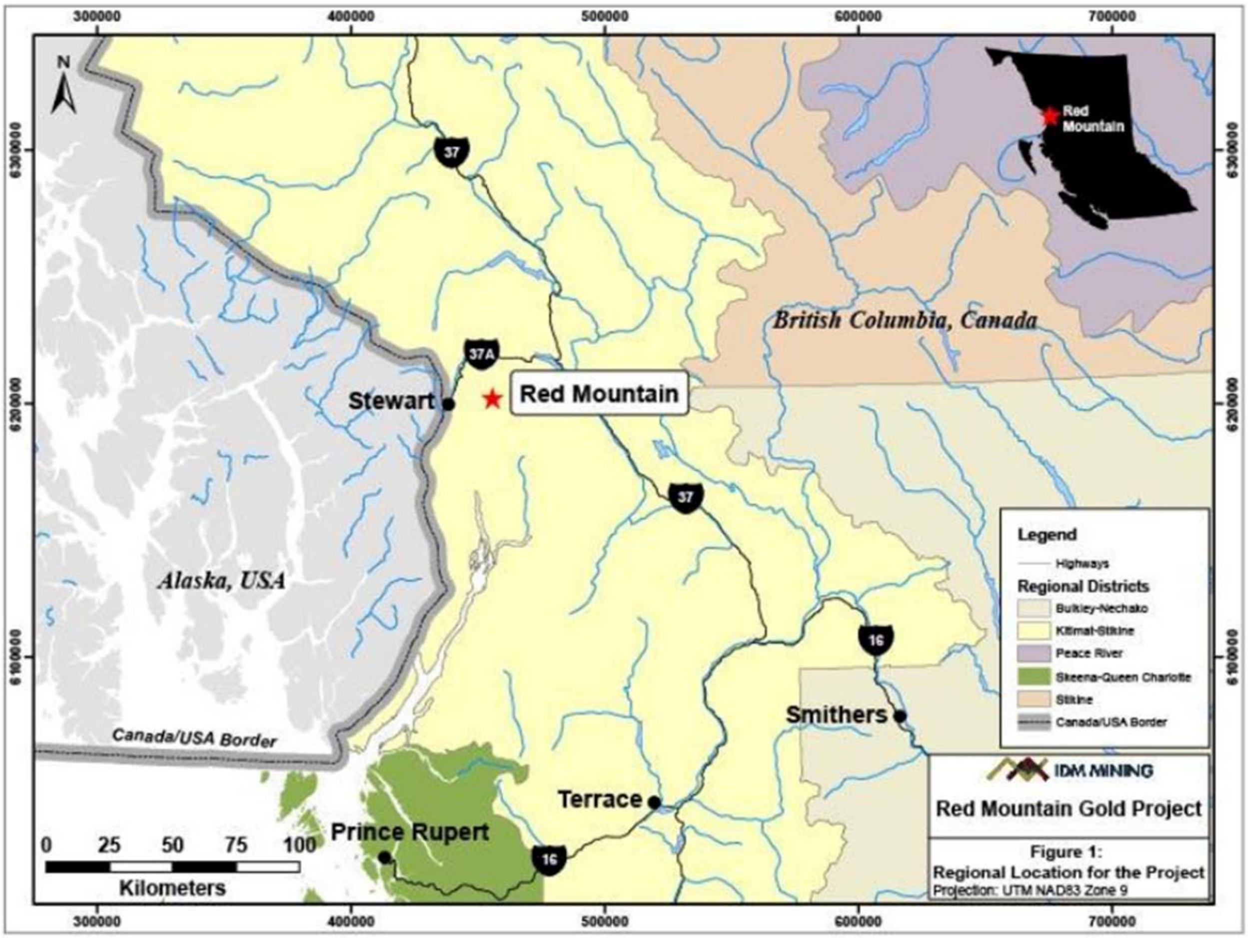


Figure 1. Red Mountain Gold Project Regional Location for the Project

The development and operation of the Project has the potential to alter existing (baseline) conditions with respect to the chemical concentrations in the vicinity of the Project. As a result, there is potential risk to aquatic and terrestrial ecological receptors of exposure to chemicals associated with Project activities. To evaluate these situations, the practice of risk assessment has evolved to provide an improved understanding of the potential for unacceptable adverse effects.

Three key factors considered in assessing baseline and potential future risks are:

- Sources of potential risk;

- Receptors of concern; and
- Exposure pathways.

Although the Project SLERA (this report) focuses specifically on chemical stressors, sources of potential risk can also include biological (e.g., changes in competition scenarios, changes to predation potential) and physical (e.g., construction activities, vehicle movements) factors. Depending on jurisdiction, sources of potential risk are referred to as hazards or stressors.

Receptors of concern refer to the ecological entities of interest (e.g., plants, fish, wildlife, birds). Depending on the risk factor and the Project-specific intent of the SLERA, the receptor groups may be evaluated at the individual, population, or community levels. Within the context of EAs, receptors of concern are often evaluate as valued components (VCs).

Exposure pathways refer to the means by which receptors are exposed to the sources of potential risk. For example, vegetation and invertebrates may be exposed to chemical stressors through direct contact in surface soil. Higher trophic-level species may be exposed through dietary uptake (ingestion) of lower trophic -level species with elevated tissue concentrations of specific chemicals.

The most important principle of risk assessment is that there can only be risk when all three factors coincide (Figure 2). If any one of these factors is not present, there is no risk.

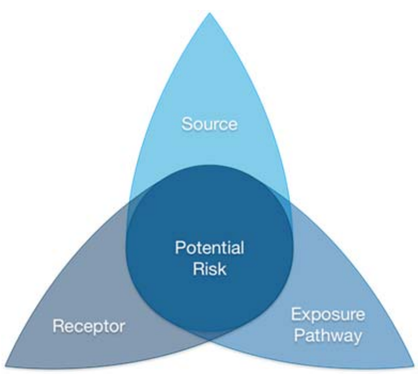


Figure 2. Venn Risk Diagram

Where all three factors coincide, further consideration is required to characterize risk through an understanding of the characteristics and activity patterns of potential receptors; understanding of the spatial and temporal nature of the source(s) and associated chemical stressors; and understanding of the exposure pathways by which receptors are exposed to the source(s)/stressor(s). A graphical illustration of the relationships among sources, exposure pathways, and receptors is provided in the form of Conceptual Site Model, presented at the end of the Problem Formulation section.

Risk assessment is an iterative process often beginning with a more conservative screening level assessment (this report) and, if necessary, moving to more detailed assessment aimed at reducing uncertainty. Screening-level assessments tend to have higher levers of uncertainty and conservatism than detailed assessments (Figure 3).

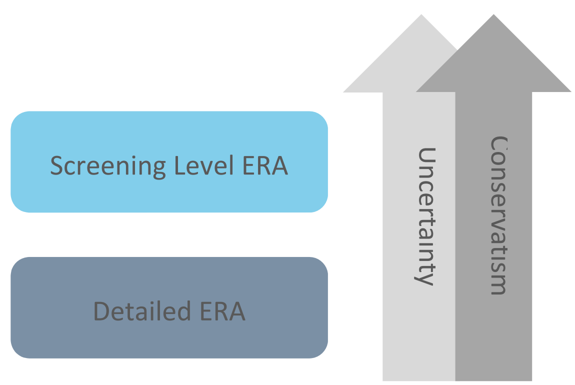


Figure 3. Relationship between Screening Level and Detailed Ecological Risk Assessments

2 PROJECT DESCRIPTION

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

The four main Project phases include: Construction (18 months), Operation (6 years), Reclamation and Closure (5 years), and Post-Closure (10 years). Reclamation will be on going during the Operation Phase. The life of the Project is anticipated to be approximately 23 years and it is expected that the Construction Phase could begin as early as Spring of 2018.

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 (1,950 masl); and,

2. Bromley Humps – also situated in the Bitter Creek watershed (1,500 masl), and is the location of the proposed Process Plant and Tailings Management Facility (TMF).

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 Process Plant will be discharged from the delivery pipelines into the TMF. Only water meeting applicable effluent limits will be discharged from the TMF into Bitter Creek. Water released from the TMF will be treated, as necessary, prior to discharge into Bitter Creek.

The material proposed 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 maximum grade of 15% at a 4.5 m by 4.5 m profile to accommodate 30-tonne haul trucks. Ore material will be hauled to the process plant on a Haul Roadan access 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 process plant, but stops short of the proposed Mine Site (Figure 4). An additional 13 km extension of the existing road is planned. Roads will not be accessible to the public. Locally developed borrows/rock quarries, adjacent to the proposed Access Road and Haul Road 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.

Electric 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 138 kV powerline.

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

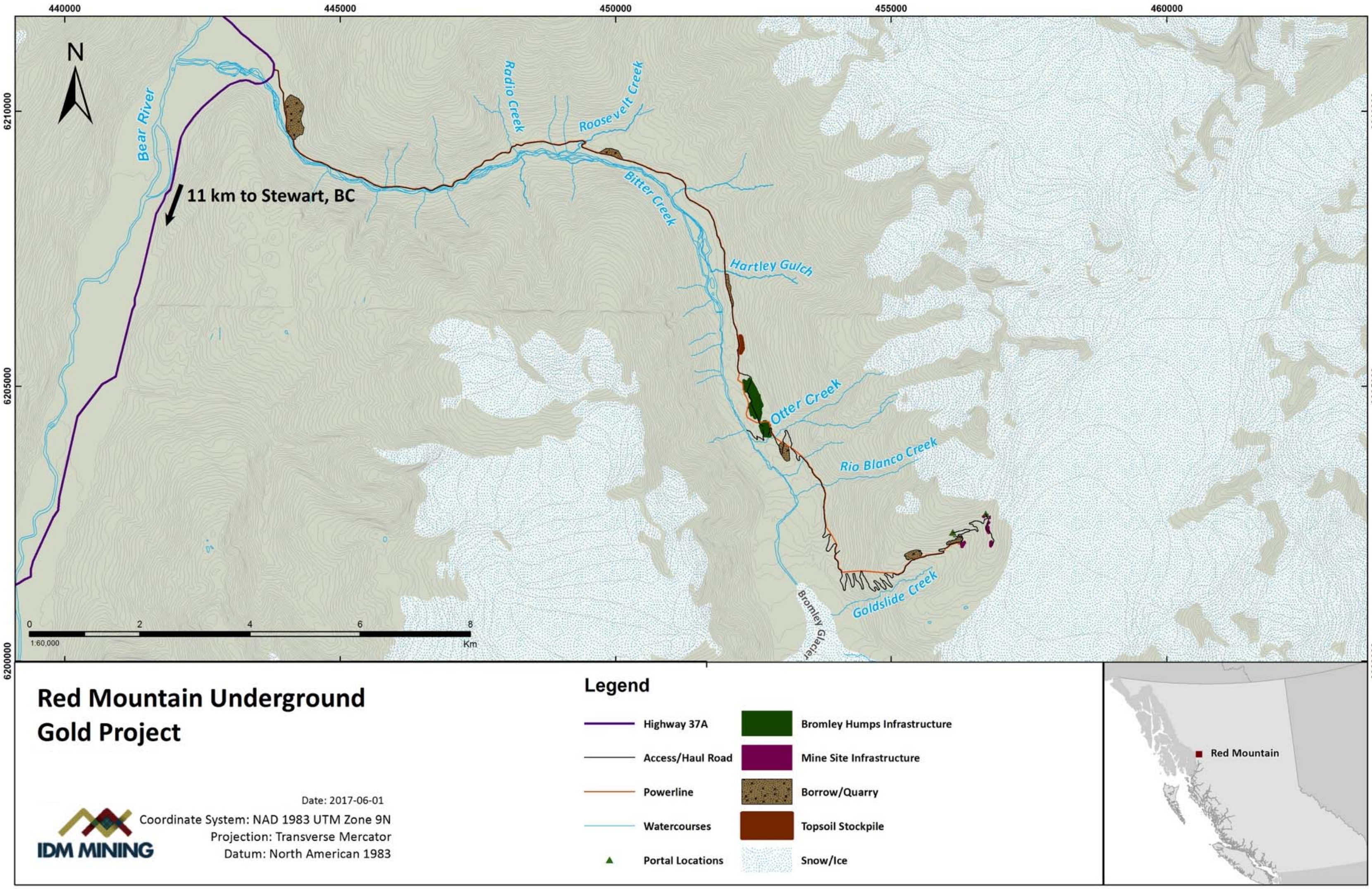


Figure 4: Project Overview

3 STUDY AREA

3.1 Local Study Area

The Local Study Area (LSA) of the SLERA matches the LSA selected for the assessment of Wildlife and Wildlife Habitat VC, which is the largest of the boundaries established for the ecological Valued Components selected for the Project and discussed in this report. The Wildlife and Wildlife Habitat VC LSA was established to provide a study area boundary for assessing the effects of the Project at the local watershed level. The LSA encompasses the full extent of the Bitter Creek watershed. It extends to the height of land on all sides of Bitter Creek, including the Roosevelt Creek drainage, and a portion of the Bromley Glacier to the south. The northwestern end of the LSA includes the mouth of Bitter Creek, where it passes Highway 37A and drains into the Bear River, including an area of floodplain forest and Clements Lake. The LSA is approximately 16,000 ha in area (Figure 5).

3.2 Regional Study Area

The Regional Study Area (RSA) of the SLERA also matches the one for Wildlife and Wildlife Habitat VC and is the spatial area that encapsulates the Project and extends beyond to the height of land to include several watersheds within the region. The RSA boundary takes into consideration the predicted habitat of selected Wildlife VCs (e.g., grizzly bears, mountain goats) over a season or a lifetime or both, among other factors. The RSA boundary provides context for the type, distribution, extent, and prevalence of ecosystems within the region. The RSA is approximately 212,000 ha in area (Figure 5).

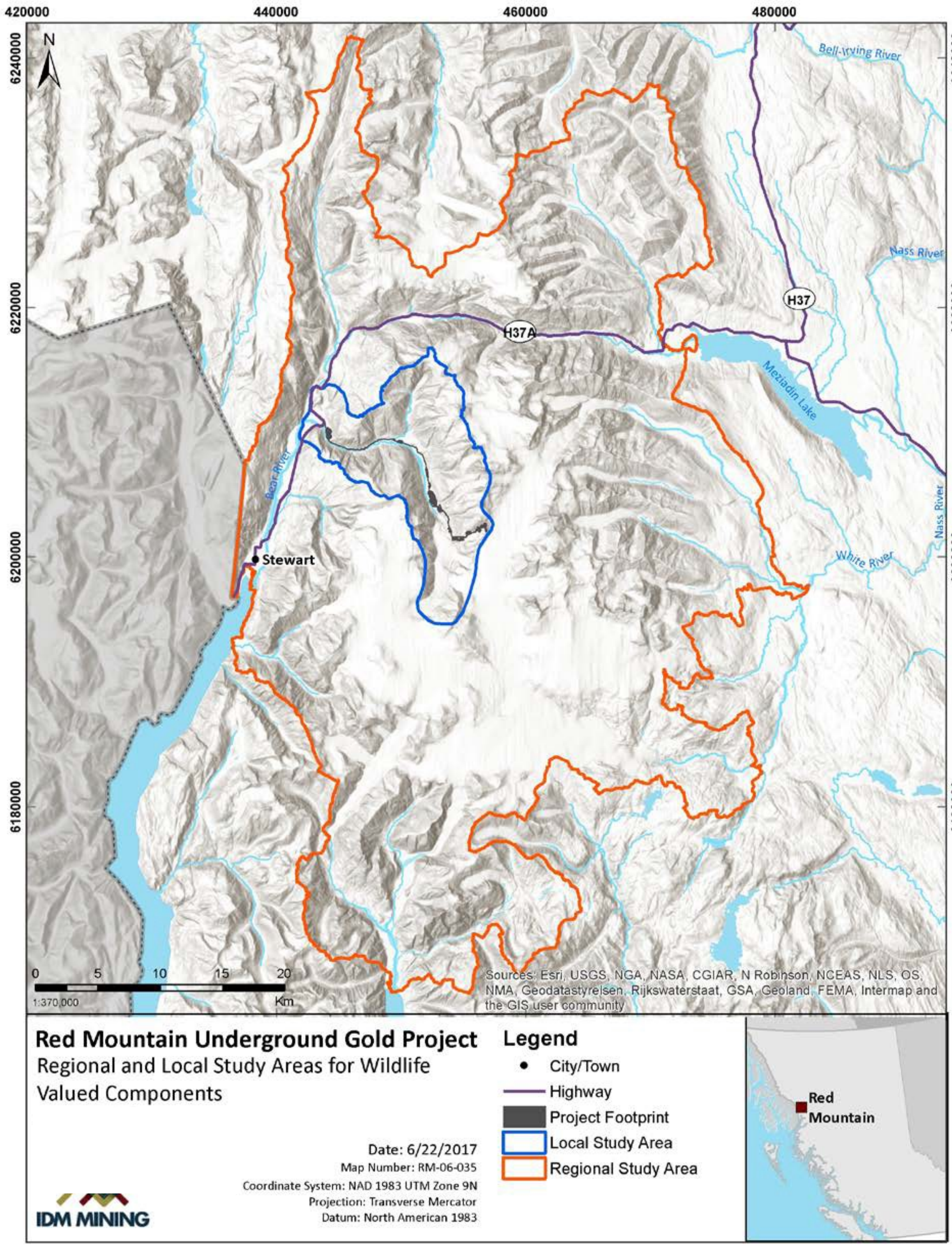


Figure 5. Local and Regional Study Area Boundaries

4 BACKGROUND

4.1 Site and Habitat Description

The Project includes the mine site consisting of high alpine environment (1,950 masl), and the Bromley Humps area, at approximately 1,500 m elevation, where the proposed TMF, mineral process plant, and other surface infrastructure will be located. The Project is located approximately 18 km east-northeast of the District of Stewart.

The Project is located within the Bitter Creek watershed, which is within the Southern Boundary Range (Volume 8, Appendix 9-A). The watershed is a largely north-south valley that drains the Bromley Glacier into the Bear River. 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 the 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 the Bromley Glacier, lower slope forests begin to be replaced by early seral shrub communities where soil development is limited and vegetation communities are in the 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 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.

There is a history of mines and mining in the Bitter Creek watershed. Highway 37A and a BC Hydro powerline cross the creek near the confluence with the 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 recreational 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 Climate

The region in which the Project is situated is characterized by generally cold weather with warm summers, but no dry seasons, and has a Köppen-Geiger climate classification of Dfb. Regions with this classification are defined as having more than four months with an average temperature greater than 10°C, and an average temperature below 22°C in the hottest month (Peel et al. 2007). The climate and hydrology are seasonally influenced by three factors: distance from the coast, site elevation, and glacial cover.

Climatic conditions at Red Mountain specifically, are influenced by high elevation and proximity to the Pacific Ocean. The mine site is in the upper part of the Red Mountain cirque, an area that is fully exposed to regional winds and precipitation.

5 OBJECTIVES

The objectives of this SLERA were to:

- Estimate risks associated with chemical exposures in the form of hazard quotients (HQs) for the relevant ecological receptor groups that include specific Project VCs under pre-Construction, pre-Operation baseline conditions;
- Estimate similar risk levels in the form of hazard quotients (HQs) under conservative projected future conditions (i.e., considering Construction, Operation, Reclamation and Closure, and Post-closure) for the same receptor groups; and
- Determine the incremental difference of risk levels between baseline and predicted future conditions.

6 PROBLEM FORMULATION

The problem formulation is the planning stage of the SLERA. The intent of the Problem Formulation was to identify the constituents of potential concern (COPCs), receptors of concern (ROCs), operable exposure pathways between COPCs and ROCs, and to identify the screening level risks. The association between sources, receptors, and exposure media is illustrated in the conceptual site model at the end of the section.

6.1 Data Evaluation

This section summarizes the approach used to identify the chemical stressors or COPCs carried forward for quantitative evaluation in the SLERA, and summarizes the COPCs within each relevant exposure medium (i.e., surface soil and surface water) that may directly or indirectly contribute to dietary exposure to COPCs. With respect to the use of predicted future concentrations of COPCs, the approach taken in the SLERA was to select the exposure concentration for each COPC from the Project phase with the highest concentration. In general, the highest concentrations were observed for the Operation phase although there were a few instances where the highest surface water concentrations were predicted to occur in the Closure and Reclamation/Post Closure phase rather than the Operation phase. Evaluating the worst-case scenario was a conservative approach in keeping with the screening level nature of the assessment.

6.1.1 Surface Soil

6.1.1.1 Baseline Soil Concentrations

Baseline soil data considered for evaluation in the SLERA comprised analyses of surface soil samples collected to support geochemical studies and for general surface soil characterization in the Bitter Creek watershed. The analytical results considered are presented in Volume 8, Appendix 9-A (Ecosystems, Vegetation, Terrain and Soils Baseline Report) and Volume 7, Appendix 1-B (Geochemical Characterization of Waste, Ore and Talus). The sample ID codes representative of baseline soil are presented in Table 1.

Table 1. Baseline Soil Sample Identification Codes

7011325-08	7011325-09	7011325-10
7011325-11	7011325-12	7011325-13
7011325-14	7011325-16	7011325-17
7011325-19	7011325-21	7011325-25
7011325-26	7011325-27	7011325-28
RS RY 1	RS RY 2	RS RY 3
RS RY 4	RS RY 6	RS RY 7
RS RY 10		

The baseline soil sampling locations are also illustrated on Figure 6.

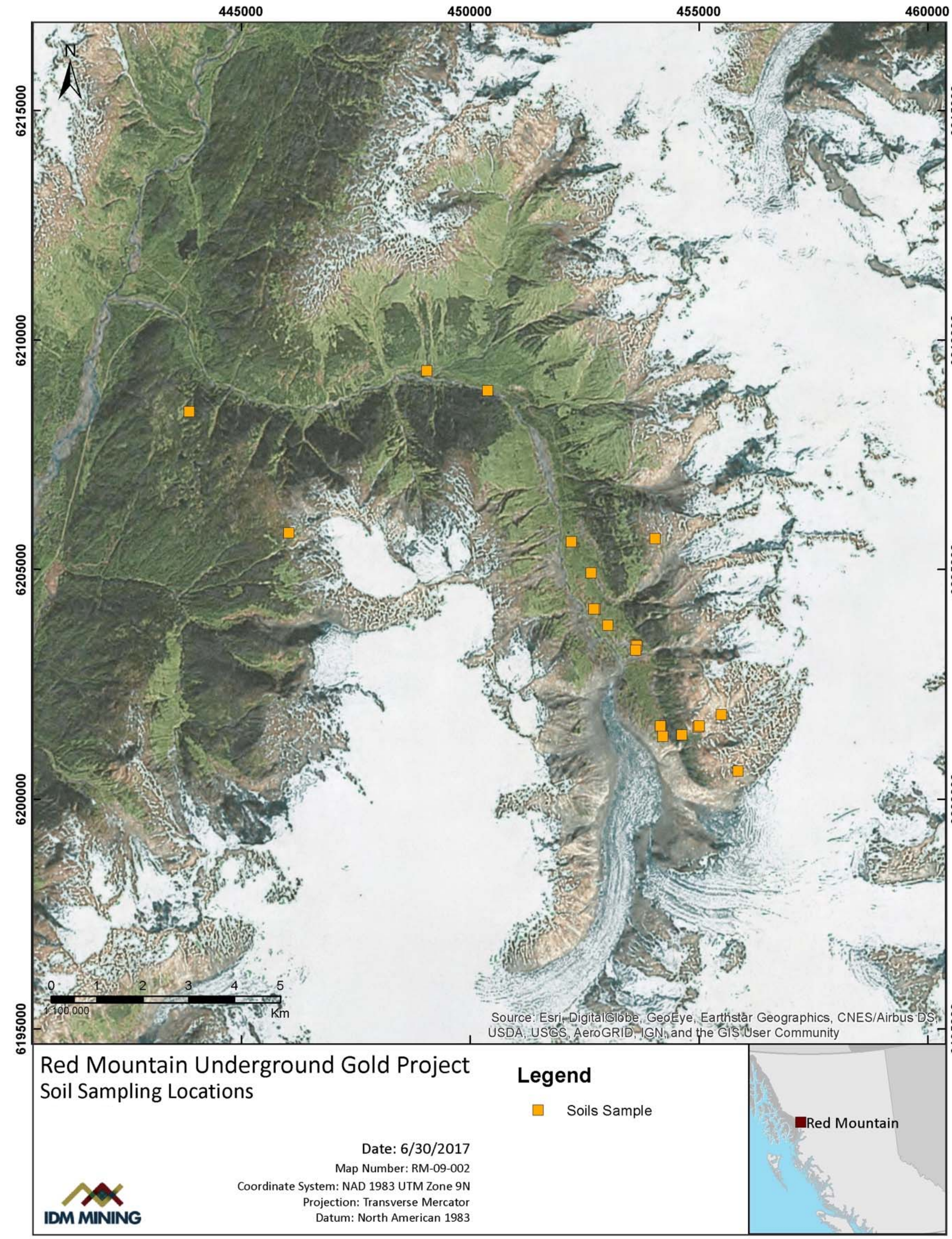


Figure 6. Baseline Soil Sampling Locations – Red Mountain Project SLERA

Summary statistics for all chemicals evaluated in baseline surface soils are presented in Table 2.

*Table 2. Baseline Soil Summary Statistics**

Chemical	Count	Minimum	Maximum	Mean	Median	75 Percentile	90 Percentile	95 Percentile
Aluminum	7	9700	29600	18714	18200	26050	28880	29240
Antimony	22	0.32	8.06	3.02	2.5	4	5.6	7.4
Arsenic	22	0.9	1573	95.4	21.4	35.1	59.9	72.9
Barium	22	49.1	1239	191	102.5	175	314	469
Beryllium	15	0.2	0.9	0.41	0.4	0.5	0.56	0.69
Bismuth	7	0.03	0.37	0.13	0.08	0.16	0.27	0.32
Boron	7	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Cadmium	22	0.03	13.97	1.1	0.44	0.67	1.10	1.35
Calcium	7	1300	19700	9257	4800	15600	19580	19640
Chromium	22	8.3	147	48	29.8	67.5	104	109
Cobalt	22	5.3	29	14	14.35	15.6	19.9	23.0
Copper	22	1.59	194	78	81.4	89.2	104	107
Gallium	7	3.7	12.6	8	8	9.7	11.3	12.0
Gold	7	0.0003	0.061	0.013	0.001	0.013	0.034	0.048
Iron	7	22700	63600	36086	35300	39450	50520	57060
Lanthanum	7	1.8	15.6	6.1	5.4	6.45	10.3	12.9
Lead	22	1.01	128	20.8	12.0	22.9	41.6	42.7
Magnesium	7	8300	30400	17529	16100	25200	28720	29560
Manganese	7	201	994	604	662	714	845	919
Mercury	22	0.005	0.128	0.043	0.05	0.063	0.080	0.092
Molybdenum	22	0.66	123	13.3	4.95	11.4	26.0	32.3
Nickel	22	4.2	74.2	33.8	31.05	44.7	53.2	55.3
Phosphorus	7	440	2710	1167	1110	1165	1810	2260
Potassium	7	400	1700	1029	1200	1350	1580	1640
Scandium	7	2.1	6.8	4.97	5	6.45	6.74	6.77
Selenium	22	< 0.1	8.3	2.35	2.2	3	3.9	4.7
Silver	22	0.006	5.9	0.77	0.5	0.7	1.02	1.58
Sodium	7	290	650	397	350	435	560	605
Strontium	7	9.2	103	44.7	39.3	63.9	87.8	95.6
Sulfur	7	800	14000	4743	2800	5900	9380	11690
Tellurium	7	< 0.02	0.83	0.20	0.05	0.23	0.57	0.70
Thallium	22	< 0.02	0.4	0.13	0.1	0.2	0.3	0.32
Thorium	7	0.3	1.8	1.03	1.1	1.25	1.5	1.65
Tin	15	< 0.2	0.7	0.36	0.3	0.3	0.54	0.62
Titanium	7	50	2640	1083	1120	1240	1854	2247
Tungsten	7	< 0.1	26.5	4.6	0.2	2.75	13.8	20.1
Uranium	22	< 0.1	1.92	0.53	0.475	0.558	1.03	1.17
Vanadium	22	11	115	73.6	74.9	85.4	98.7	111
Zinc	22	33.6	689	117	84.5	119	145	237

**NOTE: Concentrations expressed in mg/kg.*

For data evaluation purposes, the 95th percentile of the baseline soil data for each chemical was selected to represent current baseline soil conditions in the Project area.

6.1.1.2 Projected Future Soil Concentrations

Predicted future soil concentrations were determined using modeled air particulate (dust) and dustfall predictions (Volume 8, Appendix 7-A: Air Quality Modelling Report). Future concentrations were modeled for three locations (Table 3) based on relative source contributions, including background areas, current and future road areas, ore material, and waste rock. The projected metals concentrations in air particulate were then added to the 95th percentile (background) baseline soil concentration to predict future metals concentrations. The detailed methodology for predicting future surface soil concentrations is described in greater detail in the Human Health Risk Assessment (Volume 8, Appendix 22-A).

*Table 3. Predicted Future Soil Concentrations**

Chemical	Bitter Creek Area Downstream of TMF (mg/kg)	Road Between Lower Portal and Plant Site (mg/kg)	Between Lower Portal and Bitter Creek (mg/kg)
Aluminum	29398	29399	29436
Antimony	7.45	7.44	7.47
Arsenic	73.4	73.3	73.7
Barium	471	471	472
Beryllium	0.694	0.694	0.695
Bismuth	0.323	0.322	0.328
Cadmium	1.36	1.36	1.37
Calcium	19744	19748	19769
Chromium	109	109	109
Cobalt	23.2	23.2	23.2
Copper	107	107	108
Gallium	12.0	12.0	12.0
Gold	0.048	0.048	0.048
Iron	57366	57371	57441
Lanthanum	13.0	13.0	13.0
Lead	42.9	42.9	43.0
Magnesium	29714	29717	29736
Manganese	924	924	926
Mercury	0.108	0.099	0.146
Molybdenum	32.5	32.5	32.5
Nickel	55.6	55.6	55.7
Phosphorus	2272	2272	2274
Potassium	1651	1650	1660
Scandium	6.81	6.81	6.81
Selenium	4.73	4.73	4.74
Silver	1.59	1.59	1.60
Sodium	609	609	611
Strontium	96.1	96.1	96.2
Sulfur	11750	11752	11756
Tellurium	0.708	0.706	0.716
Thallium	0.322	0.322	0.323
Thorium	1.66	1.66	1.67

Chemical	Bitter Creek Area Downstream of TMF (mg/kg)	Road Between Lower Portal and Plant Site (mg/kg)	Between Lower Portal and Bitter Creek (mg/kg)
Tin	0.624	0.624	0.628
Titanium	2259	2259	2261
Tungsten	20.2	20.2	20.2
Uranium	1.18	1.18	1.19
Vanadium	112	112	112
Zinc	239	239	239

**NOTE: Concentrations expressed in mg/kg.*

6.1.1.3 Soil Screening Levels

The soil screening levels selected for COPC identification purposes were the lowest of the provincial (BC *Contaminated Sites Regulation [CSR]*; Schedules 4 and 5) (BC 2017) and federal (Canadian Environmental Quality Guidelines [CEQG]) (CCME 2017) regulatory thresholds specifically for the protection of environmental health (where available). The PL (park land) standards or RL (residential land) if PL standards weren't available, were selected as the screening levels because these are currently recommended by BCMOE for wildland areas. The soil screening levels are presented in Table 4. The lowest of the regulatory criteria were selected as the screening level for COPC identification purposes. Published BCMOE (2010) background. Background concentrations published by BCMOE (2010) were also considered, but ultimately did not affect the selection of screening values.

*Table 4. Soil Screening Levels**

Chemical	BC Background (Protocol 4) (mg/kg)	CEQG Soil Quality for the Protection of Environmental Health PL/RL (mg/kg)	BC CSR Schedule 4 - PL/RL (mg/kg)	BC CSR Schedules 5 PL/RL, Toxicity to soil Invertebrates and plants (mg/kg)	Selected Screening Value (mg/kg)
Antimony		20	20		20
Arsenic	15	17		50	17
Barium	400	500		1000	500
Beryllium	2	4	4		4
Cadmium	0.6	10		70	10
Chromium	65	64		300	65
Cobalt	15	50	50		50
Copper	50	63		150	63
Lead		300		1000	300
Mercury	0.15	12		100	12
Molybdenum	1	10	10		10
Nickel	50	45	100		50
Selenium	0.25	1	3		1
Silver	1	20	20		20
Sodium				200	200
Thallium		1.4			1.4
Tin	4	50	50		50

Chemical	BC Background (Protocol 4) (mg/kg)	CEQG Soil Quality for the Protection of Environmental Health PL/RL (mg/kg)	BC CSR Schedule 4 - PL/RL (mg/kg)	BC CSR Schedules 5 PL/RL, Toxicity to soil Invertebrates and plants (mg/kg)	Selected Screening Value (mg/kg)
Uranium		500			500
Vanadium	100	130	200		130
Zinc	150	200		450	200

**NOTE: Concentrations expressed in mg/kg.*

6.1.1.4 Soil Constituents of Potential Concern (COPCs)

Soil COPCs was completed were identified following several steps, as follows:

1. Consideration of the availability of applicable regulatory screening levels;

2. Where available, comparison of the predicted future soil concentrations with the soil screening level (right-hand column in Table 4) that was based on the most stringent of the applicable regulatory screening levels;

3. If a potentially biomagnifying chemical (e.g., cadmium, mercury, and selenium) exceeded the soil screening level it was carried forward regardless of subsequent screening steps; and

4. For parameters that exceed its respective soil screening level, the relative percent difference between the baseline and predicted future soil concentration was considered. concentrations for constituents that exceeding the soil screening levels.

Where the predicted future soil concentrations for any given constituent was less than one percent of the 95th percentile baseline concentration, it was not carried forward as a COPCs because it was considered to be within the inherent analytical uncertainty range of the baseline condition.

Step one screening resulted in the identification of 20 measured parameters with applicable soil screening levels.

The step two comparison of the screening levels with the predicted future soil concentrations identified eight parameters that were predicted to exceed the selected soil screening levels. These included arsenic, chromium, copper, molybdenum, nickel, selenium, sodium, and zinc.

Step three resulted in the inclusion of selenium.

The step four consideration of percent difference between predicted future concentrations and 95th percentile baseline concentrations revealed that only arsenic exhibited a relative difference of greater than one percent (i.e., 1.01%).

Based on the above screening, the soil COPCs carried forward for consideration of potential risk included:

- Arsenic
- Selenium

6.1.2 Surface Water

The surface water data provided to Core6 for consideration in the SLERA included the summary statistics for the baseline sampling results (total and dissolved) as well as the 50th and 90th percentile statistics for the predicted monthly future concentrations (dissolved only). Surface water data is tabulated in Appendix B and C of Volume 8, Appendix 14-A (Surface Water and Groundwater Quality Baseline Report). Surface water sampling approach and methodology is presented in Section 3 of Volume 8, Appendix 14-A.

6.1.2.1 Baseline

The baseline data considered in the SLERA included the statistical summaries for the dissolved and total analytical results from each of the major water courses in the Project area Bitter Creek, Goldslide Creek, Rio Blanco Creek, and the Bear River. Although there were multiple baseline sampling locations in each creek, the locations considered to support COPC identification included the following four locations which correlate to the sampling stations where future predicted surface water results were available:

1. Goldslide Creek (Station GSC02);
2. Rio Blanco Creek (Station RBC02);
3. Bear River (Station BR06); and,
4. Bitter Creek (Station BC06).

There were two additional locations in Bitter Creek (i.e., BC02 and BC08) with predicted future concentrations; however, the data from these locations was not carried forward for the following reasons:

- Location BC08 is located upstream of the Bromley Humps area and would therefore not be representative of discharges associated with that area, hence it's exclusion given the more conservative use of the BC06 location; and
- The BC02 location was excluded because it is much further downstream of the BC06 location, which again provides greater conservatism being located closer to the Project area, and therefore less opportunity for dilution effects.

The monthly 90th percentile concentration for surface water samples that had been collected within each of the creeks was used for data screening purposes. More specifically, Core6 used the maxima of these values for each stream; in other words, the highest of the monthly 90th percentile concentrations. For exposure estimation, as will be reiterated below, the mean of the 90th percentile data sets was used for risk characterization.

The baseline water quality information used for COPC screening is presented in Table 5. The dissolved baseline results (yearly averages of the monthly 90th percentile results) for sampling locations GSC02, RBC02, BR06, and BC06, are provided in Table 6. The reference surface water sampling locations are illustrated on Figure 7 (below).

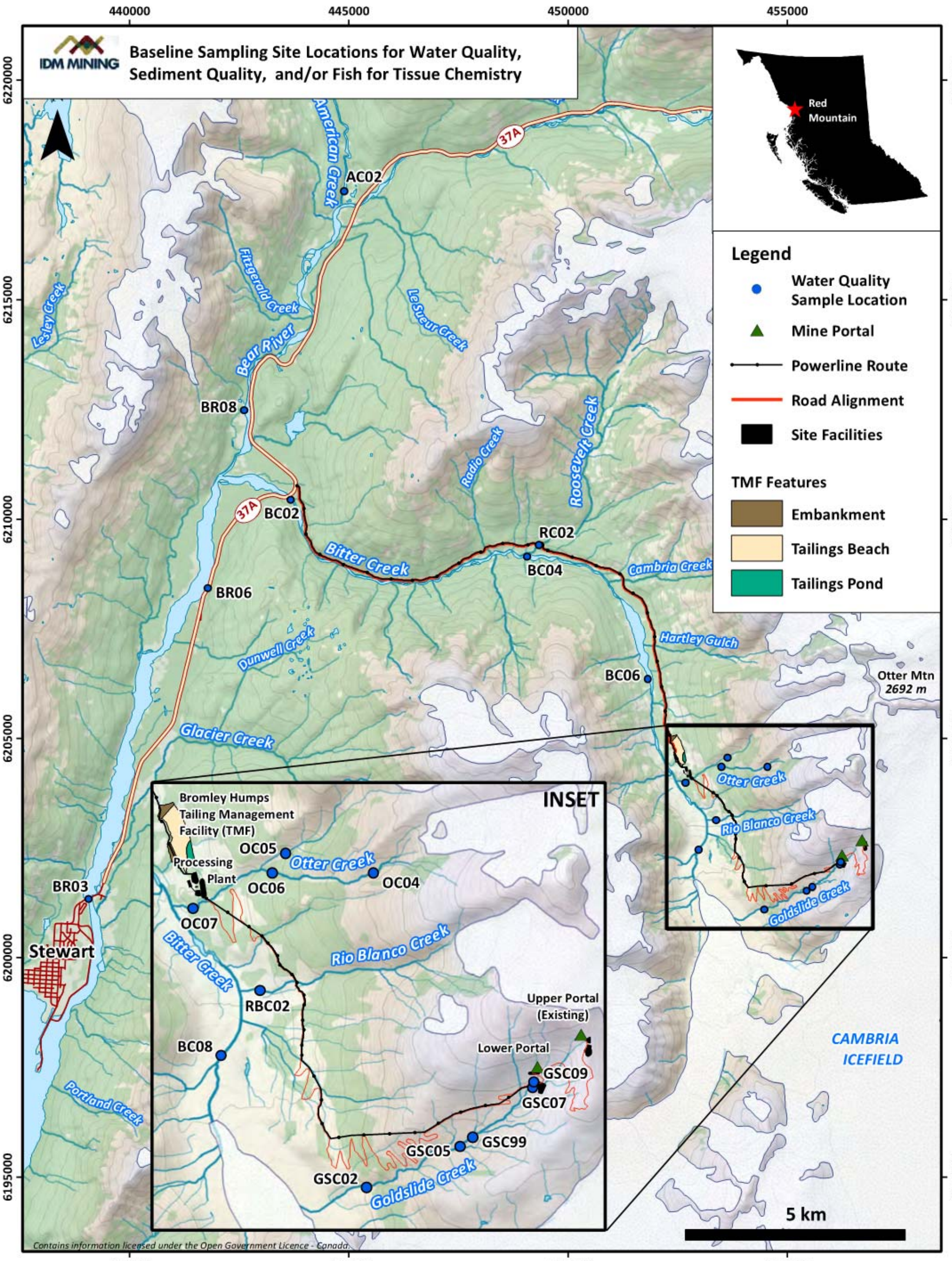


Figure 7. Baseline Surface Water Sampling Locations

The highest (maximum) concentrations across the four watercourses are presented in Table 5. with the exception of pH, conductivity, and hardness which are expressed as the mean values across the four watercourses. These concentrations, in conjunction with future predicted concentrations, were used to support COPC identification through comparison with the selected regulatory screening levels described below in Sections 6.1.2.3 and 6.1.2.4.

*Table 5. Maximum Baseline Surface Water Concentrations**

Chemical	Maximum Concentration
Field pH *	7.65
Conductivity *	184
Hardness CaCO3 *	82.0
Total Dissolved Solids	420
Total Suspended Solids	1310
Turbidity	2320
Alkalinity-Total CaCO3	124
Acidity (as CaCO3)	29
Chloride Cl	0.53
Fluoride F	0.103
Bromide Br	0.05
Sulphate SO4	180
Nitrate Nitrogen N	0.31
Nitrite Nitrogen N	0.001
Total Nitrogen	0.25
Ammonia Nitrogen N	0.0118
Ortho-Phosphate	0.0035
Phosphorus (P)-Total	1.44
Total Organic Carbon	3.96
Dissolved Organic Carbon	0.95
Aluminum T-Al	36.8
Aluminum D-Al	1.91
Antimony T-Sb	0.2
Antimony D-Sb	0.0013
Arsenic T-As	0.0808
Arsenic D-As	0.0026
Barium T-Ba	0.537
Barium D-Ba	0.096
Beryllium T-Be	0.001
Beryllium D-Be	0.001
Bismuth T-Bi	0.2
Bismuth D-Bi	0.2
Boron T-B	0.1
Boron D-B	0.1
Cadmium T-Cd	0.00293
Cadmium D-Cd	0.00085
Calcium T-Ca	145
Calcium D-Ca	145
Chromium T-Cr	0.058

Chemical	Maximum Concentration
Cobalt T-Co	0.0311
Cobalt D-Co	0.001
Copper T-Cu	0.175
Copper D-Cu	0.013
Iron T-Fe	75
Iron D-Fe	0.12
Lead T-Pb	0.0339
Lead D-Pb	0.002
Magnesium T-Mg	25.2
Magnesium D-Mg	13
Manganese T-Mn	1.98
Manganese D-Mn	0.13
Mercury T-Hg	0.000086
Mercury D-Hg	0.00001
Molybdenum T-Mo	0.03
Molybdenum D-Mo	0.03
Nickel T-Ni	0.21
Nickel D-Ni	0.0115
Selenium T-Se	0.00569
Selenium D-Se	0.00466
Silicon T-Si	47.2
Silicon D-Si	4.82
Silver T-Ag	0.0016
Silver D-Ag	0.000038
Sodium T-Na	12
Sodium D-Na	10
Strontium T-Sr	1.06
Strontium D-Sr	0.966
Thallium T-Tl	0.00021
Thallium D-Tl	0.0002
Tin T-Sn	0.0005
Tin D-Sn	0.00064
Titanium T-Ti	0.445
Titanium D-Ti	0.07
Uranium T-U	0.00102
Uranium D-U	0.00071
Vanadium T-V	0.134
Vanadium D-V	0.00635
Zinc T-Zn	0.258

Chemical	Maximum Concentration
Chromium D-Cr	0.0021

Chemical	Maximum Concentration
Zinc D-Zn	0.048

** NOTE: Results presented are expressed in mg/L.*

** = Values expressed for pH, conductivity, and hardness was the mean for the four watercourses*
T = total
D = dissolved

Table 6 presents the 90th percentile dissolved baseline concentrations for each of the four watercourses described above. The dissolved baseline concentrations were selected for the exposure assessment and risk characterization because only dissolved concentrations are available for the Project-related predictions. Therefore, use of the dissolved baseline levels for exposure assessment allows for direct comparison with the future predicted exposure levels to support identification of Project-related effects. In risk assessment terminology, these concentrations are referred to as the estimated environmental exposure concentrations (EECs).

Table 6. 90th Percentile Baseline Surface Water Concentrations by Stream

Chemical	90th Percentile Concentrations			
	BC06	BR06	GSC02	RBC02
Field pH *	7.62	7.8	7.42	7.74
Conductivity *	165	151	139	282
Hardness CaCO3 *	79	74.4	57.5	117
Total Dissolved Solids	263	168	120	277
Total Suspended Solids	587	470	4.08	103
Turbidity	674	301	0.932	41.7
Alkalinity-Total CaCO3	81.1	88	22.4	68.8
Acidity (as CaCO3)	1.64	3.77	4.18	4
Chloride Cl	0.5	0.5	0.5	0.5
Fluoride F	0.0758	0.066	0.0522	0.0916
Bromide Br	0.05	0.05	0.05	0.05
Sulphate SO4	114	43.5	68	139
Nitrate Nitrogen N	0.047	0.212	0.0237	0.0168
Nitrite Nitrogen N	0.001	0.001	0.001	0.001
Total Nitrogen	N/A	0.235	0.067	0.05
Ammonia Nitrogen N	0.00928	0.0063	0.005	0.005
Ortho-Phosphate	0.00204	0.0017	0.0013	0.00212
Phosphorus (P)-Total	0.743	0.611	0.3	0.3
Total Organic Carbon	1.67	1.27	0.5	0.55
Dissolved Organic Carbon	0.5	0.67	0.542	0.514
Aluminum T-Al	17.4	11.2	0.0962	1.62
Aluminum D-Al	0.464	0.116	0.0266	0.0376
Antimony T-Sb	0.00345	0.00258	0.00063	0.000908
Antimony D-Sb	0.00116	0.00068	0.0005	0.0005
Arsenic T-As	0.0319	0.0198	0.0005	0.00517

Chemical	90th Percentile Concentrations			
	BC06	BR06	GSC02	RBC02
Arsenic D-As	0.00129	0.00068	0.0005	0.000768
Barium T-Ba	0.251	0.195	0.0339	0.0673
Barium D-Ba	0.0524	0.088	0.0287	0.0427
Beryllium T-Be	0.001	0.001	0.001	0.001
Beryllium D-Be	0.001	0.001	0.001	0.001
Bismuth T-Bi	0.0404	0.0005	0.0005	0.0005
Bismuth D-Bi	0.04	0.0005	0.0005	0.0005
Boron T-B	0.1	0.1	0.1	0.1
Boron D-B	0.1	0.1	0.1	0.1
Cadmium T-Cd	0.00104	0.000677	0.0006	0.00101
Cadmium D-Cd	0.0000994	0.000163	0.00034	0.000222
Calcium T-Ca	67.9	45.6	28.4	72.7
Calcium D-Ca	63.3	43.4	27	68.4
Chromium T-Cr	0.0262	0.0153	0.001	0.00119
Chromium D-Cr	0.00122	0.001	0.001	0.001
Cobalt T-Co	0.0131	0.00803	0.001	0.00169
Cobalt D-Co	0.00043	0.0003	0.000682	0.000318
Copper T-Cu	0.0722	0.0414	0.0138	0.0194
Copper D-Cu	0.0017	0.001	0.00652	0.00159
Iron T-Fe	27.5	16.2	0.12	2.92
Iron D-Fe	0.0338	0.0515	0.03	0.03
Lead T-Pb	0.0153	0.0124	0.00154	0.00331
Lead D-Pb	0.0007	0.0005	0.0005	0.0005
Magnesium T-Mg	11.6	7.46	3.43	11.3
Magnesium D-Mg	7.1	4.41	2.98	7.78
Manganese T-Mn	0.799	0.511	0.0146	0.13
Manganese D-Mn	0.02	0.0174	0.0125	0.0206
Mercury T-Hg	0.0000372	0.0000133	0.00001	0.00001
Mercury D-Hg	0.000005	0.00001	0.00001	0.00001
Molybdenum T-Mo	0.00756	0.0033	0.00792	0.0051
Molybdenum D-Mo	0.00708	0.00255	0.0072	0.00299
Nickel T-Ni	0.0327	0.0218	0.00482	0.0167
Nickel D-Ni	0.00372	0.0012	0.002	0.00389
Selenium T-Se	0.00378	0.00157	0.00214	0.00421
Selenium D-Se	0.00287	0.00144	0.00219	0.00441
Silicon T-Si	24.4	18.4	3.26	3.98
Silicon D-Si	2.94	1.86	3.28	3.56
Silver T-Ag	0.000605	0.000431	0.00002	0.0000428
Silver D-Ag	0.0000236	0.00002	0.00002	0.00002
Sodium T-Na	2.54	2	2	3.53
Sodium D-Na	2.08	2	2	2.69
Strontium T-Sr	0.393	0.245	0.221	0.325
Strontium D-Sr	0.4	0.24	0.206	0.33
Thallium T-Tl	0.000202	0.0002	0.0002	0.0002
Thallium D-Tl	0.0002	0.0002	0.0002	0.0002
Tin T-Sn	0.0005	0.0005	0.0005	0.0005

Chemical	90th Percentile Concentrations			
	BC06	BR06	GSC02	RBC02
Tin D-Sn	0.0005	0.0005	0.0005	0.0005
Titanium T-Ti	0.336	0.275	0.01	0.0308
Titanium D-Ti	0.022	0.01	0.01	0.01
Uranium T-U	0.000788	0.000387	0.0002	0.000522
Uranium D-U	0.000654	0.00023	0.0002	0.000486
Vanadium T-V	0.0562	0.0341	0.001	0.00529
Vanadium D-V	0.00167	0.001	0.001	0.001
Zinc T-Zn	0.112	0.0776	0.041	0.0566
Zinc D-Zn	0.0071	0.00575	0.024	0.00994

** NOTE: Results presented are in mg/L.*
** = Values expressed for pH, conductivity, and hardness was the mean for the four watercourses in mg/L.*

6.1.2.2 Projected Future Surface Water Concentrations

The predicted future surface water quality information is described in Volume 8, Appendix 14-B (Water Quality Assessment of the Response Upper Limit Case) and Appendix 14-C (Water and Load Balance Model Report). As these results were predicted rather than measured, they represent dissolved constituent concentrations. The data available for consideration in the SLERA included the 50th and 90th percentile predictions for the four streams noted in the baseline section above. These results were also available for both the Operation Phase as well as the Closure and Reclamation, and Post Closure Phases (hereafter referred to as the Closure/Post Closure phases). To be conservative at the screening level, the 90th percentile predictions were used rather than the 50th percentile concentrations. The highest (maximum) of the 90th percentile concentrations were then determined across each of the four streams for both the Operation, Closure and Reclamation, and Post-Closure Phases. These were compared to determine which phase of the Project was predicted to result in the highest concentrations. For nearly every parameter, the Operation Phase resulted in the highest predicted concentrations, with the exceptions of chromium, lead, and silver which had their highest respective concentrations in the Closure/Post Closure phase of the Project. The highest concentrations identified across the four streams for the Operation, Closure and Reclamation, and Post-Closure Phases were used to support the COPC identification effort documented in Section 6.1.2.4 below.

The maximum of the 90th percentile predictions for operations, closure, a post-closure are presented in Table 7. The only exception was for hardness where the mean of the 90th percentile predictions is presented for comparison to the baseline levels.

*Table 7. Maximum Predicted Future Surface Water Concentrations (Operation, Closure and Reclamation, and Post-Closure Phases)**

Chemical	Maximum Predicted 90th Percentile	
	Operation	Closure / Post Closure
pH	-	-
Total Hardness *	157	138
TDS	363	345
Turbidity	605	597
Alkalinity	103	92.2
Acidity	18.6	16.4
Chloride	0.932	0.91
Fluoride	0.209	0.207
Bromide	0.0571	0.0536
Sulfate	294	177
Nitrate Nitrogen (mg/L as N)	2.06	0.276
Nitrite Nitrogen (mg/L as N)	0.0475	0.00135
Nitrogen, total	2.37	0.24
Ammonia Nitrogen	0.261	0.0346
Phosphate	0.00271	0.00261
Phosphorus, total	0.649	0.648
Total Organic Carbon	1.43	1.42
Dissolved Organic Carbon	0.87	0.834
Aluminum, dissolved	0.165	0.163
Antimony, dissolved	0.0258	0.00455
Arsenic, dissolved	0.00838	0.00155
Barium, dissolved	0.0938	0.0934
Beryllium, dissolved	0.00108	0.000999
Bismuth, dissolved	0.126	0.125
Boron, dissolved	0.108	0.0999
Cadmium, dissolved	0.00685	0.000949
Calcium, dissolved	85.7	76.2
Chromium, dissolved	0.00349	0.00415
Cobalt, dissolved	0.0092	0.00485
Copper, dissolved	0.0158	0.00953
Iron, dissolved	0.312	0.162
Lead, dissolved	0.00174	0.00272
Magnesium, dissolved	11.3	10.1
Manganese, dissolved	1.83	0.149
Mercury, dissolved	0.000167	0.0000181
Molybdenum, dissolved	0.012	0.0104
Nickel, dissolved	0.0542	0.0102
Selenium, dissolved	0.0086	0.00551
Silicon, dissolved	5.08	5.02
Silver, dissolved	0.0000698	0.000363
Sodium, dissolved	4.75	4.12
Strontium, dissolved	0.473	0.45

Chemical	Maximum Predicted 90th Percentile	
	Operation	Closure / Post Closure
Thallium, dissolved	0.000215	0.000200
Tin, dissolved	0.000544	0.000535
Titanium, dissolved	0.0113	0.0110
Uranium, dissolved	0.000839	0.000822
Vanadium, dissolved	0.001	0.000999
Zinc, dissolved	0.426	0.0567
Cyanide, total	0.00297	0.0000932
Cyanide, WAD	0.000127	0.00000398

** NOTE: Results expressed in mg/L*
** Hardness presented as the mean of the 90th percentile for dissolved concentrations, except where otherwise noted.*

For comparable risk characterization use similar to the Baseline EECs, the mean of the 90th percentile predicted future dissolved concentrations are presented in Table 8. These concentrations are all representative of the Operation Phase, with the exception of chromium, lead, and silver which were from the Closure/Post Closure predictions as these were determined to be potentially greater than the Operation Phase concentrations.

*Table 8. Mean Predicted Future Surface Water Concentrations by Stream**

Chemical	Mean of Predicted 90th Percentile Concentrations			
	BC06	BR06	GSC02	RBC02
pH	-	-	-	-
Total Hardness	176	104	170	179
TDS	226	144	123	272
Turbidity	426	152	0.638	39.6
Alkalinity	81.6	52.7	34.7	39.2
Acidity	11.3	4.07	8.28	4.74
Chloride	0.622	0.514	0.515	0.502
Fluoride	0.0914	0.0512	0.0514	0.0853
Bromide	0.0518	0.0502	0.0515	0.0502
Sulfate	111	39.1	181	128
Nitrate Nitrogen (mg/L as N)	0.281	0.255	0.934	0.0142
Nitrite Nitrogen (mg/L as N)	0.00253	0.00138	0.0219	0.00100
Nitrogen, total	0.172	0.197	1.09	0.0502
Ammonia Nitrogen	0.0215	0.00958	0.1198	0.00502
Phosphate	0.00219	0.00126	0.00139	0.00211
Phosphorus, total	0.290	0.259	0.117	0.120
Total Organic Carbon	0.837	0.976	0.575	0.548
Dissolved Organic Carbon	0.608	0.708	0.553	0.528
Aluminum, dissolved	0.111	0.0641	0.0428	0.0286
Antimony, dissolved	0.00331	0.00112	0.0134	0.000520
Arsenic, dissolved	0.00147	0.000736167	0.00449	0.000718
Barium, dissolved	0.0433	0.0733	0.0298	0.0422
Beryllium, dissolved	0.000916	0.000955	0.000984	0.000958
Bismuth, dissolved	0.0235	0.00397	0.00412	0.000193
Boron, dissolved	0.0921	0.0957	0.0984	0.0958
Cadmium, dissolved	0.000579	0.000239	0.00365	0.00022
Calcium, dissolved	59.0	34.9	56.0	59.1
Chromium, dissolved	0.001430	0.001085	0.00350	0.00274
Cobalt, dissolved	0.000990	0.000481	0.00501	0.000383
Copper, dissolved	0.00218	0.00136	0.0116	0.00141
Iron, dissolved	0.113	0.0498	0.172	0.0353
Lead, dissolved	0.000830	0.000577	0.00225	0.001643
Magnesium, dissolved	6.77	3.70	7.19	7.29
Manganese, dissolved	0.152	0.0483	0.933	0.0539
Mercury, dissolved	1.82E-05	1.03E-05	8.91E-05	7.22E-06
Molybdenum, dissolved	0.00802	0.00250	0.00873	0.00317
Nickel, dissolved	0.006994167	0.002181667	0.0285	0.0051775
Selenium, dissolved	0.00239	0.00140	0.00528	0.00391
Silicon, dissolved	2.21	1.52	3.33	3.33
Silver, dissolved	7.78E-05	3.44E-05	2.94E-04	2.25E-04
Sodium, dissolved	3.27	1.98	1.96	2.91
Strontium, dissolved	0.321	0.191	0.207	0.331
Thallium, dissolved	0.000183	0.000191	0.000196	0.000191
Tin, dissolved	0.000463	0.000490	0.000501	0.000482
Titanium, dissolved	0.0104	0.01	0.0103	0.0104

Chemical	Mean of Predicted 90th Percentile Concentrations			
	BC06	BR06	GSC02	RBC02
Uranium, dissolved	0.000647	0.000222	0.000197	0.000442
Vanadium, dissolved	0.000685	0.000721	0.000735	0.000722
Zinc, dissolved	0.0379	0.0129	0.228	0.0112
Cyanide, total	0.000721	0.000180	-	-
Cyanide, WAD	3.08E-05	7.68E-06	-	-

**Results presented are in mg/L*

6.1.2.3 Surface Water Screening Levels

The identification of surface water screening levels was based on the more conservative of the British Columbia Approved and Working Water Quality Guidelines (BCMOE 2017) and the Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CCME 2017). Where a given screening level was dependent on another parameter such as hardness, pH, temperature or chloride - the mean parameter values from the four baseline monitoring stations discussed above, were used to inform the correct screening level. The regulatory thresholds considered and the selected surface water screening levels, are presented in Table 9.

*Table 9. Surface Water Screening Levels **

Chemical	BC Approved Water Quality Guidelines: Aquatic Life,	BC Working Water Quality Guidelines for Protection of Freshwater Aquatic Life	CCME Water Quality Guidelines for the Protection of Aquatic Life	Selected Surface Water Screening Level
pH	-	-	6.5 - 9.0	6.5 - 9.0
Chloride Cl	150	-	-	150
Fluoride F	0.4, short term max	-	0.12	0.12
Sulphate SO4	309	-	-	309
Nitrate Nitrogen N	-	-	13	13
Nitrite Nitrogen N	0.02	-	0.06	0.02
Ammonia Nitrogen N	1.24	-	0.019	0.019
Aluminum D-Al	0.05	-	-	0.05
Antimony T-Sb	-	0.009	-	0.009
Arsenic T-As	0.005	-	0.005	0.005
Barium T-Ba	-	1	-	1
Beryllium T-Be	-	0.00013	-	0.00013
Boron T-B	1.2	-	1.5	1.2
Cadmium T-Cd	-	-	0.00009	0.00009
Cadmium D-Cd	0.000183	-	-	0.000191
Chromium T-Cr	-	0.0089	0.0089	0.0089
Cobalt T-Co	0.004	-	-	0.004
Copper T-Cu	0.00328	-	0.0021	0.0021
Iron T-Fe	1, short term max	-	0.3	0.3
Iron D-Fe	0.35, short term	-	-	0.35, short term

Chemical	BC Approved Water Quality Guidelines: Aquatic Life,	BC Working Water Quality Guidelines for Protection of Freshwater Aquatic Life	CCME Water Quality Guidelines for the Protection of Aquatic Life	Selected Surface Water Screening Level
	max			max
Lead T-Pb	0.00578	-	0.00266	0.00266
Manganese T-Mn	0.966	-	-	0.988
Mercury T-Hg	0.0000001	-	0.000026	0.0000001
Molybdenum T-Mo	1	-	0.073	0.073
Nickel T-Ni	-	0.082	0.082	0.082
Selenium T-Se	0.002	-	0.001	0.001
Silver T-Ag	0.00005	-	0.00025	0.00005
Thallium D-Tl	-	0.0008	0.0008	0.0008
Uranium T-U	-	0.0085	0.015	0.0085
Zinc T-Zn	0.0075	-	0.03	0.0075
Cyanide, WAD	0.005	-	0.005	0.005

**With the exception of pH, which is unitless, concentrations are presented in mg/L. Regulatory levels dependent on hardness used 86 mg/L $CaCO_3$ for calculation purposes.*

Surface Water Constituents of Potential Concern (COPCs)

The selection of surface water COPCs considered both the total and dissolved baseline surface water concentration statistics and the predicted future dissolved surface water information. If neither provincial nor federal regulatory criteria were available, the respective constituent was excluded from further consideration. As there were four discrete surface water bodies being considered under the baseline program, the COPCs identified were based on the highest (maximum) baseline concentrations measured across all four streams. This approach was taken to provide a greater level of conservatism rather than developing discrete lists for each surface water body independently. The surface water COPCs identified included:

- Fluoride;
- Nitrite;
- Ammonia;
- Dissolved Aluminum;
- Total Arsenic;
- Total Beryllium;
- Dissolved Cadmium;
- Total Cadmium;
- Total Chromium;
- Total Cobalt;
- Total Copper;

- Total Iron;
- Total Lead;
- Total Manganese;
- Total Mercury;
- Total Nickel;
- Total Selenium;
- Total Silver; and
- Total Zinc.

Cyanide was not measured in the baseline program, but the maximum predicted future cyanide WAD concentration (0.000127 mg/L) was compared to the provincial and federal regulatory screening levels (0.005 mg/L) and because it did not exceed it was not carried forward as a COPC.

6.1.3 Summary of Constituents of Potential Concern (COPCs)

A summary of the surface soil and surface water COPCs carried forward for risk estimation are presented in Table 10.

Table 10. Summary of Constituents of Potential Concern

Soil	Surface Water
Arsenic	Fluoride
Selenium	Nitrite
	Ammonia
	Dissolved Aluminum
	Total Arsenic
	Total Beryllium
	Dissolved Cadmium
	Total Cadmium
	Total Chromium
	Total Cobalt
	Total Copper
	Total Iron
	Total Lead
	Total Manganese
	Total Mercury
	Total Nickel
	Total Selenium
	Total Silver
	Total Zinc

6.2 Conceptual Site Model

The Conceptual Site Model (CSM) provides a framework for identifying the types of receptors to be considered and the pathways by which these receptors may be exposed to COPCs released by the Project. The CSM has been developed to visually represent the potential interactions between the proposed Project activities and the biophysical components of the environment, and in response to requests from NLG and regulators. The CSM is informed by both the SLERA, which focuses on ecological receptors, and the Human Health Risk Assessment (HHRA), which focuses on human receptors.

The CSM depicts the relationships between the following elements, which are necessary for a complete exposure pathway to occur in which human health may be impacted:

- Sources of contamination and COPCs;
- Contaminant release mechanisms and transport pathways;
- Exposure pathways and exposure mechanisms; and
- Exposed receptors.

The CSM integrates potential sources of stressors, affected media (transport pathways), exposure routes, and potential receptors. Pictorial and Box-and-Line CSMs are shown in Figure 8 and Figure 9, respectively.

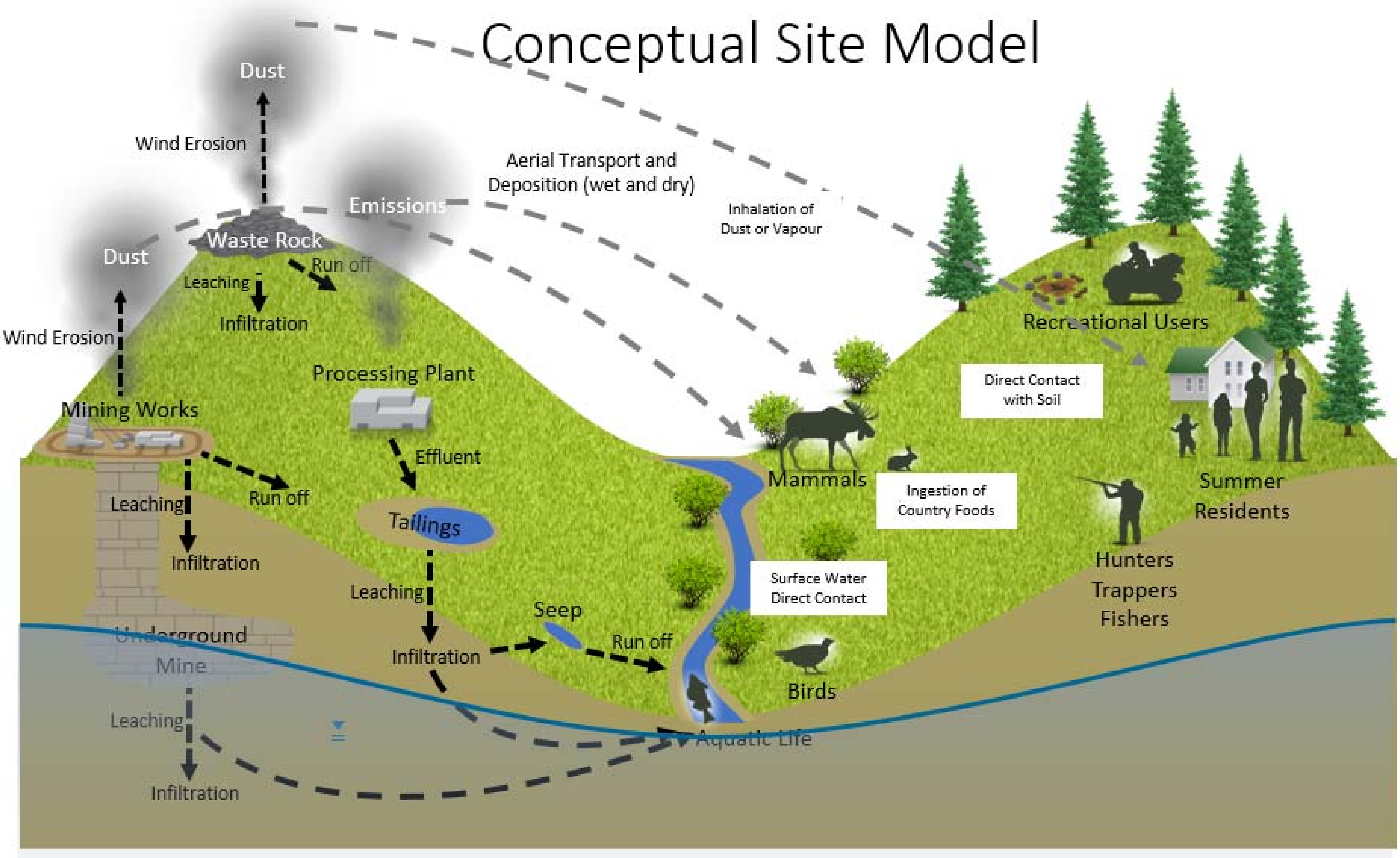
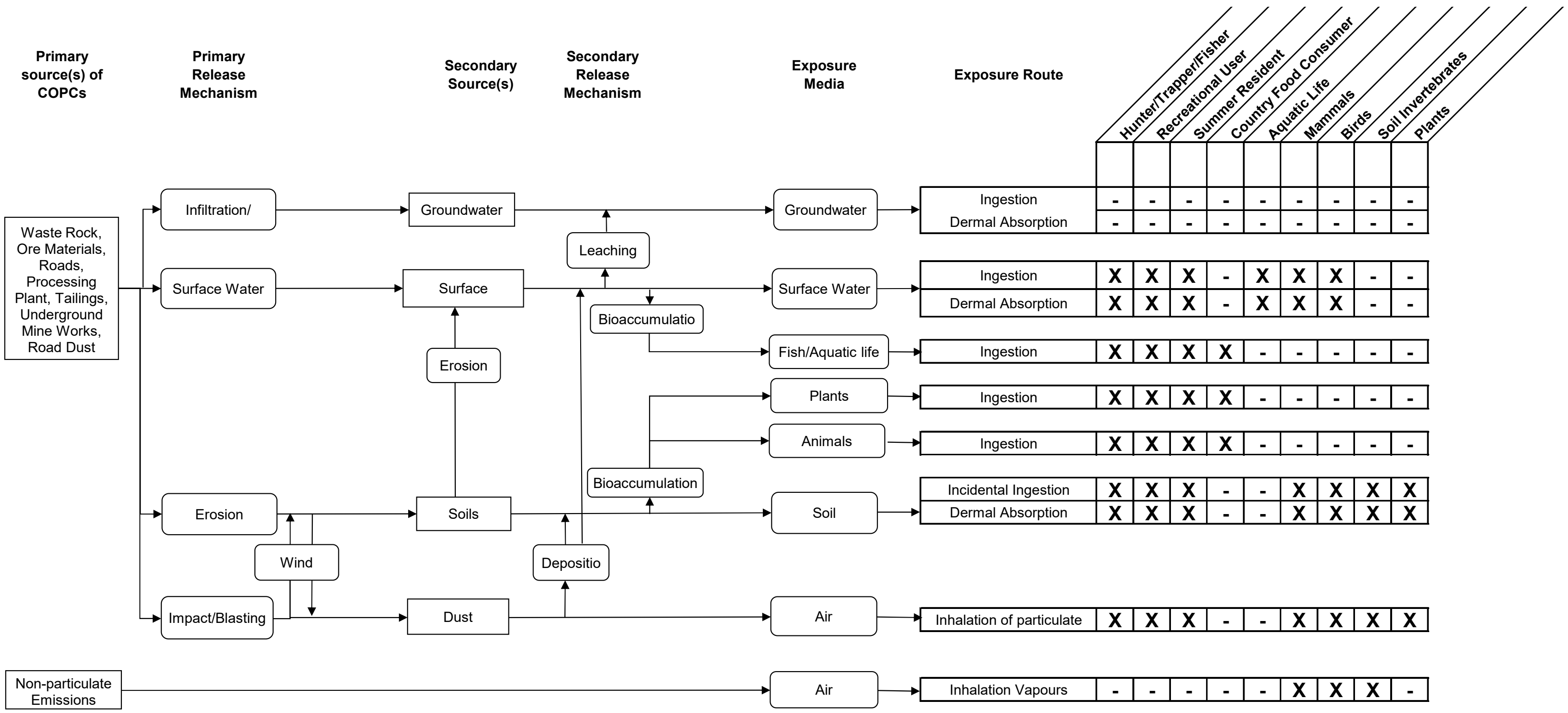


Figure 8. Pictorial Conceptual Site Model



X Exposure Route Probable
- Exposure Route not probable

Figure 9. Box-and-Line Conceptual Site Model

6.3 Screening Level Ecological Risk Characterization

6.3.1 Approach

The approach for assessing the potential influence of the Project with respect to chemical changes in the environment was to estimate the Project-related risk for COPCs identified in the terrestrial environment using the available soil data, and in the aquatic environment using the available surface water quality data. To estimate the Project-related risk, risk levels in the form of hazard quotients (HQs) were calculated for both the baseline (pre-Mine) conditions and for the worst-case predicted future conditions. The baseline HQs were then subtracted from the worst-case future HQs to clearly show the potential worst-case influence of the proposed Project.

HQs were estimated as follows:

$$HQ = \frac{EEC}{TRV}$$

Where: EEC = Estimated Environmental Concentration (mg/kg or mg/L); and,

TRV = Toxicity Reference Value (mg/kg or mg/L)

6.3.2 Soil Hazard Quotients

The soil concentrations selected as the baseline EECs were the 95th percentile concentrations from the baseline soil results (Table 2). The worst-case predicted future soil EECs selected were the highest concentrations from each of the three locations for which soil predictions were provided (Table 10). The percent difference between the baseline and predicted future EECs is also provided to support consideration of changes where soil ecological screening levels were not available (Table 3). These soil concentrations are summarized below in Table 11.

*Table 11. Baseline and Predicted Future Soil EECs and RPDs**

COPCs	Baseline Soil EECs	Predicted Future Soil EECs	Percent Difference
Arsenic	72.9	73.7	1.02%
Selenium	4.70	4.74	0.8%

**NOTE: All soil concentrations expressed in mg/kg.*

The differences between the predicted future and baseline levels for arsenic and selenium are minimal and could be argued to be within the range of analytical uncertainty; however, hazard quotients were calculated to determine the absolute risk levels and Project-related difference.

The TRVs used to derive soil-based HQs were selected from USEPA (2015) in the form of soil ecological screening values. These included screening values for plants, soil invertebrates, mammals, and birds

(Table 12). Where USEPA (2015) values were unavailable, the soil screening level identified in Section 6.1.1.3 was carried forward as the TRV for HQ estimation.

Table 12. Soil Toxicity Reference Values

COPCs	Plant Screening Levels	Soil Invertebrate Screening Levels	Mammal Screening Levels	Bird Screening Levels
Arsenic	18	60	46	43
Selenium	0.52	4.1	0.63	1.2

NOTE: All soil concentrations expressed in mg/kg.

The soil-based HQ results for the terrestrial environment are presented in Table 13.

Table 13. Terrestrial Ecological Hazard Quotients – Red Mountain Project SLERA

COPCs	Plant HQs			Soil Invertebrate HQs			Mammal HQs			Bird HQs		
	Base	Future	Diff	Base	Future	Diff	Base	Future	Diff	Base	Future	Diff
Arsenic	4.05	4.09	0.04	1.22	1.23	0.01	1.59	1.60	0.02	1.70	1.71	0.02
Selenium	9.04	9.11	0.07	1.15	1.16	0.01	7.46	7.52	0.06	3.92	3.95	0.03

6.3.3 Surface Water Hazard Quotients

The surface water concentrations selected as the baseline surface water EECs were the 90th percentile concentrations (Table 6) measured throughout the baseline sampling efforts in Bitter Creek, Rio Blanco Creek, and Goldslide Creek, and the Bear River. The baseline and predicted future surface water EECs for each of the four creeks are presented in Table 14.

*Table 14. Surface Water Baseline and Predicted Future EECs **

Constituent	Bitter Creek Location BC06		Bear River Location BR06		Rio Blanco Creek Location RBC02		Goldslide Creek Location GSC02	
	Baseline	Predicted	Baseline	Predicted	Baseline	Predicted	Baseline	Predicted
Fluoride F	0.028	0.034	0.024	0.019	0.034	0.032	0.019	0.019
Nitrite Nitrogen	0.050	0.126	0.050	0.069	0.050	0.050	0.050	1.093
Ammonia Nitrogen	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum D	5.333	1.276	1.333	0.737	0.432	0.329	0.306	0.492
Arsenic T	0.213	NA	0.132	NA	0.034	NA	0.003	NA
Arsenic D	0.009	0.010	0.005	0.005	0.005	0.005	0.003	0.030
Beryllium T	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium D	0.091	0.083	0.091	0.087	0.091	0.087	0.091	0.089
Cadmium T	4.160	NA	2.708	NA	4.040	NA	2.400	NA
Cadmium D	0.398	2.317	0.652	0.955	0.888	0.876	1.360	14.600

Constituent	Bitter Creek Location BC06		Bear River Location BR06		Rio Blanco Creek Location RBC02		Goldslide Creek Location GSC02	
	Baseline	Predicted	Baseline	Predicted	Baseline	Predicted	Baseline	Predicted
Chromium T	0.354	NA	0.207	NA	0.016	NA	0.014	NA
Chromium D	0.016	0.019	0.014	0.015	0.014	0.037	0.014	0.047
Cobalt T	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt D	0.023	0.052	0.016	0.025	0.017	0.020	0.036	0.264
Copper T	8.022	NA	4.600	NA	2.156	NA	1.533	NA
Copper D	0.189	0.242	0.111	0.151	0.177	0.157	0.724	1.285
Iron T	NA	NA	NA	NA	NA	NA	NA	NA
Iron D	0.034	0.113	0.052	0.050	0.030	0.035	0.030	0.172
Lead T	6.120	NA	4.960	NA	1.324	NA	0.616	NA
Lead D	0.280	0.332	0.200	0.231	0.200	0.657	0.200	0.899
Manganese T	NA	NA	NA	NA	NA	NA	NA	NA
Manganese D	0.215	1.631	0.187	0.519	0.222	0.580	0.134	10.027
Mercury T	0.048	NA	0.017	NA	0.013	NA	0.013	NA
Mercury D	0.006	0.024	0.013	0.013	0.013	0.009	0.013	0.116
Nickel T	0.629	NA	0.419	NA	0.321	NA	0.093	NA
Nickel D	0.072	0.135	0.023	0.042	0.075	0.100	0.038	0.549
Selenium T	0.756	NA	0.314	NA	0.842	NA	0.428	NA
Selenium D	0.574	0.479	0.288	0.281	0.882	0.782	0.438	1.056
Silver T	10.083	NA	7.183	NA	0.713	NA	0.333	NA
Silver D	0.393	1.297	0.333	0.573	0.333	3.751	0.333	4.901
Zinc T	0.933	NA	0.647	NA	0.472	NA	0.342	NA
Zinc D	0.059	0.316	0.048	0.108	0.083	0.094	0.200	1.902

** NOTE: All water concentrations expressed in units of µg/L.*

The TRVs used to derive aquatic HQs based on surface water information were the USEPA (2015) chronic freshwater screening values and are presented in Table 15. One of the challenges with the assessment was that some of the TRVs were expressed as total concentrations and others as dissolved concentrations. The predicted future water concentrations; however, were only available as dissolved concentrations. Ultimately, HQs were calculated for all surface water COPCs regardless because it is the Project-related change in risk levels from baseline to worst-case predicted future levels that are of greatest interest. As such, the HQ differences were based on application of the TRVs to the dissolved baseline and predicted future surface water concentrations. For reference purposes the absolute baseline HQs using the corresponding dissolved or total TRV was also shown.

*Table 15. Surface Water Toxicity Reference Values **

Constituent	Toxicity Reference Values
Fluoride F	2.7
Nitrite Nitrogen N	0.02

Constituent	**Toxicity Reference Values**
Aluminum D	0.087
Arsenic T	0.15
Beryllium D	0.011
Cadmium T	0.00025
Chromium T	0.074
Cobalt D	0.019
Copper T	0.009
Iron D	1
Lead T	0.0025
Manganese D	0.093
Mercury T	0.00077
Nickel T	0.052
Selenium T	0.005
Silver T	0.00006
Zinc T	0.12

** NOTE: TRVs based on USEPA (2015), expressed in units of µg/L.*

The surface water-based HQ (risk) results for the baseline and predicted future surface water conditions (where appropriate TRVs were available) are presented in Table 16.

*Table 16. Baseline and Predicted Future Aquatic Ecological Hazard Quotients**

Constituent	**Bitter Creek Location BC06**		**Bear River Location BR06**		**Rio Blanco Creek Location RBC02**		**Goldslide Creek Location GSC02**	
	Baseline	**Predicted**	**Baseline**	**Predicted**	**Baseline**	**Predicted**	**Baseline**	**Predicted**
Fluoride F	0.028	0.034	0.024	0.019	0.034	0.032	0.019	0.019
Nitrite Nitrogen N	0.050	0.13	0.050	0.069	0.050	0.050	0.050	1.1
Aluminum D	5.3	1.3	1.3	0.74	0.43	0.33	0.31	0.49
Arsenic T	0.21		0.13		0.034		0.0033	
Beryllium D	0.091	0.083	0.091	0.087	0.091	0.087	0.091	0.089
Cadmium T	4.2		2.7		4.0		2.4	
Chromium T	0.35	-	0.21	-	0.016	-	0.014	-
Cobalt D	0.023	0.052	0.016	0.025	0.017	0.020	0.036	0.26
Copper T	8.0	-	4.6	-	2.2	-	1.5	-
Iron D	0.034	0.11	0.052	0.050	0.030	0.035	0.030	0.17
Lead T	6.1	-	5.0	-	1.3	-	0.62	-
Manganese D	0.22	1.6	0.19	0.52	0.22	0.58	0.13	10
Mercury T	0.048	-	0.017	-	0.013	-	0.013	-

Constituent	Bitter Creek Location BC06		Bear River Location BR06		Rio Blanco Creek Location RBC02		Goldslide Creek Location GSC02	
	Baseline	**Predicted**	**Baseline**	**Predicted**	**Baseline**	**Predicted**	**Baseline**	**Predicted**
Nickel T	0.63	-	0.42	-	0.32	-	0.093	-
Selenium T	0.76	-	0.31	-	0.84	-	0.43	-
Silver T	10	-	7.2	-	0.71	-	0.33	-
Zinc T	0.93	-	0.65	-	0.47	-	0.34	-

** NOTE: Values expressed are unitless.*

For the COPCs where HQs could be calculated for both baseline and predicted future conditions, the following Table 17**,** presents the Project-related differences in aquatic risk levels.

Table 17. Project-Related Aquatic Hazard Quotient Differences

Constituent	Bitter Creek Location BC06			Bear River Location BR06			Rio Blanco Creek Location RBC02			Goldslide Creek Location GSC02		
	Baseline	Predicted	Difference	Baseline	Predicted	Difference	Baseline	Predicted	Difference	Baseline	Predicted	Difference
Fluoride F	0.028	0.034	0.0058	0.024	0.019	-0.0055	0.034	0.032	-0.0023	0.019	0.019	-0.00031
Nitrite Nitrogen N	0.050	0.13	0.076	0.050	0.069	0.019	0.050	0.050	0.00013	0.050	1.1	1.0
Aluminum D	5.3	1.3	-4.1	1.3	0.74	-0.60	0.43	0.33	-0.10	0.31	0.49	0.19
Beryllium D	0.091	0.083	-0.0077	0.091	0.087	-0.0041	0.091	0.087	-0.0038	0.091	0.089	-0.0015
Cobalt D	0.023	0.052	0.029	0.016	0.025	0.010	0.017	0.020	0.0034	0.036	0.26	0.23
Iron D	0.034	0.11	0.080	0.052	0.050	-0.0017	0.030	0.035	0.0053	0.030	0.17	0.14
Manganese D	0.22	1.6	1.4	0.19	0.52	0.33	0.22	0.58	0.36	0.13	10	9.9

Values expressed are unitless.

7 DISCUSSION

As noted above, the baseline measurements and HQs represent area conditions prior to Project activities. Therefore, it is of limited value to discuss the absolute baseline HQ results (Table 13) with respect to the potential for terrestrial ecological risk other than to note that they all exceed unity (1), which suggests there exists potential for terrestrial ecological risk, even at the baseline level. In natural wilderness settings the established species represent those that have adapted to, and/or are capable of tolerating, baseline conditions. As such, it is the potential for the proposed Project to increase risk above these baseline levels that is of particular interest in the SLERA. Based on the results, the Project-related terrestrial ecological risk appears low. The greatest single increase in an HQ from baseline to predicted future conditions was an HQ difference of 0.07 for selenium in plants - essentially negligible. Most of the terrestrial ecological HQ changes were considerably less. As such, it is not anticipated that the Project will result in unacceptable adverse effects on terrestrial VCs as a result of anticipated chemical releases.

The aquatic ecological risk associated with the Project was assessed for both the baseline and predicted future surface water conditions (Table 16). The absolute quality data in four watercourses: Bear River, Bitter Creek, Rio Blanco Creek, and Goldslide Creek. Upon review of the baseline and predicted future risk levels were generally negligible (HQ < is for Goldslide Creek (i.e., yielding an incremental HQ increase of 9.1) with the following notable exceptions:

- The dissolved aluminum baseline risk level in Bitter Creek is moderate, though predicted future potential for aquatic risk in Rio Blanco Creek (i.e., yielding an incremental HQ increase of 4.6 for silver), and low risk levels do not suggest it will increase as a result of the Project.

- The total cadmium, copper, lead and silver baseline risk levels in Bitter Creek and Bear River are currently at a low to moderate levels. However, review of the dissolved baseline concentrations for these parameters relative to their corresponding total concentrations indicates that the risk is associated with naturally high suspended sediment levels in these watercourses, and therefore Project release of non-turbid water would not likely increase these risk levels as the dissolved concentrations are significantly lower than the total concentrations under baseline conditions. Moreover, it is understood from consideration of the aquatic resources information (Volume 8: Appendix 18-A) that the aquatic habitat value of Bitter Creek is already marginal due to high stream velocities, heavy suspended sediment loads,(i.e., greatest incremental increases were 1.4 and low habitat complexity.

Nitrite and manganese are predicted to increase the baseline risk levels by HQ levels of 1 and 9.9 respectively, at sampling station GSC02 in Goldslide Creek. In the case of nitrite, the absolute future risk level is predicted to be low (HQ = 1.1) and therefore is not of particular concern; however, the manganese risk level (HQ = 10) is moderate. Review of the aquatic resource information presented in Volume 8: Appendix 18-A, there are fish barriers downstream of Goldslide Creek and as such, Goldslide Creek itself is of low aquatic resource value.

8 CONCLUSION

Based on the information reviewed, it is concluded that the anticipated Project-related change in terrestrial ecological risk associated with the Project is negligible.

With respect to aquatic ecological risk, it is concluded that for the majority of the COPCs, the baseline and predicted future levels are low to negligible (HQs < 1). However, there are a number of parameters where there already appears to be a low to moderate level of risk under baseline conditions (i.e., dissolved aluminum, total cadmium, copper, lead, and silver in Bitter Creek; total cadmium, copper, lead, and silver in Bear River; total cadmium, copper, and lead in Rio Blanco Creek; and total cadmium and copper in Goldslide Creek). Given these represent baseline conditions however, this is unrelated to the Project. It is of particular importance to note that the aquatic resource efforts reported in Volume 8: Appendix 18-A suggests that the aquatic resource value of the Goldslide and Rio Blanco tributaries to Bitter Creek, are low with fish barriers downstream. Bitter Creek itself was also reported to be marginal with respect to aquatic habitat value due to its inherent heavy suspended sediment loads, high velocity, and low habitat complexity. As such, the location of greatest value with respect to addressing potential for impact on aquatic life is the BR06 location in Bear River where the predicted future risk (HQ) levels were negligible.

These conclusions rely upon predicted future air quality, soil quality, and surface water quality associated with the Project. If the Project changes from that currently proposed, these conclusions should be reviewed for continued applicability.

9 REFERENCES

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