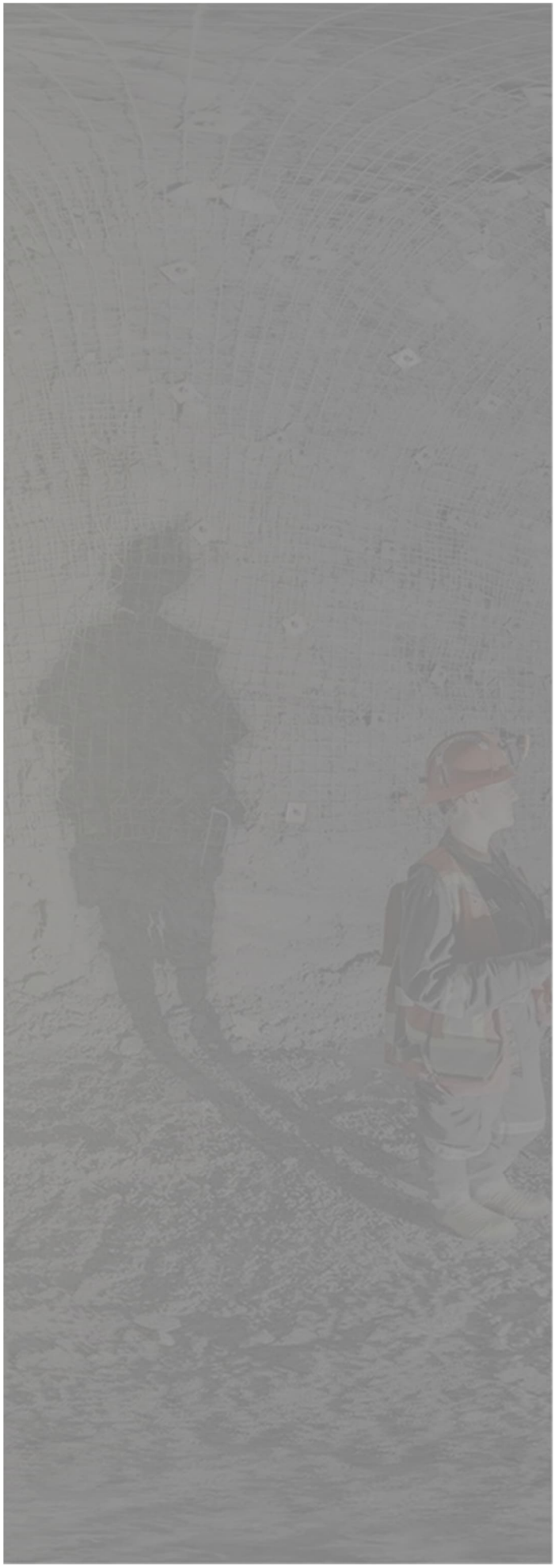
OSISKO DEVELOPMENT

CARIBOO GOLD PROJECT

Project Changes Report Rev0

April 21, 2023



OSISKO DEVELOPMENT

Cariboo Gold Project

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ABBREVIATIONS

Terminology used in his document has been defined where it is first used, while the following list has been presented to assist readers that choose to review only portions of the document.

Abbreviation	Description
%	percent
%HA	percent highly annoyed
<	less than
°C	degrees Celsius
µg/kg/day	micrograms per kilogram per day
µg/L	micrograms per litre
Application	Environmental Assessment Certificate Application
BC	British Columbia
BCWQG	BC water quality guidelines for the protection of aquatic life
BLM	biotic ligand model
$CaCO_3$	calcium carbonate
CCME	Canadian Council of Ministers of the Environment
COPC	constituent of potential concern
CWQG-PAL	Canadian water quality guideline for the protection of aquatic life
dB	decibels
dBA	A-weighted decibel units
dBC	C-weighted decibel units
DOC	dissolved organic carbon
EAO	BC Environmental Assessment Office
ECPMM	Environmental Canada's Environmental Code of Practice for Metal Mines
ENV	Ministry of Environment and Climate Change Strategy (BC)
ETFM	exposure and toxicity modifying factors
FEQG	Federal environmental quality guideline
FMR	Flood Management Reservoir
ha	hectares
HDV	heavy-duty vehicle
Hg	inorganic mercury
Hz	hertz
IDZ	initial dilution zone
L	litres
Leq	equivalent sound pressure level
LFN	low frequency noise
LOAEL	lowest observed adverse effects level

Abbreviation	Description
LOEC	lowest observed effects concentration
m	metres
m^3/day	cubic metres per day
m^3/s	cubic metres per second
m/s	metres per second
MAF	Mean Annual Flow
mg Mn/kg	milligrams of manganese per kilogram
mg Sr/kg	milligrams of strontium per kilogram
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram per day
mg/L	milligrams per litre
mg-N/L	milligrams of nitrogen per litre
MDEQ	Michigan Department of Environmental Quality
MDMER	Metal and Diamond Mining Effluent Regulations
MeHg	methymercury
MOTI	Ministry of Transportation and Infrastructure (BC)
N	nitrogen
n/a	not applicable
NH_3	un-ionized ammonia
NH_4^+	ionized ammonia
$NO3^-$	nitrate
NOAEL	no observed adverse effects level
NOEC	no observed effect concentration
NOx	nitrogen oxides
NPAG	non-potentially acid generating
ODV	Osisko Development Corp.
OGC	Oil and Gas Commission (BC)
P	phosphorus
PAG	potentially acid generating
PM	total particulate matter
PM_{10}	inhalable particulate matter (<10 microns)
$PM_{2.5}$	fine particulate matter (<2.5 microns)
POR	Point of Reception
PPRTV	Provisional Peer-Reviewed Toxicity Value
Project	Cariboo Gold Project
PSL	permissible sound level
QP	qualified professional
QR Mill	Quesnel River Mill
RCP	Reclamation and Closure Plan

Abbreviation	Description
RSL	Regional Screening Level
SPL	Sound pressure level
SSD	species sensitivity distribution
TDS	total dissolved solids
tpd	tonnes per day
tpy	tonnes per year
USEPA	United States Environmental Protection Agency
VC	Valued Component
VP	viewpoint
WARS	Wildlife Accident Reporting System
WBWQM	water balance and water quality model
WHO	World Health Organization
WQG	water quality guideline
WRSF	Waste Rock Storage Facility
WTP	Water Treatment Plant

1.0 BACKGROUND

On December 14, 2022, Osisko Development Corp. (ODV) advised the British Columbia (BC) Environmental Assessment Office (EAO) of proposed changes to Project components associated with the Cariboo Gold Project (the Project). Additional changes were added in early 2023 to further align the Project with the design for permitting. The proposed changes and initial screenings for potential effects are described in Appendix A (Cariboo Gold Project – Proposed Project Design Changes [Technical Memo 1A]) and Appendix B (Cariboo Gold Project – Proposed Project Design Changes [Technical Memo 1B] and are summarized as follows:

- Waste Rock Haulage:
  - Inclusion of the Cow Portal;
  - Adding a connection from the proposed Project underground workings to the Cow Bulk Sample Ramp; and
  - The B Road will not be upgraded as it will not be used for haulage.
- Bonanza Ledge Waste Rock Storage Facility (WRSF) Contact Water Management:
  - Removal of the WRSF Contact Water Pipeline;
  - Maintaining a Water Treatment Plant (WTP) at the Bonanza Ledge Site; and
  - Inclusion of a discharge location at the Bonanza Ledge Site into Lowhee Creek.
- Mining of the Lowhee Zone;
- Increase in the maximum production rate from 4,750 to 4,900 tonnes per day (tpd);
- Revisions to ventilation, exhaust, and escapeway raises, including addition of the new Lowhee Ventilation Raise outside the previously assessed Project Footprint;
- Bonanza Ledge Site - additional components and activities:
  - Increase in the Surface Footprint in the Revised Application, mostly consisting of areas of existing disturbance;
  - Water management revisions and associated new infrastructure, including use of the existing underground workings as a Flood Management Reservoir (FMR);
  - Power source revision;
  - Use of an Existing Overburden Stockpile;
  - Addition of a crusher, screening plant, and ore sorter for the first four years of operations;
  - Access to the sediment control pond (along existing Trail Road); and
  - Change in the configuration of the WRSF at closure and post-closure.
- Revisions to the Use of Transportation Routes and access roads, including use of A Road and Highway 26 through the District of Wells to transport concentrate during the first four years of operations;

- Minor revision to the location of the ODV Office Potable Water Well alternative location within the previously assessed Surface Footprint;
- Fuel storage changes within the previously assessed Surface Footprint;
- Increase in the maximum number of workers during the Operations Phase; and
- Minor addition to the Quesnel River Mill (QR Mill) Surface Footprint to include an existing water management ditch.

No proposed changes are occurring to the Transmission Line.

A Bonanza Ledge activity that is not directly assessed in this document is the relocation of material from the existing potentially acid generating (PAG) WRSF to the open pit, which occurred in 2019. A closure plan for the open pit is in preparation, and a low-permeability cover and diversion channels will be installed prior to construction of the Project. Because the material has already been moved and the closure cover will be constructed before Cariboo Gold activities commence, this activity is considered to be part of the existing conditions of the site. Removal of the PAG material and implementation of a closure cover which limits discharge of mine-contact water from the site is consistent with assumptions in the Revised Application and does not represent a change for the Project. The closure plan will include a monitoring plan to verify the performance of the cover.

This Project Changes Report provides a supplementary assessment of the Project to reflect the proposed changes to Project components from those described in the Environmental Assessment Certificate Application (the Application) submitted to the EAO in July 2021 and the Revised Application submitted to the EAO in October 2022.

2.0 APPROACH

Based on predicted net implications associated with, and a screening assessment for, each Valued Component (VC) addressed in the Revised Application, the following VCs and VC subcomponents were identified by ODV as requiring further effects assessments to support the proposed changes summarized in Section 1.0:

- Surface water;
- Groundwater;
- Freshwater Fish;
- Soil;
- Vegetation;
- Wildlife;
- Air Quality;
- Acoustic;
- Land Use: Visual Quality; and
- Human and Ecological Health.

The screening of VCs associated with the Project changes in Chapter 1.0 are provided in Appendix A and Appendix B. Appendix A and Appendix B summarize the justification for inclusion, or exclusion, of VCs for assessment in this Project Changes Report. Appendix A is associated with the removal of the WRSF Contact Water Pipeline from Bonanza Ledge to the Mine Site Complex, the use of the Cow Portal for hauling waste rock to Bonanza Ledge, the removal of the B Road as a haul route, maintenance of a WTP at Bonanza Ledge, and inclusion of a discharge location into Lowhee Creek. Appendix B is associated with the remainder of the changes, including mining of the Lowhee Zone, an increase in the maximum production rate, the addition of the Lowhee Ventilation Raise, changes to the Transportation Routes and access roads for the Project, changes at the Bonanza Ledge Site, and minor expansion of the QR Mill Surface Footprint.

The environmental assessment methods, VCs, VC subcomponents, spatial and temporary assessment boundaries, and residual effects evaluation criteria do not change in this supplementary assessment unless otherwise specified. These are presented in Chapters 5.0 (Valued Components Selection) and 6.0 (Valued Components Assessment Methods) of the Revised Application and the VC effects assessments (Chapter 7.0 of the Revised Application) and supporting technical appendices, where applicable. These are not reiterated below; however, reference is provided, where appropriate, to provide continuity between the Revised Application and this supplementary assessment. The effects assessments of the VCs in Chapters 3.0 to 12.0 of this report consist of a summary of baseline conditions (where relevant), an assessment of potential effects, a summary of mitigation measures, and summary of residual effects associated with the Project changes and the potential effects associated with these Project changes. Project changes summarized in Section 1.0 have only been considered in the assessment where potential interactions with a VC were determined during screening in Appendix A and Appendix B. Potential effects and residual effects not discussed in Chapters 3.0 to 12.0 of this report are expected to be unchanged from those in the Revised Application.

3.0 SURFACE WATER

3.1 Potential Interactions with Project Changes

Results of the initial screenings in Appendix A and Appendix B determined that the Project changes have the potential to interact with the Surface Water VC. Changes to the Surface Water VC (surface water quality and surface water quantity) may result from the following Project changes:

- Mining of the Lowhee Zone;
- Change in the maximum production rate from 4,750 to 4,900 tpd; and
- Use of the existing underground workings as an FMR.

3.2 Discussion of Potential Effects

3.2.1 Surface Water Quality

Project effects on surface water quality are generally summarized in Section 7.4.4.4 of the Revised Application. Mining of the Lowhee Zone, the change in the maximum production rate, and the use of the existing underground workings as an FMR have the potential to change surface water quality in Lowhee Creek through the discharge of treated effluent during the Construction, Operations, Closure, and Post-Closure (Active Care) Phases and through seepages following decommissioning of the WTP in the Post-Closure (Passive Care) Phase.

This effects assessment focuses on the Lowhee Creek drainage when active discharge from the Bonanza Ledge WTP is occurring, specifically the effluent at the point of discharge to Lowhee Creek, seepages at post-closure, and predicted water quality at assessment nodes in the downstream receiving environment. Stouts Gulch water quality is assessed for the post-closure period only with respect to seepages.

The Project changes will influence water quality in Jack of Clubs Lake; however, the direction of change will be positive because the loading of constituents of potential concern (COPCs) will be lower and for a shorter duration than presented in the Revised Application. Moreover, it is expected that water quality guidelines can be met at the edge of the initial dilution zone (IDZ) in Jack of Clubs Lake, even with the lower discharge volume because the diffuser design is being updated to enhance mixing. Water quality predictions and the effects assessment for Jack of Clubs Lake for the lower rate of discharge and shorter duration will be presented in permitting.

The Project changes are not expected to influence water quality downstream of the confluence of the Willow River and Lowhee Creek as the overall loading will remain the same after discharges from Jack of Clubs Lake and Lowhee Creek have mixed in the Willow River. Water quality in the Willow River is not discussed in this document.

3.2.1.1 *Effluent Assessment*

Water treatment is designed such that effluent concentrations will meet the existing effluent permit limits (Permit 17876, last amended June 29, 2022). The permit limits for deleterious substances (as defined in the Metal and Diamond Mining Effluent Regulations [MDMER]) are also below MDMER limits in the Construction, Operations, Closure, and Post-Closure (active care) Phases. Therefore, predicted effluent quality will meet the Project objectives and federal regulatory compliance limits (Table 3-1).

Table 3-1 Bonanza Ledge Effluent Permit Limits Compared with Metal and Diamond Mining Effluent Regulations Limits and BC Short-Term Acute Guidelines

Parameter	Units	MDMER	BCWQG	Maximum Concentration in Effluent[a]
		Maximum Authorized Concentration in a Grab Sample	Short-Term Acute	
Field Measured				
pH	pH units	6.0-9.5	6.5-9.0	6.0-9.5
Temperature	°C	-	-	n/a
Conventional Parameters				
Hardness, as $CaCO_3$	mg/L	-	-	n/a
Total suspended solids	mg/L	30	25 above background	30
Major Ions				
Chloride	mg/L	-	600	600
Sulphate	mg/L	-	-	392
Nutrients				
Nitrate	mg-N/L	-	33	6
Nitrite	mg-N/L	-	0.60 [b]	0.1
Total ammonia	mg-N/L	13-26 [c]	1.9-2.0 [d]	**10**
Totals Metals				
Arsenic	µg/L	200	-	5.2
Cobalt	µg/L	-	110	**200**
Copper	µg/L	200	-	8
Iron	µg/L	-	1,000	**1,200**
Lead	µg/L	160	417 [e]	60
Manganese	µg/L	-	3,394 [e]	-
Molybdenum	µg/L	-	46,000	
Nickel	µg/L	500	-	30
Selenium	µg/L	-	-	3
Silver	µg/L	-	3.0 [e]	0.12
Zinc	µg/L	800	341[e]	76

Parameter	Units	MDMER	BCWQG	Maximum Concentration in Effluent[a]
		Maximum Authorized Concentration in a Grab Sample	Short-Term Acute	
Dissolved Metals				
Aluminum	µg/L	-	100 [f]	**140**
Cadmium	µg/L	-	2.8 [e]	-
Copper	µg/L	-	- [g]	-
Iron	µg/L	-	350	-

Notes: Bolded concentrations are higher than the short-term maximum BC Ministry of Environment and Climate Change Strategy (ENV) guideline.
(a) The permit provides discharge limits that vary by season and maximum versus mean concentration. This column presents the highest of the potential discharge concentrations.
(b) Guideline is chloride dependent and was calculated based on the chloride concentration observed in the background dataset (15 mg/L).
(c) Limit calculated by converting the unionized ammonia limit (1.00 mg-N/L) to total ammonia based on a pH of 8.5 and temperature range of 5.0 to 15°C.
(d) The ammonia guideline is pH and temperature dependent. The minimum ammonia guideline (1.9 mg-N/L) is based on the combination of field pH (8.5) and water temperature (15°C).
(e) Guideline is hardness dependent and is based on a hardness of 1,125 mg/L.
(f) Guideline is pH dependent and based on a pH of 8.5.
(g) The ENV short-term guideline for dissolved copper was not used in the effluent assessment due to the sensitivity of the biotic ligand model to toxicity modifying factors (pH, hardness, and dissolved organic carbon [DOC]) and the uncertainty in the prediction of DOC in treated effluent.
MDMER = Metal and Diamond Mining Effluent Regulations; BCWQG = BC water quality guidelines for the protection of aquatic life (ENV, 2019c; 2021); °C = degrees Celsius; $CaCO_3$ = calcium carbonate; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; n/a = not applicable; µg/L = micrograms per litre; - = no limit or guideline.

The maximum effluent concentrations for total ammonia nitrogen, total cobalt, total iron, and dissolved aluminum are above the respective short-term acute guidelines; acute effects are not expected as follows:

- Ammonia occurs in two forms in natural waters, un-ionized ammonia (NH_3) and the ionized form (NH_4^+), the proportion of each of which is governed by temperature and pH (Nordin and Pommen 1986). The water quality guideline (WQG) is set based on the toxicity of the un-ionized form to salmonids, and expressed as total ammonia nitrogen, based on pH and temperature. At a pH of 8.5 and temperature of 15°C, the un-ionized ammonia component of a total ammonia concentration of 2 milligrams per litre (mg/L) would be 0.16 mg/L, which is at the low end of the reported range of acute lethality to rainbow trout (0.16 to 1.1 mg/L; Thurston and Russo 1983).
- The BC short-term acute guideline for total cobalt (110 micrograms per litre [µg/L]) was derived by multiplying the 48-hr LC50 for the most sensitive species, *Daphnia magna*, by a safety factor of 0.1 (Nagpal 2004). The 96-hr LC50 value for Rainbow Trout was reported to be 1,406 µg/L. The maximum permit limit of 200 µg/L is below both of these acute toxicity values, and therefore, there is low potential for acute mortality.

- The guideline for total iron (1,000 µg/L) has been identified as being overprotective in many circumstances (Phippen et al. 2008). For example, Linton et al. (2007) found slight to moderate changes in aquatic community population structure along a gradient of increasing iron concentrations and recommended a protective guideline of 1,740 µg/L. Randall et al. (1999) reported an LC_{50} of 11,480 µg/L for ferric sulphate in *Daphnia longispina* and suggested that the particulate nature of the iron caused the effects rather than the toxic properties of iron itself.
- The short-term WQG for aluminum was set to the former federal WQG of 100 µg/L as total aluminum (Butcher 1988) but in dissolved form. The original derivation of the federal guideline is not clear, and therefore, additional information was sought from the 2018 guideline derived by the United States Environmental Protection Agency (USEPA; 2018), which considered the ameliorating influence of hardness and dissolved organic carbon (DOC). USEPA (2018) reported species mean acute values of 2,944 µg/L for *Daphnia magna* (most sensitive species) and 3,312 µg/L for Rainbow Trout (third most sensitive species), as normalized values at a pH of 7.0, hardness of 100 mg/L, and DOC of 1 mg/L. Mean acute values for these species would be higher were the toxicity data normalized to Lowhee Creek pH (7.5), hardness (50 mg/L), and DOC (1.5 to 2 mg/L). The predicted values are lower than these species mean acute values; therefore, the effluent limit for dissolved aluminum is not expected to cause acute lethality.

Based on a comparison of concentrations in treated effluent with MDMER limits and BC short-term acute guidelines, acute toxicity to either Rainbow Trout or *Daphnia magna* is not expected, and no residual impacts from effluent at the point of discharge are predicted.

For parameters without limits or WQGs, a search of the toxicological literature (ECOTOX; USEPA 2021) was made to identify relevant acute toxicity data (Appendix 7.4-13 of the Revised Application). This ECOTOX search was supplemented by a brief literature search for peer-reviewed publications on the aquatic toxicity of each parameter using the University of Saskatchewan Library and Google Scholar. Parameters in Table 3-2 without limits or acute WQGs were sulphate and selenium. Only these parameters are discussed below.

- Sulphate toxicity is reduced at higher hardness, and effluent hardness is expected to be greater than 500 mg/L as $CaCO_3$. At similar hardness, the 48-hr LC_{50} with *Daphnia magna* found in ECOTOX for sodium sulphate was 8,600 mg/L, derived from an exposure using water with a mean hardness of 563 mg/L as $CaCO_3$ (Meyer et al. 1985). The lowest 48-hr LC_{50} with an invertebrate species tested in very hard water (578 mg/L as $CaCO_3$) was 3,288 mg/L with *Ceriodaphnia dubia* (Soucek and Kennady 2005). No sulphate toxicity studies with rainbow trout were found in ECOTOX. The 96-hr LC_{50} for Fathead Minnow (*Pimephales promelas*) tested in very hard water (563 mg/L as $CaCO_3$) was 15,200 mg/L (Meyer et al., 1985). A review of the BC water quality guideline (BCWQG) for sulphate found a 96-hr LC_{50} with *Pimpephales promelas* of 7,960 mg/L (Meays and Nordin 2013) and a 96-hr LC_{50} with rainbow trout of 9,900 mg/L (Singleton 2000). All LC_{50}s reported here are greater than the maximum effluent limit for sulphate (392 mg/L, Table 3-1).
- For selenium, the lowest 96-hr LC_{50}s with Rainbow Trout found in an ECOTOX search was 1,800 µg/L (Palawski et al. 1985; Hunn et al. 1987), and the lowest 48-hr LC_{50} with *D. magna* was 250 µg/L (Nassos et al. 1980). The lowest acute toxicity value for invertebrates was a 48-hr LC_{50} of 83 µg/L for the scud, *Gammarus pseudolimnaeus* (Brooke 1987), and for fish was a 96-hr LC_{50} of 30 µg/L for Fathead Minnows (Kilch 1976). The maximum permit limit (3 µg/L) is below these values (Table 3-1), suggesting that selenium in the treated effluent would not cause acute lethality to fish or invertebrates.

3.2.1.2 Receiving Environment Assessment

3.2.1.2.1 Water Quality in Lowhee Creek during Construction, Operations, Closure, and Post-Closure (Active Care)

The water balance and water quality model (WBWQM) incorporating the Bonanza Ledge site into the Project is currently in progress and is expected to be available for permitting. In lieu, this assessment of potential for effects in the receiving environment is based on Bonanza Ledge-specific water quality predictions prepared by Mavin Terra Solutions (Mavin Terra 2022). It was assumed that Mavin Terra's predictions for the active closure period are representative of Project phases up to passive closure because water management and treatment structures are still in place (i.e., diversion ditches, sediment control pond, and water treatment plant). More specifically, the conceptual model for the WBWQM is based on the following considerations:

- Bonanza Ledge operations are complete (no new mining is occurring).
- Clean-water diversion ditches remain active.
- Bonanza Ledge underground workings will continue to be dewatered to facilitate backfilling. The dewatering effluent is transported to the Sediment Control Pond and then to the Bonanza Ledge WTP for treatment prior to discharge to Lowhee Creek. Once the underground workings are allowed to re-flood, the underground water will continue to report to the WTP until the portal is plugged.
- Pumping of water from the Cow Portal to the Bonanza Ledge WTP during bulk sampling.
- Material from the existing PAG WRSF was relocated to the open pit in 2019.
- Material from bulk sample mining will be deposited to the existing PAG and non-potentially acid generating (NPAG) WRSFs.
- Open pit seepage enters the Bonanza Ledge underground workings, which are being dewatered as described above. Thus, the seepage is contained and treated prior to discharge to the environment.
- Sludge from the WTP is shipped off-site.
- Discharge from the WTP to the environment is represented by permit limits, with one exception. Mavin Terra (2022) did not take into account changes to Permit 17876, which was amended in June 2022 to include a concentration limit for chloride (i.e., a maximum of 600 mg/L from May to June, and a maximum of 150 mg/L from July to April). Instead, Mavin Terra (2022) assumed that the chloride concentration in the effluent would be the molar equivalent of the amount of sulphate removed by the treatment system plus a set factor to account for reagent use. Consequently, Mavin Terra (2022) considered the chloride predictions to be uncertain. This is supported by actual monitoring data from the existing Bonanza Ledge WTP as summarized in Golder Technical Memorandum 20, submitted in response to technical questions on the Application. The measured chloride concentrations from the WTP were, on average, 230 mg/L (max 334 mg/L) from July to April and, on average, 65 mg/L (max 88 mg/L) from May to June. At these values, it would not be possible for maximum concentrations greater than 334 mg/L to be observed at downstream prediction nodes. Thus, it was assumed for the purpose of this assessment that the June 2022 permit limits would be met, and that, during freshet, the WTP effluent would be diluted at least four times, thus reaching the long-term chronic WQG at downstream assessment nodes.

The water quality modeling during this time period is considered to be a reasonable surrogate for active Lowhee Zone mining:

- The dewatering effluent from Bonanza Ledge underground workings is considered to be similar to that expected from dewatering associated with Lowhee Zone mining. When the volume of site water to be treated is such that the current Bonanza Ledge permitted maximum discharge rate would be exceeded, excess water will be stored in the FMR. This activity would be short-term and not expected to result in changes in groundwater reaching Lowhee Creek.
- The WTP design described in the Revised Application considered data from Bonanza Ledge as an analog for the design basis. On this basis, it is assumed that the planned WTP can accommodate inputs from the Cow Portal and Lowhee Zone Mining.

For the Post-Closure (passive care) Phase, water quality predictions were made by adding inputs from the Project WRSF to the predictions by Mavin Terra (2022) for post-closure (passive care) for the Bonanza Ledge site components using the mass balance approach as generally described for Assessment Component 5 in Section 7.4.7.2.2.2 of the Revised Application.

Mavin Terra (2022) predicted water quality at nodes on Lowhee Creek, based on the inflow components, as summarized in Table 3-2.

Table 3-2 Components of Lowhee Creek Modelling Nodes

Node	Inflow Components

LC-3.9 (edge of Initial Dilution Zone [IDZ])	• Discharge from Upper Lowhee Creek:
	  o Discharge from Sediment Control Pond
	  o Discharge from Sediment Control Pond WTP
	  o Runoff from Cow Mountain (Watson's Gulch)
	  o Interflow from Cow Mountain
	  o Runoff from Barkerville Mountain
	  o Interflow from Barkerville Mountain
	• East Diversion Ditch (non-contact water) runoff and interflow
	• Seepage from NPAG WRSF (a)
	• Seepage from PAG WRSF (a)

LC-1.5	• Discharge from LC-3.9 • Runoff from LC-1.5 catchment • Interflow from LC-1.5 catchment • Seepage from underground workings • Groundwater baseflow

Notes: [a] The plume from under the WRSFs will not reach LC-3.9 for 25 years and thus will not contribute to Lowhee Creek water quality during Project operations.
NPAG = non-potentially acid generation; PAG = potentially acid generating; WRSF = Waste Rock Storage Facility; WTP = Water Treatment Plant.

Water quality predictions were compared to two sets of long-term chronic guidelines to identify COPCs:

- BCWQG was calculated using exposure and toxicity modifying factors (ETMFs) from existing (pre-discharge) conditions ("current conditions" in Table 3-3). This comparison was conducted to meet regulatory policy expectations; however, it is not considered to be realistic because there will be a co-occurring change in ETMFs.
- BCWQG was calculated using ETMFs from the predicted concentrations during discharge ("future conditions" in Table 3-3). This comparison considers the co-occurring change in ETMFs, such as hardness, which from a toxicological perspective, is the relevant hardness. Parameters with predicted concentrations within 80% of the BCWQG or greater than the BCWQG were also discussed.

The COPCs identified in this screening are presented in Table 3-3. The screened water quality predictions are presented in Appendix C.

Table 3-3 Constituents of Potential Concern in Water Identified for Lowhee Creek during the Construction, Operations, Closure, and Post-Closure (Active Care) Phases

Parameter	Lowhee Creek	
	LC 3.9	LC 1.5
Chloride	C / F / 0.8	-
Total Ammonia	C / F / 0.8	0.8
Total Beryllium	C / F / 0.8	C / F / 0.8
Total Chromium	C / F / 0.8	0.8
Total Manganese	C	C
Total Mercury	C / F / 0.8	0.8
Total Selenium	0.8	-
Dissolved Copper	C / F / 0.8	C / F / 0.8

Notes: Predicted water quality was screened to identify constituents of potential concern:
C = maximum concentration above water quality guideline calculated using baseline exposure and toxicity modifying factors.
F = maximum concentration above water quality guideline calculated using predicted exposure and toxicity modifying factors.
0.8 = maximum concentration above 80% of the water quality guideline calculated using predicted exposure and toxicity modifying factors.

The potential for adverse effects on aquatic life are discussed by COPC below:

Chloride:

- As discussed above, the chloride predictions from Mavin Terra (2022) are not considered reliable for this assessment, and it was thus assumed that effluent from the WTP would have a maximum concentration of 600 mg/L from May to June and a maximum concentration of 150 mg/L from July to April. Thus,
  - From July to April, it is assumed that the long-term chronic WQG will be met, and effects will not occur.

  - From May to June, the effluent would need to be diluted at least four times to meet the long-term chronic WQG, which is reasonable to assume for LC-1.5. It is possible that a concentration of 150 mg/L would not be achieved at LC-3.9.
- The BCWQG was derived by applying a safety factor of five to the lowest observed effects concentration (LOEC) of 735 mg/L, which caused a 50% reduction in reproduction in a 7-day *Ceriodaphnia dubia* toxicity test (Degreave 1992). The second most sensitive endpoint reported was for *Pimephales promelas* (Fathead Minnow) embryos, for which a 874 mg/L concentration of chloride caused a 50% reduction in embryo survival (Beak 1999). The maximum effluent chloride concentration of 600 mg/L below these LOEC values, and no effects are expected.

Total Ammonia:

- Predicted monthly maximum total ammonia concentrations exceeded the BCWQG from January to March at LC-3.9 and exceeded 80% of the BCWQG at LC-1.5 (Appendix C). Predicted 75th percentile total ammonia concentrations exceeded 80% of the BCWQG from January to March at LC-3.9 (Appendix C).
- Predicted monthly maximum total ammonia concentrations from January to March at LC-3.9 and LC-1.5 were 0.66 milligrams of nitrogen per litre (mg-N/L) and 0.47 mg-N/L, respectively (1.4 times the BCWQG and exceeding 80% of the BCWQG, respectively). Monthly 75th percentile concentrations of total ammonia in January, February, and March were also screened, as maximum concentrations are predicted to be overly conservative. Predicted monthly 75th percentile ammonia concentrations from January to March at LC-3.9 were 0.40 mg-N/L, exceeding 80% of the BCWQG.
- Ammonia occurs in two forms in natural waters, un-ionized ammonia (NH_3) and the ionized form (NH_4^+), the proportion of each of which is governed by temperature and pH (Nordin and Pommen 1986). The BCWQG is set based on the toxicity of the un-ionized form to salmonids, and expressed as total ammonia based on pH and temperature. Rather than applying a safety factor to the guideline, the lower 95% prediction limit of the model was used as a precaution. Although monthly maximum total ammonia concentrations exceed the BCWQG in January through March, maximum concentrations are predicted to be overly conservative. Monthly 75th percentile concentrations of total ammonia are below the BCWQG. Based on the conservatism built into the BCWQG and the unlikelihood of total ammonia reaching the maximum predicted concentrations in January through March, it is unlikely for effects on aquatic life to occur.

Total Beryllium:

- Predicted total beryllium concentrations exceed the BCWQG in all months at LC-3.9 and LC-1.5 (Appendix C).
- Predicted total beryllium at both LC-3.9 and LC-1.5 ranged from 0.30 to 0.50 µg/L (2.3 to 3.8 times the BCWQG).

- The Michigan Department of Environmental Quality (MDEQ; 2014, 2018) developed guidelines for beryllium that include a final chronic value derivation for beryllium that is hardness dependent. This derivation follows the standard USEPA derivation procedure for WQGs; in this case, there were inadequate chronic toxicity data for direct chronic benchmark derivation. The derivation incorporated an acute-to-chronic ratio of 18, yielding the following hardness-dependent equation: exp((1.68391 x ln(hardness)) – 5.8575). MDEQ does not specify the hardness range for which the equation applies. However, the toxicity data used to calculate the relationship indicates a range of hardness between 22 and 400 mg/L as $CaCO_3$. The guideline values within this hardness range are 0.52 to 69 µg/L. Predicted beryllium concentrations are below this range, and therefore, no effects are expected.

Total Chromium:

- Predicted monthly maximum total chromium concentrations exceeded the BCWQG from January to March at LC-3.9 and exceeded 80% of the BCWQG at LC-1.5 (Appendix C). Monthly 75th percentile concentrations of total chromium in January, February, and March were also screened, as maximum concentrations are predicted to be overly conservative. These January to March predicted monthly 75th percentile total chromium concentrations did not exceed the BCWQG or 80% of the BCWQG (Appendix C).
- Predicted monthly maximum total chromium concentrations from January to March at LC-3.9 and LC-1.5 were 1.1 and 0.91 µg/L, respectively (1.1 times the BCWQG and exceeding 80% of the BCWQG, respectively).
- BC has adopted the Canadian Council of Ministers of the Environment (CCME) WQGs (CCME 1999), which have been derived for two oxidation states of chromium:
  - Trivalent chromium BCWQG of 8.9 µg/L is based on a 102-day LOEC (survival) for Rainbow Trout, with a 10-fold safety factor; and
  - Hexavalent chromium BCWQG of 1 µg/L is based on a 14-day LOEC for *Ceriodaphnia dubia*, with a 10-fold safety factor. An updated Federal environmental quality guideline (FEQG) for hexavalent chromium has recently been published, developed using toxicity data for 24 species (ECCC 2018). Chronic toxicity values for fish ranged from 10 µg/L for Brook Trout to 3,500 µg/L for Medaka (*Oryzias latipes*) and Guppy (*Poecilia reticulata*). Among invertebrates, the chronic toxicity effects ranged from 5 µg/L for the cladoceran, *D. magna*, to 1,100 µg/L for brown hydra (*Hydra oligactis*). The FEQG was selected using the 5th percentile of the species sensitivity distribution (SSD; 5 µg/L). This guideline represents the concentration below which either no, or only low, likelihood of adverse effects on aquatic life are expected.
- Predicted total chromium concentrations are below the trivalent chromium BCWQG.

- Chromium speciation data have not been collected for Lowhee Creek or Stouts Gulch (monitoring results are for total chromium only). In general, hexavalent chromium is the principal species found in surface waters and is persistent where there is low availability of oxidizable organic matter to reduce hexavalent chromium to trivalent chromium (Velma et al., 2009; ATSDR, 2012). Total chromium in Lowhee Creek or Stouts Gulch is therefore expected to consist of a higher proportion of hexavalent chromium than trivalent chromium; up to approximately 60% of total chromium can be composed of hexavalent chromium (CCME 1999).
- Effects are not expected because predicted total chromium concentrations are below the FEQG.

Total Manganese:

- Predicted monthly maximum total manganese concentrations exceeded the BCWQG from January to March at LC-3.9 and LC-1.5 when compared to BCWQGs calculated with baseline hardness (Appendix C). However, it is unrealistic that predicted manganese concentrations would occur at the same time as baseline concentrations of hardness. Consequently, BCWQGs calculated with baseline hardness are predicted to be overly conservative. Predicted monthly maximum total manganese concentrations did not exceed the BCWQG or 80% of the BCWQG at LC-3.9 or LC-1.5 when the guideline was calculated with predicted hardness. Monthly 75th percentile concentrations of total manganese in January, February, and March were also screened, as maximum concentrations are predicted to be overly conservative. These January to March predicted monthly 75th percentile total manganese concentrations did not exceed the BCWQG or 80% of the BCWQG (Appendix C).
- Predicted monthly maximum total manganese concentrations from January to March at LC-3.9 and LC-1.5 were 1,733 and 1,227 µg/L, respectively (1.1 times the BCWQG).
- The BCWQG for manganese is based on the LOEC and hardness relationship with an application factor of 0.25 (4:1 safety factor). The lowest chronic value found for manganese (1,040 µg/L) was for Rainbow Trout in a four-month exposure. Although the monthly maximum total manganese concentrations from January to March exceed this LOEC value, maximum concentrations are predicted to be overly conservative. Under the unlikely scenario in which total manganese concentrations reach the maximum predicted concentrations for January through March, it is possible that some effects to the most sensitive fish species may be observed. However, under the more likely scenario in which total manganese concentrations do not exceed the predicted monthly 75th percentile, no effects on fish or other aquatic life are expected.

Total Mercury:

- Predicted monthly maximum total mercury concentrations exceeded the BCWQG from January to March at LC-3.9 and exceeded 80% of the BCWQG at LC-1.5 (Appendix C).
- Predicted monthly maximum total mercury concentrations from January to March at LC-3.9 and LC-1.5 were 0.012 and 0.0096 µg/L, respectively (1.2 times the BCWQG and exceeding 80% of the BCWQG, respectively).

- The BCWQG for mercury is back calculated using bioaccumulation factors for uptake of methylmercury (MeHg) in avian consumers of fish and varies with the proportion of MeHg versus inorganic mercury (Hg) (MOE 2001). This WQG is lower than the level expected to protect aquatic biota from chronic effects. Consequently, the maximum predicted total mercury concentration of 0.012 µg/L (1.2 times the BCWQG) is not expected to cause adverse effects in aquatic biota.

Dissolved Copper:

- Predicted dissolved copper concentrations exceed the BCWQG in January, February, March, and December, and at LC-3.9 and LC-1.5 (Appendix C). Predicted dissolved copper concentrations exceeded 80% of the BCWQG in August at LC-1.5 (Appendix C).
- Predicted concentrations of dissolved copper in January, February, March, and December at LC-3.9 ranged from 0.91 to 1.3 µg/L (1.8 to 1.4 times the BCWQG), with 1.3 µg/L being the monthly maximum concentration in January, February, and March. Monthly 75th percentile concentrations of dissolved copper in January, February, and March were also screened, as maximum concentrations are predicted to be overly conservative. The January, February, and March monthly 75th percentile concentrations at LC-3.9 are 0.98 µg/L (1.4 times the BCWQG).
- Predicted concentrations of dissolved copper in January, February, March, and December at LC-1.5 ranged from 0.61 to 0.90 µg/L (1.2 to 1.5 times the BCWQG), with 0.90 µg/L being the monthly maximum concentration in January, February, and March. Monthly 75th percentile concentrations of dissolved copper in January, February, and March were also screened, as maximum concentrations are predicted to be overly conservative. The January, February, and March monthly 75th percentile concentrations at LC-1.5 are 0.77 µg/L (1.9 times the BCWQG).
- The BCWQG is calculated using a biotic ligand model (BLM), and toxicity is ameliorated primarily by hardness, dissolved organic carbon, and pH. Invertebrates, the most sensitive taxonomic group, were used to derive the guideline (i.e., EC_{20} normalized concentrations are for newly hatched pond snails [*Lymnaea stagnalis*]), with a 2-fold uncertainty factor applied (BC ENV 2019b). Effects are not expected because the predicted concentrations are within two times this effects level. Thus, no adverse effects on aquatic species are expected to occur.

3.2.1.2.2 Water Quality in Lowhee Creek and Stouts Gulch during Post-Closure (Passive Care)

In the Post-Closure (Passive Care) Phase, groundwater seepages will not be captured and treated prior to discharge, and thus may impact the receiving environments in Lowhee Creek and Stouts Gulch. Predicted water quality in Lowhee Creek and Stouts Gulch was screened as described above. The COPCs identified in this screening are presented in Table 3-4 and include sulphate, nitrite, arsenic, beryllium, chromium, cobalt, and copper. The potential for eutrophication due to increased nitrogen was also evaluated. The screened water quality predictions are presented in Appendix C.

Table 3-4 Constituents of Potential Concern in Water Identified for Lowhee Creek and Stouts Gulch during the Post-Closure (Passive Care) Phase

Parameter	Lowhee Creek		Stouts Gulch	
	LC 3.9	LC 1.5	SG 1.35	SG 0.25
Sulphate	C / F / 0.8	C / F / 0.8	C / F / 0.8	-
Nitrite	C / F / 0.8	0.8	-	-
Aluminum (dissolved)	C / F / 0.8	-	-	-
Arsenic (total)	C / F / 0.8	C / F / 0.8	C / F / 0.8	C / F / 0.8
Beryllium (total)	C / F / 0.8	C / F / 0.8	C / F / 0.8	C / F / 0.8
Chromium (total)	C / F / 0.8	C / F / 0.8	C / F / 0.8	0.8
Cobalt (total)	C / F / 0.8	C / F / 0.8	C / F / 0.8	-
Copper (dissolved)	C / F / 0.8	C / F / 0.8	C / F / 0.8	C / F / 0.8

Notes: Predicted water quality was screened to identify constituents of potential concern:
C = maximum concentration above water quality guideline calculated using baseline exposure and toxicity modifying factors.
F = maximum concentration above water quality guideline calculated using predicted exposure and toxicity modifying factors.
0.8 = maximum concentration above 80% of the water quality guideline calculated using predicted exposure and toxicity modifying factors.
- none

The potential for adverse effects on aquatic life is discussed by COPC below.

Sulphate:

- Predicted sulphate concentrations exceed the hardness-dependent BCWQG from November to February at LC-3.9 and in November, January, and February at LC-1.5 (Appendix C). These exceedances occurred regardless of whether median baseline or median predicted hardness was used to calculate the BCWQG. Predicted sulphate concentrations were at or below the BCWQG at SG-1.35 and SG-0.25.
- Predicted sulphate concentrations from November to February ranged from 535 to 549 mg/L at LC-3.9 (1.3 times the BCWQG) and 354 to 364 mg/L at LC-1.5 (0.9 to 1.2 times the BCWQG).
- The sulphate WQG is based on an LC_{20} for Rainbow Trout, the most sensitive species, with an uncertainty factor of 2 applied (Meays and Nordin 2013). Effects are not expected because the predicted concentrations are within two-times the effects level.

Nitrite:

- Predicted nitrite concentrations exceed the chloride dependent BCWQG in January and February at LC-3.9 and exceed 80% of the BCWQG in January and February at LC 1.5 (Appendix C). The Mavin Terra predictions did not include chloride predictions for January to March; thus, the median monthly baseline chloride concentrations were used to calculate the BCWQG. However, chloride is not expected to remain at baseline concentrations, as evidenced by predicted chloride concentrations greater than 2 mg/L in other months (April to December).

- Predicted nitrite concentrations in January and February are 0.0265 mg-N/L at LC-3.9, which are 1.3 times the BCWQG calculated with median monthly baseline chloride concentrations of 1.0 to 1.4 mg/L.
- The long-term chronic WQG was at the concentration "at which some evidence of harm to fish occurs" (BC ENV 2021a). The effect is a potential increase in methaemoglobin and decrease in haemoglobin in red blood cells. The long-term chronic WQG was set at 0.02 mg/L at chloride concentrations less than 2 mg/L, which was documented to be the maximum level acceptable for salmonids continuously exposed to recycled water in fish rearing tanks. However, the BCWQG acknowledges that nitrite toxicity is ameliorated by chloride; the nitrite WQG is adjusted according to an observed ratio of chloride to nitrite in some tests summarized by BC ENV (2021a). At chloride concentrations greater than 2 mg/L, the BCWQG for nitrite is 0.04 mg/L, and predicted nitrite concentrations are below this value; thus, no effects are expected.

Arsenic:

- Predicted arsenic concentrations exceed the BCWQG in one or more months at all prediction nodes (Appendix C):
  - At LC-3.9, predicted concentrations are 1.03 to 3.2 times greater than the BCWQG of 5 µg/L in April and August to December, with concentrations ranging from 5.1 to 16 µg/L.
  - At LC-1.5, the predicted concentration is 1.8 times greater than the BCWQG in December at 9.0 µg/L.
  - At SG-1.35, predicted concentrations are 1.1 to 2.1 times greater than the BCWQG in April, November, and December, with concentrations ranging from 5.7 to 11 µg/L. Predicted concentrations in August and September (4.7 to 4.8 µg/L) were within 80 and 100% of the BCWQG.
  - At SG-0.25, the predicted concentration is 1.2 times greater than the BCWQG in December at 6.1 µg/L.
- The BCWQG for arsenic is the same as the Canadian water quality guideline for the protection of aquatic life (CWQG-PAL) (BC ENV 2021b). The CWQG-PAL is based on a 14-d EC_{50} of 50 µg/L for growth of the algae *Scenedesmus obliquus*; this value was multiplied by an application factor of 0.1 to yield the 5 µg/L guideline value (CCME 1999). BC ENV (2021b) notes that the invertebrate *Daphnia magna* was the most sensitive freshwater organism, with a 21-d flow-through chronic bioassay yielding a LOEC for growth of 20 µg/L and a no observed effect concentration (NOEC) of 10.5 µg/L. Predicted arsenic concentrations are below this NOEC, and thus effects are not expected.

Beryllium:

- Predicted beryllium concentrations exceed the BCWQG in all months at LC-3.9 and LC-1.5, from August to April at SG-1.35, and from November to February at SG-0.25 (Appendix C). At SG-0.25, predicted concentrations in March and April and from August to October were within 80 and 100% of the BCWQG.

- At LC-3.9, predicted concentrations are 3.0 to 3.9 times the BCWQG of 0.13 µg/L, ranging from 0.40 to 0.50 µg/L.
- At LC-1.5, predicted concentrations are 2.3 to 3.9 times the BCWQG, ranging from 0.30 to 0.50 µg/L.
- At SG-1.35, predicted concentrations are 1.2 to 2.1 times the BCWQG between August and April, ranging from 0.16 to 0.27 µg/L.
- At SG-0.25, predicted concentrations are 1.4 times the BCWQG between November and February at 0.18 µg/L.

- The BCWQG is a working WQG, which is based on ANZECC (2000). ANZECC's "indicative interim working level" is based on applying a large safety factor of 1,000 to the lowest acute toxicity value observed in soft water (130 µg/L at a hardness of 23 mg/L as $CaCO_3$) for the most sensitive fish species, the Guppy, *Poecilia reticulata*. ANZECC did not intend for this level to be used as a guideline but rather as an indication of whether further investigation may be needed.
- MDEQ (2014, 2018) developed guidelines for beryllium that include a final chronic value derivation for beryllium that is hardness dependent. This derivation follows the standard USEPA derivation procedure for WQGs; in this case there were inadequate chronic toxicity data for direct chronic benchmark derivation; the derivation incorporated an acute-to-chronic ratio of 18, yielding the following hardness-dependent equation: exp((1.68391 x ln(hardness)) – 5.8575). MDEQ does not specify the hardness range for which the equation applies. However, the toxicity data used to calculate the relationship indicates a range of hardness between 22 and 400 mg/L as $CaCO_3$. The guideline values within this hardness range are 0.52 to 69 µg/L. Predicted beryllium concentrations are below this range, and therefore no effects are expected.

Chromium:

- Predicted total chromium concentrations exceed the most conservative BCWQG for chromium (i.e., 1 µg/L) in one or more months at LC-3.9, LC-1.5, and SG-1.35.
  - At LC-3.9, predicted concentrations are 1.1 to 2.1 times the hexavalent chromium BCWQG in April, August, September, November, and December, with concentrations ranging from 1.1 to 2.1 µg/L. In October, the predicted concentration is just below the BCWQG.
  - At LC-1.5, the predicted concentration in December is 1.4 times the hexavalent chromium BCWQG at 1.4 µg/L. Predicted concentrations in April and November are between 80 and 100% of the BCWQG.
  - At SG-1.35, the predicted concentration in December is 1.3 times the hexavalent chromium BCWQG at 1.3 µg/L. Predicted concentrations in April, September, and November are between 80 and 100% of the BCWQG.
  - At SG-0.25, predicted concentrations are below the hexavalent chromium BCWQG; in December the predicted concentration is between 80 to 100% of the BCWQG.

- BC has adopted the CCME WQGs (CCME 1999), which have been derived for two oxidation states of chromium:
  - Trivalent chromium BCWQG of 8.9 µg/L is based on a 102-day LOEC (survival) for Rainbow Trout, with a 10-fold safety factor; and
  - Hexavalent chromium BCWQG of 1 µg/L is based on a 14-day LOEC for *Ceriodaphnia dubia*, with a 10-fold safety factor. An updated FEQG for hexavalent chromium has recently been published, developed using toxicity data for 24 species (ECCC 2018). Chronic toxicity values for fish ranged from 10 µg/L for Brook Trout to 3,500 µg/L for Medaka (*Oryzias latipes*) and Guppy (*Poecilia reticulata*). Among invertebrates, the chronic toxicity effects ranged from 5 µg/L for the cladoceran, *Daphnia magna*, to 1,100 µg/L for brown hydra (*Hydra oligactis*). The FEQG was selected using the 5th percentile of the SSD (5 µg/L). This guideline represents the concentration below which either no, or only low, likelihood of adverse effects on aquatic life are expected.
- Predicted total chromium concentrations are below the trivalent chromium BCWQG.
- Chromium speciation data have not been collected for Lowhee Creek or Stouts Gulch (monitoring results are for total chromium only). In general, hexavalent chromium is the principal species found in surface waters and is persistent where there is low availability of oxidizable organic matter to reduce hexavalent chromium to trivalent chromium (Velma et al. 2009; ATSDR 2012). Total chromium in Lowhee Creek or Stouts Gulch is therefore expected to consist of a higher proportion of hexavalent chromium than trivalent chromium; up to approximately 60% of total chromium can be composed of hexavalent chromium (CCME 1999).
- Effects are not expected because all predicted total chromium concentrations are below the FEQG.

Cobalt:

- Predicted cobalt concentrations exceed the BCWQG of 4 µg/L from November to February at LC-3.9, LC-1.5, and SG-1.35 (Appendix C). Predicted cobalt concentrations were below 80% of the BCWQG at SG-0.25.
- Predicted cobalt concentrations from November to February ranged from 7.2 to 7.3 µg/L at LC-3.9 (1.8 times the BCWQG), 4.8 to 4.9 µg/L at LC-1.5 (1.2 times the BCWQG), and 5.9 to 6.0 µg/L at SG-1.35 (1.5 times the BCWQG).
- The BCWQG was based on a geometric mean LOEC in 21 and 28-day reproductive tests using *Daphnia magna* and *Ceriodaphnia dubia*, with a safety factor of 2 applied (Nagpal 2004). The lower than typical safety factor was used because cobalt is an essential nutrient. Effects are not expected because the predicted concentrations are within two-times the effects level.

Dissolved Copper:

- The BCWQG is calculated using a BLM, and toxicity is ameliorated primarily by hardness, dissolved organic carbon, and pH. For screening the predictions, guideline values were calculated with the BLM using predicted hardness, pH 7.5, and median monthly baseline DOC concentrations. Temperature was estimated as 5°C in winter, 10°C in freshet and fall, and 15°C in summer, which is consistent with the assumptions made in the Revised Application. Predicted dissolved copper concentrations exceed the BCWQG in one or more months at all four prediction nodes:
  - At LC-3.9, predicted concentrations are 1.1 to 4.2 times the BCWQG from November to April and August and September, with concentrations ranging from 0.57 to 2.1 µg/L. Predicted concentrations in October are also between 80 to 100% of the BCWQG.
  - At LC-1.5, predicted concentrations from August to April are 1.1 to 3.7 times the BCWQG, with concentrations ranging from 0.49 to 1.5 µg/L.
  - At SG-1.35, predicted concentrations from August to March are 1.1 to 2.3 times the BCWQG, with concentrations ranging from 0.90 to 1.6 µg/L. Predicted concentrations in April are also between 80 and 100% of the BCWQG.
  - At SG-0.25, predicted concentrations from November to March and in August are 1.2 to 2.3 times the BCWQG, with concentrations ranging from 0.74 to 1.3 µg/L. Predicted concentrations in September and October are also between 80 and 100% of the BCWQG.
- Invertebrates, the most sensitive taxonomic group, was used to derive the guideline (i.e., EC_{20} normalized concentrations are for newly hatched pond snails [*Lymnaea stagnalis*]), with a 2-fold uncertainty factor applied (BC ENV 2019b). Freshwater snails, such as *Lymnaea* spp., are not expected to occur in Lowhee Creek and Stouts Gulch, as most freshwater snails generally prefer shallow and slow-moving waters with dense vegetation, except for *Fluminicola* spp., which inhabit cold, well-oxygenated, flowing streams and rivers; this genus of snail is rare in BC, with only one species present, reported in the southern Columbia and Kootenay rivers near Castlegar and Trail (Klinkenberg 2021). Therefore, adverse effects on snails during early development are not expected during any Project phase; adverse effects on other molluscs or other invertebrates (such as crustaceans) or fish are not expected as predicted concentrations were below normalized chronic toxicity values.

Potential for Eutrophication

Nitrogen (N) in the form of nitrate (NO_3^-) and phosphorus (P) have relatively low toxicity to aquatic organisms, and the effects of these macronutrients are usually indirect (Nordin and Pommen 1986). Some nutrient enrichment can improve the fish productivity of a waterbody (i.e., by increasing the availability of food); however, beyond a certain assimilative capacity, excess nutrient input can lead to a process called eutrophication (Nordin 1985).

Nitrogen and phosphorus are the two primary nutrients required for plant growth. When the levels of nitrogen and phosphorus in a waterbody increase, plants such as algae respond by increasing productivity (i.e., growth of biomass). Different species of algae have different optimum uptake in different ranges of nutrient concentrations; therefore, the species composition of an algal community can change (Nordin 1985). As a result, invertebrate and fish communities can change as the type of

food organisms available also changes. Nutrient enrichment resulting in excess algal growth can also cause the physical alteration of substrates, including smothering fish spawning and benthic invertebrate habitat.

In the water column, nutrient enrichment can result in a phenomenon known as an “algal bloom,” either in the water column or on shallow substrates, depending on the nature of the waterbody. It is not possible, with information typically available, to reliably predict when an algal bloom may occur; however, certain conditions are more favourable to algal growth. Factors contributing to algal growth in streams, in addition to elevated nutrient concentrations, include: the amount of solar exposure; low, stable water velocity; stable substrates with large surface area; warm temperatures; the phosphorus-binding capacity of the substrates, the type of plants present, and low invertebrate grazing (Nordin 1985; DeBusk 1999).

There is no BCWQG for total phosphorus for the protection of aquatic life in streams, because several factors, including nutrient concentrations, contribute to nuisance levels of algal growth (BC ENV 2021c). Instead, BC ENV (2021c) recommends a maximum algal biomass corresponding to 100 mg/m^2 chlorophyll *a*. Algal biomass higher than this value may result in changes in abundance and species composition of stream invertebrates (e.g., shift from *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies), and *Trichoptera* (caddisflies) to oligochaetes), which can affect availability of preferred prey items for fish. Dissolved oxygen concentrations can be reduced due to algal respiration to below tolerance levels for different life stages fish. Physical effects of increased algal growth include damage to damage to eggs or spawning gravel.

It is difficult to predict how nutrient inputs to streams may result in changes in periphyton growth or whether the BCWQG for chlorophyll *a* may be exceeded. One method is to consider the ratio of nitrogen to phosphorus to identify which nutrient may be limiting. Nitrogen:phosphorus (N:P) ratios (as mg/mg) were calculated following the approach of Nordin (1985), based on the water concentrations of total nitrogen (the sum of total Kjeldahl nitrogen, nitrate as nitrogen, and nitrite as nitrogen) and total phosphorus currently observed in Lowhee Creek and Stouts Gulch. Water with an N:P <5 is considered to be nitrogen limited, N:P ratios of 5 to 15 are indicative of no limitation or co-limitation, and N:P ratios >15 are considered to be phosphorus limited (Nordin 1985). This relationship is better defined for lakes than streams; however, it does provide an indication of potential for excess algal growth with the addition of either of the nutrients.

Table 3-5 provides a summary of N:P ratios calculated for LC-3.9, LC-1.5, SG-1.35, and SG-0.25 for monitoring data collected from 2015 to 2021. The calculated ratios are indicative of no limitation or a phosphorus limitation, and there were no seasonal patterns. This suggests that the addition of nitrogen will not result in increased periphyton growth or eutrophic conditions. Moreover, nitrogen is predicted to peak during winter months when primary productivity is at its lowest and, therefore, there is little plant growth to take up added nitrogen.

Table 3-5 Nitrogen:Phosphorus Ratios in Lowhee Creek and Stouts Gulch, 2015-2021

Station	Number of Data Points	Minimum	Median	Average	Maximum
LC-3.9	154	4	140	246	1,388
LC-1.5	175	0.2	40	63	478
SG-1.35	76	1.3	20	29	122
SG-0.25	79	3	19	31	318

3.2.2 Surface Water Quantity

Project effects on surface water quantity are generally summarized in Section 7.4.4.4 of the Revised Application. Mining of the Lowhee Zone, the change in the maximum production rate, and the use of the existing underground workings as an FMR have the potential to change surface water quantity in Lowhee Creek through the discharge of treated effluent during the Construction, Operations, Closure, and Post-Closure (Active Care) Phases and through seepages following decommissioning of the WTP in the Post-Closure (Passive Care) Phase.

Potential changes to streamflow in Lowhee Creek and Stouts Gulch were evaluated generally as described in Section 7.4.7.2.2.1 of the Revised Application. Changes to baseflows resulting from groundwater removal were predicted as described in Section 7.5 of the Revised Application and in Section 4 of this document. Streamflow statistics were then derived for select assessment locations for the Construction, Operations, Closure, and Post-Closure Phases.

Predicted streamflow statistics are provided in Table 3-6. This information was provided to the other disciplines to support their effects assessments (e.g., Freshwater Fish). No further analysis was done, and the conclusions in the Revised Application were unchanged.

Table 3-6 Predicted Changes in Flows in Lowhee Creek and Stouts Gulch

Flow Period	Lowhee Creek							Stout's Gulch		
	Flows (m^3/s)				Change (%)			Flows (m^3/s)		Change (%)
	Existing Condition	Construction	Operations / Closure	Post-Closure	Construction	Operations / Closure	Post-Closure	Existing condition	Post-Closure	Post-Closure
MAF	0.097	0.105	0.105	0.108	8.5	8.6	11.8	0.070	0.075	6.9
Monthly Average										
Jan	0.026	0.034	0.036	0.039	29.4	36.9	49.7	0.019	0.021	10.2
Feb	0.017	0.026	0.027	0.031	50.3	59.8	79.7	0.012	0.014	12.7
Mar	0.021	0.031	0.033	0.036	42.7	52.5	68.3	0.015	0.017	11.3
Apr	0.096	0.110	0.110	0.113	14.6	14.4	17.6	0.069	0.074	6.9
May	0.335	0.345	0.345	0.347	2.9	3.0	3.7	0.241	0.256	6.0
Jun	0.302	0.289	0.304	0.309	0.8	1.4	2.2	0.218	0.231	6.0
Jul	0.117	0.111	0.121	0.125	3.6	4.3	6.9	0.084	0.090	6.7
Aug	0.046	0.043	0.053	0.057	16.1	16.3	23.5	0.033	0.036	8.3
Sep	0.051	0.048	0.059	0.063	15.8	16.1	22.6	0.037	0.040	8.0
Oct	0.063	0.059	0.073	0.074	15.5	12.6	17.7	0.045	0.049	7.6
Nov	0.058	0.055	0.067	0.067	15.1	10.5	16.2	0.042	0.045	7.7
Dec	0.030	0.028	0.039	0.039	29.6	18.0	29.1	0.022	0.024	9.6
Peak Flows										
Q2	0.883	0.852	0.899	0.940	-0.2	1.8	6.5	0.735	0.755	2.8
Q10	8.2	7.9	7.9	8.283	-3.0	-2.78	1.3	6.857	7.072	3.2
Q100	28.3	27.4	27.4	28.442	-3.2	-3.2	0.6	23.707	24.448	3.1
Low Flows										
7Q2	0.010	0.013	0.009	0.009	30.37	-11.3	-13.3	0.007	0.009	17.0
7Q10	0.007	0.010	0.006	0.005	49.3	-15.3	-18.0	0.005	0.006	23.1

Notes: % = percent; m^3/s = cubic metres per second; MAF = Mean Annual Flow

3.3 Mitigation

Mitigation measures for Surface Water are summarized in Section 7.4.5 of the Revised Application. No changes to mitigation measures are proposed.

3.4 Characterization of Residual Effects

The Project changes of maintaining the WTP at the Bonanza Ledge site and including a discharge location at the Bonanza Ledge site into Lowhee Creek will reduce loading of parameters of potential concern to Jack of Clubs Lake and for a shorter duration compared to the Revised Application. Project changes are not expected to influence water quality downstream of the confluence of the Willow River and Lowhee Creek as the overall loading will remain the same after discharges from Jack of Clubs Lake and Lowhee Creek have mixed in the Willow River.

3.4.1 Water Quality in Lowhee Creek during Construction, Operations, Closure, and Post-Closure (Active Care)

The discharge of treated effluent into Lowhee Creek was not assessed in the Revised Application. Using the same residual effect characterization criteria as described in Section 7.4.7.2.1 of the Revised Application, the characterization of this residual effect is provided in Table 3-7. The characterization is the same as that for Treated Effluent Discharge to Jack of Clubs Lake (Section 7.4.7.3.4 in the Revised Application).

Table 3-7 Residual Effect Characterization for Changes in Surface Water Quality due to Treated Effluent Discharge to Lowhee Creek

Criteria	Characterization	Description
Context	Neutral	Lowhee Creek already receives similar discharge from Bonanza Ledge, and will likely be able to adapt to the potential residual effect.
Magnitude	Low	Surface water concentrations will be similar relative to existing conditions, and will generally remain below relevant Surface Water Quality guidelines or toxicological benchmarks.
Extent	Local	The extent of the effect will be limited to the Local Assessment Area.
Duration	Medium-term	The input of effluent will occur during discharge of treated effluent from construction through to the active care period of post-closure; once effluent discharge ceases, concentrations will return to the concentrations observed prior to Bonanza Ledge operations.
Reversibility	Fully Reversible	The change in concentrations will reverse upon cessation of treated effluent discharge.
Frequency	Regular	Surface water concentrations will be the same as for Bonanza Ledge and will remain consistent during operations. Starting in closure and post-closure (active care), when discharge volumes decrease, and in post-closure (passive care), once effluent discharge ceases, creek concentrations will decrease to be similar to existing conditions.
Affected Populations	Even	The potential effect is experienced by any and all sub-populations.

Sources of uncertainty in the residual effects assessment for the treated effluent discharge to Lowhee Creek are as follows:

- Effluent quality predictions:
  - Conservative use of expected maximum permitted discharge concentrations.
- Water quality predictions and related sources of uncertainty in input data:
  - The water quality model prepared by Mavin Terra (2022) has been validated against streamflow and water quality monitoring data; thus, for most parameters, uncertainty is considered low.
  - Influence of geochemical controls on pH and alkalinity estimates, and stability of secondary minerals. The uncertainty in the relative range of pH and alkalinity is moderate.
- ETMFs used to calculate WQGs.
- Estimates of eutrophication potential, which are based on existing conditions (2015-2021) total nitrogen: total phosphorus ratios and may over-estimate the bioavailability of nutrients to algal communities.

The risk and uncertainty for treated effluent discharge to Lowhee Creek during operations and closure is characterized in Table 3-8. There is high confidence and low uncertainty in the effects assessment for the following reasons:

- There is a good understanding of the cause-effect relationship between the Project and water quality. There are sufficient data to understand the quality of the influent into the WTP, the concentrations that could occur in the receiving environment, and the potential for adverse effects on aquatic resources. Of the latter, there is a robust dataset to evaluate the toxicological effects of the changes in water quality on aquatic life, wildlife, and human health.
- The effectiveness of the selected mitigation measures is moderate to high. Water treatment will be required to achieve the effluent targets and engineering design is ongoing to further refine the treatment design.
- There is a low degree of uncertainty associated with data inputs and modelling techniques, and variation from the predicted effects is expected to be low. Conservative assumptions were applied in the modelling such that predicted concentrations in Lowhee Creek were not under-estimated. Specifically, effluent discharge was assumed to occur at discharge limits continuously through the life-of-mine, which are the maximum allowed concentrations. It is more likely that effluent volumes and concentrations will be below these limits, and thus the effluent concentrations, surface water concentrations at the IDZ are likely to be lower.

Given the above assessment, there is high confidence and hence low uncertainty in the effects assessment.

Table 3-8 Risk and Uncertainty Characterization for Treated Effluent Discharge to Lowhee Creek

Criteria	Characterization	Rationale
Likelihood	High	Changes to surface water concentrations will occur.
Consequence	Minor	Magnitude is low, and extent is local, which results in a minor rating per the consequence matrix in Chapter 6.0, Table 6.7-1 of the Revised Application.
Risk	Low	Consequence is minor, and likelihood is high, which results in a low rating per the risk matrix in Chapter 6.0, Table 6.7-2 of the Revised Application.
Uncertainty	Low	There is high confidence and hence low uncertainty in the effects assessment because effluent discharge was assumed to occur at discharge limits, which are the maximum allowed concentrations. This overestimates effluent concentrations and surface water concentrations in the creek and provides a high level of conservatism in the assessment.

As with other Surface Water residual effects, the importance is considered high. Surface water quality has been identified as a top interest by Indigenous nations, community members, the public, local governments, and/or provincial and federal government agencies.

3.4.2 Water Quality in Lowhee Creek and Stouts Gulch during Post-Closure (Passive Care)

As evaluated in the Revised Application, in the Post-Closure (Passive Care) Phase, mine-related groundwater will no longer be captured and treated and can seep into the receiving environment at Lowhee Creek and Stouts Gulch. Although the water quality predictions for Lowhee Creek and Stouts Gulch have been updated, no changes to the overall residual effects assessment provided in Section 7.4.7.3.7 of the Revised Application are anticipated.

3.5 Cumulative Effects

No adverse residual effects to Surface Water are anticipated associated with the Project changes assessed in this document. The overall changes presented in this document will not alter the overall findings of the effects assessment. No cumulative effects were identified for the Surface Water VC in the Revised Application, and the level of effects associated with the Project changes discussed in this document are consistent with the conclusion of no cumulative effects.

4.0 GROUNDWATER

4.1 Potential Interactions with Project Changes

Results of the initial screenings in Appendix A and Appendix B determined that the Project changes have the potential to interact with the Groundwater VC. Changes to the Groundwater VC (groundwater quantity and groundwater quality) may result from the following Project changes:

- Mining of the Lowhee Zone;
- Change in the maximum production rate from 4,750 to 4,900 tpd; and
- Use of the existing Bonanza Ledge underground workings as an FMR.

The existing Cow Portal, and connection of the Project underground workings to the existing Cow Portal Ramp, was included in the modelling for the Revised Application, similar to the historical mine workings and the existing workings at Bonanza Ledge.

4.2 Discussion of Potential Effects

Potential effects on groundwater quantity and quality are generally summarized in Section 7.5.4 of the Revised Application. Mining of the Lowhee Zone, the change in the maximum production rate, and the use of the existing Bonanza Ledge underground workings as an FMR, has the potential to alter groundwater quality and quantity.

Mining of the Lowhee Zone and the connection of this area to the Project workings alters the extent of the underground workings. The somewhat larger footprint has the potential to cause the following potential effects:

- Changes to groundwater quantity at the Mine Site during construction and operations due to dewatering of the underground workings.
- Changes to groundwater quantity at the Mine Site post-closure due to the flooding of the underground developments.
- Changes to groundwater quality at the Mine Site due to migration and discharge of groundwater from flooded underground workings during closure and post-closure.

Change in the maximum production rate from 4,750 tpd to 4,900 tpd has the potential to slightly alter the timing of groundwater extractions associated with the dewatering of the underground workings. The change in production rate, however, will not alter the residual effects to groundwater quantity or quality relative to existing conditions at the end of operations, in closure, or in post-closure, as this is controlled by the final extents of the underground development.

Use of the existing Bonanza Ledge underground workings as an FMR has the potential to result in short-term alteration of groundwater quality adjacent to the underground. The FMR consists of a sector of the existing Bonanza Ledge underground openings that will be isolated to contain up to an estimated 84,000 m^3 of contact water. This mechanism will serve to temporarily store contact water in the Bonanza Ledge FMR when the Bonanza Ledge WTP capacity cannot keep up with the total contact

water inflow on site. While water is temporarily stored in the underground above the elevation of adjacent creeks, contact water may seep out of the underground towards adjacent creeks, the closest of which is Lowhee Creek. The seepage loss would be temporary, and flow would be expected to be recaptured when the flood water is pumped back out of the underground. The maximum duration of use for the FMR is 50 days for a Wet Year Scenario. As part of Bonanza Ledge mine closure, a shaft closure plug has been installed in the vertical shaft previously connecting the historical workings in the Mine Site area with the Bonanza Ledge underground. Additional closure plugs will be required for the two Bonanza Ledge portals, and the three closure plugs will support the use of the Bonanza Ledge underground as an FMR.

Placement of a shaft closure plug in the vertical shaft removes the direct connection of the Bonanza Ledge underground to the Mine Site historical workings through the shaft, which will result in less underground contact water discharging from the Bonanza Ledge underground to the Mine Site area during operations and closure. This may partially or fully mitigate any additional discharges from the Lowhee Zone.

The lack of connection between the Bonanza Ledge underground and the historical workings was considered in a groundwater model developed for the Bonanza Ledge Phase II Project (Hatfield 2020), which assessed seepage migration pathways from the Bonanza Ledge underground and pit to surface water receptors in the Bonanza Ledge area at closure following reflooding of the Bonanza Ledge underground. Although drainage from the Bonanza Ledge underground through the historical workings towards the Wells Aquifer was assumed in the Revised Application, the predicted changes in groundwater flow and groundwater quality assuming no connection to the Mine Site workings and a flooded Bonanza Ledge underground (Hatfield 2020) was considered and incorporated into the Surface Water Balance and Water Quality Model developed for the Bonanza Ledge area in the Revised Application (Mavin Terra Solutions 2020). As any effects from underground contact water discharging to surface water through groundwater in the Bonanza Ledge area have already been considered in the Revised Application, they are not discussed further in this document.

4.2.1 Groundwater Modelling Methodology

Predictions of changes to groundwater quantity and quality were made using the previously developed numerical model for the Project. Development of the numerical and conceptual hydrogeological model for the Mine Site and its calibration were provided in Appendix 7.5-3 of the Revised Application.

Similar to the model simulations prepared and documented in the Revised Application, simulations were prepared for the development of the revised underground mine plan. Relative to these simulations in the Revised Application, the following changes were made to the model:

- The specified head boundaries (operations) and discrete feature elements in the model (post-closure) were modified to reflect the new underground mine with the addition of the Lowhee Zone. The underground mine location and elevations were derived from the updated 3-D representation of the underground development provided by ODV.

- Consistent with the Revised Application, the historical Mine Site workings were represented at all stages of development using discrete feature elements of high hydraulic conductivity (1 m/s), along with the Project workings and Bonanza Ledge underground at post-closure. This method effectively simulates the connection of flooded mine workings; however, as noted in the Revised Application, use of discrete feature elements can result in artificially high negative pressures in the unsaturated zone through the equalization of hydraulic head across both the saturated and unsaturated workings (hydraulic head equalizes to the lowest point of dewatering). The negative pressure can increase flow to the underground above that which would occur and result in lower hydraulic heads. This will bias changes in streamflow and flow to the underground to be conservatively high (i.e., overestimate groundwater inflow to the underground and overestimate baseflow loses). To understand environmental effects of the Project (maximum underground water management and stream base flow changes), the limitation of the adopted method is considered conservative. Simulations were conducted for post-closure conditions in the Revised Application wherein discrete feature elements above the workings were replaced with seepage nodes. Under these conditions, higher stream base flow and lower contributions of flood underground mine water to surface water receptors was predicted, confirming the use of discrete feature elements introduces conservatism in the modelling approach.
- A plug was placed at the connection of the Bonanza Ledge underground with the nearby vertical shaft of the Mine Site underground workings. This was conducted by introducing a break in the discrete elements at the location of the closure plug to remove the connection between the Bonanza Ledge underground and the Mine Site historical underground workings. The introduction of the break in the underground workings has the side effect of reducing the artificially high negative pressures previously induced in the unsaturated zone of the Bonanza Ledge underground during operations as a result of the dewatering of the historical Mine Site workings (hydraulic head in the Bonanza Ledge underground now equilibrates to the lowest point of assumed dewatering at Bonanza Ledge, rather than the elevation of water levels in the deeper historical Mine Site underground).
- The Bonanza Ledge underground and open pit were assumed to be continuously dewatered during operations to allow for the underground to be used as an FMR.
- Steady-state simulations were prepared to predict the groundwater flow conditions and changes instream baseflow relative to existing conditions, with the introduction of the shaft closure plug, at the end of operations, and at post-closure. Steady state simulations were also prepared to support the estimation of the proportion of underground mine water that may be present in the groundwater discharge to the Wells Aquifer and to surface water at post-closure.

Except for the above changes to the groundwater model, no other changes were made to the model setup and assumptions used for predicting groundwater conditions as part of the Revised Application. The reader is referred to Appendix 7.5-3 of the Revised Application for a full description of the model and its assumptions.

4.2.2 Groundwater Modelling Results

4.2.2.1 Predicted Mine Inflows

Two steady-state simulations were prepared to predict the groundwater inflow to the underground workings with the addition of the Lowhee Zone, with the results summarized in Table 4-1. The simulations were prepared for the Base Case Model (model with calibrated values) and for Alternative Scenario 1 (hydraulic conductivity of bedrock increased by a factor of two). Alternative Scenario 1 was the uncertainty scenario presented in the Revised Application with the highest predicted groundwater inflows.

Predicted flows in the updated groundwater model with the Lowhee Zone and shaft closure plug are within 200 m^3/day and slightly lower than predictions represented in the Revised Application. The reduction in flow for operations relative to the Revised Application is associated with the introduction of the shaft closure plug. As discussed, the introduction of the break in the discrete elements to represent the shaft closure plug reduces the artificially high negative pressures previously induced in the unsaturated zone of the Bonanza Ledge underground during operations as a result of the dewatering of the historical Mine Site workings (hydraulic head in the Bonanza Ledge underground now equilibrates to the lowest point of assumed dewatering at Bonanza Ledge, rather than elevation of water levels in the deeper historical Mine Site underground).

Table 4-1 Predicted Groundwater Inflow

Model Simulation	Revised Application (m^3/day)	Updated Model with Lowhee Zone and Shaft Closure Plug (m^3/day)
Base Case	9,300	9,100
Alternative Scenario 1	12,700	12,500

Notes: Predicted groundwater inflow includes inflow to the historical Mine Site underground development, Project underground and Bonanza Ledge underground and open pit.
m^3/day = cubic metres per day

4.2.2.2 Stream Base Flow

Table 4-2 presents a summary of predicted changes in baseflow at the following stages: with the introduction of the shaft closure plug, at the end of operations, and at post-closure. Assessment nodes are unchanged from the Revised Application.

Table 4-3 presents a summary of predicted changes in the percent of underground mine water from the Project workings in baseflow at the following stages: with the introduction of the shaft closure plug and at post-closure. Operations are not considered in Table 4-3 predictions as the underground will be a sink due to dewatering (flow will be towards rather than away from the dewatered undergrounds). Underground mine water percentages presented in Table 4-3 for baseflow include water that contacts the historical Mine Site workings and new Project workings that discharges to surface water. It does not include the Bonanza Ledge underground that was already considered in the Bonanza Ledge Water Balance and Water Quality Model used in the Revised Application (see Section 4.2). Assessment nodes are unchanged from the Revised Application.

Predicted reductions in baseflow at the end of operations and closure are similar to or lower than values assessed in the Revised Application. No changes to the overall residual effects assessment provided in Section 7.5.8 of the Revised Application are therefore anticipated associated with groundwater quantity and the Project changes described in Section 4.1.

The predicted percent of underground mine water from the Project workings and historical Mine Site workings in baseflow is similar to or lower than the values in the Revised Application. No changes to the overall residual effects assessment provided in Section 7.5.8 of the Revised Application are therefore anticipated associated with groundwater quantity and the Project changes described in Section 4.1. Overall, consistent with the Revised Application, flooded water from the Mine Site historical and Project underground workings is predicted to flow through the groundwater flow system and discharge primarily to the Willow River, with potential small contributions to the flow upstream of the outlet of Jack of Clubs Lake.

Table 4-2 Predicted Changes in Baseflow

Assessment Node		Base Case							Alternative Scenario 1 Bedrock Factor of Two Higher						
		Existing (m^3/day)	Existing with Plug (m^3/day)	% Change from Existing	Operations (m^3/day)	% Change from Existing	Closure (m^3/day)	% Change from Existing	Existing (m^3/day)	Existing with Plug (m^3/day)	% Change from Existing	Operations (m^3/day)	% Change from Existing	Closure (m^3/day)	% Change from Existing
Mine Seepage 1		375	375	0%	0	-100%	425	13%	425	425	0%	0	-100%	475	12%
Mine Seepage 2		550	525	-5%	0	-100%	1,025	86%	625	625	0%	0	-100%	1175	88%
Mine Seepage 5		500	75	-85%	0	-100%	0	-100%	875	300	-66%	0	-100%	0	-100%
H16	Willow River Downstream Confluence with Mosquito Creek	46,550	46,475	0%	39,750	-15%	46,325	0%	45,525	45,750	0%	38,125	-18%	45,900	1%
H16'	Willow River Upstream Confluence with Mosquito Creek	45,625	45,525	0%	39,175	-14%	45,425	0%	44,900	45,125	1%	37,850	-17%	45,325	1%
H24	Slough Creek at the Highway 26 Crossing	10,200	10,425	2%	10,500	3%	10,425	2%	10,400	10,400	0%	10,900	7%	10,400	0%
H21	Jack of Clubs Upstream of Jack of Clubs Lake	13,025	13,050	0%	13,050	0%	13,050	0%	12,950	12,975	0%	13,650	5%	12,975	0%
H12	Black Jack Gulch Upstream of Barkerville	525	525	0%	525	0%	525	0%	325	350	8%	350	-33%	325	0%
H25	Upper Mosquito Creek Close to Confluence with Willow River	350	375	7%	300	-14%	350	0%	50	75	50%	50	-86%	50	0%
SG-0.25	Stouts Gulch Upstream of the Culvert at Barkerville	1,800	1,875	4%	1,875	4%	2,000	11%	1,525	1,600	5%	175	-90%	1,700	11%
SG-1.35	Stouts Creek Upstream of Confluence with Williams Creek	1,200	1,275	6%	1,275	6%	1,375	15%	900	975	8%	1,000	-17%	1075	19%
EG-0.25	Emory Gulch Upstream of the Confluence with Stouts Gulch	200	225	13%	225	13%	300	50%	125	200	60%	175	-13%	275	120%
LC-1.5	Lowhee Creek Upstream of the Confluence with Willow River	1,050	1,125	7%	900	-14%	1,075	2%	625	750	20%	550	-48%	750	20%
LC-3.9	Lowhee Creek (near the toe of the WRSF)	425	425	0%	400	-6%	425	0%	225	225	0%	5,250	1135%	225	0%
LC	Lowhee Creek Upstream Planned Diversion to Willow River	1,050	1,125	7%	900	-14%	1,075	2%	625	750	20%	550	-48%	750	20%
WG	Watson's Gulch Upstream Confluence with Lowhee Creek	100	175	75%	150	50%	275	175%	<50	150	200%	125	25%	250	400%
WC-8.0	Williams Creek at Barkerville	12,025	12,050	0%	12,050	0%	12,125	1%	11,550	11,650	1%	12,075	0%	11,725	2%
WLM-02	William's Creek Upstream of Walker Gulch	4,975	4,950	-1%	4,975	0%	4,925	-1%	4,975	4,975	0%	5,250	6%	5,100	3%
CG	Conklin Gulch Upstream Confluence with William's Creek	2,225	2,225	0%	2,225	0%	2,225	0%	2,200	2,200	0%	2,275	2%	1,850	-16%
WC	William's Creek at the Confluence with Willow River	23,550	23,625	0%	23,250	-1%	23,650	0%	23,200	23,300	0%	23,325	-1%	23,350	1%
JC	Outlet at Jack of Clubs Lake to Willow River (includes Lowhee Creek catchment)	19,425	19,375	0%	18,100	-7%	19,250	-1%	18,775	18,900	1%	17,875	-8%	18,875	1%
WR-5	Willow River Reach 5	21,050	20,900	-1%	16,250	-23%	20,825	-1%	20,525	20,650	1%	15,225	-28%	20,800	1%

Notes: m^3/day = cubic metres per day; % = percent

Table 4-3 Summary of the Percent of Underground Mine Water in Baseflow (from Project Underground and Historical Mine Site Workings)

Assessment Node		Base Case			Alternative Scenario 1: Bedrock Factor of Two Higher		
		Proportion of Underground Water in Baseflow (%)			Proportion of Underground Water in Baseflow (%)		
		Existing	Existing with Plug	Closure	Existing	Existing with Plug	Closure
Mine Seepage 1		100	100	100	100	100	100
Mine Seepage 2		100	100	100	100	100	100
Mine Seepage 5		100	100	0	100	100	0
H16	Willow River Downstream Confluence with Mosquito Creek	0.8	0.6	<0.5	1.2	1.2	1.9
H16'	Willow River Upstream Confluence with Mosquito Creek	0.8	0.8	<0.5	1.2	1.2	1.9
H24	Slough Creek at the Highway 26 Crossing	0	0	0	0	0	0
H21	Jack of Clubs Upstream of Jack of Clubs Lake	0	0	0	0	0	0
H12	Black Jack Gulch Upstream of Barkerville	0	0	0	0	0	0
H25	Upper Mosquito Creek Close to Confluence with Willow River	0	0	0	0	0	0
SG-0.25	Stouts Gulch Upstream of the Culvert at Barkerville	0	0	0	0	0	0
SG-1.35	Stouts Creek Upstream of Confluence with Williams Creek	0	0	0	0	0	0
EG-0.25	Emory Gulch Upstream of the Confluence with Stouts Gulch	0	0	0	0	0	0
LC-1.5	Lowhee Creek Upstream of the Confluence with Willow River	0	0	0	0	0	0
LC-3.9	Lowhee Creek (near the toe of the WRSF)	0	0	0	0	0	0
LC	Lowhee Creek Upstream Planned Diversion to Willow River	0	0	0	0	0	0
WG	Watson's Gulch Upstream Confluence with Lowhee Creek	0	0	0	0	0	0
WC-8.0	Williams Creek at Barkerville	0	0	0	0	0	0
WLM-02	William's Creek Upstream of Walker Gulch	0	0	0	0	0	0
CG	Conklin Gulch Upstream Confluence with William's Creek	0	0	0	0	0	0
WC	William's Creek at the Confluence with Willow River	0	0	0	0	0	0
JC	Outlet at Jack of Clubs Lake to Willow River (includes Lowhee Creek catchment)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
WR-5	Willow River Reach 5	2.2	2.2	0.8	3.2	3.1	5.1

Notes: % = percent; < = less than

4.2.3 Influence on Wells Aquifer and Community of Wells Pumping Well

Similar to the Revised Application, the Mine Site model predicts that water in the flooded mine workings will migrate through the groundwater flow system to the Wells Aquifer, where it could be intercepted by the capture zone for the Wells community water supply well. A sensitivity run was simulated for post-closure assuming only the Lowhee Zone would be mined, with connection of the Lowhee Zone to the Cow Portal. The scenario assumes that the Lowhee Zone will be developed such that it does not intercept the Project workings, and therefore does not require active dewatering of these underground workings during operations.

Particle tracking was used for the post-closure simulation to predict where seepage would migrate after the Lowhee Zone underground workings were allowed to reflood. Seepage from the Lowhee Zone was predicted to migrate from the Lowhee underground area, through the nearby historical workings to the Wells Aquifer, and then discharge to the Willow River. No seepage pathway to the District of Wells drinking water well was predicted. The results of this sensitivity run support that mining of the Lowhee Zone can occur in tandem with the refinement of mitigation options presented in Section 7.5.5.1 of the Revised Application related to the District of Wells drinking water well. Mining of the Lowhee Zone, without development of the remainder of the Project underground workings, is not predicted to cause irreversible changes to the groundwater quality intercepted by the District of Wells drinking water well.

4.2.4 Use of Bonanza Ledge as a Flood Management Reservoir

The FMR consists of a sector of the existing Bonanza Ledge underground openings that will be isolated to contain up to an estimated 84,000 m^3 of contact water. This mechanism will serve to temporarily store contact water in the Bonanza Ledge FMR when the Bonanza Ledge Water Treatment capacity cannot keep up with the total contact water inflow on site. While water is temporarily stored in the underground above the elevation of adjacent creeks, contact water may seep out of the underground towards Lowhee Creek or Stouts Gulch, affecting local groundwater quality adjacent to the Bonanza Ledge underground. The seepage loss would be temporary, and flow would be expected to be recaptured when the flood water is pumped out of the underground. The maximum duration of use for the FMR is 50 days for the Wet Year Scenario.

Calculations were undertaken using Darcy's Law, shown below, to estimate how far seepage water may migrate from the FMR towards nearby surface water features, the closest of which is Lowhee Creek, during a 50-day flood event.

$$V = K \frac{\Delta h}{\Delta L} \frac{1}{n}$$

Where:

V = groundwater flow velocity (m/s)

K = average hydraulic conductivity of the surrounding rock mass (m/s)

Δh = difference in hydraulic head between the highest water level in the FMR and the valley floor (Lowhee Creek; m)

ΔL = length along the flow path between the underground workings and Lowhee Creek (320 m)

n = average rock effective porosity (0.001)

The calculations assumed the following:

- A bedrock hydraulic conductivity (K) of 4 × 10^{-8} m/s, corresponds to the highest hydraulic conductivity value adopted in the uncertainty scenarios evaluated in the groundwater model (Appendix 7.5-3 of the Revised Application).
- A porosity (n) of 0.001 based on published values for bedrock (Guimera and Carrera 1999).
- A travel distance of 320 m between the Bonanza Ledge underground and Lowhee Creek.
- A maximum hydraulic head difference of up to 40 m between the flooded underground and Lowhee Creek. This hydraulic head difference results in a hydraulic gradient of 0.125 (40 m head difference divided by the approximate horizontal distance between the underground and Lowhee Creek).
- For the travel calculations, the hydraulic gradient of 0.125 (40 m hydraulic head difference) is assumed to be present over the entire two months of a flooding event. In actuality, the gradient will be lower as the water level rises to its peak flood elevation and as the flooded water is pumped out of the underground.

Considering the above values, the seepage velocity between the flooded underground was estimated to be approximately 0.5 m/day towards Lowhee Creek. Considering a flood event duration of 50-days, seepage water is estimated to migrate up to 25 m from the flooded Bonanza Ledge underground. In consideration that Bonanza Ledge will be dewatered to elevations below Lowhee Creek outside of a flood event, seepage loss from the FMR would be expected to be recaptured once the flood water is pumped out of the underground and not discharge to adjacent creeks. No residual effects are therefore expected from the use of the existing Bonanza Ledge underground workings as an FMR.

4.3 Mitigation

Mitigation measures for Groundwater are summarized in Section 7.5.5.1 of the Revised Application. No changes to mitigation measures are proposed.

4.4 Characterization of Residual Effects

Updated groundwater modelling results indicate that base flow reductions at the end of operations and post-closure will be similar to or lower than those assessed in the Revised Application. No negative changes to the overall residual effects assessment for groundwater quantity at the Mine Site provided in Section 7.5.8 of the Revised Application are anticipated.

Updated groundwater modelling results indicate that the discharge of underground mine water at post-closure will be similar or lower than those assessed in the Revised Application. No negative changes to the overall residual effects assessment for groundwater quality at the Mine Site provided in Section 7.5.8 of the Revised Application are anticipated.

4.5 Cumulative Effects

No adverse residual effects to Groundwater are anticipated associated with the Project changes assessed in this document. The overall changes presented in this document will not alter the overall findings of the effects assessment. No cumulative effects were identified for the Groundwater VC in the Revised Application and the level of effects associated with the Project changes discussed in this document are consistent with the conclusion of no cumulative effects.

5.0 FRESHWATER FISH

5.1 Potential Interactions with Project Changes

Results of the initial screenings in Appendix A and Appendix B determined that the Project changes have the potential to interact with the Freshwater Fish VC. Changes to the Freshwater Fish VC may result from the following Project changes:

- Removal of the WRSF contact water pipeline;
- Maintaining a WTP at the Bonanza Ledge site; and
- Inclusion of a discharge location at the Bonanza Ledge site into Lowhee Creek.

5.2 Discussion of Potential Effects

Project effects on freshwater fish are generally summarized in Section 7.9.4 of the Revised Application. Treatment of water at Bonanza Ledge and discharge into Lowhee Creek have the potential to affect the following:

- Direct mortality to fish, eggs, or larvae from instream works;
- Loss or alteration of instream or riparian habitat;
- Change to surface water quality resulting in effects to fish, fish habitat, and aquatic resources; and
- Change in surface water quantity resulting in effects to fish, fish habitat, and aquatic resources.

5.2.1 Direct Mortality to Fish

During the Operations and Post-Closure Phases, instream construction will be required to maintain and subsequently decommission an existing discharge structure that will release treated mine contact effluent into the upstream end of Lowhee Creek. Instream works may cause direct mortality to fish, eggs, or larvae, including equipment and construction vehicles in aquatic habitats. The existing discharge infrastructure in Lowhee Creek will be used during operations, which means that no instream construction will be required to install the discharge infrastructure. During maintenance and decommissioning, mitigation measures described in Section 7.9.5.1 of the Revised Application will be implemented to reduce effects to fish and fish habitat. Relevant mitigation measures include:

- Conducting instream work during applicable timing windows to protect fish unless otherwise approved by the applicable provincial or federal authority;
- Conducting instream work in the dry or during low flows, or frozen; and
- Retaining a qualified professional (QP) to conduct a fish salvage, if required.

The direct mortality of fish is not expected associated with the Project changes during the Construction or Post-Closure Phases, and this pathway will not be carried forward.

5.2.2 Loss or Alteration of Instream or Riparian Habitat

During the Construction and Post-Closure Project Phases, activities within instream and riparian areas will be required to maintain and subsequently decommission the existing discharge structure that will release treated effluent into the upstream end of Lowhee Creek. Loss or alteration of fish habitat associated with the activities may lead to effects to fish, including changes to fish behaviour and fish communities.

The existing discharge structure is located in a portion of Lowhee Creek that was previously disturbed from historical mining activities. The instream and riparian footprint of the existing discharge structure is not expected to change considerably during operations as existing discharge infrastructure will be used during operations. Removal of the discharge location during post-closure will follow mitigation measures described in Section 7.9.5.1 of the Revised Application to reduce effects to instream and riparian habitat.

The loss or alteration of instream or riparian habitat associated with the Project changes during the Construction and Post-Closure Project Phases is not expected, and this pathway will not be carried forward.

5.2.3 Change to Surface Water Quality Resulting in Effects to Fish, Fish Habitat, and Aquatic Resources

Changes to water quality can include changes in water temperature, pH, nutrient concentrations, contaminant concentrations, including metals and sediment. This pathway can lead to changes in fish habitat and aquatic resources, which ultimately can affect fish.

During the Operations and Post-Closure Project Phases, the maintenance and subsequent removal of the existing discharge structure that would release treated effluent into the upstream end of Lowhee Creek could result in changes in total suspended sediment loads from construction in instream or riparian habitats. During operations and decommissioning activities (Post-Closure Phase) that could occur in instream and riparian habitats, the mitigation measures described in Section 7.9.5.1 of the Revised Application will be implemented to reduce the mobilization of sediment in Lowhee Creek. The mitigation measures will include implementing upland erosion and sediment control measures, management of water during construction, and appropriate use of material that will not increase suspended sediment loads. A change to surface water quality from changes in sediment associated with the Project changes during the Operations and Post-Closure Project Phases is not expected and this pathway will not be carried forward.

During the Construction and Operations Phases, the discharge of treated mine contact water from the Bonanza Ledge WTP has the potential to change water quality, which could affect fish, fish habitat, and aquatic resources in Lowhee Creek and potentially in downstream watercourses. Currently, the discharge of treated effluent water into Lowhee Creek from the existing Bonanza Ledge WTP is governed by existing Permit 17876. Water quality predictions for Lowhee Creek and their potential for effects to fish and other aquatic biota are discussed in Section 3.1.

5.2.4 Change in Water Quantity Resulting in Effects to Fish and Fish Habitat

Changes to water quantity (flow) in Lowhee Creek from water treatment activities could lead to changes in water depth and velocities. An increase in flows could include changes in migration patterns, the displacement or stranding of fish, or the displacement of fish from their habitat and creation of migration barriers. Additionally, an increase in flows could result in erosion of banks and beds, which can cause suspended sediment to settle in available spawning and rearing habitat downstream.

Reductions in flows in Lowhee Creek could potentially alter the preferred habitat for juvenile or small bodied fish that prefer lower flow velocities. Lower flows can reduce the volume of pool areas which adults or large bodied fish use for refuge or overwintering habitat. The availability of suitable overwintering habitat is important for salmonids who use this habitat as refugia from high-velocity water and limiting interactions with other fish. Velocity barriers can interrupt critical spawning and overwintering migrations leading to reduced annual recruitment, as well as lower overwintering survival and spawning success for fish.

During the Construction, Operations, Closure, and Post-Closure Phases, there is potential for discharge from the Bonanza Ledge WTP to change flows in Lowhee Creek. The water treatment strategy that was presented in the Revised Application resulted in mine contact surface water being collected and conveyed to the Mine Site Complex WTP near Jack of Clubs Lake following its construction and commissioning, resulting in flow reductions in Lowhee Creek. During operations, and continuing into the Closure and Post-closure Phases, while treatment is required, the changes in the Project will maintain treatment of mine contact water at the Bonanza Ledge WTP, which will maintain a hydrograph for Lowhee Creek similar to existing conditions. Prior to construction of the Mine Site Complex WTP, some underground water will be treated at the Bonanza Ledge WTP and discharged into Lowhee Creek. Underground dewatering would not occur during high flow conditions in Lowhee Creek; consequently, eliminating the discharge of effluent water into Lowhee Creek during freshet.

Changes to surface water quantity associated with the Project changes during the Construction, Operations, and Post-Closure Phases have potential to occur and will be carried forward for further assessment.

5.3 Mitigation

Mitigation measures for Freshwater Fish are summarized in Section 7.9.5.1.1 of the Revised Application. No changes to mitigation measures are proposed.

5.4 Characterization of Residual Effects

Of the potential Project effects identified in Section 5.2, none are expected to result in residual effects to fish, fish habitat, or aquatic resources following implementation of mitigation (Table 5-1). The Project changes assessed in this report represent a reduction in effects to fish, fish habitat, and aquatic resources compared to the level of effects assessed in the Revised Application. The outcomes of the Project changes in terms of Freshwater Fish will result in maintaining water quality similar to ambient conditions and maintaining flows in Lowhee Creek similar to existing flows, with negligible changes in instream or riparian footprints. The elimination of the use of the B Road as a haul route will offset instream and riparian footprint-related effects from upgrading watercourse crossing structures in the Lowhee Creek watershed. Removal of the B Road as a haul route will reduce the generation of dust

and sediment from the use of the road during mining operations, which will eliminate associated potential effects to Freshwater Fish.

Table 5-1 provides a summary of Project components, potential effects, direction of change, and a determination of residual effect. The direction of change column in Table 5-1 refers to a potential change from existing conditions and is measured using the following criteria:

- Negative—The potential effects will have a detrimental change compared to the existing conditions of fish, fish habitat, or aquatic resources.
- Neutral—The potential effects will have no detectable change, or a negligible change, compared to the existing conditions of fish, fish habitat, or aquatic resources.
- Positive—The potential effects will have a beneficial change compared to the existing conditions of fish, fish habitat, or aquatic resources.

5.4.1 Change to Surface Water Quality Resulting in Effects to Fish, Fish Habitat, and Aquatic Resources

An assessment of potential changes in surface water quality is provided in Section 3.1. No residual effects to fish, fish habitat, or the aquatic environment are expected.

5.4.2 Change in Water Quantity Resulting in Effects to Fish and Fish Habitat

During the Construction and Operations Project Phases, dewatering of the Bonanza Ledge underground pit will occur with the treated effluent being discharged into Lowhee Creek. The predicted changes in flows are provided in Section 3.2 (Surface Water Quantity).

During the Construction Phase, Mean Annual Flow (MAF) in Lowhee Creek is projected to increase 8.5% as a result of dewatering of the Bonanza Ledge underground area. Average monthly flow increases from existing conditions range from 0.8% in June to 50% in February. From mid-April to late June when Rainbow Trout would be expected to be spawning (McPhail 2007), the increases in flows of 14% to 0.8% are not expected to cause a detrimental change in spawning habitat or behaviour in Lowhee Creek. The flow increases in April are expected to be 14.6% and would be expected to decrease near the end of April as flows in Lowhee Creek naturally increase during freshet and discharge into Lowhee Creek when dewatering of the Bonanza Ledge underground pit seasonally stops.

Flow changes during operations are similar to flow trends predicted during construction; the MAF in Lowhee Creek is projected to increase by 8.6%. Average monthly flow increases from existing conditions range from 1.4% in June to 60% in February. The increases in flows from April to June are 14% to 1.4% and would not be expected to cause a detrimental change in spawning habitat or behaviour in Lowhee Creek. The flow increases in April are expected to be 14.4% and would be expected to decrease near the end of April as flows in Lowhee Creek naturally increase during freshet and discharge into Lowhee Creek when dewatering of the Bonanza Ledge underground pit seasonally stops.

For the purposes of evaluating water quantity changes during the Closure Phase, flow changes are anticipated to be the same as during operations when the Bonanza WTP is discharging effluent into Lowhee Creek.

During the Post-Closure Phase, the increase in the catchment area of Lowhee Creek, as a result of mining operations, will result in a 11.8% increase in MAF. Average monthly flow increases range from 2.2% in June to 79.7% in February. From mid-April to late June when Rainbow Trout (*Oncorhynchus mykiss*) are spawning, the increases in flows of 17.6% to 2.2% would not be expected to cause a detrimental change in spawning habitat or behaviour in Lowhee Creek.

Across all Project phases, the highest increases in monthly average flows are from January to March during the winter low flow period. The increase in flows during this low flow time would be expected to increase the quality of overwintering potential in Lowhee Creek during the Construction, Operations, Closure, and Post-Closure Phases. It is assumed that these changes in streamflow are within the historical change of variability, and existing watercourses are able to convey flows.

During upgrading (construction) of the Bonanza Ledge WTP, a temporary interruption of flow of treated effluent into Lowhee Creek could occur during start-up of the WTP infrastructure. The duration of this flow interruption is still to be determined. Temporary interruptions of flow would also occur during WTP maintenance (which would occur approximately 18 days a year). These interruptions are expected to be of short duration (hours) and are expected to have a negligible effect on flows in Lowhee Creek. During interruptions of flow from the WTP, non-contact surface water inputs will continue to be conveyed into Lowhee Creek, as well as inputs of flow from Watsons Gulch, which flows into Lowhee Creek immediately downstream of the Bonanza Ledge WTP discharge structure. Maintaining these flow inputs are anticipated to reduce the effects of flow interruptions associated with WTP start-up and maintenance.

Changes in flows in Lowhee Creek during the Construction, Operations, Closure, and Post-Closure Phases are not expected to result in negative effects to fish, fish habitat, or the aquatic environment and have potential to increase the quality of overwintering habitat during the winter low flow period. Underground dewatering would not occur during high flow conditions in Lowhee Creek, which would greatly reduce flow changes during freshet and during Rainbow Trout spawning periods in Lowhee Creek.

Table 5-1 Summary of Residual Effects Assessment for Fish and Fish Habitat

Project Component or Activity	Potential Effects or Pathway of Interaction	Direction of Change	Residual Effect
Construction Phase			
Treat and discharge water from the Bonanza Ledge WTP: • Removal of the WRSF contact water pipeline • Maintaining the existing WTP at the Bonanza Ledge Site • Inclusion of a discharge location at the Bonanza Ledge Site into Lowhee Creek	• Direct mortality to fish, eggs, or larvae from instream works	Neutral	None
	• Loss or alteration of instream or riparian habitat from the footprint of the Lowhee Creek discharge structure	Neutral	None
	• Change in surface water quality from water treatment and discharge leading to changes in fish, fish habitat, or aquatic resources	Neutral	None
	• Change in surface water quantity from water treatment and discharge leading to changes in fish, fish habitat, or aquatic resources	Positive	None

Project Component or Activity	Potential Effects or Pathway of Interaction	Direction of Change	Residual Effect
Operations Phase			
Treat and discharge water from the Bonanza Ledge WTP: • Removal of the WRSF contact water pipeline • Maintaining a WTP at the Bonanza Ledge Site • Inclusion of a discharge location at the Bonanza Ledge Site into Lowhee Creek	• Change in surface water quality from water treatment and discharge leading to changes in fish, fish habitat, or aquatic resources	Neutral	None
	• Change in surface water quantity from water treatment and discharge leading to changes in fish, fish habitat, or aquatic resources	Positive	None
Closure Phase			
Treat and discharge water from the Bonanza Ledge WTP	• Change in surface water quality from water treatment and discharge leading to changes in fish, fish habitat, or aquatic resources	Neutral	None
	• Change in surface water quantity from water treatment and discharge leading to changes in fish, fish habitat, or aquatic resources	Positive	None
Post-Closure Phase			
• Ongoing water treatment at the Bonanza Ledge Site, until no longer needed • Decommissioning, dismantling, and removal of the Bonanza Ledge WTP and Lowhee Creek treated effluent discharge structure • Post-Closure monitoring (active and passive care periods)	• Direct mortality to fish, eggs, or larvae from instream works	Neutral	None
	• Loss or alteration of instream or riparian habitat from removal of the Lowhee Creek discharge structure	Neutral	None
	• Change in surface water quality from water treatment or discharge leading to changes in fish, fish habitat, or aquatic resources	Neutral	None
	• Change in surface water quantity from water treatment and discharge leading to changes in fish, fish habitat, or aquatic resources	Positive	None

Notes: WTP = Water Treatment Plant; WRSF = Waste Rock Storage Facility

5.5 Cumulative Effects

No adverse residual effects to fish, fish habitat, and aquatic resources are anticipated associated with the Project changes assessed in this document. The Project changes represent a reduction in the level of effects to Freshwater Fish compared to effects that were previously identified in the Revised Application. No residual cumulative effects were identified for the Freshwater Fish VC in the Revised Application and the reduction in the level of effects associated with the Project changes discussed in this document are consistent with the conclusion of no residual cumulative effects.

6.0 SOIL

6.1 Potential Interactions with Project Changes

Results of the initial screenings in Appendix A and Appendix B determined that the Project changes have the potential to interact with soil and terrain resources during the Construction, Operations, Closure, and Post-Closure Phases. Changes to the Soil VC subcomponents (soil quantity, soil quality, and terrain stability) may result from the addition of the following Project changes:

- Lowhee Ventilation Intake Raise;
- Expansion of the Bonanza Ledge Site;
- Changes in the Bonanza Ledge WRSF configuration at closure and post-closure;
- Use of A Road for access during all Project phases; and
- Expansion of the QR Mill Surface Footprint.

6.2 Discussion of Potential Effects

Potential changes to Soil VC subcomponents from the Project changes are discussed in further detail below.

Project effects on soils and terrain are summarized in Section 7.6.4.4 of the Revised Application. No additional effects beyond those assessed in the Revised Application are anticipated for Soil VC subcomponent during the Construction, Operations, Closure, or Post-Closure Phases.

6.2.1 Inclusion of the Lowhee Ventilation Raise

Mining of the Lowhee Zone will expand the underground footprint and require construction of the Lowhee Ventilation Raise, which will be accessed via an existing road off of the A Road.

Construction of the Lowhee Ventilation Raise will result in the loss of approximately 1.0 hectares (ha) of the M6 soil map unit (Appendix 7.6-1; Soils and Terrain Existing Conditions Report). This soil loss is expected to be temporary with the salvage, storage, and replacement of topsoil with implementation of a Soil Management Plan and the Reclamation and Closure Plan (RCP).

If unmitigated, construction activities can alter the soil quality (i.e., soil degradation) through soil compaction and rutting, wind and water erosion, and admixing, and may introduce terrain instability. Once construction is complete, operation of the Lowhee Ventilation Raise is not anticipated to result in further soil loss or degradation. The Closure Phase will result in the replacement of salvaged soil and implementation of the RCP.

6.2.2 Changes at the Bonanza Ledge Site

The proposed boundary of the Surface Footprint for the Bonanza Ledge Site has expanded to accommodate:

- New crusher and screening plant on surface;
- Existing ore sorter;

- Existing garage;
- Existing warehouse;
- Existing mine offices;
- Use of the existing underground workings as an FMR; and
- Change in the WRSF configuration at closure and post-closure (see Section 6.2.3).

Minimal soil loss is expected as the proposed activities and infrastructure at the Bonanza Ledge Site will occur on lands that are currently within the permitted *Mines Act* Permit boundary for the Bonanza Ledge Phase II project. These lands have mostly been previously cleared of vegetation and soils, with approximately 88% of the area having already been disturbed.

Should the entirety of the Bonanza Ledge Site be required, an additional 1.5 ha of temporary soil loss from the M2 soil map unit (Appendix 7.6-1; Soils and Terrain Existing Conditions Report) would occur. Changes to soil quality and terrain stability are not expected unless construction is required in undisturbed portions of the Bonanza Ledge Site. Following the mitigations outlined in the Revised Application during construction, changes to soil quality and terrain stability would be reduced.

Once construction is complete, operation of Bonanza Ledge is not anticipated to result in additional changes to Soil VC subcomponents. Additionally, the Closure Phase will result in the replacement of salvaged soil and implementation of the RCP.

6.2.3 Change in the Waste Rock Storage Facility Configuration at Closure and Post-Closure

The reconfiguration of the Bonanza Ledge WRSF during closure will result in a larger surface area, gentler slopes, and a lower elevation of the final height of the WRSF.

The proposed expansion will occur within the boundary of the expanded Bonanza Ledge Site and changes to soil quantity and/or soil quality from this activity would be accounted for in the expansion of the Bonanza Ledge Site (see Section 6.2.2). The new configuration will positively affect the soil quantity and terrain stability subcomponents as gentler slope gradients will reduce soil loss from water erosion and decrease potential instability of the closure landscape.

6.2.4 Use of A Road and Highway 26 through Wells

The Transportation Route to access the Lowhee Zone area will change as follows:

- Extending the use of the A Road, from the existing Cow Portal to Highway 26, from temporary use for the first year of the Construction Phase to use for all Project phases, including use for hauling concentrate for the first four years of operations.
- Extending the Transportation Route to include use along Highway 26 from where A Road connects to the proposed new highway bypass.

These changes occur along existing roads and will not result in effects to Soil VC subcomponents during the Construction, Operations, Closure, and Post-Closure Phases. An increase in dust accumulation on soils adjacent to the road is anticipated from the increased road use, which can lead to a reduction in soil productivity. The highest concentration of dust accumulation is expected within 15 m of the road (Air Quality Effects Assessment; Appendix 7.2-1 of the Revised Application), suggesting that changes to soil quality would be limited and restricted to the area directly adjacent to the A Road.

6.2.5 Expanded QR Mill Footprint Area

The QR Mill footprint has been expanded to include an existing water management ditch. The ditch is currently functional and further changes are not expected; as such, no changes to Soil VC subcomponents are predicted during the Construction, Operation, Closure, or Post-Closure Phases.

6.3 Mitigation

Mitigation measures outlined in Section 7.6.5 of the Revised Application will be implemented to reduce the potential adverse effects of the Project changes on Soil VC subcomponents. No additional mitigation measures are required.

6.4 Characterization of Residual Effects

The Project changes increase potential soil and terrain disturbance compared to the Revised Application. The increase is a maximum of 2.5 ha of temporary soil loss and is considered minimal (an increase of 20% from the 12.4 ha in the Revised Application for the QR Mill and Mine Site); therefore, no changes to the overall residual effects assessment for Soil provided in Section 7.6.6 of the Revised Application are anticipated.

6.5 Cumulative Effects

Overall changes presented in this document will not alter the cumulative effects assessment for the Soil VC subcomponents in Section 7.6.9 of the Revised Application. The effects identified associated with the Project changes discussed in this document are consistent with the conclusions presented in the Revised Application.

7.0 VEGETATION

Section 7.7 of the Revised Application provided an evaluation of the potential Project-related effects on the Vegetation VC subcomponents. Results of the initial screening (Appendix A and Appendix B) determined that the Project changes described in Section 1.0 have the potential to interact with Vegetation VC subcomponents during the Construction, Operations, Closure, and Post-Closure Phases.

7.1 Potential Interactions with Project Changes

Potential negative effects on the Vegetation VC subcomponents from activities associated with the Project changes are discussed below.

The Surface Footprint will increase by 20.80 ha or 4.4% compared to the 473 ha Project footprint from the Revised Application. This increase in the Surface Footprint includes 12.13 ha of existing anthropogenic disturbance, 0.01 ha of sparsely vegetated lands, and 8.66 ha of forested lands (dry to fresh forest, intermediate forest, and wet forest). Table 7-1 summarizes the ecosystem groups that occupy the areas that have been added as part of the Project changes. Table 7-2 summarizes the potential for Vegetation VC subcomponents to interact with the Project changes. Vegetation VC subcomponents with potential negative interactions with the Project Changes (Table 7-2) were carried forward and further discussed in the following sections. The “direction of change” column in Table 7-2 refers to a potential change from existing conditions and is measured using the following criteria.

- Negative—The potential effects will have a detrimental change compared to the existing conditions of the Vegetation VC.
- Neutral—The potential effects will have no detectable change, or a negligible change, compared to the existing conditions of the Vegetation VC.
- Positive—The potential effects will have a beneficial change compared to the existing conditions of the Vegetation VC.

Table 7-1 Ecosystem Groups within the Project Changes Footprint Area

Ecosystem Group	Project Changes Footprint Area			
	Bonanza Ledge (ha)	Lowhee Ventilation Raise (ha)	QR Mill (ha)	Total (ha)
Anthropogenic	11.75	0.23	0.15	12.13
Dry to Fresh Forest	2.40	0	0	2.40
Intermediate Forest	5.30	0.29	0	5.59
Sparsely Vegetated	0.014	0	0	0.01
Wet Forest	0	0.67	0	0.67
Total	**19.46**	**1.19**	**0.15**	**20.80**

Notes: ha = hectare; QR Mill = Quesnel River Mill

Table 7-2 Potential Project Changes Interactions with the Vegetation Valued Component

Project Component or Activity	Potential Interaction with Vegetation VC Subcomponents				Direction of Change and Potential Effect or Pathway of Interaction
	Plant Species of Interest	Plant Communities of Interest	Wetland Function	Ecosystems	
Construction Phase					
Expanded QR Mill Footprint area	No	No	No	No	Neutral; no vegetation clearing or new activity. Existing drainage ditch.
Inclusion of the existing Cow Portal	No	No	No	No	Neutral; vegetation clearing has already occurred as part of the bulk sample permit.
Removal of B Road upgrades	No	No	No	No	Positive; removal of the B Road from the Project eliminates the requirement for upgrading, thereby reducing surface level impacts (e.g., grading, vegetation clearing, additional road traffic, spread or introduction of invasive plants, and deposition of dust).
Removal of the Bonanza Ledge WRSF contact water pipeline	No	No	No	No	Positive; removal of the pipeline from the Project eliminates the requirement for upgrading, thereby reducing surface-level impacts (e.g., grading, vegetation clearing, additional road traffic, spread or introduction of invasive plants, and deposition of dust).
Maintaining a WTP at the Bonanza Ledge Site, expansion of the Bonanza Ledge footprint, and use of aboveground infrastructure at Bonanza Ledge	Yes	Yes	No	Yes	Negative; although the WTP already exists, there is potential for vegetation clearing, additional road traffic, spread of introduction of invasive plants, and deposition of dust. Although it will occur at closure, expansion of the WRSF will result in vegetation clearing and new disturbance. No wetlands are present within the surface footprint of the Bonanza Ledge Site.
Inclusion of a discharge location at the Bonanza Ledge site into Lowhee Creek	Yes	Yes	No	Yes	Negative; potential loss or alteration of riparian communities, spread or introduction of invasive plants, and potential deposition of dust from maintenance of the Lowhee Creek discharge structure. No wetlands are present within the surface footprint of the Bonanza Ledge Site.
Inclusion of a Lowhee Ventilation Raise	Yes	Yes	No	Yes	Negative; vegetation clearing, potential spread or introduction of invasive plants, and potential deposition of dust from activities at the Lowhee Ventilation Raise. No wetlands are present within the surface footprint.

Project Component or Activity	Potential Interaction with Vegetation VC Subcomponents				Direction of Change and Potential Effect or Pathway of Interaction
	Plant Species of Interest	Plant Communities of Interest	Wetland Function	Ecosystems	
Use of A Road and Highway 26 through Wells	Yes	Yes	No	Yes	Negative; although A Road and Highway 26 already exist and no new vegetation clearing is proposed, additional road traffic may result in the spread or introduction of invasive plants and deposition of dust. No wetlands are present within the surface footprint of either road.
Operations Phase					
Inclusion of the existing Cow Portal	No	No	No	No	Neutral; the Cow Portal has already been cleared under the bulk sample permit. Activities at this location are already underway.
Removal of B Road Upgrades	No	No	No	No	Positive; removal of the B Road from the Project eliminates the potential for Project-related impacts to Vegetation (e.g., additional road traffic, spread or introduction of invasive plants, and deposition of dust).
Removal of the Bonanza Ledge WRSF contact water pipeline	No	No	No	No	Positive; removal of the pipeline from the Project eliminates the potential for Project-related impacts to Vegetation (e.g., additional road traffic, spread or introduction of invasive plants, and deposition of dust).
Inclusion of a discharge location at the Bonanza Ledge site into Lowhee Creek	No	No	No	No	Neutral; no effects to Vegetation are anticipated.
Treat and discharge water from the Bonanza Ledge WTP	No	No	No	No	Neutral; no effects to Vegetation are anticipated.
Use of aboveground infrastructure at Bonanza Ledge	Yes	Yes	No	Yes	Negative; use of aboveground infrastructure has the potential to increase vehicle and equipment traffic, spread or introduce invasive plants, and deposit dust. No wetlands are present within the surface footprint of Bonanza Ledge.
Inclusion of mining at the Lowhee Deposit	No	No	No	No	Neutral; increase in production rate and resource extraction at the Lowhee Deposit is not anticipated to have a direct or indirect impact on Vegetation.

Project Component or Activity	Potential Interaction with Vegetation VC Subcomponents				Direction of Change and Potential Effect or Pathway of Interaction
	Plant Species of Interest	Plant Communities of Interest	Wetland Function	Ecosystems	
Inclusion of a Lowhee Ventilation Raise	Yes	Yes	No	Yes	Negative; potential spread or introduction of invasive plant, and potential deposition of dust from activities at the Lowhee Ventilation Raise. No wetlands are present within the surface footprint.
Use of A Road and Highway 26 through Wells	Yes	Yes	No	Yes	Negative; although A Road and Highway 26 already exist and no new vegetation clearing is proposed, additional road traffic may result in the spread or introduction of invasive plants and deposition of dust. No wetlands are present within the surface footprint of either road.
Closure Phase					
Treat and discharge water from the Bonanza Ledge WTP	No	No	No	No	Neutral; no effects to Vegetation are anticipated.
Post-Closure Phase					
Ongoing water treatment at the Bonanza Ledge site, until no longer needed	No	No	No	No	Neutral; no effects to Vegetation anticipated.
Decommissioning, dismantling, and removal of the Bonanza Ledge WTP and Lowhee Creek treated effluent discharge structure	Yes	Yes	No	Yes	Negative; additional road traffic, spread or introduction of invasive plants, and deposition of dust. No wetlands are present within the surface footprint of the Bonanza Ledge Site.
Post-Closure monitoring (active and passive care periods)	Yes	Yes	No	Yes	Negative; road traffic, spread or introduction of invasive plants, and deposition of dust.

Notes: QR Mill = Quesnel River Mill; VC = Valued Component; WRSF = Waste Rock Storage Facility; WTP = Water Treatment Plant

7.2 Discussion of Potential Effects

Potential negative effects to the Vegetation VC subcomponents from the Project changes are identified in Table 7-2 and, if unmitigated, could cause a loss or alteration to Vegetation VC subcomponents. The Vegetation VC subcomponents, as follows, were evaluated for potential interactions with the Project changes:

- Plant Species of Interest – provincially and federally listed plant species and lichens, traditional use plant species, invasive and non-native plant species, and forage species for wildlife.
- Plant Communities of Interest – provincially listed ecological communities, whitebark pine proposed critical habitat, and ecological communities valued for traditional plant use.
- Wetland Function – wetland distribution and wetland function.
- Ecosystems – ecosystems, old forests, grassland, alpine and subalpine communities, wildlife tree reserve areas, and riparian communities.

No provincially or federally-listed plant species or lichens, whitebark pine proposed critical habitat, wetlands, or old forests are known to intersect the Project changes footprint areas, and these subcomponents have not been carried forward in the following sections. Potential effects and mitigation measures are described in further detail below for the affected Vegetation VC subcomponents.

7.2.1 Expanded QR Mill Footprint Area

The expansion of the QR Mill footprint occupies 0.15 ha of ecosystems mapped to the anthropogenic group (Table 7-1) to include an existing water management ditch. The ditch is currently functional and further changes are not expected. As there are no required changes to the water management ditch, there are no anticipated changes to Vegetation VC subcomponents during the Construction, Operations, and Closure Phases of the Project associated with this Project change. In the Post-Closure Phase, decommissioning of the ditch may result in indirect negative effects on the Vegetation VC subcomponents due to increased road traffic, spread or introduction of invasive plant species, and deposition of fugitive dust. No additional mitigation measures beyond those described in the Revised Application are recommended for this change.

7.2.2 Inclusion of the Cow Portal

The Cow Portal was constructed as part of Cow Bulk Sample exploration activities (Appendix A). While the portal was constructed, it was not connected to existing underground workings. The inclusion of the Cow Portal will require construction of an underground connection ramp to link the Cow Portal and existing ramp to an underground drift providing an underground route to transfer waste rock to the Bonanza Ledge WRSF. Works required to activate this portal will occur in the underground route away from the Cow Portal entrance.

Operation of the Cow Portal will include trucks hauling ore (during the first four years of operations), and waste rock exiting the portal and indirect negative effects to the Vegetation VC subcomponents during all phases of the Project is anticipated to occur due to increased road traffic, spread or introduction of invasive plant species, and deposition of fugitive dust. No additional mitigation measures beyond those described in the Revised Application are recommended for this change.

7.2.3 Changes at the Bonanza Ledge Site

The existing Bonanza Ledge WTP is a scalable unit, meaning that it can be upgraded to increase capacity. The WTP would be maintained and upgraded, as necessary, to manage water volumes associated with the Project. Upgrades to the existing WTP would be contained to the footprint described in the Revised Application and will not result in additional loss or alteration of Vegetation. Removal of the contact water pipeline from the Project eliminates the potential effects associated with the construction and operation of this component, such as vegetation clearing. This will result in a positive impact for all Vegetation VC subcomponents.

The proposed increased boundary of the Surface Footprint for the Bonanza Ledge Site occupies 19.46 ha and has expanded to accommodate:

- New crusher and screening plant on the surface;
- Existing ore sorter;
- Existing garage;
- Existing warehouse;
- Existing mine offices;
- Use of the existing underground workings as an FMR; and
- Change in the WRSF configuration at closure and post-closure.

As shown in Table 7-1, this area consists mainly of ecosystems mapped to the anthropogenic group (11.75; 60.4%) but also includes ecosystems mapped to the dry to fresh forest group (2.40 ha; 12.3%), intermediate forest group (5.30 ha; 27.2%), and sparsely vegetated group (0.014 ha; 0.1%).

Use of aboveground infrastructure at Bonanza Ledge may result in direct and indirect effects on Vegetation during all phases of the Project because of vegetation clearing, increased vehicle and equipment traffic, spread or introduction of invasive plant species, and deposition of fugitive dust. No additional mitigation measures beyond those described in the Revised Application are recommended for this change.

7.2.4 Inclusion of the Existing Discharge Location at Lowhee Creek

The existing WTP discharges treated water to Lowhee Creek approximately 500 m northwest of the WTP. The inclusion of this structure is not expected to require new vegetation clearing beyond what is described in the Revised Application. Indirect negative effects on Vegetation may occur during all Project phases because of increased vehicle and equipment traffic, spread or introduction of invasive plant species, and deposition of fugitive dust. No additional mitigation measures beyond those described in the Revised Application are recommended for this change.

7.2.5 Mining at the Lowhee Deposit and the Lowhee Ventilation Raise

Mining of the Lowhee Zone will expand the underground footprint and require construction of the Lowhee Ventilation Intake Raise.

The additional Lowhee underground infrastructure would connect to the existing Cow Portal Ramp (existing by the time of Project start). The Valley Portal will continue to be used as the main services access following the first four years of operations, as presented in the Revised Application. While

clearing of the ventilation raise footprint will require clearing of approximately 1.19 ha (0.23 ha of anthropogenic area, 0.29 ha of intermediate forest, and 0.67 ha of wet forest; Table 7-1), it will be accessed via an existing road that will not require clearing.

Direct and indirect negative effects to Vegetation may occur during all Project phases because of vegetation clearing, increased vehicle and equipment traffic, spread or introduction of invasive plant species, and deposition of fugitive dust. No additional mitigation measures beyond those described in the Revised Application are recommended for this change.

7.2.6 Use of A Road and Highway 26 through Wells

The Transportation Route to access the Lowhee Zone area will change as follows:

- Extending the use of the A Road, from Highway 26 to the B Road junction, from temporary use for the first year of the Construction Phase to use for all Project phases, particularly during the first four years of operations for hauling concentrate.
- Extending the Transportation Route to incorporate use along Highway 26 from the Mine Site Complex bypass to the A Road connection east of Wells.

These changes occur along existing roads and will not result in additional direct effects on Vegetation during the Construction, Operations, Closure, and Post-Closure Phases. However, indirect effects may occur because of increased road traffic, spread or introduction of invasive plant species, and deposition of fugitive dust. No additional mitigation measures beyond those described in the Revised Application are recommended for this change.

7.3 Mitigation

No additional mitigations outside of those presented in Section 7.7.5 of the Revised Application are required.

7.4 Characterization of Residual Effects

None of the Project changes described in Section 1.0 are expected to result in residual effects to Vegetation VC subcomponents following implementation of mitigation measures identified in Section 7.7.5 of the Revised Application. In general, the Project changes are expected to result in no change or a minor change in potential effects to Vegetation VC subcomponents compared to the initial effects assessed in the Revised Application. Mitigation measures presented in Section 7.7.5 of the Revised Application are expected to reduce the potential for residual effects to Vegetation.

The addition of the expanded QR Mill footprint area will not result in any vegetation clearing, and there are no anticipated changes to Vegetation VC subcomponents during the Construction, Operations, and Closure Phases of the Project. Indirect effects to Vegetation may occur during the Post-Closure Phase as decommissioning of the existing ditch may result in indirect negative effects to the Vegetation VC subcomponents.

Inclusion of the Cow Portal will not result in new vegetation clearing, and changes to the Vegetation VC subcomponents are expected to be associated with indirect negative effects due to increased traffic (e.g., spread or introduction of invasive plant species and dust).

The increased footprint proposed at Bonanza Ledge is expected to result in direct effects to the Vegetation VC due to the clearing of 7.71 ha of ecosystem not in the anthropogenic group (Table 7-1; dry to fresh forests, intermediate forests, and sparsely vegetated) and indirect effects to adjacent vegetated areas due to increased traffic.

The use of the Bonanza Ledge WTP and existing effluent discharge structure eliminates the need for a new contact water pipeline and associated vegetation clearing associated with its construction. The discharge of treated effluent water into Lowhee Creek from the existing Bonanza Ledge WTP is not expected to result in a change to water quality and will result in a neutral effect from current conditions for loss or alteration to Vegetation at this location and in the downstream systems.

Mining at the Lowhee Zone will occur underground and is not anticipated to result in direct changes to the Vegetation VC. Construction of the Lowhee Ventilation Raise will result in negative direct effects to the Vegetation VC due to the clearing of 0.96 ha of ecosystems not in the anthropogenic group (Table 7-1; intermediate forests and wet forest) and indirect effects to adjacent vegetated areas due to increased traffic.

Use of the A Road and Highway 26 through Wells is not anticipated to result in negative direct effects to the Vegetation VC as there will be no new vegetation clearing. Indirect effects to the Vegetation VC are anticipated due to increased traffic (e.g., spread or introduction of invasive plant species and dust).

Table 7-3 provides a summary of Project components, potential effects, direction of change, and a determination of residual effect. The direction of change column in Table 7-3 refers to a potential change from existing conditions and is measured using criteria described in Section 7.1.

Mitigation measures for the Vegetation VC subcomponents are summarized in Section 7.7.5 of the Revised Application. These mitigation measures will be used to reduce potential effects due to upgrades, maintenance, and decommissioning of the expanded Project components. No changes to mitigation measures for the Vegetation VC are proposed.

Table 7-3 Summary of Residual Effects Assessment for Vegetation

Project Component or Activity	Potential Effects or Pathway of Interaction	Direction of Change	Residual Effect	Additional Mitigation
Construction Phase				
Expanded QR Mill Footprint Area	Loss or alteration of Vegetation VC subcomponents through vegetation clearing and increased traffic. Affected subcomponents include traditional use plants; non-native and invasive species; species for wildlife forage; listed ecosystems; ecological communities valued for traditional plant use; ecosystems; grassland, alpine, and subalpine communities; and wildlife tree reserves.	Neutral	No	No new mitigation measures beyond those summarized in Section 7.7.5 of the Revised Application
Inclusion of the existing Cow Portal		Neutral	No	
Maintaining a WTP at the Bonanza Ledge site and addition of aboveground infrastructure at Bonanza Ledge		Negative	No	
Inclusion of a discharge location at the Bonanza Ledge site into Lowhee Creek		Negative	No	
Inclusion of a Lowhee Ventilation Raise		Negative	No	
Use of A Road and Highway 26 through Wells		Negative	No	
Operations Phase				
Expanded QR Mill Footprint Area	Loss or alteration of Vegetation VC subcomponents through vegetation clearing and increased traffic. Affected subcomponents include traditional use plants; non-native and invasive species; species for wildlife forage; listed ecosystems; ecological communities valued for traditional plant use; ecosystems; grassland, alpine, and subalpine communities; and wildlife tree reserves.	Negative	No	No new mitigation measures beyond those summarized in Section 7.7.5 of the Revised Application
Inclusion of the existing Cow Portal		Neutral	No	
Maintaining a WTP at the Bonanza Ledge site and addition of aboveground infrastructure at Bonanza Ledge		Negative	No	
Inclusion of a discharge location at the Bonanza Ledge site into Lowhee Creek		Neutral	No	
Treat and discharge water from the Bonanza Ledge WTP		Neutral	No	
Inclusion of a Lowhee Ventilation Raise		Negative	No	
Use of A Road and Highway 26 through Wells		Negative	No	

Project Component or Activity	Potential Effects or Pathway of Interaction	Direction of Change	Residual Effect	Additional Mitigation
Closure Phase				
Treat and discharge water from the Bonanza Ledge WTP	Loss or alteration of Vegetation VC subcomponents through vegetation clearing and increased traffic. Affected subcomponents include traditional use plants; non-native and invasive species; species for wildlife forage; listed ecosystems; ecological communities valued for traditional plant use; ecosystems; grassland, alpine, and subalpine communities; and wildlife tree reserves.	Neutral	No	No new mitigation measures beyond those summarized in Section 7.7.5 of the Revised Application
Post-Closure Phase				
Ongoing water treatment at the Bonanza Ledge site, until no longer needed	Loss or alteration of Vegetation VC subcomponents through vegetation clearing and increased traffic. Affected subcomponents include traditional use plants; non-native and invasive species; species for wildlife forage; listed ecosystems; ecological communities valued for traditional plant use; ecosystems; grassland, alpine, and subalpine communities; and wildlife tree reserves.	Neutral	No	No new mitigation measures beyond those summarized in Section 7.7.5 of the Revised Application
Decommissioning, dismantling, and removal of the Bonanza Ledge WTP and Lowhee Creek treated effluent discharge structure		Negative	No	
Post-Closure monitoring (active and passive care periods)		Negative	No	

Notes: QR Mill = Quesnel River Mill; VC = Valued Component; WTP = Water Treatment Plant

7.5 Cumulative Effects

The Project changes represent a negligible negative change in effects to Vegetation compared to those previously identified in the Revised Application. Overall changes presented in this document will not alter the cumulative effects that were identified for Vegetation VC subcomponents in the Revised Application and the effects identified with the Project changes discussed in this document are consistent with the conclusion presented in the Revised Application.

8.0 WILDLIFE

Section 7.8 of the Revised Application provided an evaluation of the potential Project-related effects to the Wildlife VC subcomponents. Table 8-1 summarizes the potential for Wildlife VC subcomponents to interact with the Project changes. Wildlife VC Subcomponents with potential adverse interactions with the Project changes in Section 1.0 have been carried forward and further discussed in the following sections. The direction of change column in Table 8-1 refers to a potential change from existing conditions and is measured using the following criteria.

- Negative—The potential effects will have a detrimental change compared to the existing conditions of the wildlife VC.
- Neutral—The potential effects will have no detectable change, or a negligible change, compared to the existing conditions of the wildlife VC.
- Positive—The potential effects will have a beneficial change compared to the existing conditions of the wildlife VC.

Table 8-1 Potential Project Interactions for Wildlife – Direction of Change

Project Component or Activity	Direction of Potential Effect on Wildlife VC Subcomponents								
	Amphibians	Bats	Songbirds	Forest Birds and Raptors	Southern Mountain Caribou	Ungulates	Large Carnivores	Medium Carnivores	Furbearers
Expanded QR Mill Footprint area	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Inclusion of the existing Cow Portal	Neutral	Negative	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Removal of B Road Upgrades from Project description	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Removal of the Bonanza Ledge WRSF contact water pipeline	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Maintaining a WTP at the Bonanza Ledge site and Use of aboveground infrastructure at Bonanza Ledge	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Inclusion of a discharge location at the Bonanza	Negative	Negative	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral

Project Component or Activity	Direction of Potential Effect on Wildlife VC Subcomponents								
	Amphibians	Bats	Songbirds	Forest Birds and Raptors	Southern Mountain Caribou	Ungulates	Large Carnivores	Medium Carnivores	Furbearers
Ledge Site into Lowhee Creek									
Inclusion of mining at the Lowhee Deposit	Neutral	Negative	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Inclusion of a Lowhee Ventilation Raise	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Use of A Road and Highway 26 through Wells	Neutral	Neutral	Neutral	Neutral	Negative	Negative	Negative	Neutral	Neutral

Notes: QR Mill = Quesnel River Mill; VC = Valued Component; WRSF = Waste Rock Storage Facility; WTP = Water Treatment Plant

8.1 Potential Interactions with Project Changes

Table 8-2 identifies the Project changes during each Project phase and evaluates if Project activities have potential to interact with the Wildlife VC subcomponents.

Table 8-2 Potential Negative Project Interactions for Wildlife

Project Component or Activity	Potential Negative Interactions with Wildlife VC Subcomponents									
	Amphibians	Bats	Songbirds	Forest Birds/ Raptors	Ungulates	Southern Mountain Caribou	Furbearers	Medium Carnivores	Large Carnivores	Potential Negative Effect or Pathway of Interaction
Construction Phase										
Expanded QR Mill Footprint area	No	No	No	No	No	No	No	No	No	None. Extended area is already disturbed and will not require additional vegetation clearing or sensory disturbance during construction beyond what was assessed in the Revised Application.
Inclusion of the existing Cow Portal	No	Yes	No	No	No	No	No	No	No	Potential loss or degradation of bat habitat from re-activating the existing Cow Portal. Potential direct mortality to bats from blasting and associated construction of the underground connection ramp.
Removal of B Road Upgrades from Project description	No	No	No	No	No	No	No	No	No	None. Removal of the B Road from the Project eliminates the requirement for upgrading, thereby reducing surface level impacts (e.g., grading).
Removal of the Bonanza Ledge WRSF contact water pipeline from Project Description	No	No	No	No	No	No	No	No	No	None. Removal of the WRSF contact water pipeline from the Project eliminates effects attributed to the construction and operation of the component.
Maintaining a WTP at the Bonanza Ledge site and use of aboveground infrastructure at Bonanza Ledge	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	WTP already exists. Aboveground infrastructure at Bonanza Ledge mostly already exists. Majority of the footprint was cleared previously under an approved *Mines Act* Permit. Additional clearing may be required and is included in the habitat loss calculated below.

Project Component or Activity	Potential Negative Interactions with Wildlife VC Subcomponents									
	Amphibians	Bats	Songbirds	Forest Birds/ Raptors	Ungulates	Southern Mountain Caribou	Furbearers	Medium Carnivores	Large Carnivores	Potential Negative Effect or Pathway of Interaction
Inclusion of a discharge location at the Bonanza Ledge Site into Lowhee Creek	Yes	Yes	No	No	No	No	No	No	No	Potential loss or alteration of riparian habitat from maintenance of the Lowhee Creek discharge structure. Potential direct mortality to amphibians from instream works required at the discharge location. Potential indirect mortality to bats and amphibians through changes in water quality and/or levels.
Inclusion of a Lowhee Ventilation Raise	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Potential habitat loss and alteration from the addition of the ventilation raise.
Use of A Road and Highway 26 through Wells	No	No	No	No	Yes	Yes	No	No	Yes	Potential disruption to movement and direct mortality from increased traffic on the A Road and Highway 26.
Operations Phase										
Inclusion of the existing Cow Portal	No	Yes	No	No	No	No	No	No	No	Potential sensory disturbance to bats from equipment operation.
Removal of B Road Upgrades	No	No	No	No	No	No	No	No	No	None; eliminates the use and maintenance of the B Road, reducing potential road-based mortality to wildlife.
Removal of the Bonanza Ledge WRSF contact water pipeline from Project Description	No	No	No	No	No	No	No	No	No	None; eliminates the requirement for operation of a contact water pipeline.
Inclusion of a discharge location at the Bonanza Ledge Site into Lowhee Creek	Yes	Yes	No	No	No	No	No	No	No	Direct mortality to amphibians from operational maintenance required at the discharge location. Potential loss or alteration of amphibian habitat from changes in water levels.

Project Component or Activity	Potential Negative Interactions with Wildlife VC Subcomponents									
	Amphibians	Bats	Songbirds	Forest Birds/ Raptors	Ungulates	Southern Mountain Caribou	Furbearers	Medium Carnivores	Large Carnivores	Potential Negative Effect or Pathway of Interaction
										Indirect mortality to amphibians and bats from changes in water quality and ingestion of contaminated prey species.
Treat and discharge water from the Bonanza Ledge WTP	Yes	Yes	No	No	No	No	No	No	No	Indirect mortality to amphibians and bats from changes in water quality and ingestion of contaminated prey species.
Use of aboveground infrastructure at Bonanza Ledge	No	No	No	No	No	No	No	No	No	Aboveground infrastructure at Bonanza Ledge mostly already exists. Majority of the footprint was cleared previously under an approved *Mines Act* Permit. Additional clearing may be required and is included in the habitat loss calculated below.
Inclusion of mining at the Lowhee Deposit	No	No	No	No	No	No	No	No	No	None. Increase in production rate and resource extraction at the Lowhee Zone is not anticipated to have a direct or indirect effect on wildlife.
Inclusion of a Lowhee Ventilation Raise	No	No	No	No	No	No	No	No	No	None. Once constructed, activities at the Lowhee Zone are not anticipated to have a direct or indirect effect on wildlife.
Use of A Road and Highway 26 through Wells	No	No	No	No	Yes	Yes	No	No	Yes	Potential direct mortality from increased traffic on the A Road and Highway 26
Closure Phase										
Treat and discharge water from the Bonanza Ledge WTP. Expansion of the WRSF to stabilize slopes (vegetation removal).	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Direct habitat loss during closure. Indirect mortality to amphibians and bats.

Project Component or Activity	Potential Negative Interactions with Wildlife VC Subcomponents									
	Amphibians	Bats	Songbirds	Forest Birds/ Raptors	Ungulates	Southern Mountain Caribou	Furbearers	Medium Carnivores	Large Carnivores	Potential Negative Effect or Pathway of Interaction
Post-Closure Phase										
Ongoing water treatment at the Bonanza Ledge site, until no longer needed	No	No	No	No	No	No	No	No	No	No adverse effects are anticipated to Wildlife VC.
Decommissioning, dismantling, and removal of the Bonanza Ledge WTP and Lowhee Creek treated effluent discharge structure	No	No	No	No	No	No	No	No	No	
Post-Closure monitoring (active and passive care periods)	No	No	No	No	No	No	No	No	No	

Notes: QR Mill = Quesnel River Mill; VC = Valued Component; WRSF = Waste Rock Storage Facility; WTP = Water Treatment Plant

8.2 Discussion of Potential Effects and Mitigation

Potential adverse effects to wildlife from the Project changes are identified in Table 8-2, and, if unmitigated, could cause a change in habitat and/or populations. Potential effects and mitigation measures are described in further detail below for Wildlife VC subcomponents.

8.2.1 Loss or Alteration of Habitat

Habitat loss and alteration refers to the direct removal of or reduction in the capability of habitat to support wildlife. While habitat removal is typically one of the most noticeable effects of a Project, habitat alteration due to the reduction in habitat function (e.g., change in vegetation composition) can also alter the availability of habitat for wildlife species. Wildlife responses to these changes are variable, with some species acclimatizing to activities and others avoiding areas of the Project.

8.2.1.1 Expanded QR Mill Footprint Area

Expansion of the QR Mill footprint has been made to include an existing water management ditch. The ditch is currently functional, and no further changes are expected. As there are no required changes to the water management ditch, there are no anticipated changes to habitat for Wildlife VC subcomponents during the Construction, Operations, Closure, or Post-Closure Phases. No additional mitigation measures are required for this change.

8.2.1.2 Inclusion of the Existing Cow Portal

The Cow Portal was constructed as part of the Cow Bulk Sample exploration activities. While the portal was constructed, it was not connected to existing belowground infrastructure. The Cow Portal is tarped in the winter, blocking access. Winter bat acoustic surveys were not conducted at this location as the portal had not been constructed when baseline surveys were undertaken.

The inclusion of the Cow Portal will require construction of an underground connection ramp to link the Cow Portal and existing ramp and bulk sample area to the Mine Site Complex, providing an underground route to transfer waste rock to the Bonanza Ledge WRSF. There are no proposed changes near the existing entrance to the portal that would alter the suitability of the structure as bat habitat, as works required to activate this portal will occur in the underground route away from the Cow Portal entrance.

Operation of the Cow Portal will include trucks hauling ore (during the first four years of operations) and waste rock exiting the portal. Bats are not anticipated to be impacted during operations as ongoing mining operation is expected to reduce the suitability of habitat at the Cow Portal for bats. Closure of the Cow Portal should consider mitigations outlined in the Revised Application to prevent bats from accessing portals during the Closure and Post-Closure Phases.

The inclusion of the Cow Portal is not expected to negatively effect habitat for the other Wildlife VC subcomponents assessed in the Revised Application during the Construction, Operations, Closure, or Post-Closure Phases as there are no planned above grade upgrades to the portal.

8.2.1.3 Changes at the Bonanza Ledge Site

The existing Bonanza Ledge WTP is a scalable unit, meaning that it can be expanded to increase capacity. The WTP would be maintained and upgraded, as necessary, to manage water volumes associated with the Project. Upgrades to the existing WTP would be contained to the footprint described in the Revised Application and will not result in direct habitat loss for Wildlife VC subcomponents. Removal of the contact water pipeline from the Project eliminates the potential effects associated with the construction and operation of this component, such as vegetation clearing. This will result in a positive impact for all Wildlife VC subcomponents.

The proposed Surface Footprint for the Bonanza Ledge Site has expanded to accommodate:

- New crusher and Screening plant on surface;
- Existing ore sorter;
- Existing garage;
- Existing warehouse;
- Existing mine offices;
- Use of the existing underground workings as an FMR; and
- Expansion of the WRSF at closure.

This is to allow use of existing Bonanza Ledge Phase II disturbance areas for the infrastructure and activities above, as well as for laydown and storage activities.

Proposed Project changes at the Bonanza Ledge Site will mainly occur on previously disturbed lands (i.e., areas in the currently permitted *Mines Act* Permit boundary for the Bonanza Ledge Phase II project where vegetation has been previously removed). Expansion of the WRSF will be required during closure to stabilize slopes. Anticipated habitat loss has been calculated for each Wildlife VC subcomponent and will mostly result in the loss of nil or low-quality habitat for most wildlife VC subcomponents and will not result in notable impacts. Limited vegetation clearing will be required on the northwestern perimeter of Bonanza Ledge, resulting in changes to:

- Northern goshawk: 0.2 ha low suitability habitat;
- Townsend’s warbler: 0.1 ha low suitability habitat;
- Wolverine: 7.7 ha high suitability habitat;
- Olive-sided flycatcher: 0.1 ha moderate and 7.6 ha low suitability habitat;
- Little brown myotis: 11.8 ha high suitability habitat; and
- Moose: 7.7 ha low suitability habitat.

The work is also anticipated to impact 19.5 ha rated as high capability grizzly bear habitat; however, this area has predominately been cleared. Clearing during closure may also impact modelled caribou habitat; however, the amount of habitat loss cannot be calculated from the provincial caribou habitat model used in the Revised Application as the outputs of this model do not reflect the current cleared conditions of Bonanza Ledge.

Operations activities at Bonanza Ledge are not anticipated to result in habitat lost for Wildlife VC subcomponents. Additionally, following expansion and closure of the WRSF, the Closure Phase will result in habitat restoration for several Wildlife VC subcomponents.

8.2.1.4 Inclusion of the Existing Discharge Location at Lowhee Creek

The existing WTP discharges treated water to Lowhee Creek, approximately 500 m northwest of the WTP. Amphibian presence and breeding has not been recorded in Lowhee Creek downstream of this structure; however, Columbia spotted frog (*Rana luteiventris*) egg masses, and tadpoles were recorded proximal to the Lowhee Creek headwaters, upstream of the existing WTP in an anthropogenic wetland formed from backwatering behind a culvert underneath the C Road.

The inclusion of this structure is not expected to require new clearing or habitat alteration beyond what is described in the Revised Application. Direct habitat loss during operations is not expected beyond maintenance of vegetation immediately adjacent to the discharge structures. Loss and alteration of riparian habitat that can support amphibian living habitat has been identified as a potential effect during the Closure Phase of the Project when removal of riparian habitat may be required to decommission the existing discharge structure.

In addition to direct loss of habitat, amphibian breeding habitat may be changed due to fluctuations in water levels in Lowhee Creek downstream of the discharge structure. Increased water discharge into the stream could raise water levels, altering downstream amphibian breeding habitat, if available. This could result in changes to breeding behaviours as emergent vegetation required to support egg masses and provide instream shelter is altered. This change is expected to be short-term as emergent vegetation is anticipated to establish once water levels have adjusted to discharge.

Based on the Project changes and the application of mitigation measures outlined in Section 7.8.5 of the Revised Application, the loss or alteration of habitat associated with the Construction, Operations, Closure, and Post-Closure Phases is not expected.

8.2.1.5 Mining at the Lowhee Deposit and the Lowhee Ventilation Raise

Mining of the Lowhee Zone will expand the underground footprint and require construction of the Lowhee Ventilation Raise. The additional Lowhee underground infrastructure would connect to the existing Cow Portal Ramp (existing by the time of the Project start). The Valley Portal will continue to be used as the main services access after the first four years of operations, as presented in the Revised Application. The zones are accessed by main ramps connecting to haulage drifts, and each individual zone has an internal ramp system. Vegetation clearing will occur to accommodate the construction of the ventilation raise; however, the raise will be accessed via an existing road that will not require clearing. Anticipated habitat loss has been calculated for each Wildlife VC subcomponent based on habitat models presented in the Revised Application. These values are in addition to loss calculations presented in the Revised Application:

- Little brown myotis: An additional 0.2 ha of high suitability living habitat.
- Olive-sided flycatcher: 0.2 ha moderate suitability olive-sided flycatcher reproducing habitat.

- Southern mountain caribou: 1.19 ha (0.86 good and 0.33 better[1]) of late winter and spring habitat for southern mountain caribou.
- Wolverine: 1.0 ha of high suitability wolverine denning habitat.
- Grizzly bear: 1.2 ha high suitability habitat.

Overall, construction of the Lowhee Ventilation Intake Raise will result in minimal habitat loss for the noted Wildlife VC subcomponents. Once construction is complete, operation of the Lowhee Ventilation Intake Raise is not anticipated to result in habitat loss for any Wildlife VC subcomponent. Additionally, the Closure Phase will result in habitat restoration for several Wildlife VC subcomponents. Given the effective application of mitigation measures presented in the Revised Application, the habitat loss associated with the construction, operations, and closure of the Lowhee Ventilation Intake Raise is not expected to result in cumulative effects for wildlife.

8.2.1.6 Use of A Road and Highway 26 through Wells

The Transportation Route to access the Lowhee Zone area will be changed as follows:

- Extending the use of the A Road, from Highway 26 to the B Road junction, from temporary use for the first year of the Construction Phase to use for all Project phases, particularly during the first four years of operations for hauling concentrate.
- Extending the Transportation Route to incorporate use along Highway 26 from the Mine Site Complex bypass to the A Road connection east of Wells.

These changes occur along existing roads and will not result in additional habitat loss for the Wildlife VC subcomponents during the Construction, Operations, Closure, and Post-Closure Phases.

8.2.1.7 Additional Mitigation Measures for Habitat Loss

No additional mitigations outside of those presented in Section 7.8.5 of the Revised Application are required.

8.2.2 Sensory Disturbance

Sensory disturbance can occur when project activities result in a change to light, noise, dust, or human presence from pre-Project conditions, causing a change in wildlife behaviour (Clinton and Barber 2013; Taylor and Knight 2003). Wildlife species responses to these changes are variable, with some species acclimatizing to activities and others avoiding impacted areas.

8.2.2.1 Expanded QR Mill Footprint Area

The expanded QR Mill footprint area is in use, and no changes to the water management ditch are proposed; as such, additional sensory disturbances beyond what was assessed in the Revised

[1] Mapped model results display habitat as poor, good, better, and best. For the assessment, good, better, and best were considered optimal habitat. See the Revised Application for further details.

Application are not anticipated for Wildlife VC subcomponents during the Construction, Operations, Closure, or Post-Closure Phases. No additional mitigation measures are required for this change.

8.2.2.2 Inclusion of the Existing Cow Portal

The use of the existing Cow Portal will require a new underground connection ramp to link the portal and existing ramp to an underground drift providing an underground route to transfer waste rock to the Bonanza Ledge WRSF. Construction of this connection will be mainly done by road header, but there will be a small amount of underground blasting for some refuge chambers. Sound pressure produced by blasting and other below ground activities could cause sensory disturbances to bats using the portal, if any. Bat winter acoustic surveys were not conducted at this location; however, the Cow Portal is tarped in the winter blocking access for bats. Additional mitigation measures are presented in Section 8.2.3.6 to reduce potential impacts to bats.

During operations, trucks will haul ore (during the first four years of operations) and waste rock to the surface via the Cow Portal before continuing along the existing A Road. Hauling activities, as well as maintenance of belowground facilities, are expected to result in increased noise, light, and human presence that can affect bat behaviour if present in the portal. This disturbance could result in the avoidance of previously used habitat, disruption of roosting or hibernating activities (i.e., loud anthropogenic activity creating noises that arouse bats during torpor), and displacement from feeding, breeding, or thermal or security habitat.

Closure of the Cow Portal may involve a temporary sensory disturbance while the portal undergoes closure activities; however, sensory disturbances will be temporary, and mitigation measures outlined in Section 7.8.5 of the Revised Application identified for bats would be applicable to the changes in human activity at the Cow Portal. Inclusion of the Cow Portal is not expected to affect or result in sensory disturbance to other Wildlife VC subcomponents.

8.2.2.3 Changes at the Bonanza Ledge Site

Upgrading the Bonanza Ledge WTP to accommodate the volume of water associated with the Bonanza Ledge WRSF could result in changes in noise, light, and human presence during the Construction Phase; however, the WTP is currently in operation, and upgrades would occur in an area that has previously been modified. As such, additional sensory disturbances on Wildlife VC subcomponents, except for amphibians, are expected to be negligible.

Columbia spotted frog were recorded breeding upstream of the existing WTP, proximal to the Lowhee Creek headwaters, in a wetted area formed from backwatering behind a culvert underneath the C Road. Additional aboveground structures at Bonanza Ledge will include a new crusher and screening plant, which has the potential to add to sensory disturbances at the site. This is most likely to occur during the Construction Phase while the crusher and screening plant is being built. Amphibians breeding proximal to construction areas may alter their behaviour (e.g., calling patterns) in response to additional noise. This effect is expected to be limited temporally to construction of the equipment, and amphibians are expected to adapt to the additional work.

New or increased disturbance to wildlife beyond what was assessed in the Revised Application is not expected during operation as similar activities are already occurring at the Bonanza Ledge site. Wildlife occurring proximal to Bonanza Ledge could be disturbed during closure as additional clearing activities are required during this period. Clearing during this period is limited to the northwestern perimeter of Bonanza Ledge, an area adjacent to the area being regularly used during operations. As such, wildlife

occurring proximal to Bonanza Ledge will likely have been previously exposed to sensory disturbances associated with operational activities. Sensory disturbances to wildlife during the Operations and Post-Closure Phases are not predicted.

8.2.2.4 Inclusion of the Existing Discharge Location at Lowhee Creek

Upgrades and maintenance of the WTP discharge structure may result in periodic increases in noise while equipment is operated and has the potential to impact amphibians. If these activities occur during the amphibian breeding period, noise generated from work activities could interact with amphibian vocal displays, affecting amphibian communication. Amphibian breeding has been documented upstream of the existing discharge location, proximal to the headwaters of Lowhee Creek, approximately 200 m southwest of the existing WTP. Additional amphibian breeding habitat associated with Lowhee Creek may be available downstream of the discharge point where ponding areas exist. Sensory disturbances are not anticipated during the Closure or Post-Closure Phases to Wildlife VC subcomponents.

8.2.2.5 Mining at the Lowhee Deposit and the Lowhee Ventilation Intake Raise

Mining will begin at the Lowhee Zone, using the same methodology, equipment, and dimensions as provided for the Valley, Island Mountain, Cow, and Shaft Zones in the Revised Application. Sensory disturbance is only anticipated during construction of the Lowhee Ventilation Intake Raise. Wildlife is likely to avoid the area due to increased human presence. Once in operation, the ventilation raise will only be accessed as an emergency escape way and is not expected to result in ongoing sensory disturbances for Wildlife VC subcomponents. Closure of the Lowhee Ventilation Intake Raise will result in temporary sensory disturbance, while the ventilation raise is removed; however, sensory disturbances will be temporary in nature and mitigation measures outlined in Section 7.8.5 of the Revised Application would be applicable to the changes in human activity during this time.

8.2.2.6 Use of A Road and Highway 26 through Wells

The A Road and Highway 26 are existing and do not require upgrades. As there are no required changes, there are no anticipated sensory disturbances for Wildlife VC subcomponents during the Construction, Operations, Closure, and Post-Closure Phases, beyond what was assessed in the Revised Application. No additional mitigation measures are required for this change.

8.2.2.7 Additional Mitigation Measures for Sensory Disturbance

No additional mitigations outside of those presented in Section 7.8.5 of the Revised application are required.

8.2.3 Direct Mortality

Direct mortality describes the potential for Project activities and infrastructure to result in on-site wildlife mortality. Direct mortality may occur due to site preparation, vegetation removal, ground disturbance, and collisions with Project-related traffic.

8.2.3.1 Expanded QR Mill Footprint Area

No clearing or upgrades are required to expand the QR Mill Footprint; as such, direct mortality is not anticipated for Wildlife VC subcomponent during the Construction, Operations, Closure, or Post-Closure Phases. No additional mitigation measures are required for this change.

8.2.3.2 Inclusion of the Existing Cow Portal

Construction of the underground ramp at the Cow Portal will require some underground blasting. Based on the location of the blasting work, it is unlikely that these activities would result in mortality to bats as the Cow Portal is tarped in the winter, blocking access for bats. If present during winter months, blasting could cause disturbance and/or direct mortality.

Risk of bat mortality during operation of the Cow Portal is expected to be limited predominantly because ongoing activity at the portal will likely deter bat use, which reduces potential interactions. Closure of the Cow Portal may result in temporary disturbance; however, mitigation measures presented in Section 7.8.5 of the Revised Application and below in Section 8.2.3.6 are anticipated to reduce potential use of the Cow Portal and closure activities are unlikely to result in direct mortality to bats.

Using the Cow Portal as an alternative to surface transport is expected to reduce the risk of direct mortality to other wildlife species (e.g., birds, amphibians, mammals).

8.2.3.3 Changes at Bonanza Ledge and Inclusion of the Existing Discharge Location at Lowhee Creek

With the addition of Lowhee Zone mining, an additional sediment pond will be constructed at the South Sump (southeast portion of the WRSF) in an existing disturbed area. Water from the WRSF and site will be collected into the existing Bonanza Ledge Sediment Control Pond, described in the Revised Application, and the proposed additional South Sump. The existing WTP at Bonanza Ledge will treat water from both the Sediment Control Pond and the South Sump and discharge to Lowhee Creek. During Phase 1 of the Operations Phase (Year 1 to Year 4), ODV proposes to upgrade the existing Bonanza Ledge Sediment Control Pond with a retention dike and create an FMR in the existing Bonanza Ledge mine underground workings to temporarily store water during storm events, along with a network of existing contact and non-contact water ditches.

Construction of aboveground infrastructure has the potential to result in direct mortality. Maintenance and decommissioning of the existing discharge into Lowhee Creek could also result in direct amphibian mortality through changing water levels at the discharge location, sediment control ponds, and sumps. The risk of direct mortality would be greater during the spring, summer, and early fall, during the amphibian breeding and rearing period, as amphibians are in egg and tadpole form during this period and are dependent on water conditions for survival to adulthood. However, mitigation measures outlined in Section 7.8.5 of the Revised Application are expected to reduce the impact of construction activities and prevent the direct mortality of wildlife species. Earth works during closure activities could result in direct morality of smaller wildlife, such as amphibians. In addition, vegetation clearing during the sensitive bird nesting period could result in loss of eggs and chicks that are unable to move away from work activities.

8.2.3.4 Mining at the Lowhee Deposit and the Lowhee Ventilation Intake Raise

Construction of aboveground infrastructure has the potential to result in direct wildlife mortality. The risk of mortality is increased during vegetation and ground disturbance activities, particularly during sensitive periods, such as during bird nesting. However, mitigation measures outlined in Section 7.8.5 of the Revised Application are expected to reduce the impact of construction, operations, and closure activities, and prevent the direct mortality of Wildlife VC subcomponents.

8.2.3.5 Use of A Road and Highway 26 through Wells

The Project will remove use of the B Road and will instead use the A Road and Highway 26 to exit Bonanza Ledge, slightly increasing the length of the Transportation Route. This change is predicted to increase traffic volume along the A Road and the portion of Highway 26 through Wells. Increase in traffic volume is predicted to increase the risk of wildlife mortality risk due to vehicle collision before mitigation.

Use of this revised portion of the proposed Transportation Route from A Road at Bonanza Ledge Site to Highway 26 will include:

- For the first four years of the Project:
  - 18 to 25 haul trucks per day (same number of trucks as described in the Revised Application for the Transportation Route from the Mine Site Complex to QR Mill);
  - Personnel vehicles; and
  - Delivery vehicles (e.g., supplies, fuel, etc.).
- From Year 4 to the end of mine life:
  - Two to four light (pick-up) trucks per day, and monthly delivery vehicles (e.g., for the WTP).

Wildlife road mortality data collected under the BC Ministry of Transportation and Infrastructure (MOTI) Wildlife Accident Reporting System (WARS) from 2011 to 2019 was received from BC MOTI on November 30, 2021. Based on the highest traffic scenario (shift change and a delivery day), it is estimated that 25 vehicles could be added to the roadways surrounding the Project. This would be a <1% increase in traffic from baseline (see Traffic Impact Assessment in the Revised Application). Given the nominal increase in traffic volume due to the change in the proposed Transportation Route, the increased risk of mortality to Wildlife VC subcomponents from what was assessed in the Revised Application is expected to be negligible. Mitigation measures outlined in Section 7.8.5 of the Revised Application are expected to reduce the impact of construction, operations, and closure activities, and prevent the direct mortality of Wildlife VC subcomponents.

8.2.3.6 Additional Mitigation Measures for Direct Mortality

It is understood that the Cow Portal is blocked during the winter; therefore, it is not expected to support bat hibernation. During operations, the portal will be continuously in use, reducing the suitability for bats. The Cow Portal should remain blocked prior to operations to continue to exclude bats. Surveys for hibernating bats are recommended in the event that the portal is not blocked prior to operations. Additional mitigations, such as surveys, should be implemented if the portal becomes inactive during operations. If periods of inactivity (considered more than two weeks) are anticipated during operations, a QP should be retained to develop additional mitigation measures, such as blocking access for bats or conducting additional surveys. Additional mitigation developed by a QP would be required if bats are found during surveys.

8.2.4 Indirect Mortality

Indirect mortality describes wildlife mortality that occurs as a secondary effect due to Project components or activities. Examples of indirect mortality include incidental ingestion of chemicals or contaminated food/water, or changes in predator/prey dynamics.

8.2.4.1 Expanded QR Mill Footprint area

As discussed above, the expansion of the QR Mill footprint area is not expected to require vegetation clearing or changes to the existing ditch; as such indirect wildlife mortality is not anticipated during the Construction, Operations, Closure, or Post-Closure Phases. No additional mitigation measures are required for this change.

8.2.4.2 Inclusion of the Existing Cow Portal

Inclusion of the Cow Portal is not expected to result in an increase in the risk of indirect mortality to Wildlife VC subcomponents during the Operations or Closure Phases. As bat use is not anticipated but currently unknown, construction of the underground infrastructure could cause spontaneous arousal from torpor and the indirect mortality of bats if they are utilizing the portal for winter hibernation. Mitigation measures outlined in Section 7.8.5 of the Revised Application and in Section 8.2.3.6 are expected to reduce the impact of direct mortality from construction, operations, and closure activities to bats and other wildlife species.

8.2.4.3 Changes at the Bonanza Ledge Site

Upgrades to the existing WTP and other changes at the Bonanza Ledge Site are not expected to result in indirect mortality to Wildlife VC subcomponents.

8.2.4.4 Inclusion of the Existing Discharge Location at Lowhee Creek

Indirect mortality due to changes in surface water quality is possible, but unlikely. Exposure pathways from the treated effluent water into Lowhee Creek may exist for wildlife, particularly insectivorous species (bats, songbirds) and amphibians that rely on aquatic invertebrates. The discharge of treated effluent water into Lowhee Creek from the existing Bonanza Ledge WTP is governed by Permit 17876. Section 3.1 provides a discussion of predicted surface water quality in Lowhee Creek. Based on this analysis, Project changes are not expected to result in increased or new concentrations or chemicals

The indirect mortality of bats, songbirds, and amphibians is not expected from the Project changes during the Construction, Operations, Closure, or Post-Closure Phases. No additional mitigation measures are required for this change.

8.2.4.5 Mining at the Lowhee Deposit and the Lowhee Ventilation Intake Raise

Inclusion of mining at the Lowhee Deposit and addition of the Lowhee Ventilation Intake Raise is not expected to result in an increase in the risk of indirect mortality to Wildlife VC subcomponents during the Construction, Operations, Closure, or Post-Closure Phases. No additional mitigation measures are required for this change.

8.2.4.6 Use of A Road and Highway 26 through Wells

The Project will not require updates to the A Road and Highway 26. As such, indirect mortality is not anticipated for Wildlife VC subcomponents during the Construction, Operations, Closure, or Post-Closure Phases. No additional mitigation measures are required for this change.

8.2.4.7 Additional Mitigation Measures for Indirect Mortality

Bat surveys, as stated in Section 7.8.5 of the Revised Application, should be considered, in consultation with a QP, to assess the use of the portal as winter hibernacula if the portal becomes accessible to bats.

8.3 Characterization of Residual Effects

The Project changes described in Section 1.0 are not expected to result in residual effects to Wildlife VC subcomponents beyond those described in the Revised Application following implementation of mitigation noted in Section 7.8.5 of the Revised Application. In general, the Project changes are expected to result in a negligible change in potential effects to wildlife when combined with the effects assessed in the Revised Application. The use of the existing Cow Portal and removal of B Road from the Project will negate upgrading stream crossings, reduce habitat loss and alteration, and reduce the risk of road-based wildlife mortality. Conversely, the establishment of underground connectivity between the existing Cow Portal and the Project could affect bats.

Using the Bonanza Ledge WTP and existing effluent discharge structure eliminates the need for a new contact water pipeline, thereby avoiding habitat and sensory disturbance associated with the construction of these features. The discharge of treated effluent into Lowhee Creek from the existing Bonanza Ledge WTP is not expected to change surface water quality from existing conditions and is expected to result in a neutral effect from current conditions for indirect mortality of bat and amphibians at this location or in the downstream systems.

Table 8-3 provides a summary of Project components, potential effects, direction of change, and a determination of residual effect. The direction of change column in Table 8-3 refers to a potential change from existing conditions and is measured using criteria below:

- Negative—The potential effects will have a detrimental change compared to the existing conditions of the wildlife VC.
- Neutral—The potential effects will have no detectable change, or a negligible change, compared to the existing conditions of the wildlife VC.
- Positive—The potential effects will have a beneficial change compared to the existing conditions of the wildlife VC.

Mitigation measures for Wildlife VC subcomponents are summarized in Section 7.8.5 of the Revised Application and in the relevant sections above.

Table 8-3 Summary of Residual Effect Determinations for Wildlife

Project Component or Activity	Potential Effects or Pathway of Interaction	Direction of Change	Residual Effect	Additional Mitigation
Construction Phase				
Inclusion of the existing Cow Portal	• Sensory disturbance during construction to bats	Negative	Yes	Bat surveys should be considered, in consultation with a QP, if the Portal becomes accessible to bats to assess the use of the portal as a winter hibernation. This additional mitigation measure is proposed to supplement those in Section 7.8.5 of the Revised Application.
Maintaining a WTP at the Bonanza Ledge Site and addition of aboveground infrastructure at Bonanza Ledge	• Loss or alteration habitat from vegetation removal during construction of additional infrastructure • Sensory disturbance during construction of additional infrastructure to wildlife	Negative	Yes	No new mitigation measures are proposed from those listed in Section 7.8.5 of the Revised Application.
Inclusion of a Lowhee Ventilation Raise	• Loss or alteration habitat from clearing during construction of additional infrastructure	Negative	Yes	No new mitigation measures are proposed from those listed in Section 7.8.5 of the Revised Application.
Operations Phase				
Inclusion of the existing Cow Portal	• Sensory Disturbance to bats	Negative	Yes	Bat surveys should be considered in consultation with a QP if the Portal becomes accessible to assess the use of the portal as a winter hibernation. This additional mitigation measure is proposed to supplement those in Section 7.8.5 of the Revised Application.
Use of A Road and Highway 26 through Wells	• Direct mortality to ungulates, furbearers, medium, and large carnivores through increased traffic	Negative	Yes	No new mitigation measures are proposed from those listed in Section 7.8.5 of the Revised Application.

Notes: QP = Qualified Professional; WTP = Water Treatment Plant

8.4 Cumulative Effects

The Project changes represent a negligible negative change in effects to Wildlife when combined with those previously identified in the Revised Application. Overall changes presented in this document will not alter the cumulative effects identified for Wildlife VC subcomponents in the Revised Application and the effects identified with the Project changes discussed in this document are consistent with the conclusions presented in the Revised Application.

9.0 AIR QUALITY

Results of the initial screening (Appendix A and Appendix B) determined that the Project changes described in Section 1.0 have the potential to interact with the Air Quality VC during the Construction, Operations, Closure, and Post-Closure Phases.

An initial screening assessment of the changes in air emissions resulting from the Project changes, as well as a qualitative discussion of the predicted changes in ambient air concentration, is presented in the subsections below.

9.1 Potential Interactions with Project Changes

Changes to the Air Quality VC may result from the following Project changes:

- Annual mine ore production to 1,500 tpd during years 1 to 4 (Phase 1) of mine production, with full production rate of 4,900 tpd during remaining years 5 to 16 (Phase 2);
- Removal of the use of B Road by heavy-duty vehicle (HDV) traffic during the entire life of mine;
- Aboveground trucking of ore and waste rock only from the Cow Portal beside A Road to Bonanza Ledge during the first 4 years of mine operation, and not along B Road;
- Aboveground trucking of waste rock only from the Cow Portal beside A Road to Bonanza Ledge during the final 12 years of mine operation, and not along B Road;
- Storage, crushing, and sorting of ore at Bonanza Ledge during the first four years of mine operation;
- Trucking of sorted ore from Bonanza Ledge along A Road to Highway 26, and subsequently through Wells during the first four years of mine operation; and
- Relocation of select mine ventilation portals and vents throughout the entire operational period.

9.2 Discussion of Potential Effects

The potential for each of the Project changes listed above to increase or decrease Project air contaminant emissions was considered. The subsections below discuss the considerations for each Project change.

9.2.1 Phased Production Rates and Early Development of Lowhee Deposit

In and of itself, the reduction in mine production rates during the initial four years of the 2023 modified Project plan is not predicted to result in an appreciable change in Project emissions. Review of a modified mine plan summary provided by ODV indicated that the maximum annual volumes of waste rock and ore handled during years 1-4 and 4-16 did not differ considerably from the Revised Application. As such, there was not a strong justification for changing the assumed total activity levels of underground and surface equipment. Instead, changes in emissions associated with specific changes to the location and types of activities carried out during the newly proposed two development phases were assessed as described below.

9.2.2 Removal of B Road to Heavy Duty Vehicle Traffic

The removal of B Road (extending from the Mine Site Complex up to the midpoint of A Road) from the Project for use in hauling waste rock by HDVs during the entire mine life will result in a reduction in estimated emissions of particulate matter from road dust. As the HDV traffic that previously would have traversed B Road will still be occurring, primarily through underground haulage of waste to the Cow Portal beside A Road, no overall reduction of emission from haulage vehicles is expected as the haulage vehicles are electric whether they are used on surface or underground.

9.2.3 Aboveground Trucking of Ore and Waste Rock

Due to the removal of use of B Road to HDV traffic, all aboveground trucking of waste rock for the full mine life will occur from the Cow Portal along A Road to the WRSF at Bonanza Ledge. Beyond the reduction in particulate matter from road dust associated with the removal of B Road (detailed above), there will be no other changes to emissions associated with waste rock haulage or storage.

The aboveground trucking of raw ore from the Cow Portal along A Road to Bonanza Ledge during Phase 1 will result in an increase in emissions of particulate matter from road dust, as the Revised Application did not include any aboveground trucking of raw ore. The road dust emissions associated with aboveground ore trucking will end when the mine transitions to Phase 2 operations when raw ore processing will happen underground and within the Mine Services Building.

9.2.4 Storage, Crushing, and Sorting of Ore at Bonanza Ledge

During Phase 1, ore will be placed into an ore storage pile at Bonanza Ledge and crushed, screened, and sorted prior to loading into highway haul trucks for transportation to QR Mill for further processing. All of the ore handling operations occurring at Bonanza Ledge represent incremental emissions of fugitive particulate matter relative to the Revised Application. Standard USEPA estimation methodologies for Aggregate Handling and Storage Piles (USEPA 2006), Western Surface Coal Mining (USEPA 1998), and Metallic Minerals Processing (USEPA 1982) were utilized to determine the magnitude of incremental emissions associated with ore handling. It was assumed that the ore screening, crushing, and sorting will occur in an enclosed structure with particulate emissions control devices installed.

9.2.5 Trucking of Sorted Ore from Bonanza Ledge

During Phase 1, sorted ore will be hauled from Bonanza Ledge, along the A Road to Highway 26, through Wells, and onwards to QR Mill. This operation produces incremental emissions of particulate matter from road dust (both unpaved and paved) relative to the Revised Application, which assumed all sorted and concentrated ore haulage occurred from the Mine Services Building in the Mine Site Complex. It will also result in a modest increase in aboveground diesel exhaust emissions from highway ore haul trucks, but in the context of overall Project emissions, this change is anticipated to be minimal.

9.2.6 Relocation of Mine Ventilation Portals and Vents

With the Project changes, the locations of all exhaust portals and vents except the Primary/Valley Portal and Island Mountain Portal will be adjusted relative to what was presented in the Revised Application. The largest change will be the use of the Cow Portal Exhaust along A Road for the duration of the Project, from construction through year 16. Additionally, the majority of the exhaust flow from the Island Mountain Portal will be relocated to a new Shaft Exhaust Raise.

Despite the relocation of mine ventilation locations, the overall ventilation flows expected with the Project changes are similar to the flows in the Revised Application, and the highest underground activity levels are also similar; therefore, total emissions from underground activities (and thus from ventilation portals) are not expected to change considerably. Instead, the primary effect of the ventilation relocation throughout the Project lifespan is a shift of ventilation flows and emissions away from the Primary/Valley and Island Mountain Portals located on the valley bottom in Wells to higher elevation locations with setbacks away from Wells.

9.2.7 Summary

The following table provides a per-phase summary of the emissions changes detailed above, disaggregated to the main areas in which the changes occur. As discussed above, the largest changes are associated with road dust and ore handling dust, so the table is focused on these air contaminants.

Table 9-1 Summary of Emissions Changes Associated with the Project Changes

	Phase 1 (Year 1-4) Change Relative to Revised Application (tonnes per year)			Phase 2 (Year 4-16) Change Relative to Revised Application (tonnes per year)		
	Total PM	**PM_{10}**	**$PM_{2.5}$**	**Total PM**	**PM_{10}**	**$PM_{2.5}$**
A Road	13.63	3.37	0.30	0.00	0.00	0.00
B Road	-6.82	-1.72	-0.19	-6.82	-1.72	-0.19
Bonanza Ledge	4.39	1.69	0.42	0.00	0.00	0.00
Highway 26 Through Wells	3.20	0.61	0.15	0.00	0.00	0.00
Total Change	14.39	3.95	0.67	-6.82	-1.72	-0.19
Percentage Change of Total Mine Emissions Relative to Revised Application Maximums	23%	16%	8%	-11%	-7%	-2%

Notes: % = percent; PM = total particulate matter; PM_{10} = inhalable particulate matter: $PM_{2.5}$ = fine particulate matter

As the table indicates, the increase in aboveground haulage and ore handling activity in Phase 1 (Years 1 – 4) results in a net increase in particulate matter emissions relative to the Revised Application, primarily along A Road and in the Bonanza Ledge area, with a smaller increase in emissions along Highway 26 through Wells. Conversely, Phase 2 (Years 5 – 16) results in a net decrease in particulate matter emissions associated with the planned elimination of B Road haulage operations.

Associated with the increase in emissions during Phase 1, there are expected to be increases in predicted ambient levels of particulate matter in the Bonanza Ledge area, and along A Road, with modest increases along Highway 26 through Wells. The majority of these increases will occur away from the community of Wells, and most sensitive receptors identified in the Revised Application. It's also important to emphasize that these increased emissions and their associated effects would occur only during Years 1 – 4 of the Project. For emissions occurring near sensitive receptors, particularly along Highway 26, additional emissions control measures, such as periodic road sweeping during dry weather, could considerably reduce emissions and associated ambient impacts. Additionally, increased frequency of the application of a dust suppressant during dry conditions along A Road could reduce unpaved road dust emissions and associated ambient impacts.

As previously noted, the relocation of the mine ventilation portals and vents associated with the Project changes does not result in a net decrease in emissions from underground operations. However, relative to the Revised Application, it does shift 10.6 tonnes per year (tpy) nitrogen oxides (NO_x), 2.4 tpy total particulate matter (PM), 1.2 tpy particulate matter <10 microns (PM_{10}), and 0.9 tpy particulate matter <2.5 microns ($PM_{2.5}$) away from the valley bottom in Wells to higher elevation emission points that are set back away from sensitive receptor locations. This is likely to have a positive effect on predicted ambient air contaminant levels at sensitive receptor locations within Wells.

9.3 Mitigation

Mitigation measures outlined in Section 7.2.5 of the Revised Application will be implemented to reduce the potential effects of the Project changes. Additional mitigation measures during Phase 1 include road sweeping along Highway 26 in Wells and the increased frequency of the application of a dust suppressant during dry conditions along A Road.

9.4 Identification of Residual Effects

The Phase 1 (Years 1 – 4) Project changes have the potential to cause a neutral to negative change to the effects of the Project compared to the Revised Application during dry conditions. These changes will be addressed by implementing the additional mitigation measures stated in Section 9.3, which, following implementation, are predicted to result in a neutral change compared to the Revised Application.

The Phase 2 (Year 5 – 16) Project changes are predicted to result in a positive change to the overall residual effects compared to the Revised Application.

9.5 Cumulative Effects

The Project changes have the potential to cause a positive change overall to cumulative effects compared to the Revised Application during Phase 2 (Years 5 – 16) and cause a neutral change to cumulative effects compared to the Revised Application during Phase 1 (Years 1 – 4) assuming application of the additional mitigation measures noted above for Phase 1, which will reduce the estimated emissions, and thus associated ambient impacts during this phase.

10.0 ACOUSTIC ENVIRONMENT

Section 7.3 of the Revised Application provided an evaluation of the potential Project-related effects to the Acoustic VC subcomponents. Results of the initial screening (Appendix A and Appendix B) determined that the Project changes described in Section 1.0 have the potential to interact with Acoustic resources during the Construction and Operations Phases.

10.1 Potential Interactions with Project Changes

Appendix D provides a description of potential interactions between Acoustic resources and the Project changes, including resulting changes in the VC study boundary and the Construction and Operations Phase modelling scenarios. Potential interactions between Acoustic resources and the Project changes only occur at the Mine Site; therefore, only those scenarios have been revised as described below.

10.2 Discussion of Potential Effects

Potential effects to Acoustic resources at the Mine Site incorporating the Project changes are provided below. Consistent with Section 7.3 and Appendix 7.3.2 of the Revised Application, two representative receptors from the Mine Site are presented. These are the same receptors used in the Revised Application. The results from the remaining receptors can be found in Appendix D.

In the results discussed below, control mitigation was assumed to be in place, as discussed in Section 7.3 and Appendix 7.3.2 of the Revised Application and updated as described in Section 9.3.

10.2.1 Change in Noise Levels

10.2.1.1 Audible Noise from Construction

In Section 7.3.4.4.1.1 and Appendix 7.3.2 of the Revised Application, the predicted sound levels for the Construction Phase scenario at two receptors near the mine were presented, comparing compliance limits of Health Canada Guidelines (Health Canada 2017) and Environmental Canada's Environmental Code of Practice for Metal Mines (ECPMM) Guidelines (Environment Canada 2009). Table 10-1 and Table 10-2 provide the updated results based on the Project changes, illustrating compliance with Health Canada Guidelines and ECPMM Guidelines, respectively. Figure E of Appendix D provides the equivalent sound level contours for the Project Construction Phase for the Mine Site area during daytime hours.

Table 10-1 Predicted Sound Level at Points of Reception – Construction (Health Canada Guidelines)

POR ID	ADJ Baseline	ADJ Project	Cumulative	Allowable Change in %HC	Actual Change in %HC	Effect Assessment
R3_09	51.4	54.1	56.0	6.5	2.0	No Effect, No Further Mitigation
R1_05	50.1	54.6	55.9	6.5	2.4	No Effect, No Further Mitigation

Notes: ADJ: Adjusted in accordance with Health Canada guidelines; ID = Identification; POR = Point of Reception; %HC = percent of Health Canada Guideline

Table 10-2 Predicted Sound Level at Points of Reception – Construction (ECPMM Guidelines)

POR ID	The Project Contributed SPL at POR Day/Night (Leq – dBA)	Performance Limit Day/Night (dBA)	Compliance with Criteria (Yes/No)
R3_09	44 / 44	55 / 45	Yes
R1_05	45 / 45	55 / 45	Yes

Notes: SPL: sound pressure level; dBA = A-weighted decibel units; ID = Identification; POR = Point of Reception; Leq = equivalent sound pressure level

10.2.1.2 Audible Noise from Operations

In Section 7.3.4.4.1.2 and Appendix 7.3.2 the Revised Application, the predicted sound levels for the operations scenario at two receptors near the mine were presented, comparing compliance limits of Health Canada Guidelines (Health Canada 2017) and ECPMM Guidelines (Environment Canada 2009). Table 10-3 and Table 10-4 below present the updated results based on the Project changes, illustrating compliance with Health Canada Guideline limits and ECPMM Guidelines, respectively. Figure D in Appendix D provides the equivalent sound level contours for the Project Operations Phase in the Mine Site area during daytime hours.

Table 10-3 Predicted Sound Level at Points of Reception – Operations (ECPMM Guidelines)

POR ID	ADJ Baseline	ADJ Project	Cumulative	Allowable Change in %HC	Actual Change in % HC	Effect Assessment
R3_09	51.4	53.3	55.5	6.5	1.8	No Effect, No Further Mitigation
R1_05	50.1	54.8	56.1	6.5	2.0	No Effect, No Further Mitigation

Notes: ADJ: Adjusted in accordance with Health Canada guidelines; ID = Identification; POR = Point of Reception; %HC = percent of Health Canada guideline.

10.2.1.3 Low Frequency Noise

In Section 7.3.4.4.1.3 and Appendix 7.3.2 of the Revised Application, the predicted sound levels for the operations scenario at two receptors near the mine were presented comparing compliance limits endpoints as discussed in Section 7.3 of the Revised Application. As indicated in the updated results provided in Table 10-4 and Table 10-5 for the Construction and Operations Phase scenarios, respectively, based on the Project changes, the low frequency noise (LFN) effects from the Project (the difference between dBA and dBC) remain greater than the limit of 20 decibels (dB); therefore, tonal components were reviewed. The tonal components are below 250 hertz (Hz); therefore, the LFN effects from the Project changes are not a concern as per guidelines.

Table 10-4 Predicted Low Frequency Sound Level at Points of Reception – Construction

POR ID	The Project Contributed SPL at POR (LEQ – dBA)	The Project Contributed SPL at POR (LEQ – dBC)	Difference (dBC-dBA)	Limit for Difference (dB)	Is dBC – dBA > 20 (Yes/No)	Is there Tonal Below 250 Hz (Yes/No)	Compliance with Criteria (Yes/No)
R3_09	45	61	16	20	No	No	Yes
R1_05	45	63	18	20	No	No	Yes

Notes: SPL: sound pressure level; dBA = A-weighted decibel units; dBC = C-weighted decibel units; ID = Identification; POR = Point of Reception; Leq = equivalent sound pressure level; Hz = hertz

Table 10-5 Predicted Low Frequency Sound Level at Points of Reception – Operations

POR ID	The Project Contributed SPL at POR (Leq – dBA)	The Project Contributed SPL at POR (Leq – dBC)	Difference (dBC-dBA)	Limit for Difference (dB)	Is dBC – dBA > 20 (Yes/No)	Is there Tonal Below 250 Hz (Yes/No)	Compliance with Criteria (Yes/No)
R3_09	43	68	24	20	Yes	No	Yes
R1_05	45	72	27	20	Yes	No	Yes

Notes: SPL: sound pressure level; dBA = A-weighted decibel units; dBC = C-weighted decibel units; ID = Identification; POR = Point of Reception; Leq = equivalent sound pressure level; Hz = hertz

10.2.2 Additional Considerations

In Section 7.3.4.4.4 and Appendix 7.3.2 of the Revised Application, there were additional assessments conducted and included in Attachment E of Appendix 7.3.2 of the Revised Application. The changes and impacts associated with the Project changes were also assessed as described below. Additional detail is provided in Appendix D.

Assessment of Operations Phase Noise in Accordance with BC Oil and Gas Commission (OGC) Permissible Sound Level

The most affected receptor remains R1_05, with a cumulative predicted sound level of 54 dBA during the daytime and 47 dBA during the nighttime, which remains the same as assessed for the Revised Application and is within the BC OGC permissible sound level (PSL) limits of 58 dBA during the day and 48 dBA during the night. In addition, the cumulative predicted sound levels comply with the PSL at all receptors during operations; thus, noise control measures above what were already previously identified in Appendix 7.3.2 of the Revised Application are not required. Additional detail is provided in Appendix D.

Assessment of Potential Use of Additional Sources such as a Roadheader instead of Blasting during Construction and Pile Driving for Bridge Construction

The impacts of the additional sources, such as the roadheader and pile driving with the proposed Project changes as mentioned above, are noted below:

- The updated predicted sound levels for the construction scenario with the additional two sources (roadheader use during mining of the Lowhee Zone and piling activities during bridge construction) and the Project changes still show compliance with Health Canada Guideline limits and no significant added contribution to actual sound levels (Health Canada 2017).
- The overall sound levels at the representative points of reception (PORs) for the predictable worst-case Operations Phase scenario for the Project with the additional two sources and the Project changes still show compliance with the limits of ECPMM Guidelines (Environment Canada 2009).
- Even though BC OGC guidelines do not provide specific noise limits for construction activities, for completeness, the use of the roadheader and pile driving construction activities were compared against PSL limits of BC OCG Noise Guidelines (BC OGC 2018). The highest predicted sound level of 54 dBA during the daytime and 46 dBA during the nighttime is still within the BC OGC PSL limits of 58 dBA during the day and 48 dBA during the night.

Low Frequency Noise from Construction

The A-weighted and C-weighted sound level due to the construction of the Project with the additional Project sources are provided in Appendix D. The highest predicted sound level difference between dBA and dBC is still 24 dB, which is more than the limit of 20 dB. Therefore, tonal components below 250 Hz were verified in accordance with the BC OCG guideline. The verification showed that there were no tonal components below 250 Hz noted. Therefore, the LFN effects from the Project are not a potential concern. In addition, as discussed during the review process, a monitoring requirement was considered for LFN, and is still a recommendation.

Impulsive and Vibration Noise

The Project changes have no impact on impulsive and vibration noise from construction equipment and thus no changes are required from the assessment in the Revised Application, and the predicted sound levels at the closest receptors will remain in compliance with the sound level limits without the need for additional noise control measures or vibration control measures beyond those already stated in Appendix 7.3.2 of the Revised Application.

Noise Induced Hearing Loss

As per Health Guidelines, there is no known risk of permanent hearing loss associated with sound levels below 70 dBA, regardless of the exposure (Health Canada 2017). The highest predicted sound level with the Project changes is 51 dBA at R3_09, which is less than 70 dBA; therefore, risk of noise induced hearing loss from the Project is not identified.

Noise Induced Sleep Disturbance

The highest predicted daytime and nighttime hourly sound levels at the window of R3_09 are 51 dBA and 44 dBA, respectively. The Health Guidelines define sleep disturbance by saying “for estimating the likelihood of sleep disturbance on any given night;” this implies sleep disturbance should only be addressed during nighttime hours (Health Canada 2017). The highest predicted nighttime hourly sound level is 44 dBA (R3_09); therefore, with the Project changes, noise-induced sleep disturbance is not likely.

Interference with Speech Comprehension

Speech comprehension effects could be a concern if sound levels are greater than 55 dBA. Given the Project sound levels with the Project changes remain less than 55 dBA outdoors, interference with speech comprehension is still not expected.

Potential Human Health Effects

The results in the revised tables (Appendix D) with the Project changes shows that the percent highly annoyed (%HA) is still less than 6.5; therefore, potential human health effects are minimal.

10.3 Mitigation

The mitigation measures provided in Section 7.3.7.1 (Table 7.3-13) and Appendix 7.3.2 of the Revised Application were used and assumed in the updated noise assessment to demonstrate compliance with the guidelines discussed in Section 7.3 of the Revised Application.

However, the following additional mitigation for the Operations Phase were assumed in the assessment and can be used to demonstrate compliance:

- Transformers used at the Cow Portal and Bonanza Ledge Site will be no more than 100 dBA of total sound power level.
- Fans at ventilation raises and portal exhausts will have at least the following sound attenuation:
  - Portal Exhaust (Cow Zone) Fan sound levels will be below 106 dBA (116 dBA – 10 dB); and
  - Ventilation Raise Exhaust (Shaft Zone) Fan sound levels will be below 104 dBA (124 dBA – 20 dB).

10.4 Characterization of Residual Effects

Updated operations noise or construction noise predictions reflecting the Project changes show compliance with Health Canada Guidelines, BC OGC Guidelines, and ECPMM Guidelines with implementation of the mitigation described in Section 10.3. Therefore, the residual effects identification and characterization for noise in Table 7.3-21 of Section 7.3 of the Revised Application remains unchanged.

10.5 Cumulative Effects

Since no changes are predicted to residual effects as a result of the Project changes on noise, the cumulative effects assessment provided in Table 7.3-23 of Section 7.3 of the Revised Application remains unchanged.

11.0 VISUAL QUALITY

Expansion of the Bonanza Ledge WRSF at closure changes the viewing at conditions at VP7 (Goldfields Ditch) presented in the Revised Application. Revisions to other viewpoints as a result of Project changes were not determined to be required (see Appendix A and Appendix B).

11.1 Potential Interactions with Project Changes

A photo-composite image (Figure 1; Appendix E) representing the viewing conditions at closure at VP7 (Goldfields Ditch) were evaluated using the methods detailed in Appendix 7.11-5 (Section 4.2.3) of the Revised Application to determine the visual contrast exhibited by the Project changes within the surrounding landscape. Ratings of visual element contrast and dominance, and an overall contrast rating, were assigned for the viewpoint to summarize the degree to which the Project changes will visually fit within the existing landscape.

In order to determine contrast, the physical characteristics of Project components were evaluated by visual design elements (i.e., colour, form, line, and texture) and compared to the existing landscape conditions. Table 11-1 summarizes the element visual contrast, dominance, and overall contrast rating for the viewpoint and provides an associated rationale.

Due to the considerable increase in the horizontal extent of the revised WRSF, the scale of the Project element in the view is predicted to increase, even though it is partially screened by topography from VP7. Because of the increase in the perceived scale of the WRSF, the Dominance Rating has been changed from “Subordinate” (in the Revised Application) to “Co-dominant.” The definition of “Co-dominant” is “the alteration is plainly visible as one of several major objects in the setting with features of equal visual importance and/or is located in a prominent position.”

Table 11-1 Contrast Rating Results

Viewpoint	Visual Contrast Rating		Description
VP7 (Goldfields Ditch)	Contrast Rating	Moderate	Broad, horizontal and irregular form of WRSF landform.
			Fine texture of waste rock.
			Dark colour and mottled pattern of exposed waste rock.
	Dominance Rating	Co-dominant	Waste rock storage landform is a major feature within the view and similar in scale to existing landforms in the landscape setting.
			Broad horizontal form, in scale with adjacent sloping ridgelines.
	Overall contrast for VP7	Strong	

Notes: VP = viewpoint; WRSF = Waste Rock Storage Facility

The Bonanza Ledge WRSF will be revegetated at closure, with grasses establishing during post-closure, as simulated in Figure 2 (Appendix E). It is expected that a green grass cover will establish over the whole surface within 3 to 5 years after planting. Upon establishment of the grasses, the aesthetic character of the WSRF will appear more like a natural landform, in terms of both colour and texture. Removal of existing infrastructure and establishment of tree species, if possible, would further reduce visual contrast over time.

11.2 Discussion of Potential Effects

The overall Visual Contrast rating has been rated as “Strong” due to the adjustment to the Dominance Rating as viewed from VP7 (Goldfields Ditch). As such, the Visual Impact Rating changes from Low to Moderate (as described in Section 4 of Appendix 7.11-5 of the Revised Application). The ratings are summarized in Table 11-2 (below).

Table 11-2 Viewpoint Visual Impact Rating

Viewpoint	Landscape Rating	Contrast Rating	Visual Impact Rating
VP7 (Goldfields Ditch)	Low	Strong	Moderate

Notes: VP = viewpoint

11.3 Mitigation

Mitigation measures outlined in Table 7.11-14 of the Revised Application will be implemented to reduce the potential for visual effects due to the Project changes. Key mitigation listed in Table 7.11-14 applicable to the changes at VP7 include:

- Progressively reclaim disturbed land (e.g., revegetation).
- Implement Reclamation Monitoring Plan taking into consideration visual quality objectives identified by residents, Indigenous nations, and stakeholders.

Outcomes of reclamation on the expanded Bonanza Ledge WRSF during post-closure are described in Section 11.1.

No additional mitigation is proposed.

11.4 Characterization of Residual Effects

Over time, the successful establishment of grass cover is predicted to reduce the WRSF’s visual contrast. However, due to the scale of the WRSF and the years required for full vegetation establishment, it is expected to remain co-dominant in the view, and visual contrast is expected to remain strong. The successful establishment of vegetation on the WRSF may reduce visual contrast to the point where it is compatible with the existing landscape and appears subordinate in the view.

Although the visual impact rating for VP7 increases with the Project changes compared to the Revised Application, no changes to the overall residual effects assessment for Visual Resources provided in Section 7.11.7.3.7 of the Revised Application are anticipated. Consequently, no changes in the overall cumulative effects assessment for Land Use provided in Section 7.11.9 of the Revised Application are anticipated.

12.0 HUMAN HEALTH

Results of the initial screening (Appendix A and Appendix B) determined that the Project changes described in Section 1.0 have the potential to interact with the Human and Ecological Health VC during the Construction, Operations, Closure, and Post-Closure Phases. This assessment focuses on two subcomponents: Human Health and Ecological Health.

For Human and Ecological Health, the Project interactions identified for other VCs/subcomponents (i.e., Air Quality [Section 9.0], Surface Water Quality [Section 3.0], and Groundwater [Section 4.0]) were reviewed to identify whether the potential exists for the Project to affect Human and Ecological Health through predicted changes to Air Quality, Surface Water Quality, or other components of the physical environment. A discussion of the predicted changes in ambient air and surface water concentrations, and how these changes may affect the Human and Ecological Health VC, is presented in the subsections below. Updated groundwater modelling results (Section 4.4) indicate that the discharge of underground mine water at post-closure will be similar or lower than assessed in the Revised Application, so changes to groundwater are not discussed further here.

12.1 Potential Interactions with Project Changes

Changes to the Human and Ecological Health VC may result from the following Project changes that affect ambient air and surface water quality as summarized below:

Air Quality

- Annual mine ore production to 1,500 tpd during years 1 to 4 (Phase 1) of mine production, with full production rate of 4,900 tpd during remaining years 5 to 16 (Phase 2);
- Removal of the use of B Road by HDV traffic during the entire life of mine;
- Aboveground trucking of ore and waste rock only from the Cow Portal beside A Road to Bonanza Ledge during the first 4 years of mine operation, and not along B Road;
- Aboveground trucking of waste rock only from the Cow Portal beside A Road to Bonanza Ledge during the final 12 years of mine operation, and not along B Road;
- Storage, crushing, and sorting of ore at Bonanza Ledge during the first four years of mine operation;
- Trucking of sorted ore from Bonanza Ledge along A Road to Highway 26, and subsequently through Wells during the first four years of mine operation; and
- Relocation of select mine ventilation portals and vents throughout the entire operational period.

Surface Water Quality

- Mining of the Lowhee Zone;
- Change in the maximum production rate from 4,750 to 4,900 tpd; and
- Use of the existing underground workings as an FMR.

12.2 Discussion of Potential Effects

Potential effects to Human Health at the Mine Site incorporating the Project changes and subsequent changes to ambient air and water quality are provided below.

12.2.1 Ambient Air Quality

As summarized in Section 9.2.7 (Table 9-1), the increase in aboveground haulage and ore handling activity in Phase 1 (Years 1 to 4) results in a net increase in particulate matter emissions relative to the Revised Application, primarily along A Road and in the Bonanza Ledge area, with a smaller increase in emissions along Highway 26 through Wells. Conversely, Phase 2 (Years 5 to 16) results in a net decrease in particulate matter emissions associated with the planned elimination of B Road haulage operations.

Associated with the increase in emissions during Phase 1, there are expected to be increases in predicted ambient levels of particulate matter in the Bonanza Ledge area, and along A Road, with modest increases along Highway 26 through Wells. The majority of these increases will occur away from the community of Wells, and most sensitive receptors identified in the Revised Application. It's also important to emphasize that these increased emissions and their associated effects would occur only during Years 1 to 4 of the Project. For emissions occurring near sensitive receptors, particularly along Highway 26, additional emissions control measures, such as periodic road sweeping during dry weather, could considerably reduce emissions and associated ambient impacts. Additionally, increased frequency of the application of a dust suppressant during dry conditions along A Road could reduce unpaved road dust emissions and associated ambient impacts.

As previously noted, the relocation of the mine ventilation portals and vents associated with the Project changes does not result in a net decrease in emissions from underground operations. However, relative to the Revised Application, it does shift emissions away from the valley bottom in Wells to higher elevation emission points that are set back away from sensitive receptor locations. This is likely to have a positive effect on predicted ambient air contaminant levels at sensitive receptor locations within Wells.

12.2.2 Surface Water Quality

Project effects on surface water quality are generally summarized in Section 7.4.4.4 of the Revised Application. Mining of the Lowhee Zone, the change in the maximum production rate, and the use of the existing underground workings as an FMR have the potential to change surface water quality in Lowhee Creek through the discharge of treated effluent during the Construction, Operations, Closure, and Post-Closure (Active Care) Phases and through seepages following decommissioning of the WTP in the Post-Closure (Passive Care) Phase.

This effects assessment focuses on the Lowhee Creek drainage when active discharge from the site WTP is occurring, specifically the effluent at the point of discharge to Lowhee Creek, seepages at post-closure, and predicted water quality at assessment nodes in the downstream receiving environment. Stout's Gulch water quality is assessed for the post-closure period only with respect to seepages.

The Project changes will influence water quality in Jack of Clubs Lake; however, the direction of change will be positive because the loading of constituents of potential concern will be lower and for a shorter duration than presented in the Revised Application. Moreover, it is expected that water quality guidelines can be met at the edge of the IDZ in Jack of Clubs Lake even with the lower discharge

volume because the diffuser design can be updated to enhance mixing. Water quality predictions and the effects assessment for Jack of Clubs Lake for the lower rate of discharge and shorter duration will be presented in permitting.

The Project changes are not expected to influence water quality downstream of the confluence of the Willow River and Lowhee Creek as the overall loading will remain the same after discharges from Jack of Clubs Lake and Lowhee Creek have mixed in the Willow River. Water quality in the Willow River is not discussed in this document.

12.2.2.1 Water Quality in Lowhee Creek during Construction, Operations, Closure, and Post-Closure (Active Care)

The WBWQM incorporating the Bonanza Ledge site into the Project is currently in progress and is expected to be available for permitting. In lieu, this assessment of potential for effects in the receiving environment is based on Bonanza Ledge-specific water quality predictions prepared by Mavin Terra Solutions (Mavin Terra 2022). The conceptual model for the WBWQM is based on the following considerations during backfilling of the underground workings and bulk sample mining at the Cow Portal:

- Bonanza Ledge operations are complete (no new mining is occurring).
- Clean-water diversion ditches remain active.
- Bonanza Ledge underground workings will continue to be dewatered to facilitate backfilling. The dewatering effluent is transported to the Sediment Control Pond and then to the Bonanza Ledge WTP for treatment prior to discharge to Lowhee Creek.
- Pumping of water from the Cow Portal to the Bonanza Ledge WTP during bulk sampling.
- Material from the existing PAG WRSF was relocated to the open pit in 2019.
- Material from bulk sample mining will be deposited to the existing PAG and NPAG WRSFs.
- Open pit seepage enters the Bonanza Ledge underground workings, which are being dewatered as described above. Thus, the seepage is contained and treated prior to discharge to the environment.
- Sludge from the WTP is shipped off-site.
- Discharge from the WTP to the environment is represented by permit limits, with one exception. Mavin Terra (2022) did not take into account changes to Permit 17876, which was amended in June 2022 to include a concentration limit for chloride (i.e., a maximum of 600 mg/L from May to June and a maximum of 150 mg/L from July to April). Instead, Mavin Terra (2022) assumed that the chloride concentration in the effluent would be the molar equivalent of the amount of sulphate removed by the treatment system plus a set factor to account for reagent use. Consequently, Mavin Terra (2022) considered the chloride predictions to be uncertain. This is supported by actual monitoring data from the existing Bonanza Ledge WTP as summarized in Golder Technical Memorandum 20, submitted in response to technical questions on the Application. The measured chloride concentrations from the WTP were on average 230 mg/L (max 334 mg/L) from July to April, and on average 65 mg/L (max 88 mg/L) from May to June. At these values, it would not be possible for maximum concentrations greater than 334 mg/L to be observed at downstream prediction nodes. Thus, it was assumed for the purpose of this assessment that the June 2022 permit limits would be met, and that, during freshet, the WTP effluent would be diluted at least four times, thus reaching the long-term chronic WQG at downstream assessment nodes.

The water quality modeling during this time period is considered to be a reasonable surrogate for active Lowhee Zone mining:

- The dewatering effluent from Bonanza Ledge underground workings is considered to be similar to that expected from dewatering associated with Lowhee Zone mining. When the volume of site water to be treated is such that the current Bonanza Ledge permitted maximum discharge rate would be exceeded, excess water will be stored in the FMR. This activity would be short-term and not expected to result in changes in groundwater reaching Lowhee Creek.
- The WTP design described in the Revised Application considered data from Bonanza Ledge as an analog for the design basis. On this basis, it is assumed that the planned WTP can accommodate inputs from the Cow Portal and Lowhee Zone Mining.

For the Post-Closure (passive care) Phase, water quality predictions were made by adding inputs from the Project WRSF to the predictions by Mavin Terra (2022) for post-closure (passive care) for the Bonanza Ledge site components using the mass balance approach as generally described for Assessment Component 5 in Section 7.4.7.2.2.2 of the Revised Application.

Mavin Terra (2022) predicted water quality at nodes on Lowhee Creek, based on the inflow components, as summarized in Table 12-1.

Table 12-12 Components of Lowhee Creek Modelling Nodes

Node	Inflow Components

LC-3.9 (IDZ)	• Discharge from Upper Lowhee Creek:
	  o Discharge from Sediment Control Pond
	  o Discharge from Sediment Control Pond WTP
	  o Runoff from Cow Mountain (Watson's Gulch)
	  o Interflow from Cow Mountain
	  o Runoff from Barkerville Mountain
	  o Interflow from Barkerville Mountain
	• East Diversion Ditch (non-contact water) runoff and interflow
	• Seepage from NPAG WRSF (a)
	• Seepage from PAG WRSF (a)

LC-1.5	• Discharge from LC-3.9 • Runoff from LC-1.5 catchment • Interflow from LC-1.5 catchment • Seepage from underground workings • Groundwater baseflow

Notes: [a] The plume from under the WRSFs will not reach LC-3.9 for 25 years and thus will not contribute to Lowhee Creek water quality during Project operations.
NPAG = non-potentially acid generation; PAG = potentially acid generating; WRSF = Waste Rock Storage Facility; WTP = Water Treatment Plant.

The stations in Lowhee Creek and Stouts Gulch assessed for potential adverse effects in people and wildlife were selected to represent water quality at Groundhog Lake Snowmobile Trail (LC-3.9), Nugget Hills RV Park (LC-1.5), and Ned's Connector Trail (SG-0.25 and SG-1.35). The receptor locations representative of trails are not expected to be sources of drinking water; ingestion of water at these locations is expected to be from incidental ingestion through recreational activities. The receptor location LC-1.5 representative of water quality at Nugget Hills RV Park could potentially be the source of drinking water for residents.

Water quality predictions were compared to health-based water quality screening criteria for people and terrestrial wildlife, where available (Appendix C, Table C-1 to C-7). Several constituents (i.e., ammonia, hardness, phosphorus, total dissolved solids [TDS], lithium, thallium, and titanium) were not carried forward as COPCs for the following reasons:

- Health Canada (2020) indicates that ammonia is a naturally occurring compound that is produced by the body and efficiently metabolized in healthy people; therefore, a water quality guideline is not needed. Ammonia was not retained for further evaluation in the qualitative health evaluation.
- Water hardness is a water quality indicator that describes the water quality based on dissolved ions or minerals. Health Canada (2020) indicates that hardness may have aesthetic effects and that a health-based guideline is not necessary. Calcium and magnesium, which are the primary constituents of hardness, are not considered to be a direct public health concern. Therefore, hardness was not retained for further qualitative evaluation.
- The BC ENV (2020) drinking water quality guideline for phosphorus (i.e., 0.01 mg/L) is based on aesthetic effects on drinking water sourced from lakes, where the taste and odour effects of algae are considered. Algae bloom formation within lakes is common due to the stagnant water; however, algae blooms are less common in rivers and streams due to the dynamic and flowing nature of the system. A health-based guideline for phosphorus is not available from the relevant provincial or federal regulatory agencies; therefore, phosphorus was not evaluated further in the human health risk assessment.
- The Health Canada (2020) drinking water quality guideline for TDS is based on aesthetic effects, where higher concentrations (i.e., >500 mg/L) may result in unpalatability of the water and mineral deposition or corrosion of water distribution systems. A health-based guideline for TDS is not available from the relevant provincial or federal regulatory agencies; therefore, TDS is not evaluated further in the human health risk assessment.
- The surface water screening criterion for lithium were based on the USEPA Provisional Peer-Reviewed Toxicity Value (PPRTV) of 2 micrograms per kilogram per day (µg/kg/day) (USEPA 2008). Lithium is used for the treatment of bipolar disorder and schizophrenia, either solely or in combination with anti-depressant or anti-psychotic drugs. There are many toxicological studies available on laboratory animals and people; however, they are limited to the typical therapeutic doses administered. Lithium has a low therapeutic index, meaning that while it is effective in the treatment of bipolar disorder and schizophrenia, the dose necessary to achieve the therapeutic effects is very close to the dose that also causes adverse effects. As a result, lithium doses administered to patients are monitored by regular blood tests. Long-term treatment with this medication is generally also associated with adverse health effects, and the risks of these adverse health effects are balanced with the benefit gained by therapeutic effects of lithium. The USEPA

(2008) indicates that there are no studies available with administered doses below the lower end of the therapeutic range, which would represent the more typical exposure in the environment. As a result, the USEPA (2008) has identified the lower end of the therapeutic dose to be the lowest adverse effect level and applied an uncertainty factor of 1,000 to derive the PPRTV. The uncertainty factor includes a factor of 10 for the use of a lowest observed adverse effects level (LOAEL) rather than a no observed adverse effects level (NOAEL), a factor of 10 for human variability (e.g., protection of sensitive subpopulations), and a factor of 10 for database uncertainties. The USEPA (2008) indicates there is low to medium confidence in the PPRTV.

- The surface water screening criterion for thallium was based on the USEPA PPRTV of 0.00001 milligrams per kilogram per day (mg/kg/day) for soluble thallium (USEPA 2012a). The USEPA indicated that the available studies on thallium toxicity in humans are of poor quality and not suitable for deriving a TRV or a provisional reference dose. The screening chronic provisional reference dose proposed by the USEPA (2012a) is based on a high level of uncertainty. Uncertainty factors were based on extrapolation from animals to humans (10), human variability (10), lack of adequate developmental toxicity data (10), and extrapolation from sub-chronic to chronic exposure (3), for a total uncertainty factor of 3,000. The USEPA Regional Screening Levels (RSLs) were typically adopted by BC ENV (2021d) as the groundwater drinking water standard in the CSR for constituents where the CSR have not provided a derivation. However, due to the uncertainties associated with the USEPA RSL for thallium, it has not been adopted in the CSR.
- Titanium was similarly not retained as a COPC. No guidelines have been developed by any of the reviewed jurisdictions. USEPA RSLs have been developed for titanium tetrachloride, but, given that this is a volatile form of titanium, these RSLs are based upon inhalation toxicity rather than oral toxicity, which is the relevant exposure pathway for surface water exposure. As there is inadequate toxicological information related to oral toxicity, which is the primary pathway of exposure, titanium was not evaluated further in the human health risk assessment.

For some constituents, including chloride, phosphorus, sulphate, and TDS, only aesthetic objectives were available. The following hierarchy was used in the selection of human and terrestrial wildlife screening values:

- **Human Health** – BC ENV drinking WQGs (BC ENV 2020) were adopted as the primary screening guidelines for the projected constituents. If a BC drinking WQG was not available, guidelines were selected in the following order of priority: Health Canada (2022) Guidelines for Drinking Water Quality followed by USEPA Regional Screening Levels for residential tap water for noncarcinogenic child resident receptors with a target hazard quotient of 0.2 (USEPA 2022). Health-based water quality guidelines were selected preferentially over aesthetic objectives.
- **Wildlife Health** – Short-term acute (i.e., maximum) and long-term chronic (i.e., average) BC Approved and Working WQGs for the protection of wildlife were selected if available (BC ENV 2021c,d). Livestock watering guidelines were selected if a wildlife water quality guideline was not available.

The COPCs identified in this screening are presented in Table 12-2. The screened water quality predictions are presented in Appendix C, Tables C-1 and C-2.

Table 12-2 Constituents of Potential Concern in Water Identified for Lowhee Creek during the Construction, Operations, Closure, and Post-Closure (Active Care) Phases

Parameter	Lowhee Creek	
	Human Health[1]	Wildlife Health
Chloride	LC-3.9, LC-1.5	LC-3.9, LC-1.5
Total Cobalt	LC-3.9, LC-1.5	-
Total Manganese	LC-3.9, LC-1.5	-
Total Strontium	LC-3.9	-

Notes: Maximum predicted water quality was screened to identify constituents of potential concern.
[1] To evaluate potential effects towards people in Lowhee Creek and Stouts Gulch, maximum predicted concentrations were compared to recreational drinking water guidelines.

The potential for adverse effects on human and wildlife health are discussed by COPC below.

12.2.2.1.1 Human Health

Chloride

The predicted chloride concentrations are not reliable as Mavin Terra (2022) did not take into account changes to Permit 17876, which was amended in June 2022 to include a concentration limit for chloride (i.e., a maximum of 600 mg/L from May to June and a maximum of 150 mg/L from July to April). Thus,

- From July to April, the projected concentration of chloride will be below the selected drinking water quality guideline (250 mg/L).
- From May to June, the projected concentration of chloride will be above the selected drinking water guideline (250 mg/L), and the effluent would need to be diluted two times to meet the drinking water guideline.

The chloride drinking water guideline (250 mg/L) is an aesthetic objective limit rather than a health-based guideline and is based on taste and potential for corrosion in the distribution system (Health Canada 2020).

Cobalt

The projected concentrations of cobalt were above the adopted drinking water quality guideline for human health at LC-3.9 in all predicted months, except for May and June, and at LC-1.5 in January, February, and March (Appendix C, Table C-1 and C-2). The highest projected concentrations of cobalt were 1.7 µg/L at LC-3.9 and 1.2 µg/L at LC-1.5, in the winter months.

The BC ENV (2021) human drinking water guideline for cobalt (i.e., 1 µg/L) is adopted from the CSR (2021), which in turn adopted the USEPA RSL for cobalt in drinking water. The USEPA RSL is based on a USEPA chronic provisional reference dose associated with a decrease in thyroid iodine uptake in humans. The chronic provisional reference dose was derived using the LOAEL of 1 milligram per kilogram (mg/kg) body weight per day and an uncertainty factor of 300 (a factor of 10 for LOAEL to

NOAEL extrapolation, a factor of 10 for lack of data regarding sensitive human subpopulations, and a factor of three for lack of multi-generation toxicity study) (USEPA 2008).

Drinking water guidelines were multiplied by 20 to obtain guidelines protective of incidental recreational consumption as per World Health Organization (WHO) guidance (WHO 2021). The factor of 20 derived by the WHO (2021) can be considered conservative as it is based on the amount of water consumed through incidental ingestion of water when swimming, which ranges from 1.7 litres (L) to 2 L per year in temperate waters and 32 L to 38 L per year in warmer waters. Conservatively, assuming an incidental ingestion rate while swimming of 38 L per year results in a factor of approximately 20. The highest projected cobalt concentration (1.7 µg/L) did not exceed the derived recreational drinking water guideline for cobalt (20 µg/L).

The risks to human health from cobalt are considered to be negligible because it is unlikely that a person would consume their entire daily water intake from Lowhee Creek at LC-3.9 and LC-1.5. LC-3.9 is located directly downstream of the mine discharge location and is not easily accessible due to steep terrain. Additionally, during winter months, the creek is likely to be covered in snow or ice. Further, there is an uncertainty factor of 300 included in the derivation of the cobalt drinking water guideline for human health, which is considered protective of concentrations marginally above the drinking water guideline.

Manganese

The projected concentrations of manganese were above the drinking water quality guideline for human health at LC-3.9 in all predicted months, except for May and June, and at LC-1.5 in January, February, and March (Appendix C, Table C-1 and C-2). The highest projected concentrations of manganese were 1,733 µg/L at LC-3.9 and 1,227 µg/L at LC-1.5 in the winter months.

The BC ENV drinking water guideline for manganese of 120 µg /L is adopted from Health Canada's (2020) maximum acceptable concentration for total manganese in drinking water. The maximum acceptable concentration is based upon a detailed investigation of the neurodevelopmental effects of oral manganese exposure in rats (Health Canada 2019). The guideline was calculated using the LOAEL of 25 milligrams of manganese per kilogram (mg Mn/kg) body weight per day and an uncertainty factor of 1,000 (10 for LOAEL to NOAEL extrapolation, 10 for interspecies variation, and 10 for intraspecies variation) (Health Canada 2019).

Drinking water guidelines were multiplied by 20 to obtain guidelines protective of incidental recreational consumption as per WHO guidance (WHO 2021). The factor of 20 derived by the WHO (2021) can be considered conservative as it is based on the amount of water consumed through incidental ingestion of water when swimming, which ranges from 1.7 to 2 L per year in temperate waters and 32 to 38 L per year in warmer waters. Conservatively, assuming an incidental ingestion rate while swimming of 38 L per year results in a factor of approximately 20. The highest projected manganese concentration (1,733 µg/L) did not exceed the derived recreational drinking water guideline for manganese (2,400 µg/L).

The risks to human health from manganese at LC-3.9, representative of water quality at Groundhog Lake Snowmobile Trail, are considered to be negligible because it is unlikely that a person would consume all of their daily water intake from this location. LC-3.9 is located directly downstream of the mine discharge location and is not easily inaccessible due to steep terrain. Additionally, during winter

months the creek is likely to be covered in snow or ice. The water quality in Lowhee Creek at LC-1.5, representative of the potential drinking water source for Nugget Hills RV Park, is not suitable for drinking as the exceedances of the manganese drinking water guideline at LC-1.5 are not marginal.

Strontium

The projected maximum concentrations of strontium were above the drinking water quality guideline for human health at LC-3.9 in January, February, and March (Appendix C, Table C-1). The highest predicted maximum concentration of strontium at LC-3.9 was 7,260 µg/L in the winter months.

The BC ENV drinking water guideline for strontium of 7,000 µg/L is adopted from Health Canada's (2018) maximum acceptable concentration for total strontium in drinking water. The maximum acceptable concentration is based on a detailed investigation of bone toxicity observed in weaning rats in low doses (Health Canada 2018). The guideline was calculated using the NOAEL of 425 milligrams of strontium per kilogram (mg Sr/kg) body weight per day and an uncertainty factor of 300 (10 for interspecies variability, 10 for intraspecies variability, and 3 for database deficiencies) (Health Canada 2018).

Drinking water guidelines were multiplied by 20 to obtain guidelines protective of incidental recreational consumption as per WHO guidance (WHO 2021). The factor of 20 derived by the WHO (2021) can be considered conservative as it is based on the amount of water consumed through incidental ingestion of water when swimming, which ranges from 1.7 to 2 L per year in temperate waters and 32 to 38 L per year in warmer waters. Conservatively, assuming an incidental ingestion rate while swimming of 38 L per year results in a factor of approximately 20. The highest projected strontium concentration (7,260 µg/L) did not exceed the derived recreational drinking water guideline for strontium (140,000 µg/L).

The risks to human health from strontium are considered to be negligible because it is unlikely that a person would consume all of their daily water intake from Lowhee Creek at LC-3.9 during winter months as the creek is likely to be covered in snow or ice. Additionally, there is an uncertainty factor of 300 included in the derivation of the strontium drinking water guideline for human health, which is considered protective of concentrations marginally above the drinking water guideline.

12.2.2.1.2 Wildlife Health

The projected water quality did not exceed guidelines for the protection of wildlife health in Lowhee Creek during the Construction, Operations, Closure, and Post-Closure (Active Care) Phases.

12.2.2.2 Water Quality in Lowhee Creek and Stouts Gulch during Post-Closure (Passive Care)

In the Post-Closure (Passive Care) Phase, groundwater seepages will not be captured and treated prior to discharge, and thus may impact the receiving environments in Lowhee Creek and Stouts Gulch. Predicted water quality in Lowhee Creek and Stouts Gulch was screened as described above. The COPCs identified in this screening are presented in Table 12-3 and include sulphate, cobalt, and manganese. The screened water quality predictions are presented in Appendix C, Tables C-3 to C-6.

Table 12-33 Constituents of Potential Concern in Water Identified for Lowhee Creek and Stouts Gulch during the Post-Closure (Passive Care) Phase

Parameter	Lowhee Creek		Stouts Gulch	
	Human Health	Wildlife Health	Human Health	Wildlife Health
Sulphate	LC-3.9	-	-	-
Total Cobalt	LC-3.9, LC-1.5	-	SG-1.35, SG-0.25	-
Total Manganese	LC-3.9, LC-1.5	-	SG-1.35, SG-0.25	-

Notes: Maximum predicted water quality was screened to identify constituents of potential concern

The potential for adverse effects on human and wildlife health is discussed by COPC below.

12.2.2.2.1 Human Health

Sulphate

The projected concentrations of sulphate were above the adopted drinking water guideline for human health (500 mg/L) in Lowhee Creek at LC-3.9 in January, February, November, and December (Appendix C, Table C-3). The highest projected sulphate concentration was 549 mg/L at LC-3.9 in December.

Sulphate in surface water exceeded the selected screening value of 500 mg/L. This value is based on an aesthetic objective and was conservatively selected for screening purposes in the absence of a health-based screening value from relevant jurisdictions. At concentrations ranging from 250 to 1,000 mg/L, sulphate may cause a noticeable taste (WHO 2017). Although a health-based value has not been proposed by relevant jurisdictions or the WHO, the WHO (2017) reported that gastrointestinal effects have been observed in humans at concentrations of 1,000 to 1,200 mg/L. The highest projected sulphate concentration in Lowhee Creek (549 mg/L) does not exceed the level at which gastrointestinal effects have been observed. Sulphate was, therefore, not evaluated further as a COPC in surface water.

Cobalt

The projected concentrations of cobalt were above the adopted drinking water quality guideline for human health in Lowhee Creek and Stouts Gulch in the following months (Appendix C, Table C-3 to C-6):

- January, February, April, August, September, October, November, and December at LC-3.9;
- January, February, November, and December at LC-1.5; and
- January, February, March, and April at SG-1.35 and SG-0.25.

The highest projected concentrations of cobalt were 7.3 µg/L at LC-3.9 in January and 4.9 µg/L at LC-1.5 in December.

The BC ENV (2021c) human drinking water guideline for cobalt (i.e., 1 µg/L) is adopted from the CSR (2021), which in turn adopted the USEPA RSL for cobalt in drinking water. The USEPA RSL is based on a USEPA chronic provisional reference dose associated with a decrease in thyroid iodine uptake in humans. The chronic provisional reference dose was derived using the LOAEL of 1 mg/kg body weight

per day and an uncertainty factor of 300 (a factor of 10 for LOAEL to NOAEL extrapolation, a factor of 10 for lack of data regarding sensitive human subpopulations, and a factor of 3 for lack of multi-generation toxicity study) (USEPA 2008).

Drinking water guidelines were multiplied by 20 to obtain guidelines protective of incidental recreational consumption as per the WHO guidance (WHO 2021). The factor of 20 derived by the WHO (2021) can be considered conservative as it is based on the amount of water consumed through incidental ingestion of water when swimming ranges, which ranges from 1.7 to 2 L per year in temperate waters and 32 to 38 L per year in warmer waters. Conservatively, assuming an incidental ingestion rate while swimming of 38 L per year results in a factor of approximately 20. The highest projected cobalt concentration (7.3 µg/L) did not exceed the derived recreational drinking water guideline for cobalt (20 µg/L).

The risks to human health from cobalt are considered to be negligible because it is unlikely that a person would consume their entire daily water intake from Lowhee Creek at LC-3.9 and LC-1.5 during winter months as the creek is likely to be covered in snow or ice. Further, there is an uncertainty factor of 300 included in the derivation of the cobalt drinking water guideline for human health, which is considered protective of concentrations marginally above the drinking water guideline.

Manganese

The projected concentrations of manganese were above the adopted drinking water quality guideline for human health in Lowhee Creek and Stouts Gulch in the following months (Appendix C, Table C-3 to C-6):

- January, February, November, and December at LC-3.9, LC-1.5, and SG-0.25; and
- January, February, March, and April at SG-1.35.

The highest projected concentrations of manganese were 641 µg/L at LC-3.9 in January and 426 µg/L at LC-1.5.

The BC ENV drinking water guideline for manganese of 120 µg /L is adopted from Health Canada's (2020) maximum acceptable concentration for total manganese in drinking water. The maximum acceptable concentration is based on a detailed investigation of the neurodevelopmental effects of oral manganese exposure in rats (Health Canada 2019). The guideline was calculated using the LOAEL of 25 mg Mn/kg body weight per day and an uncertainty factor of 1,000 (10 for LOAEL to NOAEL extrapolation, 10 for interspecies variation, and 10 for intraspecies variation) (Health Canada 2019).

Drinking water guidelines were multiplied by 20 to obtain guidelines protective of incidental recreational consumption as per WHO guidance (WHO 2021). The factor of 20 derived by the WHO (2021) can be considered conservative as it is based on the amount of water consumed through incidental ingestion of water when swimming, which ranges from 1.7 to 2 L per year in temperate waters and 32 to 38 L per year in warmer waters. Conservatively, assuming an incidental ingestion rate while swimming of 38 L per year results in a factor of approximately 20. The highest projected manganese concentration (641 µg/L) did not exceed the derived recreational drinking water guideline for manganese (2,400 µg/L).

The risks to human health from manganese are considered to be negligible for locations representative of Groundhog Lake Snowmobile Trail and Ned's Connector Trail because it is unlikely that a person

would consume all of their daily water intake from Lowhee Creek at LC-3.9 and Stouts Gulch at SG-1.35 and SG-0.25 during winter months as the creeks are likely to be covered in snow or ice. The water quality in Lowhee Creek at LC-1.5, representative of the potential drinking water source for Nugget Hills RV Park, is not suitable for drinking as the exceedances of the manganese drinking water guideline at LC-1.5 are not marginal.

12.2.2.2.2 Wildlife Health

There were no exceedances of guidelines for the protection of wildlife health at Lowhee Creek and Stouts Gulch during the Post-Closure (Passive Care) Phase.

12.3 Mitigation

12.3.1 Ambient Air Quality

Mitigation measures outlined in Section 7.2.5 of the Revised Application will be implemented to reduce the potential effects of the Project changes. Additional mitigation measures during Phase 1 include road sweeping along Highway 26 in Wells and the increased frequency of the application of a dust suppressant during dry conditions along A Road.

12.3.2 Surface Water Quality

Mitigation measures for Surface Water are summarized in Section 7.4.5 of the Revised Application. No changes to mitigation measures are proposed.

12.3.3 Human Health

Mitigation measures for Human Health are summarized in Section 7.13.5 of the Revised Application. No changes to mitigation measures are proposed.

12.4 Characterization of Residual Effects

12.4.1 Ambient Air Quality

The Phase 1 (Years 1 to 4) Project changes have the potential to cause a neutral to negative change to the effects of the Project compared to the Revised Application during dry conditions. These changes will be addressed by implementing the additional mitigation measures stated in Section 12.3.2, which, following implementation, are predicted to result in a neutral change compared to the Revised Application.

The Phase 2 (Year 5 to 16) Project changes are predicted to result in a positive change to the overall residual effects compared to the Revised Application.

12.4.2 Surface Water Quality

The potential for adverse effects on people and terrestrial wildlife as a result of the Project was evaluated by comparing projected water quality concentrations for the Active (Construction, Operations, Closure, Post-Closure [Active Care]) and Passive (Post-Closure [Passive Care]) Cases to water quality screening criteria for the protection of human and wildlife health.

For the Active Case, cobalt and manganese were retained as COPCs at LC-3.9 and LC-1.5, and strontium was retained as a COPC at LC-3.9 and evaluated for human health. The projected cobalt and

strontium concentrations in Lowhee Creek were marginally above the respective drinking water guidelines for protection of human health in the winter months. The projected manganese concentrations at LC-3.9 and LC-1.5 exceeded the drinking water guideline for protection of human health in the winter months when the creek is expected to be covered in snow and ice. As the exceedances were not marginal, it is recommended that this water not be used as a drinking water source.

For the Passive Case, cobalt and manganese were retained as COPCs in Lowhee Creek and Stouts Gulch. Additionally, sulphate exceeded drinking water quality guidelines in Lowhee Creek at LC-3.9 in the winter months; however, the drinking water guideline for sulphate (500 mg/L) is based on an aesthetic objective and gastrointestinal effects in humans have been observed at a higher concentration of 1,000 mg/L. The highest projected sulphate concentration at LC-3.9 (549 mg/L) does not exceed the level at which gastrointestinal effects have been observed; therefore, sulphate was not evaluated as a COPC. The projected cobalt concentrations in Lowhee Creek and Stouts Gulch were marginally above the drinking water guideline for protection of human health in the winter months. The projected manganese concentrations in Lowhee Creek exceeded the drinking water guideline for protection of human health in the winter months when the creek is expected to be covered in snow and ice. As the exceedances were not marginal, it is recommended that this water not be used as a drinking water source.

The projected water quality did not exceed guidelines for the protection of wildlife health in Lowhee Creek during the Construction, Operations, and Post-Closure (Active Care) Phases for either the Active Case or the Passive Case.

12.5 Cumulative Effects

No adverse residual effects to Human Health are anticipated associated with the Project changes assessed in this document. The overall changes presented in this document will not alter the overall findings of the effects assessment. No cumulative effects were identified for the Human Health VC in the Revised Application and the level of effects associated with the Project changes discussed in this document are consistent with the conclusion of no cumulative effects.

13.0 SUMMARY

A summary of the outcomes of the residual effects assessments and the cumulative effects assessments for the Project changes described in Appendix A and Appendix B on the VCs in the Revised Application is provided in Table 13-1. New and/or revised mitigation from the Revised Application are also presented in Table 13-1.

Table 13-1 Project Changes Assessment Summary

Valued Component	Residual Effects Assessment Outcome	Cumulative Effects Assessment Outcome	New and/or Revised Mitigation
Surface Water	The Project changes are not expected to result in residual effects to Surface Water VC subcomponents beyond those described in the Revised Application.	Project changes will not alter the cumulative effects identified for the Surface Water VC in the Revised Application and the effects identified with the Project changes are consistent with the conclusions presented in the Revised Application.	None
Groundwater	Updated groundwater modelling results indicate that base flow reductions at the end of operations and post-closure, and the discharge of underground water at post-closure, will be similar to or lower than those assessed in the Revised Application. No negative changes to the overall residual effects assessment for the Groundwater VC in the Revised Application are anticipated.	No cumulative effects were identified for the Groundwater VC in the Revised Application and the level of effects associated with the Project changes discussed in this document are consistent with the conclusion of no cumulative effects.	None
Freshwater Fish	No adverse residual effects to fish, fish habitat, and aquatic resources are anticipated associated with the Project changes assessed in this document. The Project changes represent a reduction in the level of effects to Freshwater Fish compared to effects that were previously identified in the Revised Application.	No residual cumulative effects were identified for the Freshwater Fish VC in the Revised Application and the reduction in the level of effects associated with the Project changes discussed in this document are consistent with the conclusion of no residual cumulative effects.	None
Soil	The Project changes increase potential soil and terrain disturbance compared to the Revised Application. The increase is a maximum of 2.5 ha and is considered minimal; therefore, no changes to the overall residual effects assessment provided in the Revised Application are anticipated.	Project changes will not alter the cumulative effects assessment for the Soil VC subcomponents in the Revised Application. The effects identified associated with the Project changes are consistent with the conclusions presented in the Revised Application.	None

Valued Component	Residual Effects Assessment Outcome	Cumulative Effects Assessment Outcome	New and/or Revised Mitigation
Vegetation	The Project changes are not expected to result in residual effects to Vegetation VC subcomponents beyond those described in the Revised Application.	Project changes will not alter the cumulative effects identified for Vegetation VC subcomponents in the Revised Application and the effects identified with the Project changes are consistent with the conclusions presented in the Revised Application.	None
Wildlife	The Project changes are not expected to result in residual effects to Wildlife VC subcomponents beyond those described in the Revised Application.	Project changes will not alter the cumulative effects identified for Wildlife VC subcomponents in the Revised Application and the effects identified with the Project changes are consistent with the conclusions presented in the Revised Application.	Bat surveys should be considered, in consultation with a QP, if the Cow Portal becomes accessible to bats to assess the use of the portal as a winter hibernacula.
Air Quality	The Phase 1 (Years 1 − 4) Project changes are predicted to result in a neutral change to the residual effects compared to the Revised Application. The Phase 2 (Years 5 – 16) Project changes are predicted to result in a positive change to the residual effects compared to the Revised Application.	The Project changes have the potential to cause a positive change to cumulative effects compared to the Revised Application during Phase 2 (Years 5 – 16), and cause a neutral change to cumulative effects compared to the Revised Application during Phase 1 (Years 1 – 4).	Road sweeping along Highway 26 in Wells, and the increased frequency of the application of a dust suppressant during dry conditions along A Road, during Phase 1.
Acoustic	Updated operations noise or construction noise predictions show compliance with Health Canada, BC OGC, and ECPMM Guidelines with mitigation. Therefore, the residual effects identification and characterization in the Revised Application remains unchanged.	No changes from the Revised Application.	Transformers used at the Cow Portal and Bonanza Ledge Site will be no more than 100 dBA of total sound power level. Fans at ventilation raises and portal exhausts will have at least the following sound attenuation: Portal Exhaust (Cow Zone) Fan sound levels will be below 106 dBA (116 dBA − 10 dB); and Ventilation Raise Exhaust (Shaft Zone) Fan sound levels will be below 104 dBA (124 dBA – 20 dB).

Valued Component	Residual Effects Assessment Outcome	Cumulative Effects Assessment Outcome	New and/or Revised Mitigation
Land Use - Visual Quality	Although the visual impact rating for VP7 increases with the Project changes compared to the Revised Application, no changes to the overall residual effects assessment are anticipated.	No changes from the Revised Application.	None
Human and Ecological Health	Ambient Air Quality See the Air Quality VC. Surface Water Quality Projected manganese and cobalt water quality concentrations in Lowhee Creek exceeded the drinking water guideline for the protection of human health in the winter months when the creek is expected to be cover in snow and ice. As the exceedances were not marginal, it is recommended that this water not be used as a drinking water source. Projected water quality did not exceed guidelines for the protection of wildlife health in Lowhee Creek and Stouts Gulch.	No cumulative effects were identified for the Human Health VC in the Revised Application and the level of effects associated with the Project changes discussed in this document are consistent with the conclusion of no cumulative effects.	See the Surface Water and Air Quality VCs.

Notes: dB = decibels; dBA = A-weighted decibel units; ha = hectare; QP = qualified professional; VC = Valued Component; VP = viewpoint

14.0 CLOSURE

We trust that this Project Changes Report provides sufficient information for your present needs.

15.0 REFERENCES

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APPENDIX A PROPOSED PROJECT DESIGN CHANGES MEMO (TECHNICAL MEMO 1A)

OSISKO DEVELOPMENT

MEMO

December 14, 2022

TO: KATHERINE ST. JAMES, BC Environmental Assessment Office

FROM: FRANCOIS VEZINA, Osisko Development Corp.

RE: CARIBOO GOLD PROJECT – PROPOSED PROJECT DESIGN CHANGES

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1. Introduction

This memo is intended to provide a summary of the project components associated with the Cariboo Gold Project (the "Project"; "CGP") that differ from the Environmental Assessment Certificate ("EAC") Application that Osisko Development Corp. ("ODV") submitted to the British Columbia ("BC") Environmental Assessment Office ("EAO") in July 2021, with a revised Application submitted in October 2022. ODV is seeking guidance from EAO first to find out what is required and associated timelines for proceeding with the potential Project changes provided in this memo.

Figure 1.1-3 from Chapter 1 of the Revised Application that shows the Mine Site layout was updated to present the proposed Project design changes described herein and is appended to this memo as Appendix A. Sections of this figure have been included throughout this memo as appropriate to provide greater detail for each respective proposed change.

A screening assessment of Section 25 of the *BC Environmental Assessment Act* (2018) considering the potential Project design changes presented in this memo is provided in Appendix B (Tables 1 and 2). Appendix B (Table 1) also includes a summary of the predicted net implications to the effects assessment by Valued Component ("VC") based on the potential Project changes presented herein. A detailed description of the implications to the relevant VCs associated with the effects assessment is included in Section 3 of this memo.

The Requested Project for Certification (Chapter 20.2) from the Revised Application has been updated to include the Project design changes presented in this memo and is attached as Appendix C to this memo.

2. Proposed Changes to Project Components

2.1. Waste Rock Haulage

An overview of the area associated with the proposed changes to haulage of waste rock from the Project is shown in Figure 1 below.

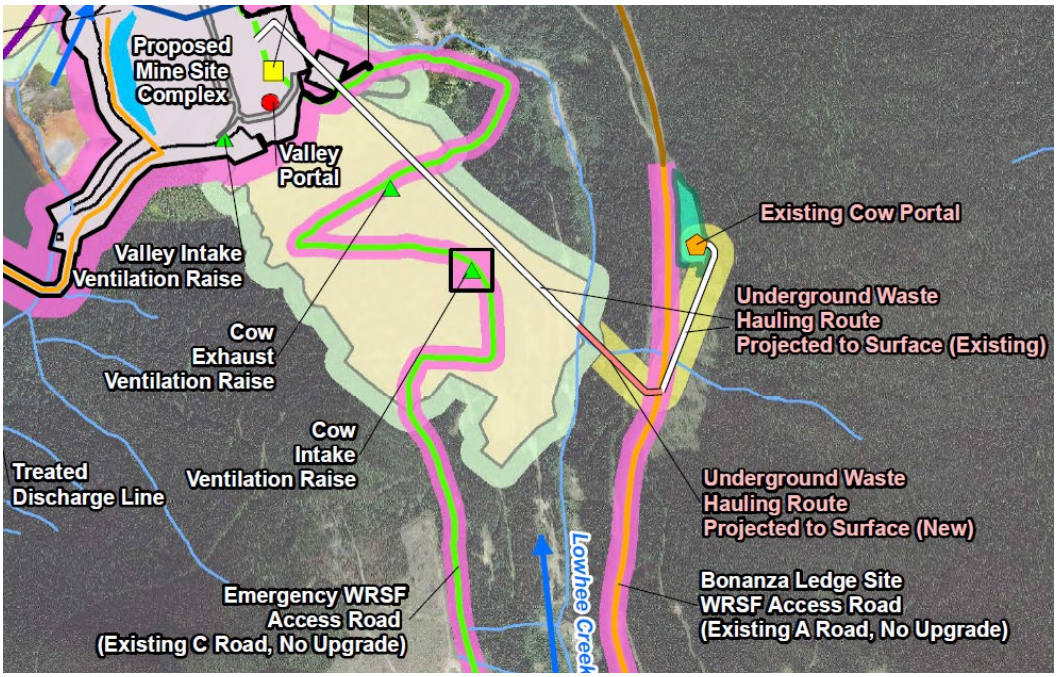


Figure 1 - Proposed CGP Waste Rock Haul Route

These changes include the following:

1. Inclusion of the Cow Portal
2. Adding a connection from the proposed CGP underground workings to the Cow Bulk Sample Ramp
3. Removal of B-Road

2.1.1. Cow Portal Inclusion & CGP-Cow Portal Underground Connection

ODV is proposing that the Cow Portal be included as a component of the Project, as well as a portion of the underground ramp leading from the Cow Portal to the Cow Bulk Sample area. Both of these pieces of infrastructure are permitted as part of the Cow Bulk Sample exploration activities authorized under MX-4-155 (soon to be incorporated under *Mines Act* Permit M-238). The Cow Portal has already been constructed on surface along the existing A Road linking the Bonanza Ledge Site with Highway 26 as authorized under the abovementioned exploration permit. Although the underground ramp leading from the Cow Portal to the Cow Bulk Sample area has not yet been constructed, this work will commence in 2023, prior to the construction of the CGP.

As a result, it is considered “existing” for the purposes of this memo (and labelled as such on all relevant figures).

The Cow Portal and existing ramp would be connected to a planned underground drift associated with the Project (both shown in Figure 1 as “Underground Waste Hauling Route Projected to Surface (Existing)”) by a newly proposed underground connection ramp (shown in Figure 1 as “Underground Waste Hauling Route Projected to Surface (New)”). The purpose of this connection is to provide an underground route by which waste rock from the underground workings associated with the Project can be transported to the Bonanza Ledge Waste Rock Storage Facility (“WRSF”), eliminating the need for the surface haul route via the B-Road.

Waste rock would be hauled from the underground workings associated with the Project via the proposed underground route shown in Figure 1. This drift would extend to the southeast beyond the originally proposed underground mine area, continuing underneath Lowhee Creek, and tying into with the existing ramp leading from the Cow Portal to the Cow Bulk Sample. Trucks hauling waste rock would surface via the Cow Portal and continue along a portion of the existing A Road to the Bonanza Ledge WRSF (note: hauling of waste rock along A Road, including from the location of the Cow Portal to the WRSF is already incorporated into the EAC Application). Surface access to the Bonanza Ledge WRSF for inspection and/or emergency purposes would be via the existing A Road, or the C Road leading from the Mine Site Complex to the Bonanza Ledge WRSF along the west side of Lowhee Creek.

The inclusion of the Cow Portal and the addition of the CGP-Cow Portal underground connection ramp would not result in any additional surface disturbance.

2.1.2. B-Road Removal

ODV is proposing that the B Road, which provides a surface connection between the Mine Site Complex and the Bonanza Ledge WRSF, be removed from the Project. By connecting the Project’s underground workings to the Cow Portal, waste rock can be hauled from the Project workings to the Bonanza Ledge WRSF via an underground route. Underground haulage of waste rock would eliminate the necessity for the B-Road and allow for its removal.

Removing the B Road would result in a net decrease in surface disturbance (no upgrades would be required), as well as substantially reduced truck traffic and dust generation near the Community of Wells. During the evaluation of the Project as part of the EA process, local stakeholders expressed concerns regarding the impact of upgrading the B Road to be suitable for use as a haul route; more specifically, there were concerns around the visual impact (including light pollution), dust and noise generation associated with the B Road upgrades.

2.2. Waste Rock Storage Facility Contact Water Management

An overview of the area associated with the proposed changes to haulage of waste rock from the Project is shown in Figure 2 below.

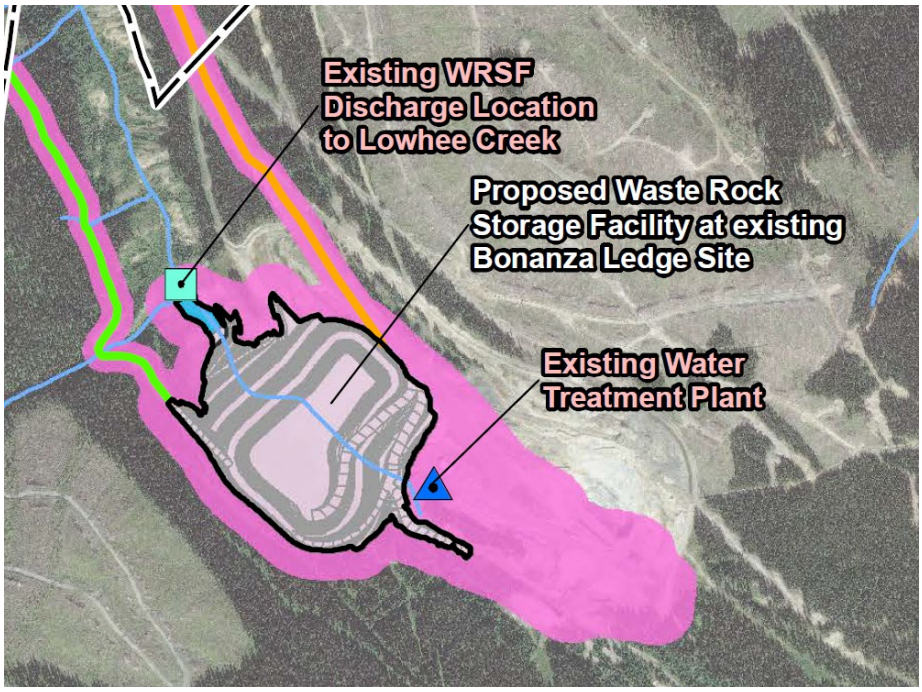


Figure 2 - Proposed Bonanza Ledge WRSF Site Configuration

These changes include the following:

1. Removal of the WRSF Contact Water Pipeline
2. Maintaining a WTP at the Bonanza Ledge Site
3. Inclusion of a discharge location at the Bonanza Ledge Site into Lowhee Creek

These changes are discussed in more detail below.

2.2.1. WRSF Contact Water Pipeline Removal

ODV would like to remove the proposed WRSF Contact Water Pipeline for conveying mine-contact water from the Bonanza Ledge WRSF area to the central Mine Site Complex water treatment plant ("WTP") from the Project.

Removing this pipeline will result in all Bonanza Ledge WRSF contact water requiring management, treatment, and discharge at the Bonanza Ledge site; thus, maintaining the existing WTP at the Bonanza Ledge Site and the associated discharge point to Lowhee Creek would be necessary for the life of the Project.

2.2.2. Maintenance of Bonanza Ledge Water Treatment Plant

ODV is proposing that the existing WTP remain at the Bonanza Ledge Site for the life of the Project and be upgraded as necessary to manage the surface flows associated with the Bonanza Ledge WRSF. The Bonanza Ledge WTP would continue to produce treated effluent meeting the quality requirements associated with the existing permit issued pursuant to the *Environmental Management Act* (EMA), PE-17876. Information presented in the EAC Application regarding water treatment technologies supports the ongoing ability to treat WRSF-contact water to the limits specified in PE-17876 should the WRSF Contact Water Pipeline not be constructed. The treatment technology of the Bonanza Ledge WTP is scalable, and the size of the treatment system contained within the WTP can be increased to handle the higher volume of mine-contact water from the Bonanza Ledge WRSF.

The water treatment system proposed for the Mine Site Complex will still be constructed to treat collected surface water and water pumped from the underground workings, as presented in the Revised Application. Therefore, the only proposed change to the Mine Site water management is that the Bonanza Ledge WTP will remain at Bonanza Ledge site to maintain water treatment at its current location, rather than moving it to the Mine Site Complex. The relocation of the Bonanza Ledge WTP was proposed in the EA because water would have been piped from the Bonanza Ledge Site to the Mine Site Complex but will no longer be necessary.

2.2.3. Lowhee Creek Discharge Inclusion

ODV is proposing that the existing discharge point to Lowhee Creek be maintained and included as part of the Project. The conceptual design in the EAC Application involving collection and conveyance of mine-contact water from the Bonanza Ledge WRSF to the Mine Site Complex WTP via the WRSF Contact Water Pipeline would result in a reduction in flows in Lowhee Creek, particularly during the winter low flow period, and would have the potential to affect fish habitat as described in the EA. By not diverting this water from Lowhee Creek, the hydrograph in Lowhee Creek would be similar to current conditions and thus fish habitat would also not change from current condition.

The discharge quality limits authorized in PE-17876 governing current discharge from the Bonanza Ledge Site are relatively close to ambient water quality guidelines, and the discharge of an increased volume of treated water to Lowhee Creek is not expected to increase the potential for effects in the receiving environment from existing conditions.

A more detailed assessment will be undertaken and presented to EAO in a subsequent memo; however, based on the information at hand from ongoing engineering studies, the removal of the WRSF Contact Water Pipeline and treatment of mine-contact water at the Bonanza Ledge Site is not expected to change the findings of the EA.

3. Effects Assessment

The detailed table illustrating the predicted net implications associated with each VC examined in the effects assessment is included in Appendix B as Table 1. For each VC, the relevant activity associated with the potential Project description changes is included and assigned one of four categories: Improvement, Neutral, No Change, or Adverse. No adverse effects associated with

the Project changes to any VC were identified. Definitions for Improvement, Neutral and No Change are provided below:

- **Improvement:** there is a net benefit or improvement to the Project effects assessment for that VC/subcomponent
- **Neutral:** there is already an existing adverse effect related to the VC/subcomponent and there will remain an adverse effect based on the proposed changes; however, the changes do not worsen the adverse effect. That is, there is a change in the description or location of the effects, or potentially require new mitigations, but the characterizations of the potential residual effects are predicted to be the same or similar.
- **No Change:** the proposed changes to the Project description do not have any change to the predicted effects (i.e., no change to the description or characterization results for the VC).

The VC subcomponents have also been identified as to whether additional assessment is warranted, to further describe effects (i.e., description of changes of the effects, updates to mitigations (if any), updates to residual effects, and potential updates to cumulative effects). Where the VC has been identified as not being carried forward for further assessment, it has been concluded that Table 1 in Appendix B provides sufficient information and there is no further action required by ODV for these VCs. Table 1 also provides a BC *Environmental Act* (2018) Section 25(a), (b), and (d) screening assessment summary by VC. Table 2 provides an assessment of the remaining Section 25 items and whether or not these items are sufficiently assessed in the Revised Application in consideration of the Project design changes presented in this memo, or, if they will need to be brought forward with a more detailed assessment.

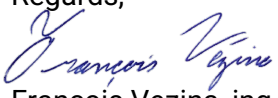
ODV will engage with the Participating Indigenous nations (Lhtako Dene Nation, Williams Lake First Nation, and Xatśūll First Nation). It is anticipated that with the net improvement to the effects assessment results, that the Participating Indigenous nations will be supportive in the process of updates to the EAC Application process.

The Indigenous interests associated with the following Indigenous nations are predicted as net improvements for related VC effects assessments based on the potential Project changes:

- Lhatako Dené Nation (Chapter 11)
- Williams Lake First Nation (Chapter 12)
- Xatśūll First Nation (Chapter 13)
- Nazko First Nation (Chapter 14)
- Tŝilhqot'in National Government (Chapter 15)

If you have any further questions regarding the above, please don't hesitate to contact me by email at fvezina@osiskodev.com or phone at 514-546-1082.

Regards,



Francois Vezina, ing., P.Eng., MBA
Senior Vice President
Project Development, Technical Services and Environment
Osisko Development Corp.

Appendix A
Cariboo Gold Project Proposed Site Infrastructure Layout Figure

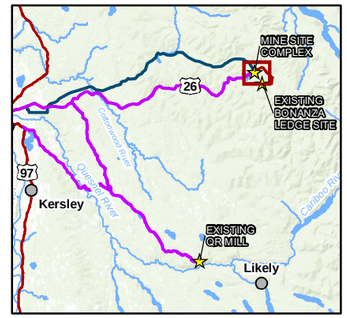
Mosquito Intake Ventilation Raise
Mosquito Creek
Ventilation Raise Access Road (Existing)
Downey Creek
Pinus Creek
Proposed Transmission Line Route
Williams Creek
Mailleue Creek
Proposed Potable Water Pipeline Option Valley Zone Central Area
Willow River
Proposed Potable Well Destination
Mosquito Exhaust Ventilation Raise
Wells
Potable Water Pipeline Option Existing BGM Office Well
Existing Temporary Early Construction Access Road
Island Mountain Portal
WRSF Contact Water Pipeline
Shaft Intake Ventilation Raise
Proposed Mine Site Complex
Valley Portal
Transportation Route
Existing Cow Portal
Valley Intake Ventilation Raise
Jack of Clubs Lake
Underground Waste Hauling Route Projected to Surface (Existing)
Cow Exhaust Ventilation Raise
Cow Intake Ventilation Raise
Treated Discharge Line
Underground Waste Hauling Route Projected to Surface (New)
Wilsons Creek
Lowhee Creek
Emergency WRSF Access Road (Existing C Road, No Upgrade)
Bonanza Ledge Site WRSF Access Road (Existing A Road, No Upgrade)
District Of Wells Boundary
093H/04
26
Existing WRSF Discharge Location to Lowhee Creek
Proposed Waste Rock Storage Facility at existing Bonanza Ledge Site
Existing Water Treatment Plant
McLellan Gulch
593000
594000
595000
596000
597000
598000
599000
5885000
5884000
5883000
5882000
5881000

LEGEND

- PROPOSED MINE PORTAL LOCATION
- PROPOSED POTABLE WELL DESTINATION
- PROPOSED VENTILATION RAISE
- FLOW DIRECTION
- HIGHWAY
- WATERCOURSE
- VENTILATION RAISE ACCESS ROAD (EXISTING)
- BONANZA LEDGE SITE WRSF ACCESS ROAD (EXISTING A ROAD, NO UPGRADE)
- EMERGENCY WRSF ACCESS ROAD (EXISTING C ROAD, NO UPGRADE)
- EXISTING TEMPORARY EARLY CONSTRUCTION ACCESS ROAD
- TRANSPORTATION ROUTE
- PROPOSED POTABLE WATER PIPELINE (OPTIONS)
- PROPOSED TRANSMISSION LINE ROUTE
- PROPOSED TRANSMISSION LINE CORRIDOR
- PROPOSED CAMP ACCESS ROAD
- PROPOSED DIFFUSER
- PROPOSED TREATED DISCHARGE LINE
- PROPOSED MINE SITE SURFACE SEDIMENT POND
- PROPOSED SURFACE DISTURBANCE AREA
- PROPOSED UNDERGROUND MINE AREA
- PROPOSED SURFACE FOOTPRINT
- PROPOSED UNDERGROUND FOOTPRINT
- BARKERVILLE HISTORIC TOWN AND PARK
- DISTRICT OF WELLS BOUNDARY

POTENTIAL PROJECT ADDITIONS FROM REVISED APPLICATION

- EXISTING COW PORTAL
- EXISTING COW PORTAL DISTURBANCE
- EXISTING WRSF DISCHARGE LOCATION TO LOWHEE CREEK
- EXISTING WATER TREATMENT PLANT
- UNDERGROUND WASTE HAULING ROUTE - PROJECTED TO SURFACE (EXISTING)
- UNDERGROUND WASTE HAULING ROUTE - PROJECTED TO SURFACE (NEW)
- ADDITIONAL UNDERGROUND FOOTPRINT



REFERENCE(S)

1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
2. HILLSHADE DERIVED FROM LIDAR DATA FLOWN BY MCELHANNAY CONSULTANTS LTD. JUNE 27, 2016.
3. BASE DATA SOURCE: ESRI, GEOBASE, NRCAN, AND THE GIS USER COMMUNITY.
4. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

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OSISKO DEVELOPMENT

CARIBOO GOLD PROJECT

MINE SITE - CURRENT AND PROPOSED INFRASTRUCTURE – POTENTIAL UPDATED

REV.	DESCRIPTION	DATE	INITIALS
A		12/2/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
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Appendix B
Effects Assessment Valued Components Impacts

Table 1. Net Implications to the Effects Assessment by Valued Component for the Potential Project Changes and Assessment of Section 25(a), (b), and (d) of the BC *Environmental Assessment Act* (2018)

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
Air Quality	Air Quality	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site Complex to Cow Portal	Improvement	• Reduced dust generation from site preparation activities • Reduced air emissions from construction equipment use • Reduced dust generation on surface during operations	No	No	**25(a)** There is an overall positive change in direct and indirect Project effects on the VC associated with the Project design changes. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. The characterizations of the following residual Project effects will remain unchanged from the Revised Application: • Increase in sulphur dioxide and carbon monoxide; • Increase in nitrogen dioxide; and • Increase in Particulate Matter (Total Suspended Particulate Matter [TSP], inhalable particulate matter [PM_{10}], and fine particulate matter [$PM_{2.5}$]). No potential negative residual cumulative effects were identified for this VC in the Revised Application and there is no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
							25(d) There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Acoustic	Noise Vibration	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site Complex to Cow Portal	Improvement	• Reduced noise and vibrations from the removal of construction activities (along B Road and A Road) • Reduced noise and vibrations from the removal of hauling along B road during operations	No	No	25(a**)** There is an overall positive change in direct and indirect Project effects on the VC associated with the Project design changes. There is no need to change the assessment on the VC from that in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects and it is a more conservative approach to keep the assessment as is and unchanged. The characterizations of the following negative residual Project effects will remain unchanged from the Revised Application: • Audible noise and low noise frequency noise during construction • Audible noise and low noise frequency during operation • Noise and vibration from blasting. No potential negative residual cumulative effects were identified for this VC in the Revised Application and there is no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
							25(b) There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Surface Water	Surface Water Quality	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site Complex to Cow Portal Addition of new discharge location at Lowhee Creek	Improvement	• Reduced stream crossings from the removal of B Road • Reduced indirect effects from dust generation • Reduced potential sedimentation from construction along A and B road • Water quality in Lowhee Creek – discharge from the BL site is currently authorized by a permit issued pursuant to the *Environmental Management Act*. The discharge limits in that permit are relatively close to ambient water quality guidelines, and the discharge of an increased volume of treated water to Lowhee Creek is not expected to increase the potential for effects in the receiving environment from existing conditions. • Information presented in the Environmental Assessment Certificate (EAC) Revised Application regarding water treatment technologies supports the ongoing ability to treat mine-contact water to the limits specified in the current effluent permit should the pipeline not be constructed. The treatment technology is scalable, and the size of the treatment system can be increased to	Yes	No	**25(a)** There is an overall positive change in direct and indirect Project effects on the VC associated with the Project design changes. However, a more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. The characterizations of the following residual Project effects will remain unchanged from the Revised Application (i.e., no proposed changes to the QR Mill components): • Changes in Water Quality in the aquatic receiving environment at QR Mill due to treated effluent discharge While negative residual effects to Lowhee Creek water quality are not anticipated, the characterizations of the following residual Project effects will require updated descriptions and may have changed mitigations and/or characterizations from the Revised Application: • Changes in Water Quality in the aquatic receiving environment at Mine Site due to treated effluent discharge

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
				handle the higher volume of mine contact water at BL.			• Changes in Water Quality in the aquatic receiving environment at the Mine Site due to seepages from waste rock piles and underground workings in post-closure No potential negative residual cumulative effects were identified for this VC in the Revised Application and there is no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
	Surface Water Quantity (Hydrology)	Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Addition of new discharge location at Lowhee Creek	Neutral	• Flows in Lowhee Creek – the conceptual design in the EAC Revised Application involved collection of surface mine-contact water from the Bonanza Ledge location and transport of the water to a central water treatment plant at the Mine Site Complex. This diversion would result in a reduction in flows in Lowhee Creek, particularly during the winter low flow period, and would have the potential to affect fish habitat as described in the EAC Revised Application. By not diverting this water from Lowhee Creek, the quantity of water reporting to Lowhee Creek would be	Yes	No	**25(a)** There is an overall neutral change in direct and indirect Project effects on the VC associated with the Project design changes. That is, negative effects are associated with the Project design changes, but the negative effects were already captured in the Revised Application. However, a more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. The characterizations of the following residual Project effects will remain unchanged from the Revised

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
				more similar to current condition and thus fish habitat would also be more similar to current conditions.			Application (i.e., no proposed changes to the QR Mill components): • Changes in Water Quantity in the aquatic receiving environment at QR Mill due to treated effluent discharge The characterizations of the following residual Project effects will require updated descriptions and may have changed mitigations and/or characterizations from the Revised Application: • Changes to Water Quantity in the aquatic receiving environment at the Mine Site during construction and operations due to diversion and/or collection of runoff; • Changes to Water Quantity in the aquatic receiving environment at Mine Site during closure and post-closure due to diversion and/or collection of runoff; • Changes in Water Quantity in the aquatic receiving environment at Mine Site due to treated effluent discharge; No potential negative residual cumulative effects were identified for this VC in the Revised Application and there is no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
							25(d) There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Groundwater	Groundwater Quality Groundwater Quantity	Underground infrastructure development for the Underground Waste Hauling Route between the Mine Site Complex to the Cow Portal	No change	• Groundwater modelling in the EAC Application considered the influence of a connection of the underground workings associated with the Project to the Cow Portal. • There is no change to underground water management. The underground seepage water that is associated with the Project will be pumped to the Mine Site Complex.	No	No	**25(a)** There is overall no change in direct and indirect Project effects on the VC associated with the Project design changes. The proposed changes to the Project description do not have any change to the predicted effects (i.e., no change to the description or characterization results for the VC); therefore, there is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. The characterizations of the following residual Project effects will remain unchanged from the Revised Application: • Changes to groundwater quantity at the Mine Site during construction and operations due to dewatering of underground workings; • Changes to groundwater quantity at the Mine Site during construction, operations, and closure due to the operation of a potable water supply well; • Changes to groundwater quality at the Mine Site during closure and post-closure due to the flooding of the underground developments; • Changes to groundwater quality at the Mine Site due to groundwater seepages from waste rock piles and underground workings post-closure; • Changes to groundwater quantity at the QR Mill during construction, operations, closure, and post-closure due to the construction of the FSTSF; and

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
							• Changes to groundwater quality at the QR Mill due to construction of the FSTSF. No potential negative residual cumulative effects were identified for this VC in the Revised Application and there is no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Soil	Soil Quality	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex	Improvement	• Reduced change in soil quality resulting from dust generation and subsequent deposition during preparation activities due to the removal of B road upgrade and WRSF Contact Water Pipeline construction • Reduced change in soil quality resulting from dust generation and subsequent deposition on surface during operations with due to the removal of waste haulage on surface along the B road	No	No	**25(a)** There is an overall positive change in direct and indirect Project effects on the VC associated with the Project design changes. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. The characterizations of the following residual Project effects will remain unchanged from the Revised Application: • Alteration of Soil Quality through Compaction and Dust Accumulation; and • Alteration of Terrain Stability.
	Soil Quantity		Improvement	• Reduced soil loss due to the removal of construction activities (along B Road and A Road)	No		

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
	Terrain Stability	Hauling of waste rock underground from the Mine Site Complex to Cow Portal	Improvement	• Reduced potential for terrain stability issues due to removal of construction activities (along B Road and A Road).	No		• Direct Loss of Soil Quantity; No changes to the cumulative effects assessment is required (e.g., no quantifications of cumulative 'direct loss of soil quantity' were made and the characterizations remain unchanged based on the Project design changes). Therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(c)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Vegetation	Plant Species of Interest Plant Communities of Interest Wetland Functions Ecosystems	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site	Improvement	• Reduced vegetation loss, thus reduced loss of all subcomponents, from the removal of construction activities (along B Road and A Road) • Reduced edge effects to vegetation and wetlands (all subcomponents) from dust generation from site preparation activities • Reduced adverse effects to vegetation (all subcomponents) from dust generation on surface during operations with the removal of waste haulage on surface along the B road • Reduced potential for invasive plant introduction or spread with the removal of construction and operations activities along the B road and with the removal of construction activities along A road.	No	No	**25(a)** There is an overall positive change in direct and indirect Project effects on the VC associated with the Project design changes. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. The characterizations of the following residual Project and cumulative effects will remain unchanged from the Revised Application: • Loss or Alteration of Plant Species of Interest; • Loss or Alteration of Plant Communities of Interest; • Loss or Alteration of Wetland Function; and • Loss or Alteration of Ecosystems.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
		Complex to Cow Portal		• Reduced potential for sedimentation and erosion effects along the B road and A road during construction with the removal of B road and the WRSF Contact Water Pipeline. • The proposed changes are positive to VC/subcomponent [due to removing the upgrade construction of B road and placing waste haulage underground and by removing pipeline construction along the A road from Bonanza Ledge Site to Mine Site Complex]			**25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(c)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Wildlife	Birds (Including Individual Species or Species Groups as Appropriate) Mammals (Including Individual Species or Species Groups as Appropriate)	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site Complex to Cow Portal	Improvement	• Reduced direct effects to wildlife (all subcomponents) from habitat loss or disturbance with the removal of B road and removal of the WRSF Contact Water Pipeline • Reduced indirect effects to wildlife (all subcomponents) from noise and dust generation with the removal of construction activities along A Road and B Road and from removal of hauling waste rock on surface along the B Road	Yes	Potential	**25(a)** There is an overall positive change in direct and indirect Project effects on the VC associated with the Project design changes. However, a more detailed assessment will be required to describe and characterize the negative effects associated with the Bats and Amphibians VC subcomponents from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. The characterizations of the following negative residual Project effects will require an updated description and may have changed mitigations and/or characterizations from the Revised Application: • Amphibians: habitat alteration and direct mortality • Bats: habitat alteration and sensory disturbance The characterizations of the following negative residual cumulative effects may require an updated description and

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
	Reptiles and Amphibians (Including Individual Species or Species Groups as Appropriate)	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site Complex to Cow Portal	Improvement	• Reduced stream crossings from the removal of B Road • Reduced indirect effects from dust generation • Reduced potential sedimentation from construction along A and B road • Water quality in Lowhee Creek – discharge from the BL site is currently authorized by a permit issued pursuant to the *Environmental Management Act*. The discharge limits in that permit are relatively close to ambient water quality guidelines, and the discharge of an increased volume of treated water to Lowhee Creek is not expected to increase the potential for effects in the receiving environment from existing conditions.			may have changed mitigations and/or characterizations from the Revised Application: • Amphibians: habitat alteration and direct mortality • Bats: habitat alteration and sensory disturbance **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(c)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Freshwater Fish	Fish Habitat Aquatic Resources Fish	Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Removal of the upgrade	Improvement	• Reduced stream crossings from the removal of B Road • Reduced indirect effects from dust generation • Reduced potential sedimentation from construction along A and B road • Water quality in Lowhee Creek – discharge from the BL site is currently authorized by a permit issued pursuant to the *Environmental Management Act*. The discharge limits in that permit are relatively close to ambient water quality guidelines, and the discharge of an increased volume of treated water to Lowhee	Yes	No	**25(a)** There is an overall positive change in direct and indirect Project effects on the VC associated with the Project design changes. That is, negative effects are associated with the Project design changes, but the negative effects were already captured in the Revised Application. However, a more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. The characterizations of the following residual

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
		construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site Complex to Cow Portal Addition of new discharge location at Lowhee Creek		Creek is not expected to increase the potential for effects in the receiving environment from existing conditions. • Information presented in the Environmental Assessment Certificate (EAC) Revised Application regarding water treatment technologies supports the ongoing ability to treat mine-contact water to the limits specified in the current effluent permit should the pipeline not be constructed. The treatment technology is scalable, and the size of the treatment system can be increased to handle the higher volume of mine contact water at BL. • Flows in Lowhee Creek – the conceptual design in the EAC Revised Application involved collection of surface mine-contact water from the Bonanza Ledge location and transport of the water to a central water treatment plant at the Mine Site Complex. This diversion would result in a reduction in flows in Lowhee Creek, particularly during the winter low flow period, and would have the potential to affect fish habitat as described in the EAC Revised Application. By not diverting this water from Lowhee Creek, the quantity of water reporting to Lowhee Creek would be more similar to current condition and thus fish habitat would also be more similar to current conditions.			Project effect will remain unchanged from the Revised Application: • Loss or alteration of riparian habitat along the Transmission Line and at the Willow River bridge The characterizations of the following residual Project effect will require updated descriptions and may have changed mitigations and/or characterizations from the Revised Application: • Change in water quantity at the Mine Site and QR Mill resulting in effects to fish and fish habitat. No potential negative residual cumulative effects were identified for this VC in the Revised Application and there is no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for “Affected Population” for the residual effects identified for this VC.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
Employment and Economy	Employment Economy	All new Project changes considered	Neutral	• Any changes to CAPEX/OPEX are anticipated to be minor and would not affect overall effect characterization • No change in job opportunities are anticipated	No	No	**25(a)** There is overall a neutral change in direct and indirect Project effects on the VC associated with the Project design changes. The proposed changes to the Project description do not have any change to the characterization results for the VC; therefore, there is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. The characterizations of the following residual Project effects will remain unchanged from the Revised Application: • Employment opportunities for local and regional residents will cease. • Revenue for local, provincial, and federal governments from the Project, as well as opportunities for local businesses, will decrease. No potential negative cumulative effects were identified for this VC in the Revised Application and there is no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
	Private Property		Improvement		No	No	

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
Land and Resource Use	Tenured Land and Resource Use Public Land and Resource Use Parks and Protected Areas	All new Project changes considered		• Reduced direct and indirect effects from Project traffic during all Project phases on Private Property, Tenured Land and Resource Use and Public Land and Resource Use • The new surface footprint has been previously permitted to ODV as part of a bulk sample notice of work application • No implication to Public Land and Resource Use or Parks and Protected Areas			**25(a)** There is an overall positive change in direct and indirect Project effects on the VC [no or neutral change to some subcomponents] associated with the Project design changes. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. The characterizations of the following negative residual Project effects will remain unchanged from the Revised Application: • Loss or displacement of private property • Loss or displacement of tenured land and resource use • Reduced/changed access on Contemporary Land and Resource Use • Decrease in Environmental Conditions for Contemporary Land and Resource Use • Increased pressure on public land and resource use • Change in lighting from the Mine Site • Change in visual resources • Decrease in enjoyment/ experience for Contemporary Land and Resource Use subcomponents due to a change in landscape/viewshed No potential negative cumulative effects were identified for this VC in the Revised Application and there is no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects.
	Lighting	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site Complex to Cow Portal	Neutral	• Reduced light from the removal of construction activities (along B Road and A Road) • Reduced light from the removal of hauling along B road during operations • Operational light from Cow Portal and Bonanza Ledge water treatment plant; however, not visible from receptors	No	No	
	Visual Resources	Removal of the upgrade	Neutral	• Potential for reduced adverse visual quality effects due to the removal of construction	No	No	

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
		construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site Complex to Cow Portal		activities along B Road and A Road, thereby reduced surface infrastructure visible from the community • Potential for reduced adverse visual quality effects due to the removal of hauling along B road during operations, where visible			**25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Infrastructure and Services	Community Infrastructure and Services Transportation Infrastructure Housing and Accommodation	All new Project changes considered	No Change	• No implication to VC/subcomponent	No	No	**25(a)** There is overall no change in direct and indirect Project effects on the VC associated with the Project design changes. The proposed changes to the Project description do not have any change to the predicted effects (i.e., no change to the description or characterization results for the VC); therefore, there is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. The characterizations of the following negative residual Project effects will remain unchanged from the Revised Application:

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
							• Project-related traffic will result in increased traffic and associated issues in Wells (e.g., dust, idling, parking) [during construction]. • In-migration will increase demand for housing [during construction]. • Project-related traffic will result in increased traffic and associated issues in Wells (e.g., dust, idling, parking) [during operations]. • In-migration will increase demand for housing [during operations]. There will be no change to the assessment of the following negative cumulative effects that were identified for this VC in the Revised Application: • Increase in Demand for Housing during Construction • Increase in Demand for Housing during Operation **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual or the cumulative effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual or the cumulative effects identified for this VC.
Human and Ecological Health	Human Health	Removal of the upgrade construction of B Road Removal of the WRSF Contact	Improvement	• Reduced adverse effects to human health from dust generation from site preparation activities • Reduced adverse effects to human health from air emissions from construction equipment use	No	No	**25(a)** There is an overall positive change in direct and indirect Project effects on the VC associated with the Project design changes. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
		Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex Hauling of waste rock underground from the Mine Site Complex to Cow Portal		• Reduced adverse effects to human health dust generation on surface during operations • Reduced adverse effects to human health from changes in water quality			mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. **25(b)** There will be a neutral change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be a neutral change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
	Ecological Health	See Surface Water, Freshwater Fish and Fish Habitat, Vegetation, Soil, and Wildlife VC's above.	Improvement	• See Surface Water, Freshwater Fish and Fish Habitat, Vegetation, Soil, and Wildlife VC's above.	No	No	
Community Health	Health Infrastructure and Services	All new Project changes considered	No Change	• No implication to VC/subcomponent	No	No	**25(a)** There is no overall change in direct and indirect Project effects on the VC associated with the Project design changes. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. The residual Project positive effects will remain unchanged from the Revised Application, as follows: • Health and infrastructure and services:
	Population Health						

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
							○ Support for WVFB through workers volunteering and developing a mutual aid agreement with the WVFB ○ Support for BC Wildfire There were no negative residual effects identified for the VC in the Revised Application and that remains unchanged due to the Project design changes. ○ More volunteers in the community ○ One social work position in the community for four years; ODV will work with service providers to determine the best way to implement the position ○ ODV will encourage workers to volunteer in the community and will develop a policy that provides incentives for doing so Monitored through SEMP • Population Health: ○ Enhanced training, employment, and income in the local population ○ One social work position in the community for four years No negative residual or cumulative effects were identified for the VC in the Revised Application and there is no change to this conclusion based on the Project design changes. **25(b)** There will be no change from the Revised Application for the assessment of risk or uncertainty assessments; no risk or uncertainty were assessed because no residual negative effects were identified for this VC.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
							25(d) There will be no change from the Revised Application to assessment results for "Affected Population;" no affected populations were assessed because no residual negative effects were identified for this VC.
Archaeological and Heritage Resources	Historical Resources Archaeological Sites Palaeontological Resources	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex	Improvement	• Reduced potential for uncovering archaeological artifacts with less surface construction.	No	No	**25(a)** There is an overall positive change in direct and indirect Project effects on the VC associated with the Project design changes. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. The residual Project positive effects will remain unchanged from the Revised Application, as follows: • The discovery and documentation of pre-contact and historical resources in the LAA have provided a positive effect and a deeper understanding of Indigenous and non-Indigenous land use, which may shift the dominant Gold Rush narrative of the area's history to be more inclusive of Indigenous voices and sites. • Given the non-renewable nature of heritage resources, the preferred mitigation option is always avoiding disturbance to them; however, in instances where a site cannot be avoided, some positive effects can result. Positive effects include the recording of new sites, which may have remained otherwise unknown if not for existing conditions, studies carried out to identify Project interactions with heritage resources and the collection of site data resulting from mitigation measures.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
							• The Project may also increase access for the public or researchers to newly recorded sites, which would have remained otherwise inaccessible. • Positive effects from the recording of new archaeological sites include enhanced understanding and a larger knowledge base of past use of the Project area, which could benefit Indigenous nations, local interest groups, and academic and consulting professionals working in the field of heritage resources. No negative residual or cumulative effects were identified for the VC in the Revised Application and there is no change to this conclusion based on the Project design changes. **25(b)** There will be no change from the Revised Application for the assessment of risk or uncertainty assessments; no risk or uncertainty were assessed because no residual negative effects were identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population;" no affected populations were assessed because no residual negative effects were identified for this VC.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
Culture	Plant Species of Cultural Significance; Traditional Foods; and Indigenous Language and Teaching	Removal of the upgrade construction of B Road Removal of the WRSF Contact Water Pipeline construction along A Road and B Road from Bonanza Ledge Site to Mine Site Complex	Improvement	• Reduced potential for removing species of cultural significance, traditional foods.	No	No	There may be reduced potential for removing species of cultural significance and for use as traditional foods. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. The residual Project positive effects will remain unchanged from the Revised Application, as follows: • The potential economic development that this project can bring will be largely positive to the community. The increased population provides opportunity for increased viewership and attendance for cultural events, sale of (and potential contribution to) marketable art, and a wider population base for fundraising related to the Arts. The effect would be measured by changes in attendance numbers as cultural events, and sales volume for art products. The characterizations of the following negative residual Project effect will remain unchanged from the Revised Application: • Direct habitat alteration and loss of plant species of cultural significance. The description of and assessment of negative cumulative effects will remain unchanged from the Revised Application. As this cumulative effect is directly related to Plant Species of Cultural Significance and is identical to the cumulative effects
	District of Wells Arts Sector	All new Project changes considered	No Change	• No implication to VC/subcomponent	No	No	

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication[2]	Description			
							discussed for the Vegetation VC (i.e., Plant Species of Interest, specifically traditional use plants), further discussion on the Potential Cumulative Effects, Mitigation Measures, and Adverse Cumulative Effects Characterization was included in the Vegetation VC. Therefore, no further updates are required for this VC (culture), particularly because there will be a reduction in removal of vegetation.

[1] Only the changes in Project component or activity relevant to the VC is included.

[2] If ODV proceeds with pursuing the proposed Project changes in this letter, VCs assigned to "improvement" or "neutral" net implication will be further described in a subsequent letter, as a mini amendment. Definitions of each assigned implication are as follows:

- **Improvement** - there is a net benefit or improvement to the Project effects assessment for that VC/subcomponent
- **Neutral** - there is already an existing adverse effect related to the VC/subcomponent and there will remain an adverse effect based on the proposed changes; however, the changes do not worsen the adverse effect. That is, there is a change in the description or location of the effects, or potentially require new mitigations, but the characterizations of the potential residual effects are predicted to be the same or similar.
- **No change** - the proposed changes to the Project description do not have any change to the predicted effects (i.e., no change to the description or characterization results for the VC).

[3] Where a new mitigation has been identified as 'yes' or 'potential,' further assessment is required to determine if and/or what the mitigation is. This will be identified in a more detailed assessment in an amendment for that VC, should ODV move forward with the request to amend the proposed Project design changes.

[4] Section 25(a), (b), and (d) of the BC *Environmental Assessment Act* (2018) are as follows: (a) Positive and negative direct and indirect effects of the reviewable project, including environmental, economic, social, cultural and health effects and adverse cumulative effects, (b)risks and uncertainties associated with those effects, including the results of any interaction between effects, and (d) disproportionate effects on distinct human populations, including populations identified by gender

Table 2. Assessment of Section 25(c) and (e) to (k) of the BC *Environmental Assessment Act* (2018)

Screening Assessment of Section 25 (c) and (e) to (k) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[5]	**Assessment**
25(c) risks of malfunctions or accidents	There is an overall improvement for the assessment of the following malfunctions and accidents because there is a reduced risk of their occurrence associated with the removal of the B-Road upgrade construction and the WRSF Contact Water Pipeline construction along A- and B-Roads: • Spill – Hazardous materials released to land • Spill – Hazardous materials released to water • Vehicle or equipment accidents • Adverse weather • Fire on surface There is a **neutral change** for the following malfunctions and accidents due to the use of the underground hauling route for waste transport from the Mine Site Complex to the Bonanza Ledge WRSF via the Cow Portal, i.e., malfunctions and accidents assessment will remain unchanged, but the location is extended for the additional underground footprint: • Underground fire • Flood - Inability to manage water inflow into underground mine works • Explosives accident (Accidental detonation of explosives) • Failure of underground mine stability • Power failure The Project changes are not relevant to the following malfunctions and accidents and therefore **no change** to the assessment of them is considered necessary: • Waste rock stockpile slope failure • Tailings dam breach Overall, there are no changes to the assessment of risks of malfunctions and accidents associated with the Project design changes.
(e) effects on biophysical factors that support ecosystem function	There is an overall improvement for the assessment of effects on the biophysical factors that support ecosystem function based on the Project design changes from that assessed in the Revised Application. There is no need to change the assessment provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects at the scale and level of details assessed for biophysical factors that support ecosystem function. It is a more conservative approach to keep the assessment as is and unchanged. Therefore, no changes are needed in the Revised Application based on the Project design changes.
(f) effects on current and future generations	There is no change required to the Revised Application for the assessment on the current and future generations based on the Project design changes.
(g) consistency with any land-use plan of the government or an Indigenous nation if the plan is relevant to the assessment and to any assessment conducted under section 35 or 73;	Project changes are not anticipated to alter consistency with any land-use plan of the government or an Indigenous nation, nor to any assessment conducted under section 35 or 73..
(h)greenhouse gas emissions, including the potential effects on the province being able to meet its targets under the Greenhouse Gas Reduction Targets Act;	There is no change to the Greenhouse Gas (GHG) Emissions assessment provided in Chapter 8 of the Revised Application that would be needed based on the Project design changes.

Screening Assessment of Section 25 (c) and (e) to (k) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[5]	**Assessment**
(i)alternative means of carrying out the project that are technically and economically feasible, including through the use of the best available technologies, and the potential effects, risks and uncertainties of those alternatives;	No changes are necessary to the assessment of the alternative means of carrying out the Project provided in the Revised Application. The Project design changes provided in this memo were not identified as alternative means of carrying out the Project at the time of submission, but are considered to be positive overall from an environmental, economic and social perspective.

(j)potential changes to the reviewable project that may be caused by the environment;	There is an overall improvement in potential effects pertaining to the assessment of 'potential changes to the reviewable project that may be caused by the environment.'
	
	Improvements relate to the following potential effects of the environment on the Project due to the reduced potential of their occurrence associated with the removal of the B-Road upgrade construction and the WRSF Contact Water Pipeline construction along A- and B-Roads:
	• Seismic activity – there is less road infrastructure that could be potentially affected from seismic activity
	• Slope instability – there is less road infrastructure that could be potentially affected from seismic activity
	• Associated with climate change:
	  • decreased dust generation along the B-Road (and A-Road during construction) should temperatures rise, or if there is drought
	  • decreased risk of construction schedule delays due to extreme wind and storm activity and wildfires with the removal of B-Road upgrade construction and the WRSF Contact Water Pipeline construction along A-Road and B-Road
	There is no change to the remaining potential effects from the environment on the Project based on the Project design.

(k)other prescribed matters	There are no 'other prescribed matters' identified to assess.

OSISKO DEVELOPMENT

Appendix C

Chapter 20.2 Requested Project for Certification [December 2022 – Revised for Project Design Changes]

OSISKO DEVELOPMENT

CARIBOO GOLD PROJECT

CHAPTER 20.2: REQUESTED PROJECT FOR CERTIFICATION

December 2022



OSISKO DEVELOPMENT

Cariboo Gold Project

Box 247
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Wells, BC V0K 2R0

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DEFINITIONS

Closure	The phase of the Project where all development and production ceases. The majority of mining facilities and infrastructure are decommissioned and/or removed from the Project site. Reclamation activities are conducted and completed. Facilities necessary to support post-closure management and monitoring requirements will remain until the post closure period is authorized to conclude. Water treatment plants, associated discharge infrastructure, the camp access road, the B road, and access to the QR Mill will be maintained throughout the post-closure period.
Construction	The phase of the Project during which physical alteration of land, vegetation, or any other aspect of the natural environment occurs. For the purposes of this Certificate, Construction: (i) does not include any activities conducted solely for investigative purposes under a valid permit or authorization, and (ii) includes upgrading, repairing, replacing, or removing, any existing works or infrastructure.
Employee	Individuals employed by the Cariboo Gold Project including contractors, or those employed by the Holder on business related to the Project (collectively, Employees).
Mine Site Complex	The Mine Site Complex is located in Wells, BC, in an area defined by the polygon in Figure 20.2-3, [NAD83 Zone: 10, Easting: 595581 Northing: 5884069].
Operations	The phase of the Project beginning with the commercial operation date of the Project, which is the date on which commercial mill production is achieved and ending when commercial mill production permanently ceases, and the Closure phase begins.
Project	The Cariboo Gold Project.
Project Site	The areas described in this document for the Project.
Quesnel River Mill	The Quesnel River (QR) Mill is located in an area defined by the polygon in Figure 20.2-4, [NAD83 Zone: 10, Easting: 581717 Northing: 5836772].

ABBREVIATIONS

Terminology used in this document has been defined where it is first used, while the following list has been presented to assist readers that choose to review only portions of the document.

Abbreviation	Description
BC	British Columbia
FSTSF	Filtered Stack Tailings Storage Facility
Ha	hectare
HDS	high-density sludge
Km	kilometre
kV	kilovolt
L	Litre
LHD	Load Haul Dump Loader
M	Metre
NWP	Northwest Zone Pit
ODV	Osisko Development Corp.
Project	Cariboo Gold Project
QR Mill	Quesnel River Mill
T	tonne
TSF	tailings storage facility
WRSF	waste rock storage facility
WTS	Water treatment system

1 PROJECT OVERVIEW AND LOCATION

The Cariboo Gold Project (the Project) is an underground gold mine with a maximum production capacity of 1,735,000 tonnes per year (less than 5,000 tonnes per day maximum) for an operations period of up to sixteen years (with an additional 1-year Construction Phase, 2-year Closure Phase, and minimum 10-year Post-Closure Phase). Ore will be crushed and concentrated at the Mine Site Complex before concentrate is trucked 115 km from the Mine Site Complex on existing roads to the existing Quesnel River Mill (QR Mill) for milling.

The Project is in the District of Wells and Cariboo Regional District, British Columbia (BC). The Mine Site is located at [NAD83 Zone: 10, Easting: 595581 Northing: 5884069].

The QR Mill is located 115 km from the Mine Site, 58 km southeast of Quesnel, and 18 km northwest directly of Likely, BC. The QR Mill is located at [NAD83 Zone: 10, Easting: 581717 Northing: 5836772].

2 PROJECT COMPONENTS

The following Project components are shown on the overview map (Figure 20.2-1).

2.1 Mine Site (Figures 20.2-2, 20.2-3)

The Mine Site consists of underground infrastructure within the maximum underground footprint (Figure 20.2-2) and surface infrastructure within the proposed Mine Site Certification Boundary surface footprint (Figure 20.2-3). The proposed Mine Site Certification Boundary (Figure 20.2-3) will be a maximum of 109.0 ha and is located 80 km east of Quesnel, BC, immediately adjacent to the Community of Wells. Clearing for the Mine Site will not exceed 21.0 ha of new disturbance.

2.1.1 Mine Site Access

Access to the Mine Site will be from Quesnel on Highway 26 (Figure 20.2-1). Access includes:

- A new mine access bypass crossing Highway 26 near Wells to the Mine Site Complex. Access to the Island Mountain Portal will also be along Highway 26.
- A new 24-m clear span bridge structure over the Willow River will be installed at the entrance of the Mine Site access road to Highway 26.
- A new Camp Access Road, which will connect the mine laydown area with the new Worker Accommodation.
- The 2.2 km long Bonanza Ledge Site waste rock storage facility (WRSF) Access Road, which will be used for hauling waste rock and ore-sorter rejects from the Cow Portal to the Bonanza Ledge Site WRSF.
- Access to the Island Mountain Portal will also be along Highway 26.

2.1.2 Surface Infrastructure

Surface infrastructure at the Mine Site Complex (Figure 20.2-3) includes:

- Services Building containing a Surface Concentrator and ancillary facilities;
- Mine offices;
- Maintenance shop;
- Warehouse;
- Laydown Areas for additional storage;
- 200-person Worker Accommodation;
- Sewage and septic works;

- Fuel storage and handling facilities, including:
  - Three 40,000 litre (L) diesel storage reservoirs for powering generators during construction;
  - Four 80,000 L propane storage tanks, one located near each of the (four) ventilation intake raises;
  - One propane storage tank, located near the worker accommodation kitchen;
  - Two 50,000 L diesel fuel reservoirs located at the Mine Site Laydown Area; and
  - One 20,000 L gasoline reservoir located at the Mine Laydown Area.
- Willow River clearspan bridge, maximum of 24.0 m long and 13.8 m wide;
- Telecom and fibre-optic network;
- Mine changing room and mine rescue services;
- Access roads with a combined length of up to 13.2 km and parking for 80 spaces;
- Maximum 69 kilovolt (kV) Substation;
- Generators used during construction, and retained as backup during operations;
- Utilities; and
- Security fence and access gate.

Activities in the surface footprint areas will also include equipment laydown, staging, and movement. Construction material needs will be sourced from waste rock and from licensed third-party off-site locations.

2.1.3 Temporary Accommodations

Osisko Development Corp. (ODV) has existing accommodations (Camp A and Camp B) close to the current ODV office on Ski Hill Road within 500 m of the Mine Site Complex, as well as the existing Ballarat camp (an ODV-owned camp, located 6.6 km east/southeast of the Mine Site Complex, as shown on Figure 20.2-1). ODV plans to use these accommodations, along with existing housing in Wells (Hubs Hotel, Osisko houses, and apartments) temporarily during Project construction only, until the Worker Accommodation is complete at the Mine Site Complex.

2.1.4 Underground Related Structures

Underground related structures (Figure 20.2-2) include:

- Three Portals: Island Mountain Portal, Valley Portal, and Cow Portal (existing) with entrance (tunnel) dimensions of 5.3 m by 5.3 m each;
- Underground mining infrastructure, including:
  - Underground crusher;
  - A Rail-Veyor© system (conveyor system);
  - Underground main garages in Valley and Shaft Zones;
  - Explosive Magazine Storage;
  - Sumps, pumps, and pumping stations;
  - Charging bays for the electric machinery;
  - Lunchrooms and refuges;
  - Warehouse storage;
  - Raw and clean water reservoirs;
  - Communication network; and
  - Electrical distribution and sub-station.
- Underground equipment, including:
  - Two-boom Jumbo Drill;
  - Production drill;
  - Bolter;
  - Underground haul truck (battery electric haul truck);
  - Load Haul Dump Loader (LHD);
  - Electric Roadheader; and
  - Service and support equipment.

2.1.5 Stockpile and Waste Storage

Stockpile and waste storage facilities (Figure 20.2-3) include:

- Temporary overburden and soil stockpile - located at the existing Bonanza Ledge Site with a total volume of up to 300,000 cubic metres [m^3];
- Bulk Fill Area – located at the Mine Site Complex with a total capacity of up to 1.5 Mt of waste rock;
- Liner between historic waste rock and new infrastructure at the Mine Site Complex; and
- Lined WRSF – located at the existing Bonanza Ledge Site with a total capacity of up to 9.5 Mt.

2.1.6 Water Supply, Management, and Treatment

Water supply, water management and water treatment structures and facilities (Figure 20.2-3) include:

- A new Water Treatment System (WTS) at the Mine Site Complex including a conventional high-density sludge (HDS) lime neutralization and ferric coprecipitation system;
- An existing Water Treatment Plant at the Bonanza Ledge Site, to treat WRSF contact water;
- Non-contact water diversions;
- Contact water management structures;
- Existing ditches and culverts along access roads;
- Potable water storage and supply (two options);
- Freshwater supply (for Services Building and camp facility);
- Firewater pumping station and distribution;
- Mine Site Sediment Pond at the Mine Site Complex;
- Sediment Control Pond at Bonanza Ledge WRSF;
- Existing discharge point to Lowhee Creek;
- Treated Discharge Line to Jack of Clubs Lake; and
- Diffuser effluent discharge system at the end of the Treated Discharge Line to Jack of Clubs Lake.

2.2 Transportation Route (Figures 20.2-1)

Transportation of concentrate between the Mine Site and the QR Mill site will occur along 56 kilometres (km) of Highway 26 and 59 km of the 500 Nyland Lake Forest Service Road, a forest service road maintained by West Fraser Mills Ltd.

Transportation of workers, goods, and service providers to Wells from Quesnel, BC, will occur along Highway 26. A new highway bypass will be built before Wells to enable traffic to exit the highway before the community.

Transportation of workers and goods to the QR Mill from Quesnel will occur along Highway 26 and the 500 Nyland Lake Road, and for workers only along the Quesnel Hydraulic Road to 2700 Road and the 500 Nyland Lake Road.

2.3 Quesnel River Mill (Figure 20.2-4)

The Quesnel River Mill is located 115 km from the Mine Site, on the Quesnel River Mine property, which has historically produced gold. Infrastructure will be located within the maximum surface footprint (137.0 ha) shown in Figure 20.2-4.

2.3.1 Surface Infrastructure

Surface infrastructure will include:

- Existing Quesnel River Mill with upgrades including:
  - A covered 5,500 t concentrate storage area;

- A haul truck dump, hopper, and conveyor to by-pass the existing crushing circuit;
- A pre-aeration tank added to the existing leach circuit;
- Replacement of the existing carbon elution and electrowinning circuits;
- Replacement of existing cyanide destruction tanks;
- Addition of a tailings dewatering circuit; and
- Upgrades as required within the existing QR Mill.

- There is currently one diesel storage reservoir and one gasoline storage reservoir installed at the QR Mill, as well as another reservoir for the mill emergency generator. The existing reservoirs will be inspected and re-used for the Project if they meet current fuel storage standards and regulations.
- Existing worker accommodation to be used then replaced with new worker accommodation to house up to 40 people.
- Potential upgrades to sewage and septic works.
- Existing offices.

2.3.2 Tailings Management

Tailings Management Facilities will include:

- A Filtered Stack Tailings Storage Facility (FSTSF) that will be developed at the location of the existing Quesnel Mill Tailings Storage Facility (QR TSF). It will reach a maximum height of 15 m from the toe of the FSTSF to its crest and will store 3.4 Mt of filtered tailings over the existing tailings and waste rock in the existing TSF.

2.3.3 Water Supply, Management, and Treatment

Water supply, water management, and water treatment structures and facilities (Figure 20.2-4) include:

- FSTSF and its Ephemeral Pond (to be located at the site of the existing QR TSF once the TSF drawdown is complete and the geomembrane installed on the surface of the existing tailings and sides of the facility);
- New sediment pond;
- The existing Main Zone Pit;
- The existing North Seepage Collection Pond;
- The existing South Seepage Collection Pond (to be enlarged to increase flood storage, provide process water storage, and collect FSTSF seepage);
- The existing Northwest Zone Pit (NWP) for freshwater supply;
- The existing well for potable water supply;
- Contact and non-contact water conveyance infrastructure including diversions, spillways,

pumps, and pipelines to separately manage these volumes; and

- The existing and expanded WTS components.

2.4 Transmission Line (Figures 20.2-5 to 20.2-15)

A 69 kV, three-phase transmission line from Barlow Substation, near Quesnel to the Mine Site Complex will be constructed using existing and/or upgraded access roads. The route will be located north of Highway 26 and will parallel existing forestry roads and previously disturbed areas. The duration of the operation of the Transmission Line to support the Project will be 16 years and will be decommissioned in years 17 and 18. Other key features of the proposed transmission line are outlined below:

- The Transmission Line will have a maximum right of way dimension of 40 m in width and 69.3 km in length within the corridor presented in Figures 20.2-5 to 20.5-15. The Transmission Line corridor dimensions are 69.5 km in length and variable width, ranging from 100 m at the narrowest width to 610 m at the maximum width.
- The Transmission Line will include two types of access roads: existing roads (existing without requiring upgrades) and upgraded roads (existing roads requiring upgrades such as clearing and re-grading). There are no new roads (newly constructed roads for the purpose of the Project) proposed for the Transmission Line.
- The area of disturbance for each access road is assumed to average 15 m, including 5 m road width, with an additional 5 m of clearing on either side.

3 MITIGATION BY DESIGN

The following mitigation measures were incorporated into the design of the Project by area.

3.1 Mine Site

- Maximizing the use of existing infrastructure and brownfield sites to limit the amount of new disturbance attributable to the project. Excess waste rock (i.e., beyond that used as fill material at the Mine Site Complex) and ore sorter waste will be backfilled as cemented rock fill for underground road maintenance, and excess will be transported to the Bonanza Ledge site (an existing brownfield site) for storage.
- A highway bypass will be built to separate mine transportation activities from the town and avoid traffic going to town and associated noise and dust.
- A WTS will be used for treating contact water at the Mine Site, prior to discharge into Jack of Clubs Lake.
- Visual quality was considered in the design of the Services Building to blend in with the surrounding environment, and associated landscaping and replanting program.
- Waste rock will be transported underground from the Mine Site Complex to the Cow Portal, which will reduce surface dust, noise, and lighting impacts associated with surface transportation of waste rock from the Mine Site Complex to the Bonanza Ledge Site.
- Electric Roadheaders will be used underground to reduce the use of explosives and generation of explosive residue in the water, combustion gas in the air, and vibration caused by blasting.
- Electric and automated underground equipment and haul trucks will be used to reduce emissions, improve energy efficiency, minimize noise emission on surface, and maximize safety for personnel.
- The processing design for the Project uses a 2-step concentrating strategy which provides several important benefits from an environmental perspective. The first step of concentrating the mineralized material will be done by ore sorting technology. The ore sorter is able to separate the mineralized material from the barren material by a simple mechanical process that doesn't require any water or use of chemicals and can work at a size fraction from 10 mm to 32 mm (i.e., grinding is not required). Using this technology reduces the amount of ore requiring processing by 30% to 40%. In the first two years, before the flotation circuit is operational, ore sorting will be undertaken and will reduce the number of trucks required to transport the concentrate to the QR Mill of the same factor (30% to 40% less trucks).

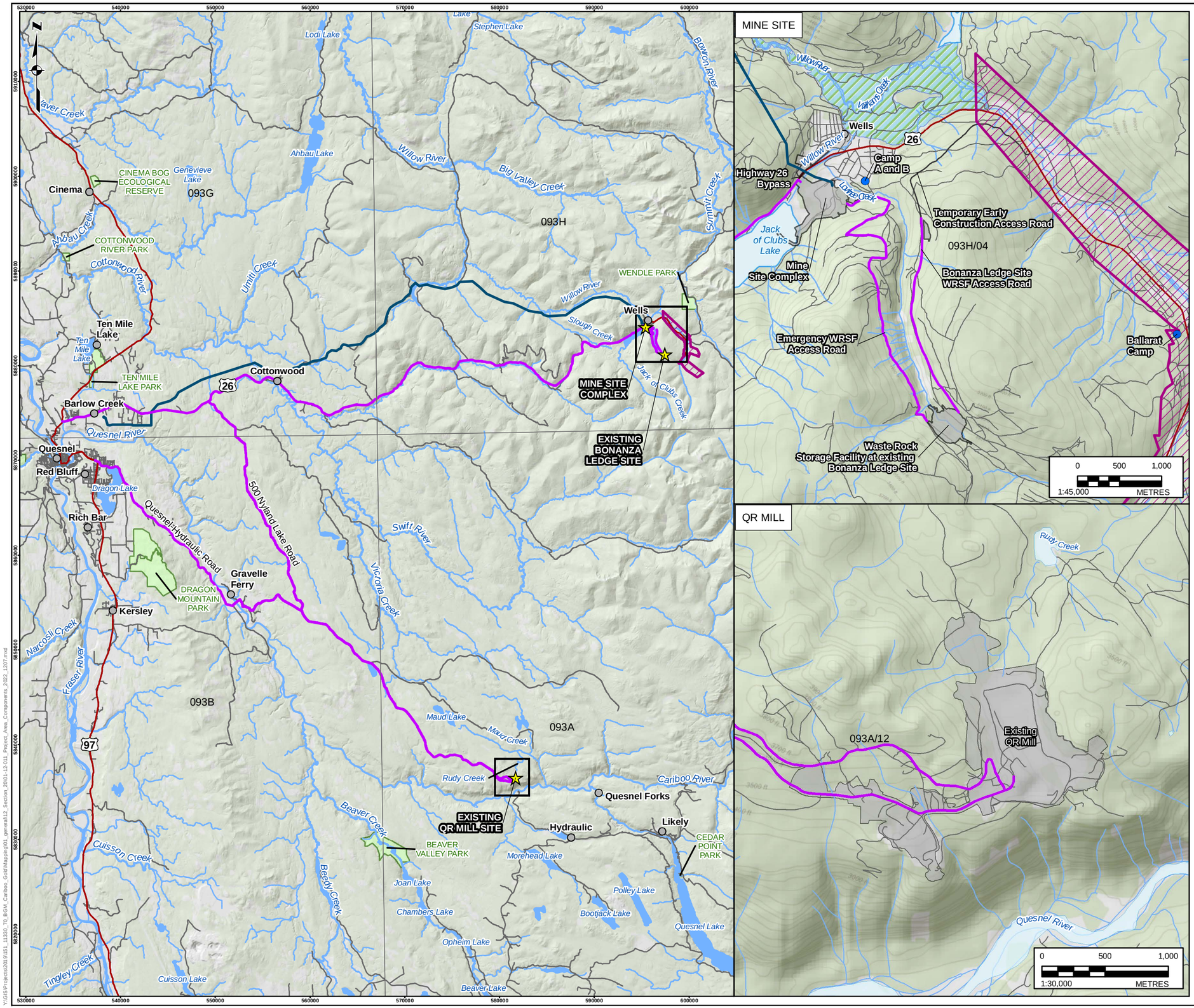
- In Years 3 – 16, the second step of concentrating is flotation. Through the use of flotation, another 80% to 85% of barren rock from the mineralized material can be separated. By using this strategy only 13% of all mined ore is sent to QR Mill as concentrate (and produces tailings that will be stored on surface). This approach further reduces water consumption, chemical and energy requirements compared to traditional processing for gold (the lixiviation stage).
- Crushing will be conducted underground to reduce surface disturbance, and ore will be transported by a vertical conveyor directly inside the mill to reduce noise and dust emitted at surface. No equipment will be required at surface to transport ore to the concentrator, minimizing equipment on surface which substantially reduces noise and dust emissions.
- Flotation tailings will be used for paste backfill, thus eliminating the need for surface tailings disposal at the Mine Site (in proximity of the community of Wells) and reducing the size of the WRSF at the Bonanza Ledge site. Having no tailings disposal facility on surface has considerable benefits from an environmental and risk perspective, with no structure retaining mine tails and water required.

3.2 Quesnel River Mill

- The Project footprint has been reduced by incorporating the use of an existing site and mill.
- A WTS will be utilized to treat contact water prior to discharge.
- The Project will incorporate filtered stack tailings on top of the existing TSF that will eliminate the need to expand the footprint required to manage tailings and use the new produced tails to help with the reclamation of the old tailings pond. The use of filtered tailings, when placed over top of the existing tailings, will avoid importing material from a borrow site and help ongoing desaturation of the existing tailings (beyond the initial TSF drawdown period during construction), thereby contributing to reclamation of the existing TSF.

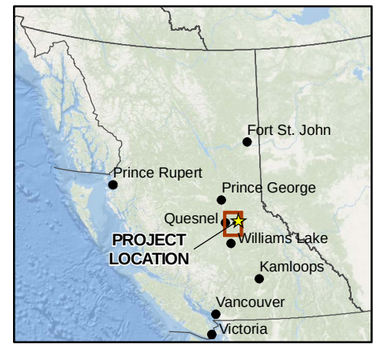
3.3 Transmission Line

- The routing and footprint were optimized to avoid Wendle Provincial Park and to minimize disturbance to critical habitat for woodland caribou and ungulate winter ranges.
- Routing of the transmission line maximized the utilization of existing disturbance corridors and reduced the need to create new access roads since planned access is facilitated via roads used previously for logging.
- Construction and use of a transmission line are anticipated to result in reduced GHG emissions, given the reduction in the requirement for local diesel-power generators through the Operations phase.



LEGEND

- POPULATED COMMUNITY
- PROJECT INFRASTRUCTURE LOCATION
- TEMPORARY EARLY CONSTRUCTION CAMP
- ROAD
- HIGHWAY
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- TRANSPORTATION ROUTE
- TRANSMISSION LINE ROUTE
- SURFACE DISTURBANCE AREA



REFERENCE(S)

1.WATER FEATURES, TRANSPORTATION FEATURES OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. CITIES/TOWNS, INDIAN RESERVES, FEDERAL LANDS AND PARK/PROTECTED AREAS OBTAINED FROM BC MINISTRY OF FORESTS, LANDS NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
3. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM Zone 10N

0 5 10 15
1:400,000 KILOMETRES

CARIBOO GOLD PROJECT

OVERVIEW OF MAJOR PROJECT COMPONENTS

REV.	DESCRIPTION	DATE	INITIALS
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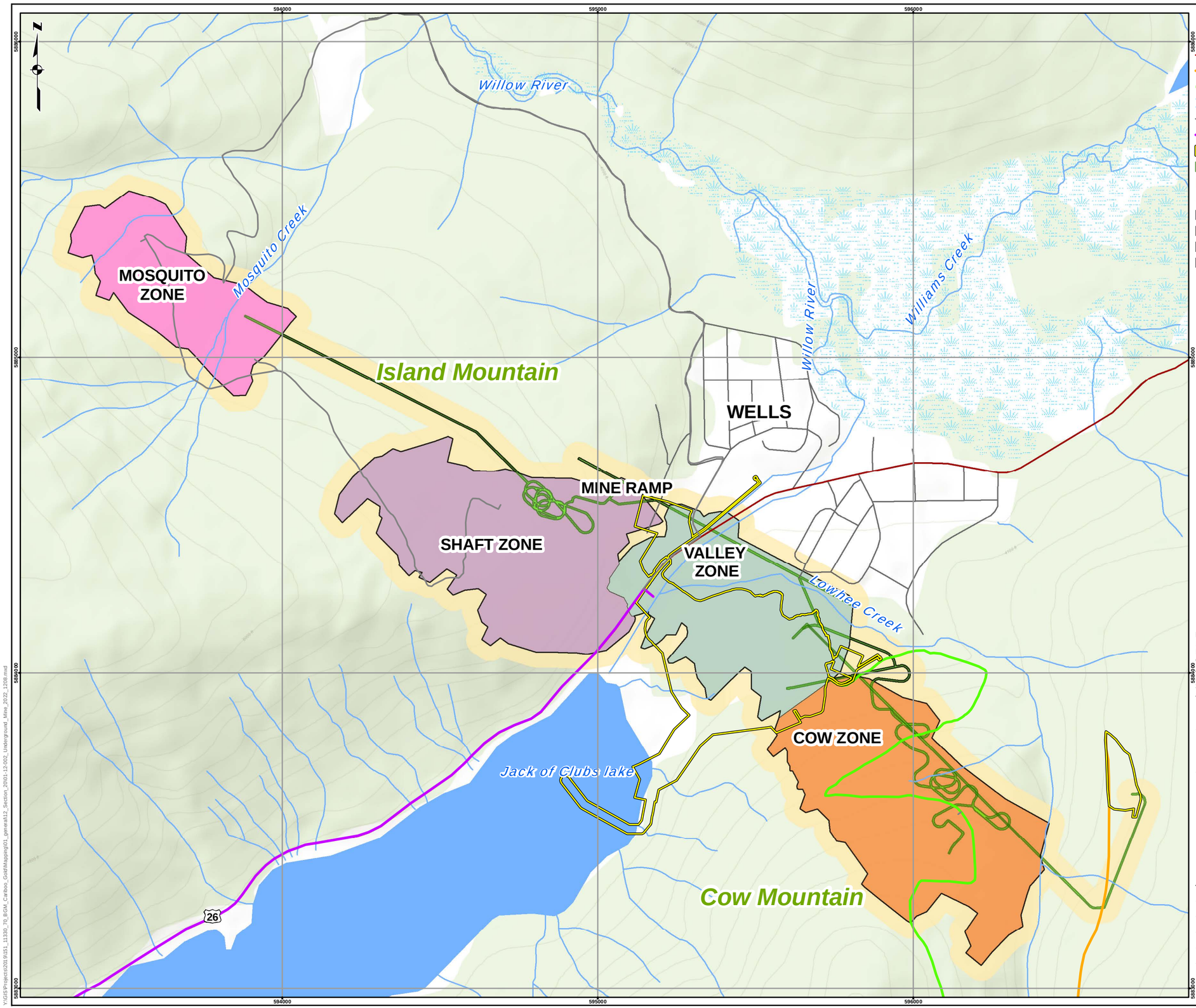
PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

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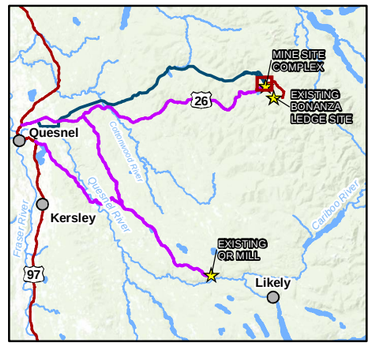


LEGEND

- ROAD
- HIGHWAY
- A ROAD (EXISTING)
- C ROAD (EXISTING)
- WETLAND
- EXISTING MINE SITE ROAD
- TRANSPORTATION ROUTE
- SURFACE DISTURBANCE AREA
- UNDERGROUND INFRASTRUCTURE
- UNDERGROUND FOOTPRINT

UNDERGROUND MINE AREA

- SHAFT ZONE
- COW ZONE
- VALLEY ZONE
- MOSQUITO ZONE



REFERENCE(S)

1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
2. BASE DATA SOURCE: ESRI, GEOBASE, NRCAN, AND THE GIS USER COMMUNITY
3. BASE DATA SOURCE: ESRI, GEOBASE, NRCAN, AND THE GIS USER COMMUNITY.
4. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM ZONE 10N

0 90 180 270 360 Meters

1:12,000 METRES

CARIBOO GOLD PROJECT

SIMPLIFIED ORE DEPOSITS AND UNDERGROUND INFRASTRUCTURE

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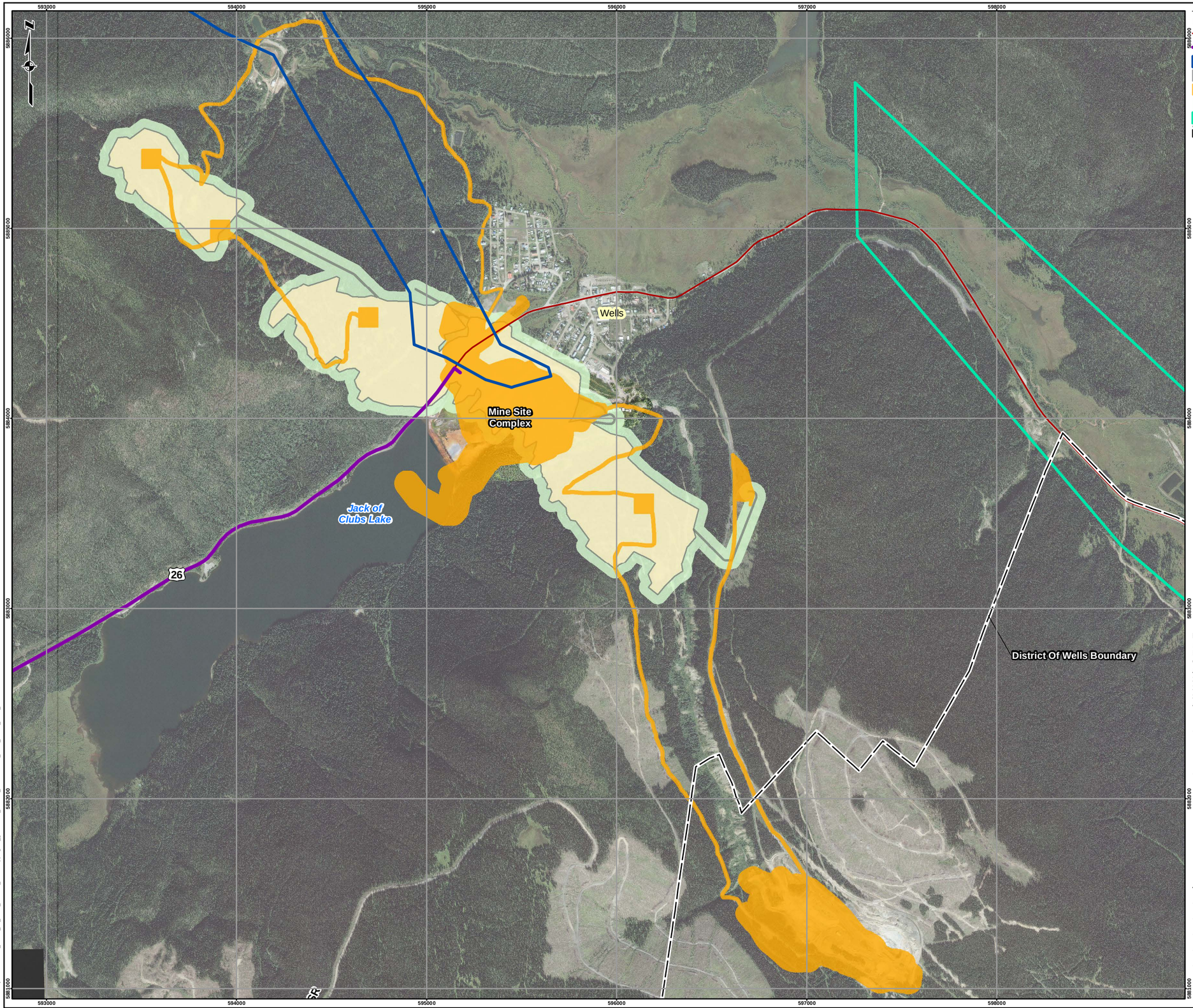
PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	20.2-2

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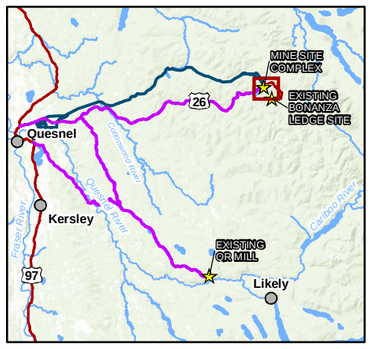
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LEGEND

- HIGHWAY
- TRANSPORTATION ROUTE
- TRANSMISSION LINE CORRIDOR
- UNDERGROUND MINE AREA
- PROPOSED MINE SITE CERTIFICATION BOUNDARY
- UNDERGROUND FOOTPRINT
- BARKERVILLE HISTORIC TOWN AND PARK
- DISTRICT OF WELLS BOUNDARY



REFERENCE(S)

1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
2. HILLSHADE DERIVED FROM LIDAR DATA FLOWN BY MCELHANNAY CONSULTANTS LTD. JUNE 27, 2016.
3. BASE DATA SOURCE: ESRI, GEOBASE, NRCAN, AND THE GIS USER COMMUNITY.
4. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM ZONE 10N

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CARIBOO GOLD PROJECT

MINE SITE SURFACE AND UNDERGROUND FOOTPRINTS

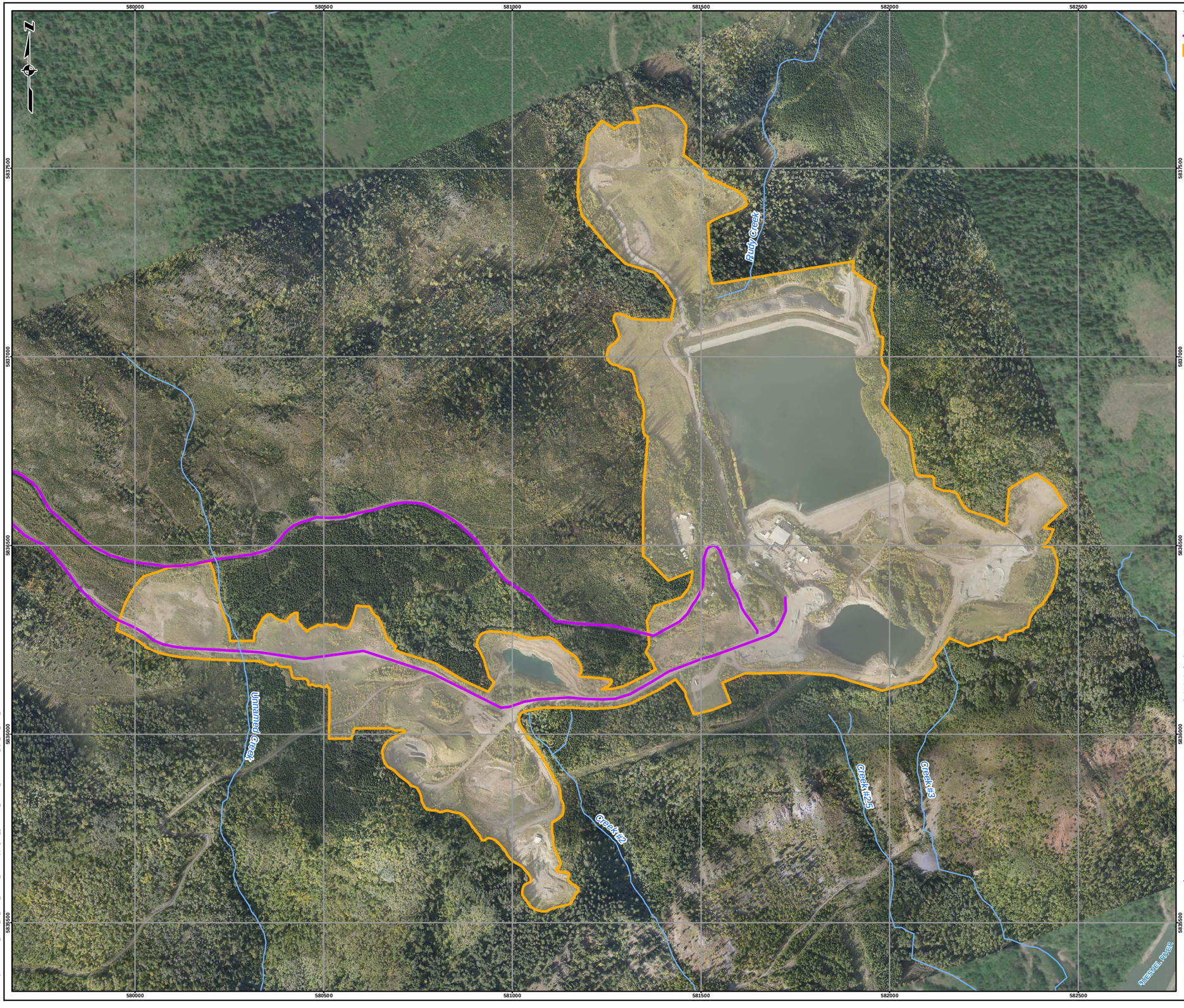
REV.	DESCRIPTION	DATE	INITIALS
A		12/13/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-3**

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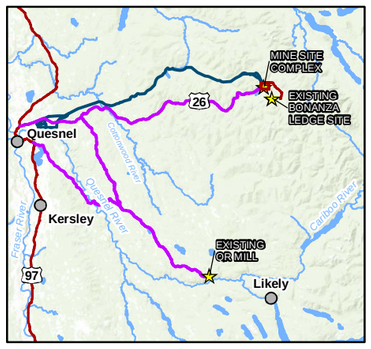
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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LEGEND

- TRANSPORTATION ROUTE
- MAXIMUM SURFACE FOOTPRINT



REFERENCE(S)

1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
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4. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM ZONE 10N

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CARIBOO GOLD PROJECT

QR MILL MAXIMUM SURFACE FOOTPRINT

REV.	DESCRIPTION	DATE	INITIALS
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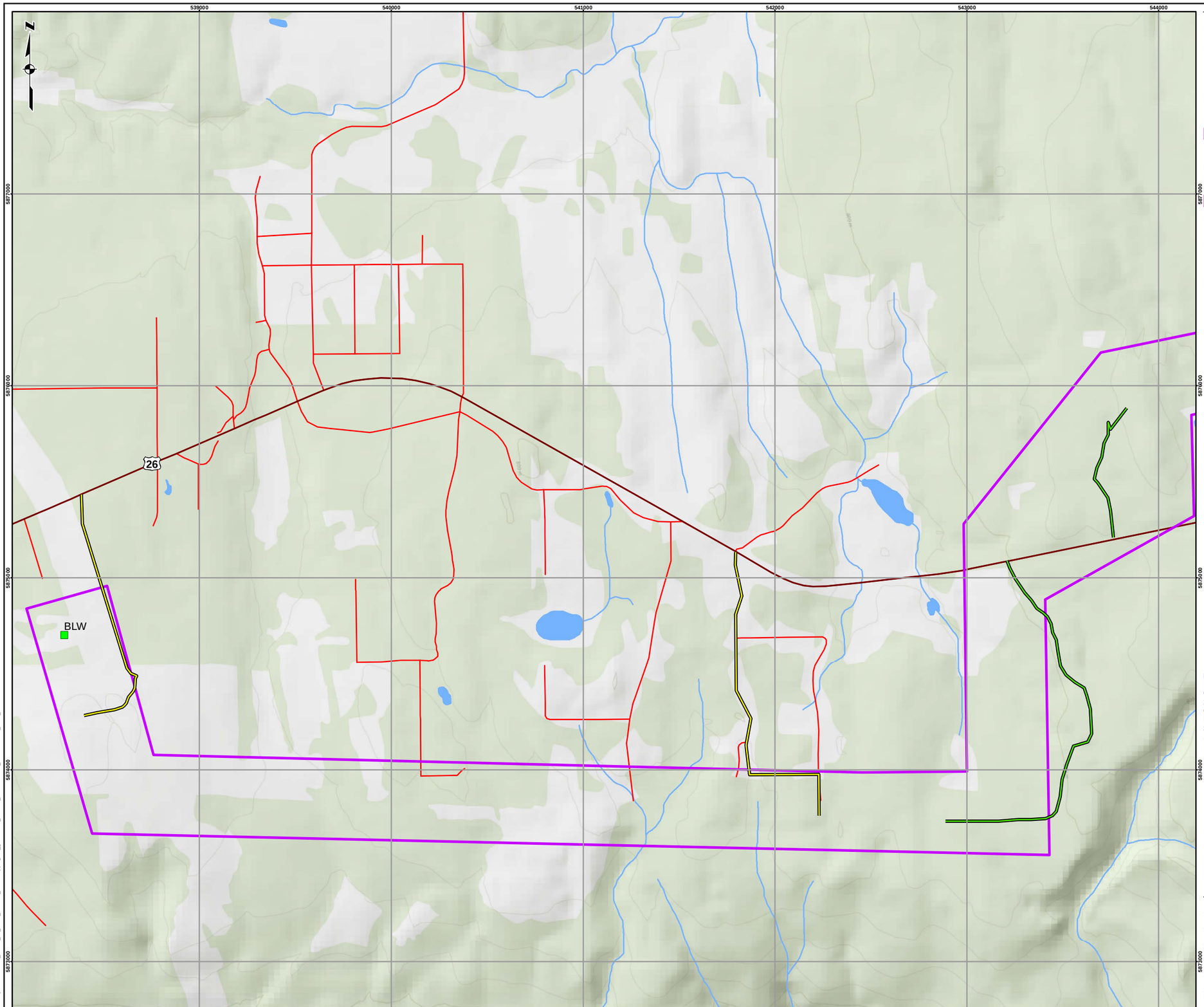
PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-4**

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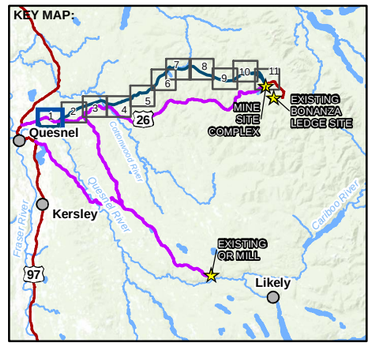
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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



REFERENCE(S)

1.WATER FEATURES, TRANSPORTATION FEATURES OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. CITIES/TOWNS, INDIAN RESERVES, FEDERAL LANDS AND PARK/PROTECTED AREAS OBTAINED FROM BC MINISTRY OF FORESTS, LANDS NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
3. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 1 OF 11

REV.	DESCRIPTION	DATE	INITIALS
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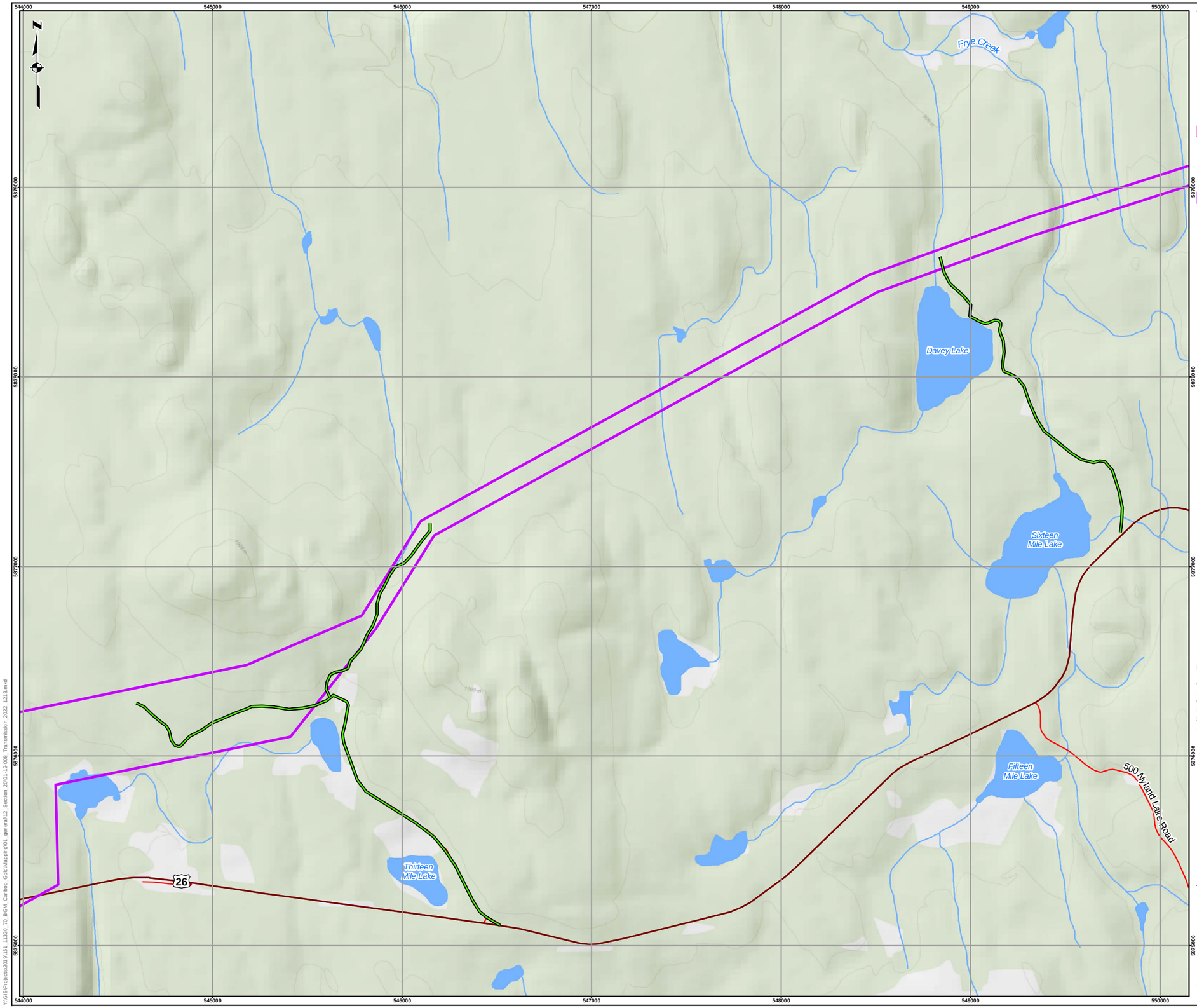
PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-5**

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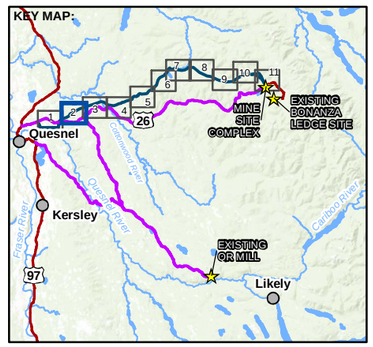
25mm

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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



REFERENCE(S)

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NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 2 OF 11

REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	20.2-6

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Cottonwood River

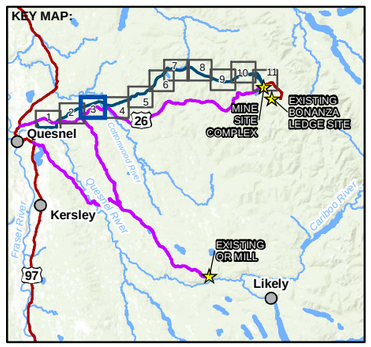
Frye Creek

Sixteen Mile Lake

26

LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



REFERENCE(S)

1.WATER FEATURES, TRANSPORTATION FEATURES OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. CITIES/TOWNS, INDIAN RESERVES, FEDERAL LANDS AND PARK/PROTECTED AREAS OBTAINED FROM BC MINISTRY OF FORESTS, LANDS NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
3. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 3 OF 11

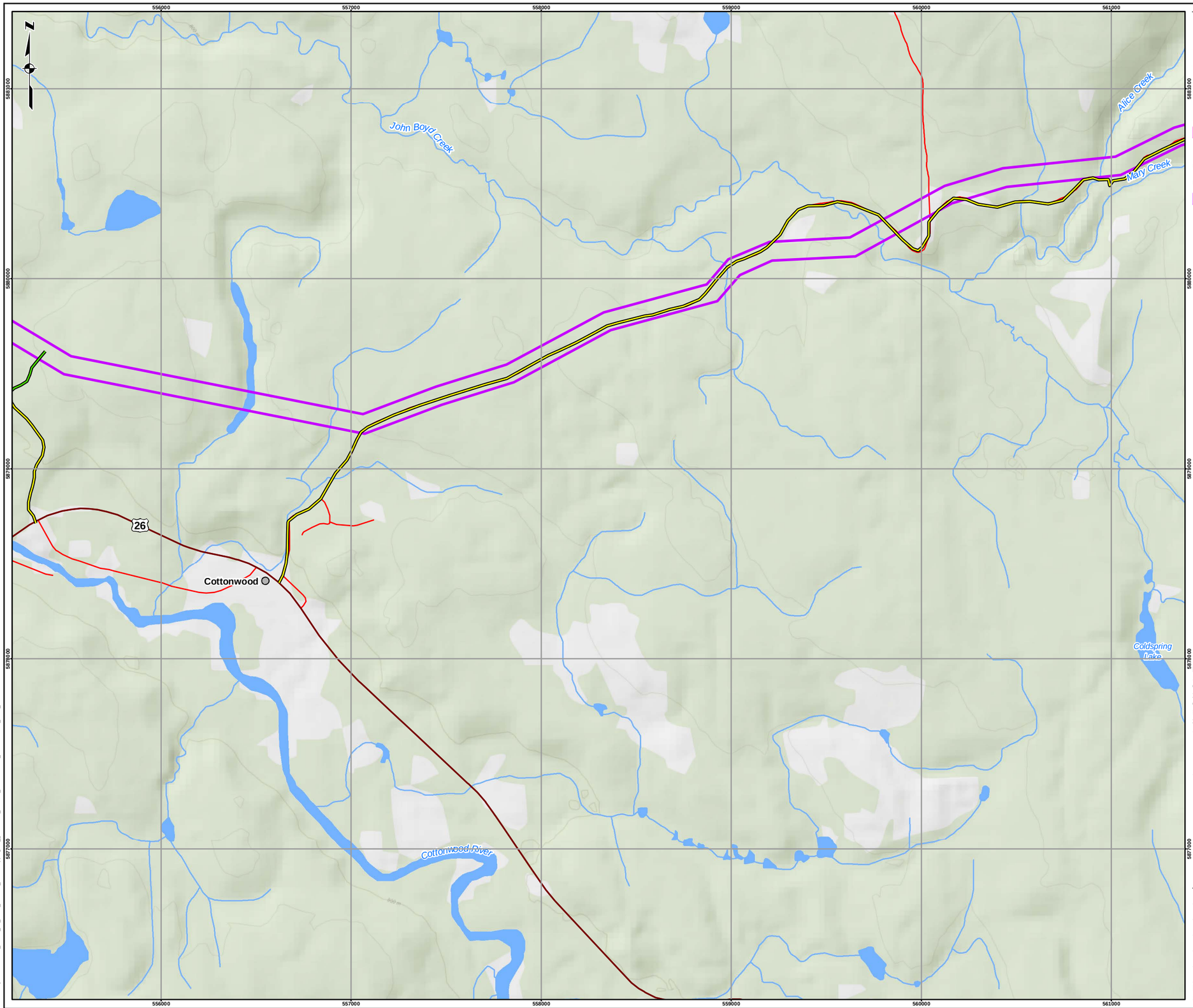
REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-7**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

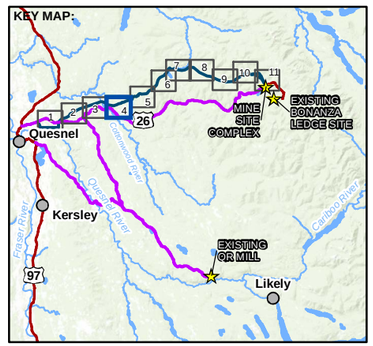
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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



REFERENCE(S)

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NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 4 OF 11

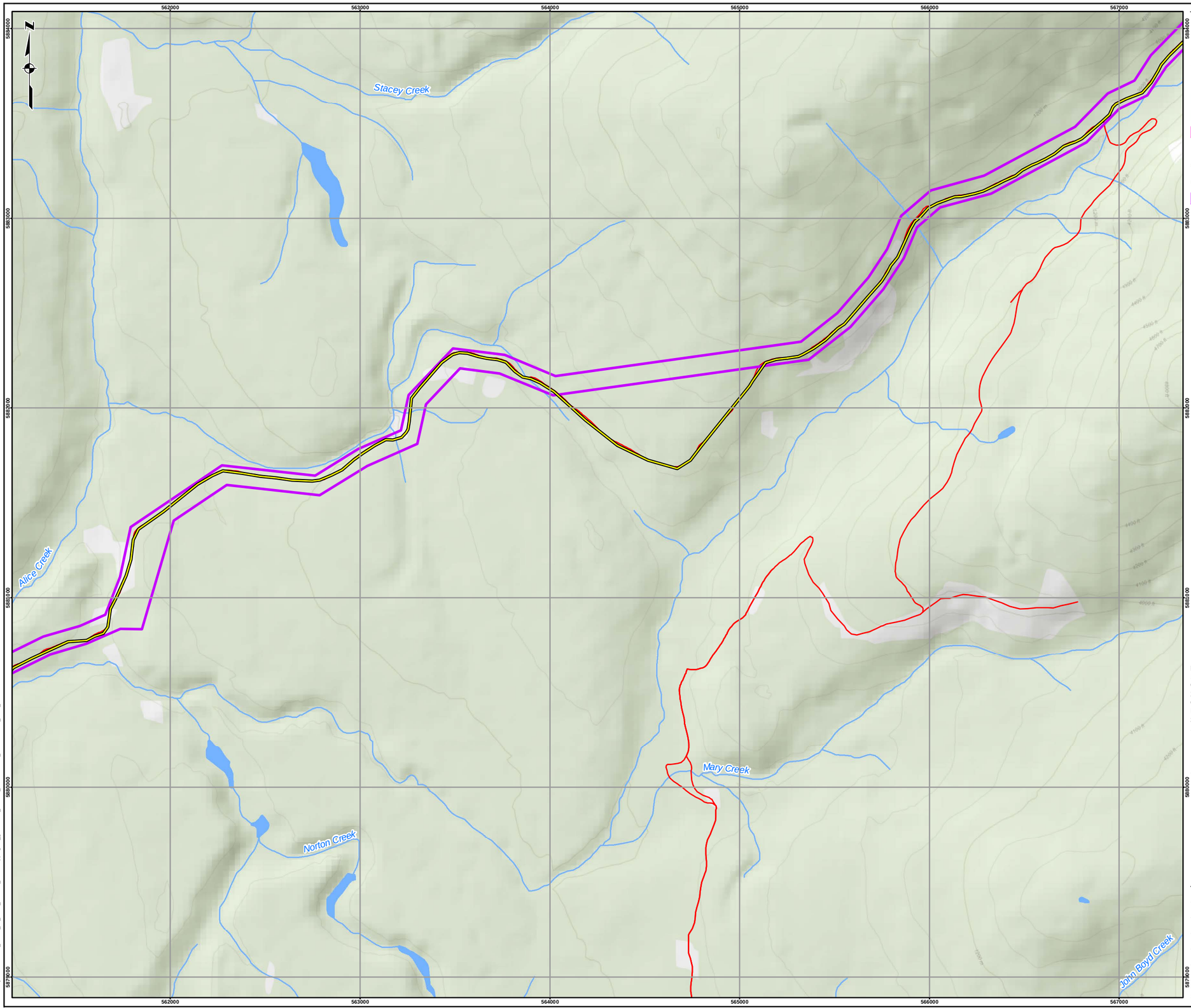
REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-8**

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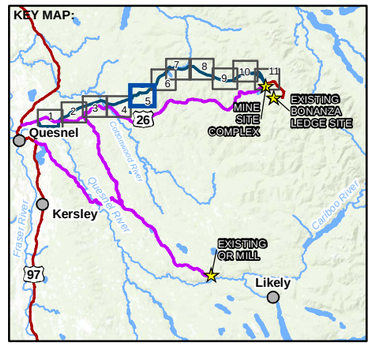
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



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NAD83 CSRS
UTM Zone 10N

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KILOMETRES
1:20,000

CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 5 OF 11

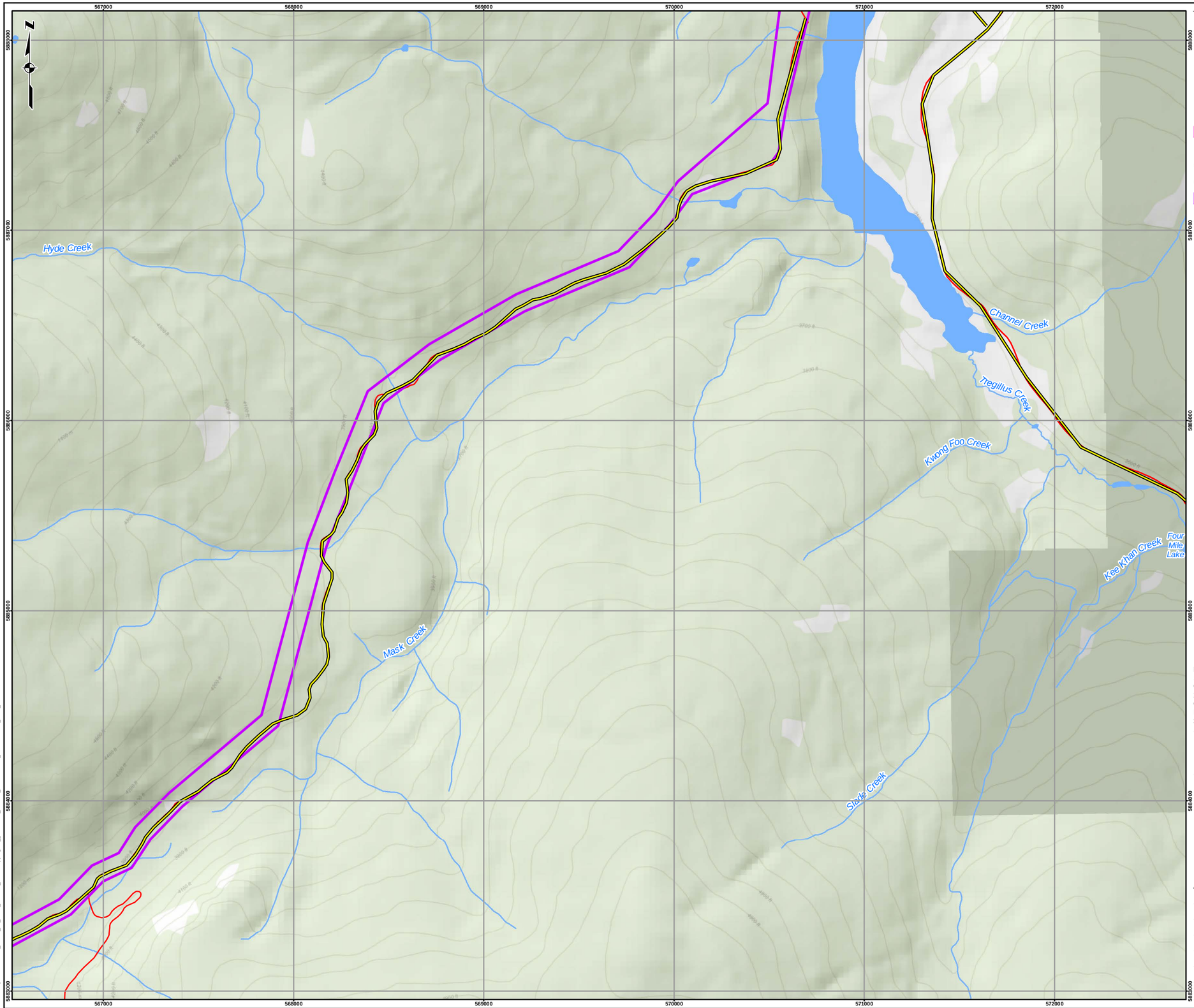
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PROJECT NO.	PHASE	REV.	FIGURE
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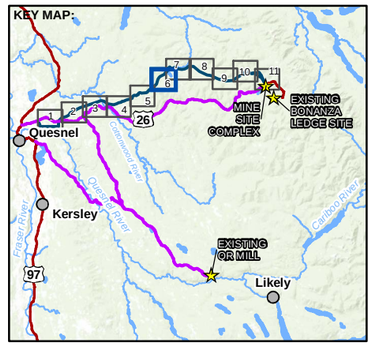
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



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NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 6 OF 11

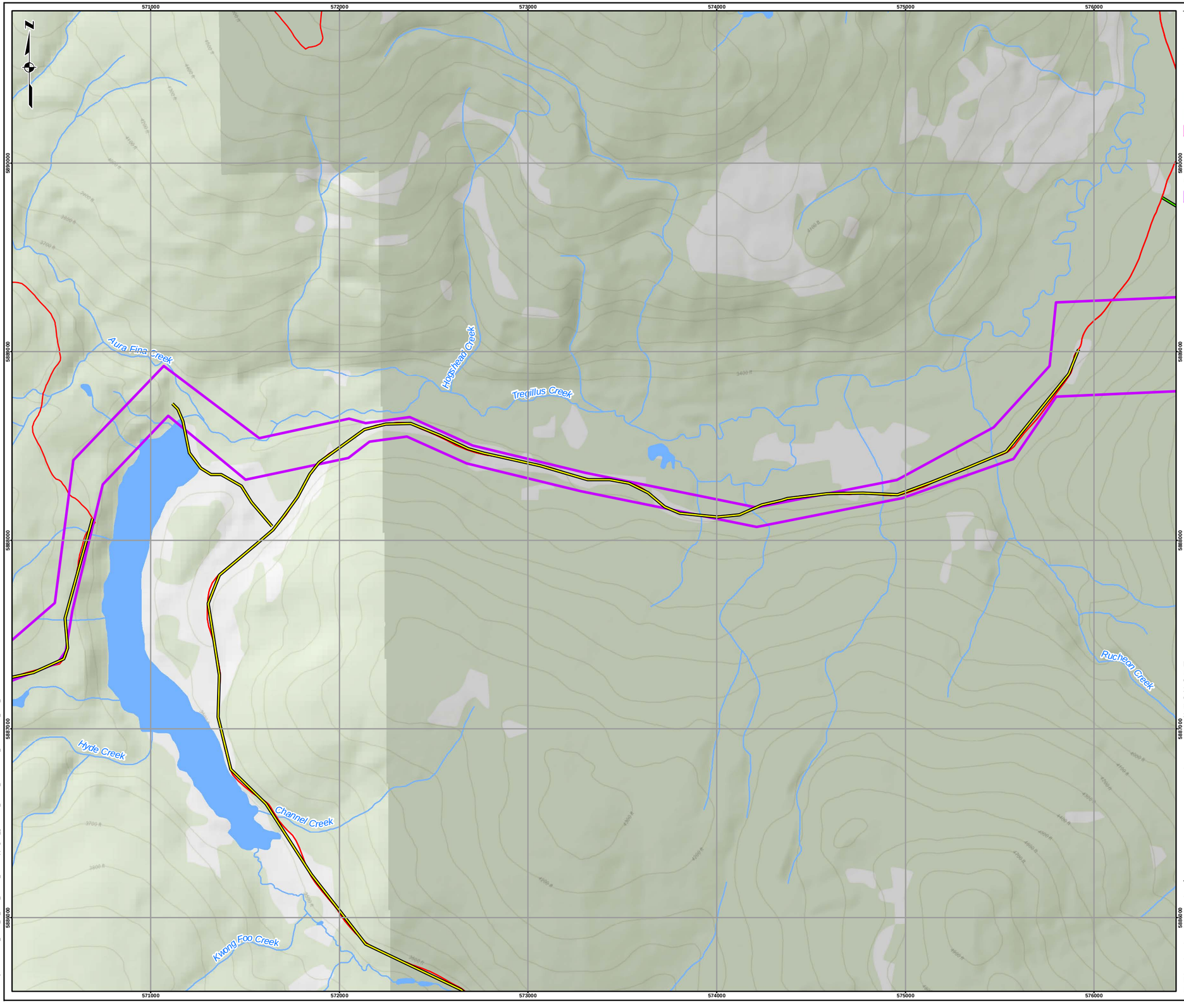
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PROJECT NO.	PHASE	REV.	FIGURE
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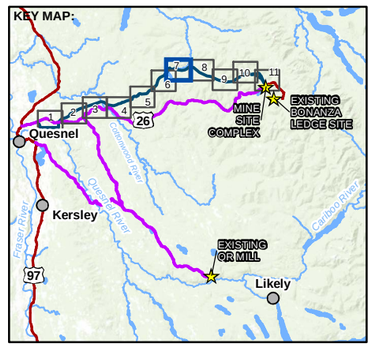
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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



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NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 7 OF 11

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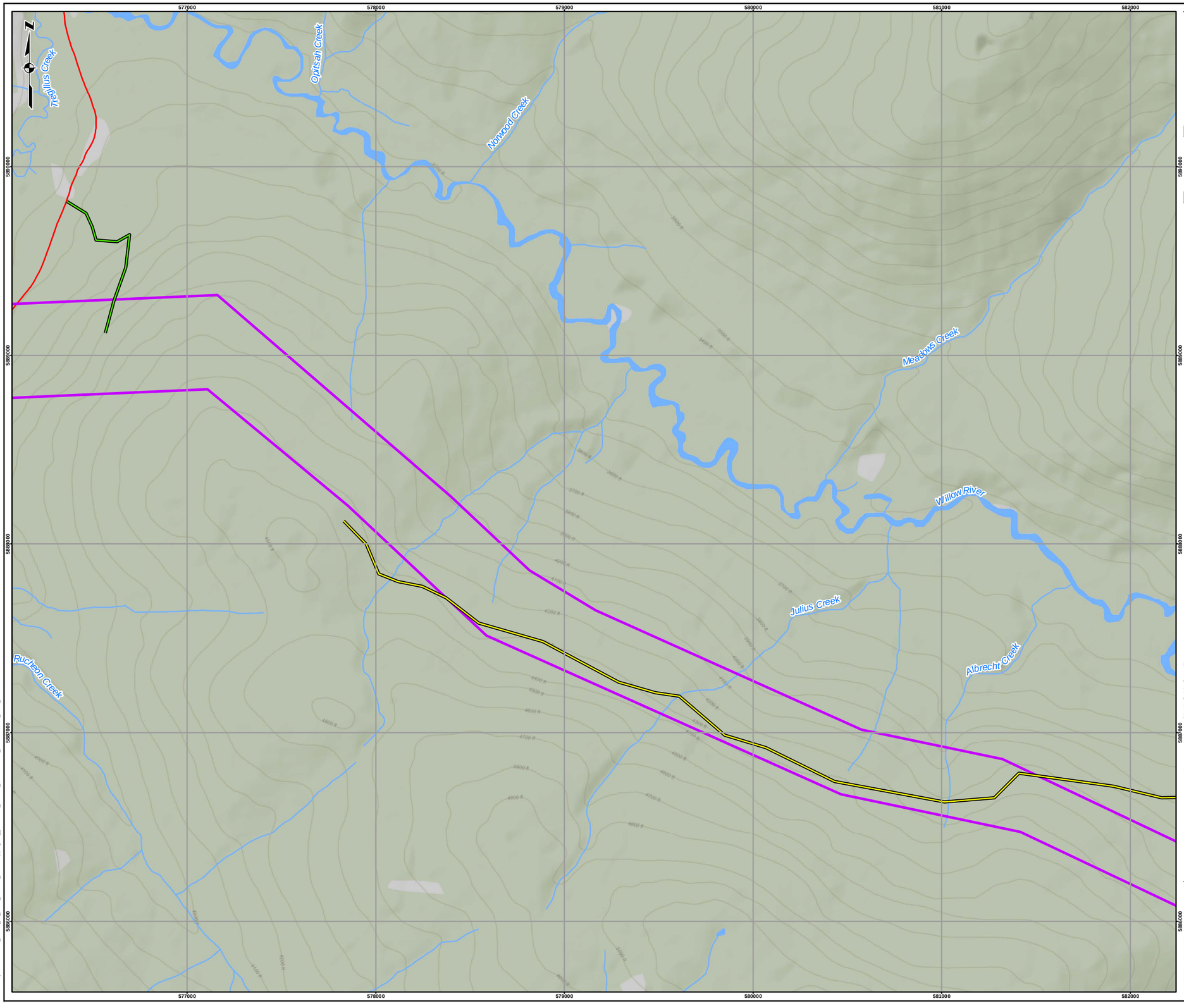
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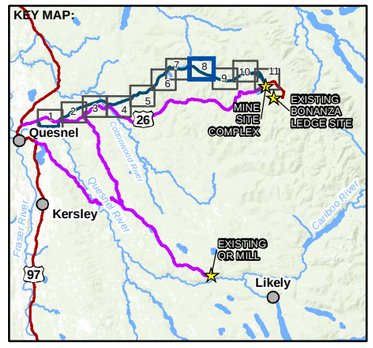
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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
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- TRANSMISSION LINE ACCESS ROAD (EXISTING)
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NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 8 OF 11

REV.	DESCRIPTION	DATE	INITIALS
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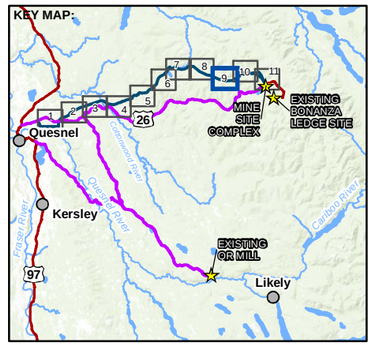
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5888000 5887000 5886000 5885000 5884000

Tom Creek
Dragon Creek
Willow River
Montgomery Creek
New Creek
Slough Creek
Nelsons Creek
Skeepy Creek

LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
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- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
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NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 9 OF 11

REV.	DESCRIPTION	DATE	INITIALS
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PROJECT NO.	PHASE	REV.	FIGURE
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5890000 5889000 5888000 5887000 5886000

N

Tom Creek

Harrascrabble Creek

Willow River

Porcupine Creek

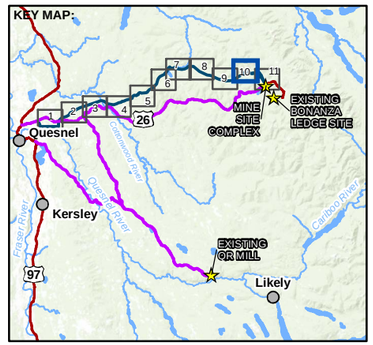
Cornish Creek

Peep O'Day Creek

Coulter Creek

LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
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NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 10 OF 11

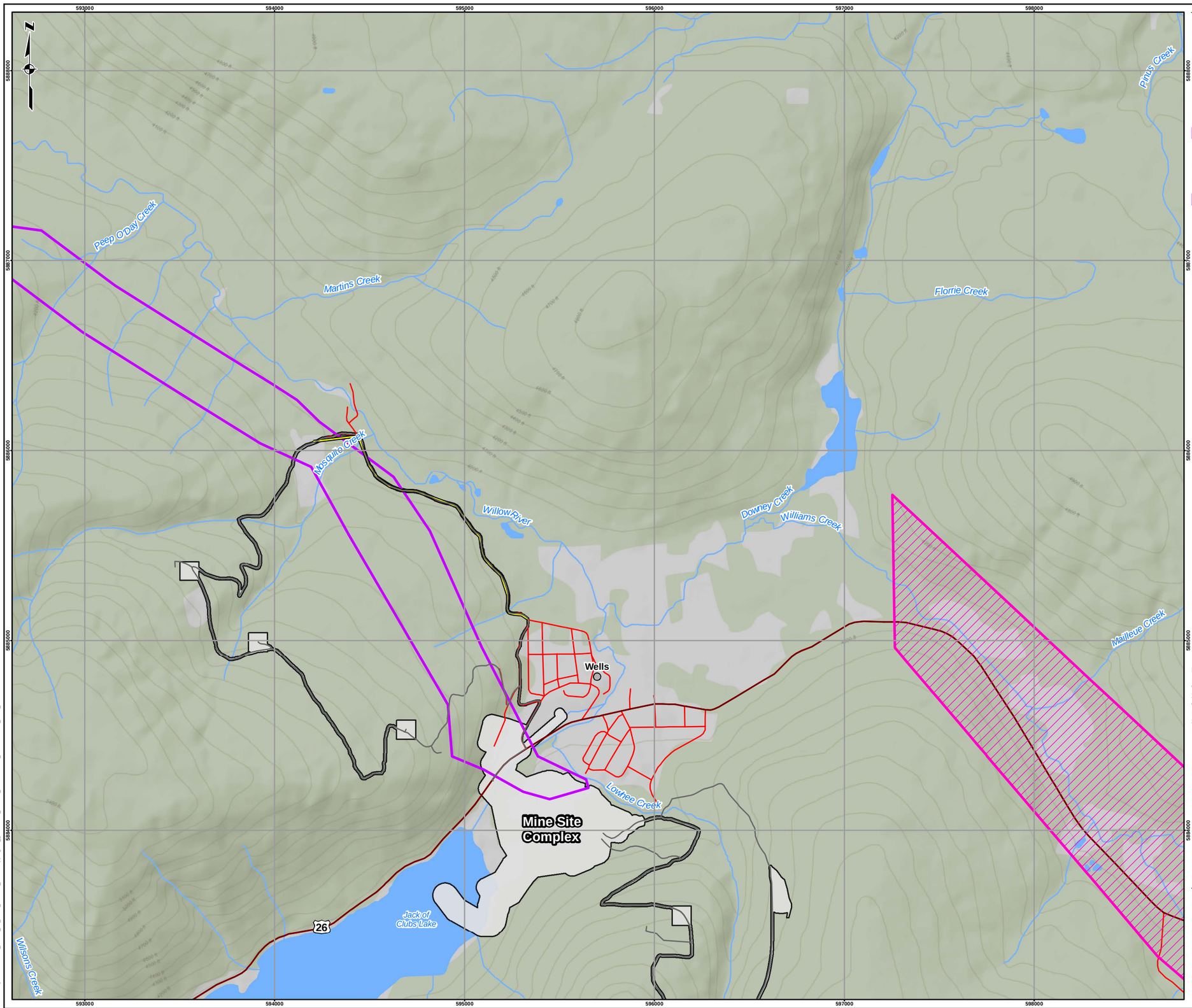
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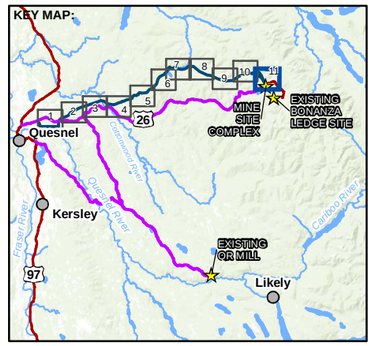
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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR
- PROPOSED MINE SITE CERTIFICATION BOUNDARY



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NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 11 OF 11

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APPENDIX B PROPOSED PROJECT DESIGN CHANGES MEMO (TECHNICAL MEMO 1B)

OSISKO DEVELOPMENT

TO:	KATHERINE ST. JAMES, BC Environmental Assessment Office
FROM:	FRANCOIS VEZINA, Osisko Development Corp.
DATE:	April 19, 2023
SUBJECT:	CARIBOO GOLD PROJECT – PROPOSED PROJECT DESIGN CHANGES (TECHNICAL MEMO 1b)

1. INTRODUCTION

On December 14, 2022, Osisko Development Corp. (ODV) submitted a Technical Memo (referred to herein as Technical Memo 1a), to the British Columbia (BC) Environmental Assessment Office (EAO) that provided a summary of the Cariboo Gold Project (the Project) components that differ from the Environmental Assessment Certificate (EAC) Application that was submitted to the EAO in July 2021, with a revised Application submitted in October 2022. Additional changes have been identified since Technical Memo 1a and this memo (referred to as Technical Memo 1b) is provided to describe the additional changes in a similar manner to that provided in Technical Memo 1a.

For reference, Technical Memo 1a described the following Project design changes:

- Waste Rock Haulage:
  - Inclusion of the Cow Portal;
  - Adding a connection from the proposed Project underground workings to the Cow Bulk Sample Ramp; and
  - Removal of the B-Road.
- Waste Rock Storage Facility Contact Water Management:
  - Removal of the Waste Rock Storage Facility (WRSF) Contact Water Pipeline;
  - Maintaining a Water Treatment Plant (WTP) at the Bonanza Ledge Site; and
  - Inclusion of a discharge location at the Bonanza Ledge Site into Lowhee Creek.

This memo provides a description of the following additional changes and/or clarifications to the Project Description and Design:

- Mining of the Lowhee Zone (Section 2.1);
- Increase in the Maximum Production Rate with the Addition of the Lowhee Zone (Section 2.2);
- Revisions to Ventilation, Exhaust, and Escapeway Raises (Section 2.3);
- Bonanza Ledge Site - Additional Components and Activities (Section 2.4):
    - Water Management Revisions and Associated New Infrastructure;
    - Power Source Revision;
    - Use of Existing Overburden Stockpile
    - Crusher, Screening Plant, and Ore Sorter
    - Change to Surface Footprint for the EAC Application;
    - Access to the Sediment Control Pond (along existing Trail Road); and
    - Change in the WRSF configuration at Closure and Post-Closure.
- Revisions to the Use of Transportation Route and Access Roads (Section 2.5);
- Clarification regarding Potable Water Well Alternative Location (Section 2.6);
- Fuel Storage Change (Section 2.7);
- Increase in the Maximum Number of Workers (Operations Phase; Section 2.8);
- Fibre Optic Line Along B Road – Clarification (Section 2.9); and
- Minor change in the QR Mill Surface Footprint (Section 2.10).

Figure 1.1-3 from Chapter 1 (Project Overview) of the Revised Application that shows the Mine Site[1] layout has been updated to present the proposed Project design changes described herein, along with the Project design changes presented previously in Technical Memo 1a (December 14, 2022). The updated Figure 1.1.3 is appended to this memo as Figure 1 in Appendix A. Sections of this figure have been included throughout this memo, as appropriate, to provide greater detail for the proposed changes.

Included in this memo are:

- A screening assessment of Section 25 of the BC Environmental Assessment Act (2018) considering the potential Project design changes presented in this memo is provided in Appendix B (Tables 1 and 2).

[1] Mine Site encompasses the Mine Site Complex and Bonanza Ledge Site, as well as road access between the two.

- A summary of the predicted net implications to the effects assessment by Valued Component (VC) based on the potential Project changes presented herein is provided in Appendix B (Table 1).
- A detailed description of the implications to the relevant VCs associated with the effects assessment is included in Section 3 of this memo.

The Requested Project for Certification (Chapter 20.2) from the Revised Application had been updated and attached to Technical Memo 1a (December 14, 2022) to reflect Project Changes presented in that memo. It has been updated since December 14, 2022, to include the Project design changes presented in this memo and is attached as Appendix C to this memo.

Although not part of the Project, a pre-Project existing conditions change was identified regarding the Bonanza Ledge Mine potentially acid generating (PAG) rock. The assumption in the Revised Application remains unchanged, i.e., that Bonanza Ledge Mine PAG in the WRSF will be removed prior to the Project start-up, but the location where it will be moved to is different than that presented in the Revised Application.

The Revised Application included the existing conditions assumption that PAG rock from Bonanza Ledge operations would be placed underground prior to Project start-up. However, the updated plan will place the Bonanza Ledge PAG on surface in the Bonanza Ledge Open Pit with a dry-cover placed over it. These activities are not part of the Project, and the end-result of the existing conditions pre-Project start-up are the same, i.e., PAG will be removed from the Bonanza Ledge WRSF location before the Project starts. More details and consideration are provided in the detailed assessment memo (Memo 2) to be submitted in conjunction with this memo.

2. PROPOSED CHANGES TO PROJECT COMPONENTS

2.1. Mining of Lowhee Zone

ODV is proposing that additional underground mining in the Lowhee Zone be included in the Revised Application. Initially, ODV was planning to incorporate mining of the Lowhee Zone as part of an amendment to the Bonanza Ledge Phase II *Mines Act* Permit (M-238). However, regulatory agency representatives from the BC Ministry of Energy, Mines and Low Carbon Innovation (EMLI), the BC Ministry of Environment and Climate Change Strategy (ENV), and the EAO advised that ODV must incorporate this activity as part of the EA process for the Project.

At the time the Project's Revised Application was submitted, the results of advanced exploration activities targeting the Lowhee Zone were not yet available. Once this information was available, it was determined that mining should proceed at Lowhee for the following reasons:

- Favourable resource and reserve estimates associated with these advanced exploration activities warranted consideration as the design advanced; and
- Proximity of the Lowhee Zone to the Bonanza Ledge site and access via Cow Portal allowed for earlier ore production with less surface and underground development than with the original Project mine plan.

An overview of the area associated with the proposed mining of the Lowhee Zone is shown in Figure 2.1-1 below.

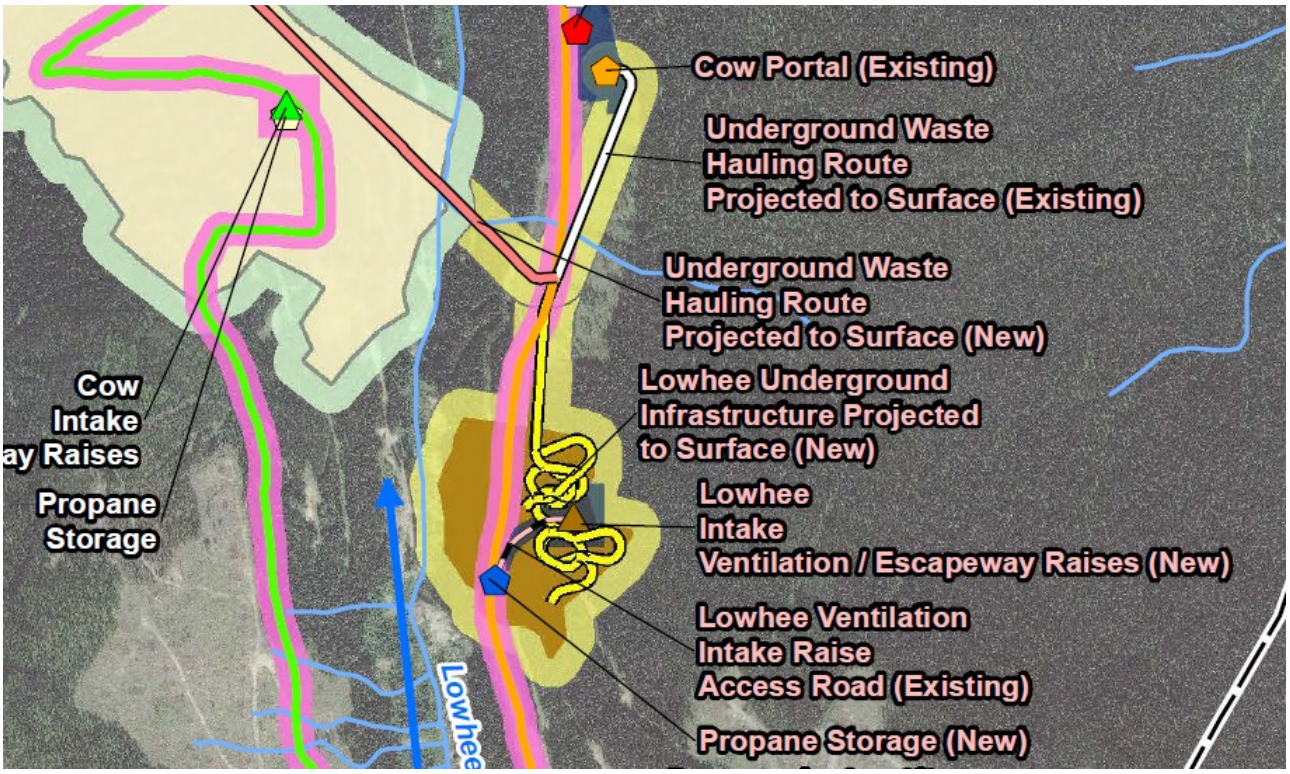


Figure 2.1-1 Proposed Underground Footprint Associated with the Lowhee Zone

(see Figure 1 in Appendix A for the legend)

Proposed Project changes associated with the Lowhee Zone include the following:

1. Inclusion of Lowhee Zone mining, underground footprint, and underground infrastructure.
2. Adding the Lowhee Ventilation Intake Raise and associated Lowhee Ventilation Intake Raise Access Road.

The additional Lowhee underground infrastructure would connect to the Cow Bulk Sample Ramp and Cow Portal (to be developed prior to the start of CGP, as identified in Technical Memo 1a (December 14, 2022; Appendix A, Figure 1). The Lowhee Zone will be accessed via Cow Portal.

Mining will begin at the Lowhee Zone, using the same methodology, equipment, and dimensions as provided for the Valley, Cow, Mosquito, and Shaft Zones in the Revised Application (October 2022). As a result of the addition of Lowhee Zone mining to the Project, the Operations Phase will now be divided into two Phases:

- Phase 1 (Year 1 to 4 of operations), focused on Lowhee Zone mining, and
- Phase 2 (Year 4 to 16 of operations) focused on mining the remaining zones (i.e., Mosquito, Shaft, Valley, and Cow zones).

In Phase 1, the ore will be processed in two stages at two sites: the Bonanza Ledge Site located at the current Bonanza Ledge Mine, and the QR Mill located 111 km from the Mine Site Complex.

Waste from the Lowhee Zone mining will be placed in the Bonanza Ledge WRSF. No changes are required to the Bonanza Ledge Site WRSF surface footprint during operations, as there is enough storage capacity at the WRSF to store the waste associated with Lowhee deposit without increasing the footprint. For the initial throughput, during Phase 1 (1,500 tpd), a pre-concentrator, including mobile crushing and ore sorting, will be located at the Bonanza Ledge Site. The use of the Bonanza Ledge Site will reduce the overall operation and transportation costs. The crushing operation will consist of two-stage crushing and screening. The crushed product will be processed in an ore sorting circuit. The resulting concentrate will be trucked to the QR Mill for further comminution, leaching, and refining. No changes are required at the QR Mill from that provided in the Revised Application.

Phase 2 will focus on mining the remaining zones as presented in the Revised Application (see Section 2.2 for changes to the maximum production rate).

A ventilation raise will be required for the Lowhee Zone mining and is shown as Lowhee Ventilation Intake Raise in Figure 2.1-1 above. Vegetation will need to be cleared for the raise and the raise will be accessed via an existing road that will not require clearing. The raise will require up to 1.0 ha of new disturbance and vegetation clearing. Changes to ventilation, exhaust, and escapeways for the Project are described in Section 2.3.

2.2. Increase in the Maximum Production Rate with the Addition of the Lowhee Zone

The production rate provided in the EAC Application was as follows:

- Year 1: 1,500 tonnes per day (tpd),
- Years 2 to 16: 4,750 tpd.

To align more closely with the feasibility study for the Project, the production rate change for the EAC Application is proposed to be as follows:

- Year 1 to 4 of operations: 1,500 tpd,
- Years 4 to 16 of operations: maximum of 4,900 tpd.

2.3. Revisions to Ventilation, Exhaust, and Escapeway Raises

ODV proposes to change several of the Intake Ventilation Raises, Exhaust Raises, and Escapeways from those presented in the Revised Application. Table 2.3-1 presents a comparison of what was presented in the Revised Application and what is currently being proposed.

It is assumed that the exact location of the raises will occur somewhere within the 100 m by 100 m footprints identified as squares in Figure 1 in Appendix A.

Table 2.3-1 Comparing Intake Ventilation Raises, Exhaust Raises, and Escapeways from the Revised Application to the Proposed New Project Configuration

Mining Zone	Intake Ventilation Raises, Exhaust Raises, and Escapeways	
	Presented in the Revised Application	New Proposed Plan
Cow	• Cow Intake Ventilation Raise • Cow Exhaust Ventilation Raise	• No Change to the Cow Intake Ventilation Raise location • Cow Exhaust no longer at the location in the Revised Application; the Cow Portal will now be the Cow Exhaust • An escapeway will be located close to the Cow Intake Ventilation Raise (within the 100 x 100 m footprint)
Lowhee	• Not included	• Addition of the Lowhee Intake Ventilation Raise and Escapeway
Mosquito	• Mosquito Intake Ventilation Raise • Mosquito Exhaust Raise	• No Change to Mosquito Intake Ventilation Raise Location • Removal of Mosquito Exhaust Raise • Addition of an Escapeway (within the 100 x 100 m footprint at the Mosquito Intake Ventilation Raise Location)
Shaft	• Shaft Intake Ventilation Raise • Island Mountain Portal as Exhaust	• Shaft Intake Ventilation Raise, Exhaust Raise and Escapeway located within the 100 m by 100 m box identified for the Shaft Intake Ventilation Raise • No Change to Island Mountain Portal as Exhaust
Valley	• Valley Intake Ventilation Raise • Valley Portal as the Exhaust Ventilation	• No Change

2.4. Bonanza Ledge Site – Additional Components and Activities

2.4.1. Water Management Revisions and Associated New Infrastructure

With the addition of Lowhee Zone mining in the updated mine plan to better align with advanced stages of Project design (Section 2.1 of this memo), waste from Lowhee Zone mining will be placed at the Bonanza Ledge Site WRSF and will require several revisions to water management infrastructure at the site. An additional sediment pond, labelled in Figure 1 of Appendix A as "South Sump", will be constructed at the southeast portion of the WRSF in an existing disturbed area. Water from the WRSF and site will be collected into the sediment control pond (SCP) that was described in the Revised Application and the proposed additional South Sump sediment

control pond. The existing WTP at Bonanza Ledge will treat water from the SCP (as described in Technical Memo 1a) and the South Sump prior to discharge to Lowhee Creek.

During Phase 1 of Operations Phase (Year 1 to Year 4), in addition to the upgraded existing Bonanza Ledge Site Sediment Control Pond (SCP) with retention dike, a Flood Management Reservoir (FMR) located in the existing Bonanza Ledge mine underground workings is proposed for temporary water storage during storm events, along with a network of surface contact and non-contact water ditches. The FMR, as well as required pipelines and pumps, requires additional surface footprint, but will be placed in existing disturbance areas associated with Bonanza Ledge Phase II project activities.

During the initial waste rock placement in the WRSF when the WRSF water is diverted toward the proposed Bonanza Ledge Site SCP during Phase 1, runoff from the southern portion of the existing site will be assumed to be clean and thus diverted away into the Stouts Gulch watershed. Contact water resulting from runoff over the developed Bonanza Ledge Site (including the early Bonanza Ledge WRSF pile) will be collected in the existing Bonanza Ledge Site SCP and treated at the upgraded WTP, prior to discharge to Lowhee Creek. The WTP will also be treating the dewatering inflow from the Cow Portal area during this phase; a combined maximum water treatment capacity of 180 m^3/hr will ultimately be available on site for both surface and underground water. A secondary emergency pumping line will be installed from the SCP to the FMR and will activate if pond levels become elevated beyond a critical threshold during higher flow periods (e.g., during freshet and/or strong precipitation event). The FMR is located in a portion of the existing Bonanza Ledge mine underground openings that will be isolated to contain up to an estimated 82,000 m^3 of contact water. Contact water will be temporarily stored in the FMR when the WTP treatment rate cannot keep up with the total contact water inflow on site. Once treatment capacity becomes available again, estimated to be between a few days to a month, water will be pumped from the FMR to the WTP for treatment before discharge.

2.4.2. Power Source Revision

ODV is proposing to use the existing Power Plant, comprised of three generators and one fuel tank, at the Bonanza Ledge Site for the Project to provide the main power source for pre-production activities and Phase 1 (up to 1,500 tpd operations) production. Two generators will also be located at the Cow Portal for Phase 1. These will also be used as emergency power only for operations once the 69 kV Transmission Line is connected for Phase 2.

2.4.3. Use of Existing Overburden Stockpile

ODV is proposing to include the use of an existing overburden stockpile at the Bonanza Ledge Site for stripping activities associated with the Bonanza Ledge WRSF preparations and early construction works. There is an existing overburden stockpile from previous operations at the Bonanza Ledge Site, which will be largely depleted for use in reclamation of previously disturbed areas no longer required for the Project, by the time the Project starts.

2.4.4. Crusher, Screening Plant, and Ore Sorter

ODV proposes to add the following infrastructure for the Project at the Bonanza Ledge Site:

- New crusher and screening plant on surface, as described in Section 2.1;
- Existing ore sorter;
- Existing garage;
- Existing warehouse; and
- Existing mine offices.

The above infrastructure will be used for Phase 1 only and will be dismantled after Phase 1 is completed. This infrastructure is being added to the Project mine plan given the decision to mine the Lowhee Zone first (see Section 2.1 of this memo). Ore crushing, screening, and sorting will occur in an enclosed structure with particulate emissions control devices installed. By undertaking initial processing of the ore at the existing Bonanza Ledge Site rather than the Mine Site Complex area for a period of time, and being much closer to the Cow Portal, i.e., the entrance point to the Lowhee Zone, ODV is able to defer most of the development and processing activities at the Mine Site Complex until a later time.

2.4.5. Change to Surface Footprint for the EAC Application

The proposed boundary of the Surface Footprint for the Bonanza Ledge Site has expanded to include additional area for the above-mentioned infrastructure, as well as for laydown and storage activities.

All proposed additional activities and infrastructure at the Bonanza Ledge Site during the Construction and Operations Phase presented in this memo will occur on previously disturbed lands, i.e., areas within the currently permitted mine area boundary of the Bonanza Ledge Phase II project where vegetation has been previously removed. There will be some additional vegetation clearing required during the Closure Phase for a change in the Waste Rock Storage Facility (see Section 2.4.7) for more information.

2.4.6. Access to the Sediment Control Pond (Along Existing Trail Road)

ODV is proposing to include an existing trail/access road that connects the A Road to the Bonanza Ledge Site SCP. In the Revised Application, this existing road was included as the WRSF Contact Water Pipeline route, but as indicated in Technical Memo 1a, ODV has removed the construction of the WRSF Contact Water Pipeline from the proposed Project. As such, ODV proposes to use the existing road for light truck or All-Terrain Vehicle (ATV) access, to undertake any monitoring or maintenance required at the SCP.

2.4.7. Change in the Waste Rock Storage Facility Configuration at Closure and Post-Closure

As the Project design advanced, the steep slopes associated with the proposed WRSF were identified by ODV and the reclamation and closure team as challenging for achieving planned

revegetation and reclamation objectives. As a result, ODV proposes to modify the WRSF configuration at closure and post-closure. The new configuration design will have gentler slopes and a lower elevation for the final height of the WRSF. Figure 2 in Appendix A provides the final footprint of the WRSF at closure and post-closure. Vegetation clearing will be required within the WRSF footprint at closure.

2.5. Revisions to the Use of Transportation Route and Access Roads

With the addition of Lowhee Zone mining to the Project, and removal of the B Road upgrade and use for hauling waste, ODV is proposing a change to the Transportation Route as follows:

- Changing use of the A Road from the existing Cow Portal to Highway 26 from Temporary use during the first year of Construction Phase to use for all Project phases; and
- Extending the Transportation Route by incorporating use of Highway 26 from where A Road connects to the proposed new highway bypass.

Use of this revised portion of the proposed Transportation Route will include the following:

- For the Construction Phase, all traffic will use A Road from Bonanza Ledge Site to Highway 26:
  - Personnel; and
  - Deliveries (e.g., supplies, fuel, etc.);
- For Phase 1 of operations, all traffic will use A Road from Bonanza Ledge Site to Highway 26, to the QR Mill, including:
  - 18 to 25 haul trucks per day (same number of trucks as described in the revised Application for the Transportation Route from the Mine Site Complex to QR Mill);
  - Personnel; and
  - Deliveries (e.g., supplies, fuel, etc.); and
- For Phase 2 of operations and to post-closure:
  - Bonanza Ledge Site access for two to four light (pick-up) trucks per day, and monthly deliveries (e.g., for the water treatment plant).

2.6. Clarification Regarding the Potable Water Well Alternative Location

The proposed location of the preferred potable water well and associated potable water pipeline presented in figures in the Revised Application was in an incorrect location (labelled as the “Potable Water Pipeline Option Existing BGM Office Well”). This preferred location is correctly presented in Figure 1 of Appendix A as “Potable Water Pipeline Option Existing BGM Office Well

(Revised)." Testing and studies associated with this potable well location were completed at the correct location.

2.7. Fuel Storage Change

ODV is proposing the following key changes to the proposed Project with respect to fuel storage:

- Addition of the existing diesel and gasoline storage at the Bonanza Ledge Site, in existing disturbed areas of the proposed Surface Footprint, as presented in Figure 1 of Appendix A as "Power Plant." See Section 2.4 of this memo for more information on use.
- Adding propane storage to the newly added Lowhee Ventilation Intake Raise (see Section 2.3 of this Memo for more information on proposed changes for raises).
- Propane storage will occur at each of the Intake Ventilation Raise footprints, which is the same plan as presented in the Revised Application, and for some of these locations, propane pipelines may need to be constructed (buried underground) from the propane tanks to the Ventilation Intake Raises. There would be no additional clearing associated with these pipelines as they would occur in the 100 m by 100 m footprints associated with the Intake Ventilation Raise (Section 2.3 of this memo).
- For the Lowhee Intake Ventilation Raise, the existing access road from A Road to the Intake Raise is assumed to require a buried underground propane pipeline from the A Road (propane storage location) to the Lowhee Ventilation Intake Raise.

Figure 1 in Appendix A has been revised to identify the currently proposed locations of fuel storage.

Chapter 1, Section 1.4.1.2.5 (Fuel Storage), of the Revised Application described the fuel storage at the Mine Site. The following is an updated description that would replace the listed mine site fuel storage and handling facilities in that section (**bold** text is where changes have occurred from the Revised Application):

- Three 40,000 litre (L) diesel storage reservoirs for powering generators during the Construction Phase only. Only one reservoir will be required once the Transmission Line is in service (and diesel generators are required as a back-up power supply source only); located near the Valley Portal;
- Five 80,000 L propane storage tanks, one located near each of the **five** ventilation intake raises;
- One propane storage tank located near the worker accommodation kitchen;
- Two 50,000 L diesel fuel reservoirs located at the Mine Site Complex (these will be located at the Fuel Farm, up to 120 m north of the valley intake ventilation raise) to be used for all diesel vehicles and equipment, including back-up generators;
- One 20,000 L gasoline reservoir for small service equipment and pick-up trucks located at the Mine Site Complex (located at the Fuel Farm);

- **50,000 L of diesel fuel reservoir located at the Bonanza Ledge Site Power Plant for power generation;**
- **35,000 L of diesel fuel reservoir located at the Bonanza Ledge Site Power Plant for operation equipment;**
- **40,000 L of gasoline reservoir located at the Bonanza Ledge Power Plant Site for small service equipment and pick-up trucks located at the Bonanza Ledge Site;**
- **50,000 L of diesel fuel reservoir located at the Cow Portal for power generation; and**
- **35,000 L of diesel fuel reservoir located at the Cow Portal for operation equipment.**

2.8. Increase in the Maximum Number of Workers (Operations)

Based on the proposed changes presented in this memo, primarily due to the increased production rate (to a maximum 4,900 tpd), the total workforce during operations would increase from 459 employees to 488 employees over the mine life.

2.9. Fibre Optic Line Along B Road

As indicated in Technical Memo 1a, ODV removed the upgrade and use of the B Road from the Project Description in the Revised Application and has replaced the hauling of waste between the Mine Site Complex and Bonanza Ledge Site WRSF with an underground waste haulage route to Cow Portal and then along the A Road to the Bonanza Ledge Site (shown in Figure 1 of Appendix A). However, the existing road has been included back into the EA Project to incorporate use of the existing Fibre Optic Line along the road and for infrequent light truck traffic for maintenance of the existing Fibre Optic Line. No upgrades to the road are required.

2.10. Minor Change in the QR Mill Surface Footprint

ODV identified a small (0.15 ha) increase to the QR Mill Surface Footprint to accommodate the use of the existing East Tailings Storage Facility (TSF) Diversion Ditch for Project water management. There is no change to the use of this ditch from existing conditions or from what was provided in the Revised Application for water management and no additional disturbance is required. Use of the ditch was included in the QR Mill Water Management Plan as part of the Revised Application; however, the Surface Footprint did not previously capture this feature and has been moved to the east side of the ditch to ensure that it is included in the QR Mill Surface Footprint. Figure 3 in Appendix A shows the revision in the northeast portion of the QR Mill Surface Footprint.

3. EFFECTS ASSESSMENT

The screening level assessment that considers the Project changes presented in this memo is provided in Appendix B. Table 1 of Appendix B illustrates the predicted net implications associated with each VC examined in the effects assessment. For each VC, the relevant activity associated with the potential Project description changes is included and assigned one of five categories, as defined below:

- **Improvement**: there is a predicted net benefit or improvement to the Project effects assessment for that VC/subcomponent.
- **Neutral**: there is already an existing adverse effect related to the VC/subcomponent and there will remain an adverse effect based on the proposed changes; however, the changes are not predicted to worsen the adverse effect. That is, there is predicted to be a change in the description or location of the effects, but the characterization of the potential effects are predicted to be the same or similar.
- **No Change**: the proposed changes to the Project description are not predicted to result in any change to the predicted effects (i.e., no change to the description or characterization results for the VC).
- **Adverse**: there is a predicted net adverse effect to the Project effects assessment for that VC/subcomponent.
- **To be determined**: the net implication from Project changes to the VC/subcomponent is not predictable through the screening process and will require the results from further detailed assessment of other VCs or will require modelling results to determine implications.

Table 1 in Appendix B identifies whether additional assessment is warranted for each VC to further describe effects (i.e., description of changes of the effects, updates to mitigations (if any), updates to residual effects, and potential updates to cumulative effects). Where the VC has been identified as not being carried forward for further assessment, it has been concluded that Table 1 in Appendix B provides sufficient information and there is no further action required by ODV for these VCs. Table 1 also provides an updated BC *Environmental Act* (2018) Section 25(a), (b), and (d) screening assessment summary by VC from that provided in Technical Memo 1a.

Table 2 in Appendix B provides an assessment of the remaining Section 25 items and whether or not these items are sufficiently assessed in the Revised Application in consideration of the Project design changes presented in this memo, or, if they will need to be brought forward with a more detailed assessment.

ODV will continue to engage with the Participating Indigenous nations (Lhtako Dené Nation, Williams Lake First Nation, and Xatśūll First Nation). It is anticipated that with the net neutral implications to the effects assessment results, that the Participating Indigenous nations will be supportive in the process of updates to the EAC Application process.

Net neutral implications are predicted to the Indigenous interests of the following Indigenous nations based on the potential Project changes and related VC effects assessments:

- Lhtako Dené Nation (Chapter 11)
- Williams Lake First Nation (Chapter 12)
- Xatśūll First Nation (Chapter 13)
- Nazko First Nation (Chapter 14)
- Tŝilhqot'in National Government (Chapter 15)

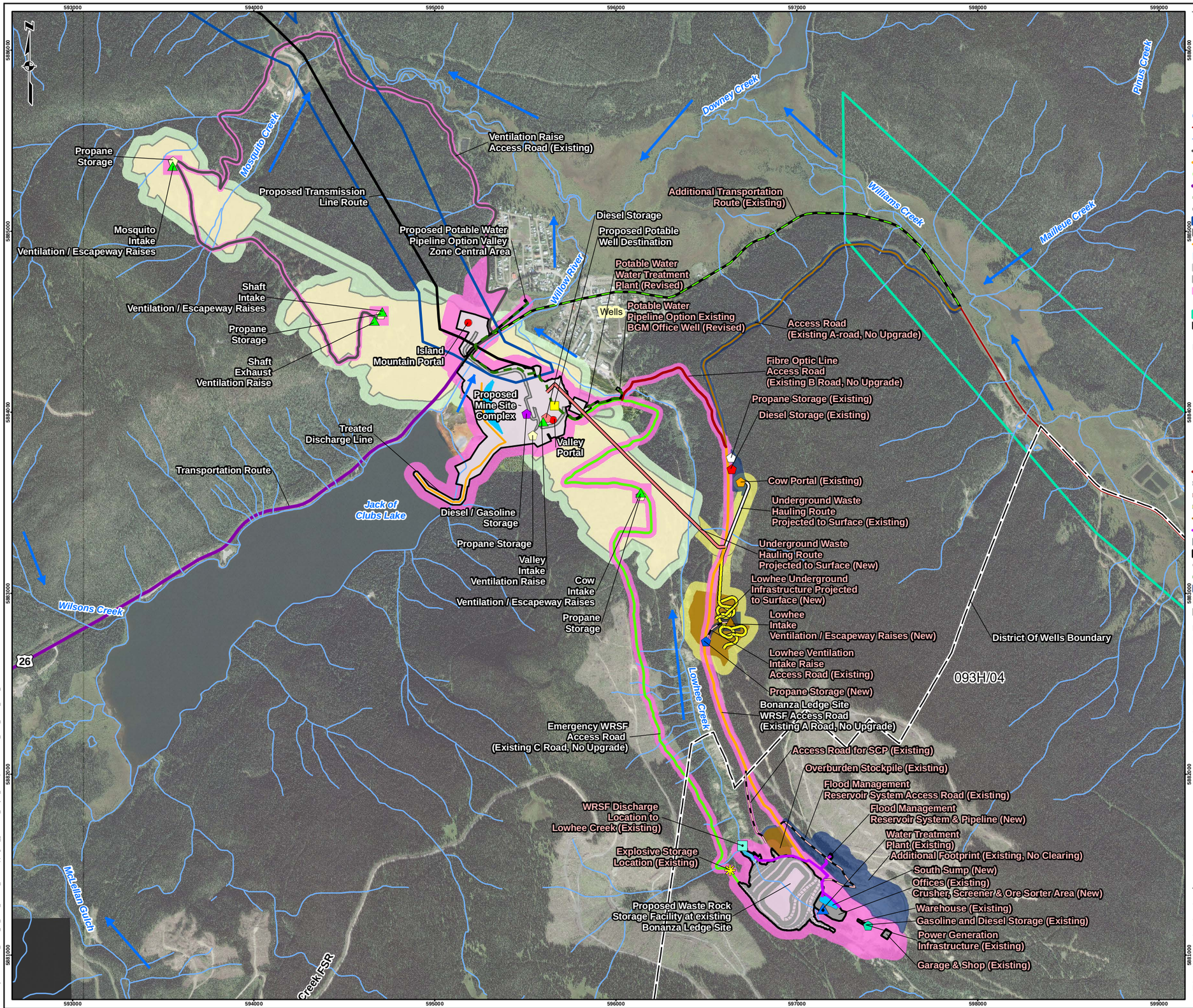
If you have any further questions regarding the above, please don't hesitate to contact me by email at fvezina@osiskodev.com or phone at 514-546-1082.

Regards,



Francois Vezina, ing., P.Eng., MBA
Senior Vice President
Project Development, Technical Services and Environment
Osisko Development Corp.

APPENDIX A. Cariboo Gold Project Proposed Site Infrastructure Layout Figures



LEGEND

- PROPOSED MINE PORTAL LOCATION
- PROPOSED POTABLE WELL DESTINATION
- PROPOSED DIESEL STORAGE
- PROPOSED DIESEL / GASOLINE STORAGE
- PROPOSED PROPANE STORAGE
- VENTILATION RAISE (EXISTING)
- FLOW DIRECTION
- HIGHWAY
- WATERCOURSE
- VENTILATION RAISE ACCESS ROAD (EXISTING)
- BONANZA LEDGE SITE WRSF ACCESS ROAD (EXISTING A ROAD, NO UPGRADE)
- EMERGENCY WRSF ACCESS ROAD (EXISTING C ROAD, NO UPGRADE)
- TRANSPORTATION ROUTE
- PROPOSED POTABLE WATER PIPELINE (OPTIONS)
- PROPOSED TRANSMISSION LINE ROUTE
- PROPOSED TRANSMISSION LINE CORRIDOR
- PROPOSED CAMP ACCESS ROAD
- PROPOSED TREATED DISCHARGE / DIFFUSER PIPELINE
- PROPOSED MINE SITE SURFACE SEDIMENT POND
- PROPOSED SURFACE DISTURBANCE AREA
- PROPOSED UNDERGROUND MINE AREA
- PROPOSED SURFACE FOOTPRINT
- PROPOSED UNDERGROUND FOOTPRINT
- BARKERVILLE HISTORIC TOWN AND PARK
- DISTRICT OF WELLS BOUNDARY

POTENTIAL PROJECT ADDITIONS FROM REVISED APPLICATION

- COW PORTAL (EXISTING)
- PROPANE STORAGE (EXISTING)
- PROPANE STORAGE (NEW)
- DIESEL STORAGE (EXISTING)
- DIESEL / GASOLINE STORAGE
- VENTILATION RAISE (NEW)
- WRSF DISCHARGE LOCATION TO LOWHEE CREEK (EXISTING)
- WATER TREATMENT PLANT (EXISTING)
- FIBRE OPTIC LINE ACCESS ROAD (EXISTING B ROAD, NO UPGRADE)
- UNDERGROUND WASTE HAULING ROUTE - PROJECTED TO SURFACE (EXISTING)
- UNDERGROUND WASTE HAULING ROUTE - PROJECTED TO SURFACE (NEW)
- LOWHEE UNDERGROUND INFRASTRUCTURE PROJECTED TO SURFACE (NEW)
- ACCESS ROAD (EXISTING A-ROAD, NO UPGRADE)
- BONANZA FLOOD MANAGMENT SYSTEM PIPELINE (NEW)
- BONANZA SOUTH SUMP (NEW)
- BONANZA LEDGE INFRASTRUCTURE (NEW)
- ACCESS ROAD (EXISTING)
- ADDITIONAL TRANSPORTATION ROUTE (EXISTING)
- ADDITIONAL SURFACE FOOTPRINT
- ADDTIONAL UNDERGROUND MINE AREA (NEW)
- ADDITIONAL UNDERGROUND FOOTPRINT

NOTES:

MAP RED TEXT: ADDITIONS OR REVISIONS MADE SINCE EAC APPLICATION (OCTOBER 2022)

MAP WHITE TEXT: INCLUDED IN EAC APPLICATION (OCTOBER 2022)

REFERENCE(S)

1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
2. HILLSHADE DERIVED FROM LIDAR DATA FLOWN BY MCELHANNAY CONSULTANTS LTD. JUNE 27, 2016.

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OSISKO DEVELOPMENT

CARIBOO GOLD PROJECT

MINE SITE - CURRENT AND PROPOSED INFRASTRUCTURE – POTENTIAL UPDATED

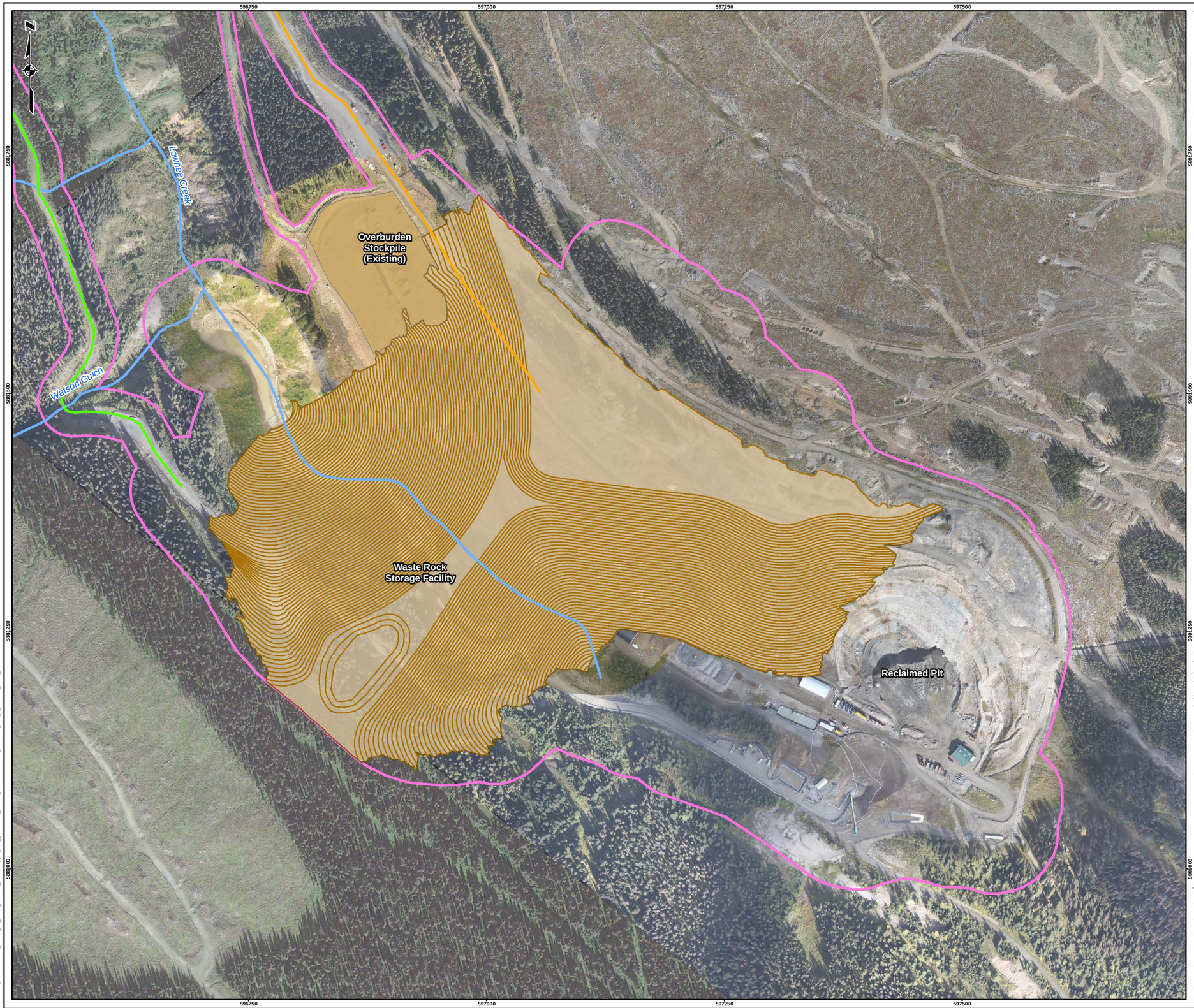
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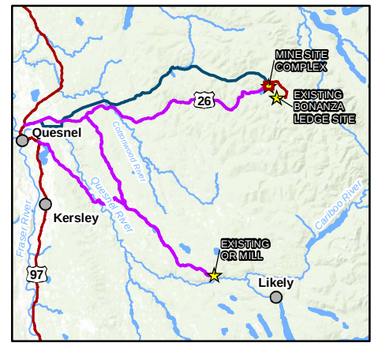
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LEGEND

- BONANZA LEDGE SITE WRSF ACCESS ROAD (EXISTING A ROAD, NO UPGRADE)
- EMERGENCY WRSF ACCESS ROAD (EXISTING C ROAD, NO UPGRADE)
- OVERBURDEN STOCKPILE (EXISTING)
- BONANZA LEDGE WASTE ROCK STORAGE FACILITY
- PROPOSED SURFACE FOOTPRINT



REFERENCE(S)

1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
2. HILLSHADE DERIVED FROM LIDAR DATA FLOWN BY MCELHANNAY CONSULTANTS LTD. JUNE 27, 2016.
3. BASE DATA SOURCE: ESRI, GEOBASE, NRCAN, AND THE GIS USER COMMUNITY.
4. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

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OSISKO DEVELOPMENT

CARIBOO GOLD PROJECT

PROPOSED WASTE ROCK STORAGE FACILITY CONFIGURATION AT CLOSURE

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PROJECT NO.	PHASE	REV.	FIGURE
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INSET MAP

North Seepage Pond
(existing to be used for the Project)

Additional Surface
Footprint (New)

PW20-01

MW20-01

PW20-02

Ruby Creek

PW20-04

Existing Potable
Water Well

MW20-02

PW20-03

Additional Surface
Footprint (New)

Proposed Filtered Stack
Tailings Storage Facility

Transportation
Route

Upgraded Septic Works

Propane Storage

Upgraded
Worker Accommodation

Propane Storage

Propane Storage

Existing
QR Mill

Propane
Storage

Diesel / Propane
Storage

Upgraded South
Seepage Collection Pond

Existing Soil
Stockpile E

Proposed
Sediment Pond

Proposed Tailings
Dewatering Plant

Upgraded Water
Treatment Plant

Proposed
Conveyor

Existing Soil
Stockpile C

Northwest Zone
Pit (existing to be
used for the Project)

Existing QR Mill Offices

Diesel / Propane
Storage

Proposed Concentrate
Feed Hopper

Existing
Main Zone Pit

Existing Soil
Stockpile D

Fuel Farm
(Diesel &
Gasoline Storage)

Existing Soil
Stockpile B

Existing Soil
Stockpile A

Proposed
Concentrate Storage

Transportation
Route

Unnamed Creek

Creek #2

Creek #2.5

Creek #3

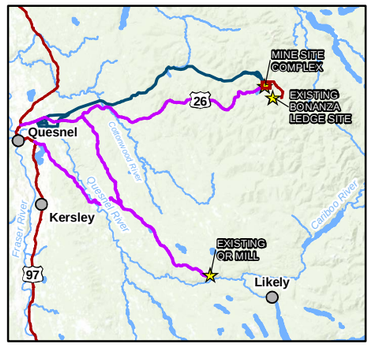
QUESNEL RIVER

LEGEND

- INTERCEPTION WELLS
- POTABLE WATER WELL
- DIESEL STORAGE (EXISTING TO BE USED FOR PROJECT)
- DIESEL / GASOLINE STORAGE (EXISTING TO BE USED FOR PROJECT)
- DIESEL / PROPANE STORAGE
- PROPANE STORAGE (EXISTING TO BE USED FOR PROJECT)
- WATERCOURSE
- FLOW DIRECTION
- PROPOSED TRANSPORTATION ROUTE
- APPROXIMATE EXISTING STOCKPILE TO BE USE FOR PROJECT
- PROPOSED SURFACE FOOTPRINT
- PROPOSED FILTERED STACK TAILINGS STORAGE FACILITY
- UPGRADED SOUTH SEEPAGE COLLECTION POND
- PROPOSED NEW INFRASTRUCTURE
- PROPOSED SEDIMENT POND

POTENTIAL PROJECT ADDITIONS FROM REVISED APPLICATION

- ADDITIONAL SURFACE FOOTPRINT



NOTES:
THE PROPOSED FILTERED STACK TAILINGS STORAGE FACILITY WILL UTILIZE THE SAME FOOTPRINT OF THE DEWATERED EXISTING TAILINGS STORAGE FACILITY

MAP RED TEXT: ADDITIONS OR REVISIONS MADE SINCE EAC APPLICATION (OCTOBER 2022)
MAP WHITE TEXT: INCLUDED IN EAC APPLICATION (OCTOBER 2022)

REFERENCE(S)
1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
2. BASE DATA SOURCE: ESRI, GEOBASE, NRCAN, AND THE GIS USER COMMUNITY.
3. STOCKPILE SOURCE: BARKERVILLE GOLD MINES LTD. (BGM). 2020. QUESNEL RIVER MINE 2020 RECLAMATION AND CLOSURE PLAN. PREPARED FOR BGM. PREPARED BY GOLDER ASSOCIATES INC. NOVEMBER 5, 2020.

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OSISKO DEVELOPMENT

CARIBOO GOLD PROJECT

QR MILL - CURRENT AND PROPOSED SURFACE INFRASTRUCTURE POTENTIAL UPDATED

REV.	DESCRIPTION	DATE	INITIALS
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PROJECT NO.	PHASE	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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APPENDIX B. Screening Effects Assessment by Valued Component

Table 1. Net Implications to the Effects Assessment by Valued Component for the Potential Project Changes and Assessment of Section 25(a), (b), and (d) of the BC *Environmental Assessment Act* (2018)

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication (Improvement/Neutral/ Adverse/No Change/ To Be Determined)[2]	Description			
Air Quality	Air Quality	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Neutral to Adverse	• The aboveground trucking of raw ore from the Cow Portal along A Road to Bonanza Ledge during the initial four years of operations will result in an increase in emissions of particulate matter from road dust. • During the initial four years of operations, ore will be dumped into an outdoor ore storage pile at Bonanza Ledge, and crushed, screened, and sorted prior to hauling to QR Mill for further processing. The ore handling operations occurring at Bonanza Ledge represent incremental emissions of fugitive particulate matter relative to the Revised Application. • During the initial four years of operations, concentrate will be hauled from Bonanza Ledge, along the full length of A Road, on Highway 26 though Wells, and onwards to QR Mill. This operation will produce incremental emissions of particulate matter from road dust (both unpaved and paved). • The locations of all exhaust portals and vents except the Primary/Valley Portal and Island Mountain Portal will be adjusted relative to the Revised Application. Despite the relocation of mine ventilation locations, the overall ventilation flows expected under the modified Project plan are similar to the flows in the Revised Application, and highest underground activity levels are also similar, so total emissions from underground activities (and thus from ventilation portals) are not expected to change considerably.	Yes	Potential	**25(a)** Identified direct and indirect Project effects on the VC associated with the Project design changes are consistent with the Revised Application, though the magnitude of the identified effect may change. A more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. Characterization of the following residual Project effects may require updated descriptions and may have changed mitigations and/or characterizations from the Revised Application: • Increase in sulphur dioxide and carbon monoxide; • Increase in nitrogen dioxide; and • Increase in Particulate Matter (Total Suspended Particulate Matter [TSP], inhalable particulate matter [PM_{10}], and fine particulate matter [$PM_{2.5}$]). No potential negative residual cumulative effects were identified for this VC in the Revised Application; this will be verified following updates to the characterization of residual effects, if required. **25(b)** There is not expected to be a change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There is not expected to be a change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Acoustic	Noise Vibration	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Neutral to Adverse	• The increase in production rate and resource extraction at the Lowhee deposit near the Cow Mountain Portal (associated hauling of waste from the portal to the Bonanza Ledge Site) are not expected to result in a change in the assessment of effects to noise presented in the Revised Application • The Lowhee ventilation raise and associated access road, and Bonanza Ledge WRSF expansion, result in new noise sources that may result in increased audible noise during the Construction and Operations Phases. • Aboveground activities at Bonanza Ledge and trucking of concentrate along the A-Road, and along Highway 26 through Wells, result in new noise sources during the first 4 years of the Operations Phase that may result in increased audible noise.	Yes	Potential	**25(a)** Identified direct and indirect Project effects on the VC associated with the Project design are consistent with the Revised Application, though the magnitude of the identified effect may change. A more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. Characterization of the following negative residual Project effects will remain unchanged from the Revised Application: • Noise and vibration from blasting. • The following residual Project effects may require updated descriptions and may have changed mitigations and/or characterizations from the Revised Application: • Audible noise and low noise frequency noise during construction • Audible noise and low noise frequency during operation No potential negative residual cumulative effects were identified for this VC in the Revised Application; this will be verified following updates to the characterization of residual effects, if required. **25(b)** There is not expected to be a change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There is not expected to be a change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication (Improvement/Neutral/ Adverse/No Change/ To Be Determined) [2]	Description			
Surface Water	Surface Water Quality	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd Bonanza Ledge WRSF Expansion at Closure	Neutral	Water quality in Lowhee Creek – discharge from the Bonanza Ledge Site is currently authorized by a permit issued pursuant to the *Environmental Management Act*. The discharge limits in that permit are relatively close to ambient water quality guidelines, and the discharge of an increased volume of treated water to Lowhee Creek is not expected to increase the potential for effects in the receiving environment from existing conditions. Information presented in the Revised Application regarding water treatment technologies supports the ongoing ability to treat mine-contact water to the limits specified in the current effluent permit should additional mine-contact water be pumped from the Lowhee Mining area to the Bonanza Ledge treatment system. The treatment technology is scalable, and the size of the treatment system can be increased to handle the higher volume of mine contact water at Bonanza Ledge.	Yes	Potential	**25(a)** There is an overall neutral change in direct and indirect Project effects on the VC associated with the Project design changes. However, a more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. Characterization of the following residual Project effects will remain unchanged from the Revised Application (i.e., no proposed changes to the QR Mill components): • Changes in Water Quality in the aquatic receiving environment at QR Mill due to treated effluent discharge While negative residual effects to Lowhee Creek water quality are not anticipated, the following residual Project effects will require updated descriptions and may have changed mitigations and/or characterizations from the Revised Application: • Changes in Water Quality in the aquatic receiving environment at Bonanza Ledge and the Mine Site Complex due to treated effluent discharge • Changes in Water Quality in the aquatic receiving environment at Bonanza Ledge and the Mine Site Complex due to seepages from waste rock piles and underground workings in post-closure No potential negative residual cumulative effects were identified for this VC in the Revised Application and there are no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for “Affected Population” for the residual effects identified for this VC.
	Surface Water Quantity (Hydrology)	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd Bonanza Ledge WRSF Expansion at Closure	Neutral	Flows in Lowhee Creek – during mining at Lowhee, mine-contact water will be pumped to the BL site for treatment prior to discharge to Lowhee Creek. Some of this water would naturally have discharged to Lowhee Creek in the middle reaches of the water body. Pumping of this and additional underground water will result in higher flows in upper Lowhee Creek than predicted in the Application, and in the fish-bearing reach, thus neutralizing in part the influence of reduced groundwater recharge during mining (see also Groundwater Quantity). Flows in Lowhee Creek will be more similar to existing conditions relative to those predicted in the Application. The rate of discharge from the WTP, however, is constrained by limits in the *Environmental Management Act* effluent discharge permit.	Yes	Potential	**25(a)** There is an overall neutral change in direct and indirect Project effects on the VC associated with the Project design changes. That is, negative effects are associated with the Project design changes, but the negative effects were already captured in the Revised Application. However, a more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. Characterization of the following residual Project effects will remain unchanged from the Revised Application (i.e., no proposed changes to the QR Mill components): • Changes in Water Quantity in the aquatic receiving environment at QR Mill due to treated effluent discharge The following residual Project effects will require updated descriptions and may have changed mitigations and/or characterizations from the Revised Application: • Changes in Water Quantity in the aquatic receiving environment at Mine Site due to treated effluent discharge. • Changes to Water Quantity in the aquatic receiving environment at the Mine Site during closure and post-closure due to diversion and/or collection of runoff;

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication (Improvement/Neutral/ Adverse/No Change/ To Be Determined) [2]	Description			
							No potential negative residual cumulative effects were identified for this VC in the Revised Application and there is no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Groundwater	Groundwater Quality Groundwater Quantity	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd	Neutral to Adverse	• The Project changes involve an expanded underground in the Lowhee area. This expansion may result in increased groundwater inflows to the underground and reduced baseflow to Lowhee Creek during operations and closure. There is also potential for alteration of groundwater quality at closure. As noted in the Revised Application, groundwater modelling predictions were conservative as a result of an artifact of the modelling process and the implemented method of representing the underground in the model. Subsequent updates to the model have improved the simulation of the underground development and, as a result, predicted inflows and effects may be within the range previous presented in the Revised Application.	Yes	Potential	25(a) Identified direct and indirect Project effects on the VC associated with the Project design are consistent with the Revised Application, though the magnitude of the identified effect may change. A more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. The following residual Project effects will require updated descriptions and may have changed mitigations and/or characterizations from the Revised Application: • Changes to groundwater quantity at the Mine Site during construction and operations due to dewatering of underground workings; • Changes to groundwater quality at the Mine Site during closure and post-closure due to the flooding of the underground developments; • Changes to groundwater quality at the Mine Site due to groundwater seepages from waste rock piles and underground workings post-closure; Characterization of the following residual Project effects will remain unchanged from the Revised Application: • Changes to groundwater quantity at the Mine Site during construction, operations, and closure due to the operation of a potable water supply well; • Changes to groundwater quantity at the QR Mill during construction, operations, closure, and post-closure due to the construction of the FSTSF; and • Changes to groundwater quality at the QR Mill due to construction of the FSTSF. **25(b)** If determined, changes from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC will be described based on updated modelling results. **25(c)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Soil	Soil Quality Soil Quantity Terrain Stability	Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Neutral	• The proposed increase in production rate and resource extraction at the Lowhee deposit near the Cow Mountain Portal is not expected to introduce new surface disturbance or increase dust generation/deposition, resulting in no change in the assessment of effects to soil subcomponents presented in the Revised Application. • There is an increased change in soil quality due to dust generation from site preparation activities for the	Yes Yes (quantifications) No	Potential	**25(a)** There is an overall neutral change in direct and indirect Project effects on the VC associated with the Project design changes. A more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable and no changes to mitigations are expected. The characterization of the following residual Project effect will remain unchanged from the Revised Application: • Alteration of Terrain Stability.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication (Improvement/Neutral/ Adverse/No Change/ To Be Determined) [2]	Description			
				Lowhee ventilation raise and associated access road, and the Bonanza Ledge WRSF expansion. • There is increased soil loss due to the addition of the Lowhee ventilation raise and the Bonanza Ledge WRSF Expansion. • TEM/bioterrain polygons that intersect the Project design change areas with new disturbance have an adequate number of field verification plots and do not need to be resampled. • No new disturbance is anticipated from Project changes associated with A Road and QR Mill.			The following residual Project effects will require an updated description and may have changed characterizations from the Revised Application: • Direct Loss of Soil Quantity; and • Alteration of Soil Quality through Compaction and Dust Accumulation 25(b) There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. 25(c) There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Vegetation	Plant Species of Interest Plant Communities of Interest Wetland Functions Ecosystems	Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Neutral	• The proposed increase in production rate and resource extraction at the Lowhee deposit near the Cow Mountain Portal are not expected to change the truck traffic or inputs to vegetation (e.g., dust) that would result in a change in the assessment of the vegetation VC presented in the Revised Application • The Project design changes are associated with increased disturbance within shrubby to mature yellow-listed upland forests. A buffered portion of the access road overlaps mapped blue-listed ecosystems; however, no direct interaction (e.g., vegetation clearing) with blue-listed ecosystems is anticipated. No new disturbance is anticipated from Project changes associated with A Road and QR Mill. • TEM/bioterrain polygons that intersect the Project design change areas with new disturbance have an adequate number of field verification plots and do not need to be resampled.	Yes	Potential	25(a) There is an overall neutral change in direct and indirect Project effects on the VC associated with the Project design changes. A more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable and no changes to mitigations are expected. The following residual Project effects will require an updated description and may have changed characterizations from the Revised Application: • Loss or Alteration of Plant Species of Interest; • Loss or Alteration of Plant Communities of Interest; • Loss or Alteration of Wetland Function; and • Loss or Alteration of Ecosystems. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(c)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Wildlife	Birds (Including Individual Species or Species Groups as Appropriate) Mammals (Including Individual Species or Species Groups as Appropriate)	Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Adverse	• The proposed increase in production rate and resource extraction at the Lowhee deposit near the Cow Mountain Portal are not expected to change the truck traffic or inputs to wildlife sensory disturbance (e.g., noise) that would result in a change in the assessment of effects to birds and mammals presented in the Revised Application • The Lowhee ventilation raise and associated access road, and Bonanza Ledge WRSF expansion, result in new disturbance that may overlap with modelled suitable habitat for VC subcomponents. No new surface disturbance is anticipated from Project changes associated with A Road and QR Mill. • Construction of the Lowhee ventilation raise and associated access road, and the Bonanza Ledge WRSF expansion, may result in increased sensory disturbance of birds and mammals and risk of bird and mammal mortality during the Construction Phase. • Impacts to wildlife from changes in air quality are to be determined (see above for the air quality VC).	Yes	Potential	**25(a)** Considering the Project changes, and the changes in Technical Memo 1a, there is an overall net negative change in direct and indirect Project effects on the VC associated with the Project design changes. However, a more detailed assessment will be required to describe and characterize the negative effects associated with the VC subcomponents from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. The following negative residual Project effects will require an updated description and may have changed mitigations and/or characterizations from the Revised Application: • Amphibians: habitat alteration and direct mortality • Songbirds: habitat alteration, sensory disturbance, and direct mortality • Forest birds and Raptors: habitat alteration, sensory disturbance, and direct mortality • Ungulates (Southern Mountain caribou): habitat alteration, sensory disturbance, disturbance to movement, and direct mortality

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication (Improvement/Neutral/ Adverse/No Change/ To Be Determined) [2]	Description			
	Reptiles and Amphibians (Including Individual Species or Species Groups as Appropriate)	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Adverse	• The proposed changes to the Project description could result in changes to water quality and quantity in Lowhee Creek. Discharge from the Bonanza Ledge Site to Lowhee Creek is currently authorized by a permit issued pursuant to the *Environmental Management Act*. The discharge limits in that permit are relatively close to ambient water quality guidelines, and the discharge of an increased volume of treated water to Lowhee Creek is not expected to increase the potential for water quality to affect the receiving environment from existing conditions. Changes in water quantity (volume) from current levels could alter downstream amphibian breeding habitat, if any, by changing water depths and vegetation characteristics. • The Lowhee ventilation raise and associated access road, and Bonanza Ledge WRSF expansion, result in an increase in new disturbance. A small increase to habitat loss and alteration from the addition of the ventilation raise and Bonanza Ledge WRF expansion is possible. No new disturbance is anticipated from Project changes associated with A Road and QR Mill.			• Ungulates (moose, mule deer): habitat alteration, sensory disturbance, and direct mortality • Large carnivores: habitat alteration, sensory disturbance, disturbance to movement, and direct mortality • Medium carnivores: habitat alteration, sensory disturbance, and direct mortality • Furbearers: habitat alteration, sensory disturbance, disturbance to movement, and direct mortality • Bats: habitat alteration, sensory disturbance, and direct mortality The following negative residual cumulative effects may require an updated description and may have changed mitigations and/or characterizations from the Revised Application: • Amphibians: habitat alteration and direct mortality • Songbirds: habitat alteration • Forest birds and Raptors: habitat alteration • Ungulates (Southern Mountain caribou): habitat alteration, sensory disturbance, disturbance to movement, and mortality • Ungulates (moose, mule deer): habitat loss and direct mortality • Large carnivores: habitat alteration, disturbance to movement, and mortality • Medium carnivores: habitat alteration and disturbance to movement • Furbearers: habitat alteration, disturbance to movement • Bats: habitat alteration and sensory disturbance **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(c)** There will be no change from the Revised Application to assessment results for “Affected Population” for the residual effects identified for this VC.
Freshwater Fish	Fish Habitat Aquatic Resources Fish	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Neutral	• Discharge from the Bonanza Ledge Site is currently authorized by a permit issued pursuant to the *Environmental Management Act*. The discharge limits in that permit are relatively close to ambient water quality guidelines, and the discharge of an increased volume of treated water to Lowhee Creek is not expected to increase the potential for effects in the receiving environment from existing conditions. • Information presented in the Revised Application regarding water treatment technologies supports the ongoing ability to treat mine-contact water to the limits specified in the current effluent permit. The treatment technology is scalable, and the size of the treatment system can be increased to handle the higher volume of mine contact water at Bonanza Ledge. • No new riparian clearing is required for the Lowhee Ventilation Raise and associated access road, or the Bonanza Ledge WRSF expansion.	Yes	No	**25(a)** There is an overall neutral change in direct and indirect Project effects on the VC associated with the Project design changes. That is, negative effects are associated with the Project design changes, but the negative effects were already captured in the Revised Application and the Project changes in Technical Memo 1a. However, a more detailed assessment will be required to describe and characterize the negative effects associated with the VC from that in the Revised Application. The mitigations presented in the Revised Application are applicable, but further assessment is needed to determine whether additional mitigations are required. Characterization of the following residual Project effect will remain unchanged from the Revised Application: • Loss or alteration of riparian habitat along the Transmission Line and at the Willow River bridge The following residual Project effect will require updated descriptions and may have changed mitigations and/or characterizations from the Revised Application: • Change in water quantity at the Mine Site and QR Mill resulting in effects to fish and fish habitat. No potential negative residual cumulative effects were identified for this VC in the Revised Application and there are no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC.

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication (Improvement/Neutral/ Adverse/No Change/ To Be Determined) [2]	Description			
							25(d) There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Employment and Economy	Employment Economy	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd	**Improvement**	• Operations Workforce will increase from an estimate of 459 employees to an estimate of 488 employees (29 employee). • The increase in operations workforces is a positive indicator of the Project's economic benefits on the community. • Given the small increase in the operations workforce, and with the described accommodation and health plan, the additional number of employees is not expected to require additional accommodation, nor affect/change the results of the effects assessment. • No changes to CAPEX, OPEX, or construction or closure workforce are anticipated.	No	No	**25(a)** There is overall a positive change in direct and indirect Project effects on the VC associated with the Project changes. The proposed changes to the Project description do not have any change to the characterization results for the VC; therefore, there is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. Characterization of the following residual Project effects will remain unchanged from the Revised Application: • Employment opportunities for local and regional residents will cease. • Revenue for local, provincial, and federal governments from the Project, as well as opportunities for local businesses, will decrease. No potential negative cumulative effects were identified for this VC in the Revised Application and there are no changes to this conclusion with the changes in Project design; therefore, no further assessment is required for cumulative effects. **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Land and Resource Use	Private Property Tenured Land and Resource Use Public Land and Resource Use Parks and Protected Areas	Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	**Neutral**	• The proposed increase in production rate and resource extraction at the Lowhee deposit near the Cow Mountain Portal are not expected to change the truck traffic or inputs to sensory disturbance (e.g., noise) that would result in a change in the assessment of effects to the land and resource use VC presented in the Revised Application. • The Lowhee ventilation raise and associated access road results in an increase of 1 ha of new footprint area, of which 0.9 ha is new disturbance and 0.1 ha is existing disturbance. • The Bonanza Ledge WRSF expansion area falls within the *Mines Act* permit boundary for the Bonanza Ledge Mine. • Changes to land disturbance would not result in changes to effects to private property, tenured land (range, forestry, traplines), or recreation land (including hunting and fishing).	No	No	**25(a)** There is an overall neutral change in direct and indirect Project effects on most VC sub-components associated with the Project design changes. There is no need to change the assessment on these sub-components from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. Characterization of the following negative residual Project effects will remain unchanged from the Revised Application: • Loss or displacement of private property • Loss or displacement of tenured land and resource use • Reduced/changed access on Contemporary Land and Resource Use • Decrease in Environmental Conditions for Contemporary Land and Resource Use • Increased pressure on public land and resource use • Change in lighting from the Mine Site • Decrease in enjoyment/ experience for Contemporary Land and Resource Use subcomponents due to a change in landscape/viewshed However, characterization of the following residual Project effect will require an updated description and may have changed mitigations and/or characterization from the Revised Application: • Change in visual resources •
	Lighting	Lowhee Ventilation Raise	Neutral	• There will be operational light from the Lowhee ventilation raise (on buildings); however, it will not be visible from receptors.	No	No	
	Visual Resources	Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Adverse	• The Lowhee ventilation raise will result in a new clearing area; however, it will not be visible from receptors or viewpoints. • The Bonanza Ledge WRSF expansion at closure will change the views from the Goldfield's Ditch viewpoint.	Yes	Potential	

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication (Improvement/Neutral/ Adverse/No Change/ To Be Determined) [2]	Description			
							25(b) There will be no change from the Revised Application to the risk or uncertainty assessments for the residual effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual effects identified for this VC.
Infrastructure and Services	Community Infrastructure and Services Transportation Infrastructure Housing and Accommodation	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd	Neutral	• Operations Workforce will increase from an estimate of 459 employees to an estimate of 488 employees (29 employee). • Given the small increase in the operations workforce, and with the described accommodation and health plan, the additional number of employees is not expected to require additional accommodation, nor affect/change the results of the effects assessment. • No changes to construction or closure workforce are anticipated.	No	No	**25(a)** There is an overall neutral change in direct and indirect Project effects on the VC associated with the Project design changes. The proposed changes to the Project description do not have any change to the predicted effects (i.e., no change to the description or characterization results for the VC); therefore, there is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. Characterization of the following negative residual Project effects will remain unchanged from the Revised Application: • Project-related traffic will result in increased traffic and associated issues in Wells (e.g., dust, idling, parking) [during construction]. • In-migration will increase demand for housing [during construction]. • Project-related traffic will result in increased traffic and associated issues in Wells (e.g., dust, idling, parking) [during operations]. • In-migration will increase demand for housing [during operations]. There will be no change to the assessment of the following negative cumulative effects that were identified for this VC in the Revised Application: • Increase in Demand for Housing during Construction • Increase in Demand for Housing during Operation **25(b)** There will be no change from the Revised Application to the risk or uncertainty assessments for the residual or the cumulative effects identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population" for the residual or the cumulative effects identified for this VC.
Human and Ecological Health	Human Health	See Air Quality and Surface Water VCs above.	To Be Determined	• To be determined based on results of Surface Water and Air Quality VC assessments.	Yes	Potential	To be determined based on results of Surface Water and Air Quality VC assessments.
	Ecological Health	See Air Quality, Surface Water, Freshwater Fish, Vegetation, Soil, and Wildlife VCs above.	To Be Determined	• To be determined based on results of Surface Water and air quality VC assessments.	Yes	Potential	
Community Health	Health Infrastructure and Services Population Health	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd	**Neutral**	• Operations Workforce will increase from an estimate of 459 employees to an estimate of 488 employees (29 employee). • Given the small increase in the operations workforce, and with the described accommodation and health plan, the additional number of employees is not expected to affect/change the results of the effects assessment.	No	No	**25(a)** There is an overall neutral change in direct and indirect Project effects on the VC associated with the Project design changes. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. It is a more conservative approach to keep the assessment as is and unchanged. The residual Project positive effects will remain unchanged from the Revised Application, as follows:

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication (Improvement/Neutral/ Adverse/No Change/ To Be Determined) [2]	Description			
				• No changes to construction or closure workforce are anticipated.			• Health and infrastructure and services: • Support for Wells Volunteer Fire Brigade (WVFB) through workers volunteering and developing a mutual aid agreement with the WVFB Support for BC Wildfire There were no negative residual effects identified for the VC in the Revised Application and that remains unchanged due to the Project design changes. More volunteers in the community One social work position in the community for four years; ODV will work with service providers to determine the best way to implement the position ODV will encourage workers to volunteer in the community and will develop a policy that provides incentives for doing so Monitored through the Socio-Economic Monitoring Plan) • Population Health: • Enhanced training, employment, and income in the local population One social work position in the community for four years No negative residual or cumulative effects were identified for the VC in the Revised Application and there is no change to this conclusion based on the Project design changes. **25(b)** There will be no change from the Revised Application for the assessment of risk or uncertainty assessments; no risk or uncertainty were assessed because no residual negative effects were identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population;" no affected populations were assessed because no residual negative effects were identified for this VC.
Archaeological and Heritage Resources	Historical Resources Archaeological Sites Palaeontological Resources	Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Neutral	• New disturbance areas are covered by the Mine Site Heritage Resource Impact Assessment (HRIA). • New disturbance areas are not within areas of archaeological sensitivity as identified in the Mine Site HRIA[5].	No	No	**25(a)** Considering the Project changes, there is an overall net neutral change in direct and indirect Project effects on the VC. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. The residual Project effects will remain unchanged from the Revised Application, as follows: • The discovery and documentation of pre-contact and historical resources in the Local Assessment Area (LAA) have provided a positive effect and a deeper understanding of Indigenous and non-Indigenous land use, which may shift the dominant Gold Rush narrative of the area's history to be more inclusive of Indigenous voices and sites. • Given the non-renewable nature of heritage resources, the preferred mitigation option is always avoiding disturbance to them; however, in instances where a site cannot be avoided, some positive effects can result. Positive effects include the recording of new sites, which may have remained otherwise unknown if not for existing conditions, studies carried out to identify Project interactions with heritage resources and the collection of site data resulting from mitigation measures. • The Project may increase access for the public or researchers to newly recorded sites, which would have remained otherwise inaccessible. • Positive effects from the recording of new archaeological sites include enhanced understanding and a larger knowledge base of past use of the Project area, which could benefit Indigenous

Valued Component (VCs)	Subcomponent	Activity[1]	Potential Project Changes - Net Implications to Effects Assessment		Carry Forward to Further Detailed Description and Effects Assessment (Yes/No)	New Mitigations (Yes / No / Potential)[3]	Screening Assessment of Section 25 (a), (b), and (d) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design[4]
			Net Implication (Improvement/Neutral/ Adverse/No Change/ To Be Determined) [2]	Description			
							nations, local interest groups, and academic and consulting professionals working in the field of heritage resources. No negative residual or cumulative effects were identified for the VC in the Revised Application and there is no change to this conclusion based on the Project design changes. **25(b)** There will be no change from the Revised Application for the assessment of risk or uncertainty assessments; no risk or uncertainty were assessed because no residual negative effects were identified for this VC. **25(d)** There will be no change from the Revised Application to assessment results for "Affected Population;" no affected populations were assessed because no residual negative effects were identified for this VC.
Culture	Plant Species of Cultural Significance; Traditional Foods; and Indigenous Language and Teaching	Lowhee Mining Lowhee Ventilation Raise Bonanza Ledge WRSF Expansion at Closure	Neutral	• The Project design changes are associated with increased disturbance within shrubby to mature yellow-listed upland forests. A buffered portion of the access road overlaps mapped blue-listed ecosystems; however, no direct interaction (e.g., vegetation clearing) with blue-listed ecosystems is anticipated. • The Bonanza Ledge WRSF expansion at closure is contained within the Bonanza Ledge *Mines Act* Permit Boundary.	No	No	**25(a)** Considering the Project changes, there is an overall net neutral change in direct and indirect Project effects on the VC. There is no need to change the assessment on the VC from that provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects. The residual Project positive effects will remain unchanged from the Revised Application, as follows: • The potential economic development that this project can bring will be largely positive to the community. The increased population provides opportunity for increased viewership and attendance for cultural events, sale of (and potential contribution to) marketable art, and a wider population base for fundraising related to the Arts. The effect would be measured by changes in attendance numbers as cultural events, and sales volume for art products. Characterization of the following negative residual Project effect will remain unchanged from the Revised Application: • Direct habitat alteration and loss of plant species of cultural significance. The description of and assessment of negative cumulative effects will remain unchanged from the Revised Application. As this cumulative effect is directly related to Plant Species of Cultural Significance, and is identical to the cumulative effects discussed for the Vegetation VC (i.e., Plant Species of Interest, specifically traditional use plants), further discussion on the Potential Cumulative Effects, Mitigation Measures, and Adverse Cumulative Effects Characterization was included in the Vegetation VC. Therefore, no further updates are required for this VC (culture).
	District of Wells Arts Sector	Lowhee Mining Addition Maximum production rate increased from 4,750 tpd to 4,900 tpd	Improvement	• Operations Workforce will increase from an estimate of 459 employees to an estimate of 488 employees (29 employee). • Given the small increase in the operations workforce and with the described accommodation and health plan, the additional number of employees is not expected to affect/change the results of the effects assessment. • No changes to construction workforce are anticipated.	No	No	

[1] Only the changes in Project component or activity relevant to the VC is included.

[2] If ODV proceeds with pursuing the proposed Project changes in this memo, VCs assigned to "neutral", "adverse", or "to be determined" net implication will be further be described in a subsequent letter, as a more detailed assessment. Definitions of each assigned implication are as follows:

Improvement - there is a predicted net benefit or improvement to the Project effects assessment for that VC/subcomponent.

Adverse - there is a predicted net adverse effect to the Project effects assessment for that VC/subcomponent.

Neutral - there is already an existing adverse effect related to the VC/subcomponent and there will remain an adverse effect is predicted based on the proposed changes; however, the changes are not predicted to worsen the adverse effect. That is, there is predicted to be a change in the description or location of the effects, but the characterization of the potential effects is predicted to be the same or similar.

To be determined: the net implication from Project changes to the VC/subcomponent is not predictable through the screening process and will require the results from further detailed assessment of other VC 's or will require modelling results to determine implications.

No Change - the proposed changes to the Project description are not predicted to result in any change to the predicted effects (i.e., no change to the description or characterization results for the VC).

[3] Where a new mitigation has been identified as 'yes' or 'potential,' further assessment is required to determine if and/or what the mitigation is. This will be identified in a more detailed assessment in an amendment for that VC.

[4] Section 25(a), (b), and (d) of the BC *Environmental Assessment Act* (2018) are as follows: (a) Positive and negative direct and indirect effects of the reviewable project, including environmental, economic, social, cultural and health effects and adverse cumulative effects, (b)risks and uncertainties associated with those effects, including the results of any interaction between effects, and (d) disproportionate effects on distinct human populations, including populations identified by gender

[5] Golder Associates Ltd. (Golder). 2021. Cariboo Gold Project Mine Site – Heritage Resource Impact Assessment under Heritage Conservation Act Permit 2016-0276. Revision 3. 31 May 2021.

Table 2. Assessment of Section 25(c) and (e) to (k) of the BC Environmental Assessment Act (2018)

Screening Assessment of Section 25 (c) and (e) to (k) of the BC *Environmental Assessment Act* (2018) related to the Changes in Project Design	Assessment
25(c) risks of malfunctions or accidents	There is an overall **improvement** for the assessment of the following malfunctions and accidents because there is a reduced risk of their occurrence associated with the changes presented in this memo, in particular the change in WRSF configuration at closure and post-closure: • Waste rock stockpile slope failure The Project changes are **neutral** to the following malfunctions and accidents: • Explosives accident • Fire There will be fuel storage at the Bonanza Ledge Site (existing fuel tanks) as part of the updated Project description, as well as buried propane pipeline at the ventilation raises, which means there is a potential risk for an explosive accident and/or fire source at these locations. Therefore, the risk of fire and explosion applies to these areas within the Surface Footprint, but there is no change to the consequence, likelihood, and risk ratings and no change to the mitigations and characterizations of the potential residual effects from that presented in the Revised Application. The Project changes are not relevant to the following malfunctions and accidents and therefore **no change** to the assessment of these is considered necessary: • Flood – Inability to manage water inflow into underground mine works • Failure of underground mine stability • Spill – Hazardous materials released to land • Spill – Hazardous materials released to water • Power failure • Tailings dam breach • Vehicle or equipment accidents • Adverse weather Overall, there are no changes to the assessment of risks of malfunctions and accidents associated with the Project design changes, i.e., the Revised Application capture the consequences, likeliness, risks, potential effects and appropriate mitigations for potential malfunctions and accidents associated with the Project.
(e) effects on biophysical factors that support ecosystem function	There is overall no change for the assessment of effects on the biophysical factors that support ecosystem function based on the Project design changes from that assessed in the Revised Application. There is no need to change the assessment provided in the Revised Application because it already captures the potential positive and negative direct and indirect effects associated with the Project, effective mitigations, and residual effects at the scale and level of detail assessed for biophysical factors that support ecosystem function. No changes are needed to the Revised Application based on the Project design changes.
(f) effects on current and future generations	There is no change required to the Revised Application for the assessment on the current and future generations based on the Project design changes.
(g) consistency with any land-use plan of the government or an Indigenous nation if the plan is relevant to the assessment and to any assessment conducted under section 35 or 73;	Project changes are not anticipated to alter consistency with any land-use plan of the government or an Indigenous nation, nor to any assessment conducted under section 35 or 73.
(h)greenhouse gas emissions, including the potential effects on the province being able to meet its targets under the Greenhouse Gas Reduction Targets Act;	It is not anticipated that Project design changes would result in meaningful impacts to overall Greenhouse Gas (GHG) emissions. No changes are needed to the GHG emissions assessment provided in Chapter 8 of the Revised Application based on the Project design changes.
(i)alternative means of carrying out the project that are technically and economically feasible, including through the use of the best available technologies, and the potential effects, risks and uncertainties of those alternatives;	No changes are necessary to the assessment of the alternative means of carrying out the Project provided in the Revised Application. The Project design changes provided were not identified as alternative means of carrying out the Project at the time of submission, but are considered to be positive overall from an environmental, economic, and social perspective.
(j)potential changes to the reviewable project that may be caused by the environment;	All previously identified management plans, key mitigation and control measures, and response procedures pertaining to effects of the environment on the Project would apply to the Project design changes and, therefore, there is no change in potential effects pertaining to the assessment of 'potential changes to the reviewable project that may be caused by the environment.'
(k)other prescribed matters	There are no 'other prescribed matters' identified to assess.

APPENDIX C. Chapter 20.2 Requested Project for Certification [April 2023 – Revised for Project Design Changes]

OSISKO DEVELOPMENT

CARIBOO GOLD PROJECT

CHAPTER 20.2: REQUESTED PROJECT FOR CERTIFICATION

April 2023



OSISKO DEVELOPMENT

Cariboo Gold Project

Box 247
3700 Ski Hill Road
Wells, BC V0K 2R0

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DEFINITIONS

Closure	The phase of the Project where all development and production ceases. The majority of mining facilities and infrastructure are decommissioned and/or removed from the Project site. Reclamation activities are conducted and completed. Facilities necessary to support post-closure management and monitoring requirements will remain until the post closure period is authorized to conclude. Water treatment plants, associated discharge infrastructure, the camp access road, the A Road, and access to the QR Mill will be maintained throughout the post-closure period.
Construction	The phase of the Project during which physical alteration of land, vegetation, or any other aspect of the natural environment occurs. For the purposes of this Certificate, Construction: (i) does not include any activities conducted solely for investigative purposes under a valid permit or authorization, and (ii) includes upgrading, repairing, replacing, or removing, any existing works or infrastructure.
Employee	Individuals employed by the Cariboo Gold Project including contractors, or those employed by the Holder on business related to the Project (collectively, Employees).
Mine Site Complex	The Mine Site Complex is located in Wells, BC, in an area defined by the polygon in Figure 20.2-3, [NAD83 Zone: 10, Easting: 595581 Northing: 5884069].
Operations	The phase of the Project beginning with the commercial operation date of the Project, which is the date on which commercial mill production is achieved and ending when commercial mill production permanently ceases, and the Closure phase begins.
Project	The Cariboo Gold Project.
Project Site	The areas described in this document for the Project.
Quesnel River Mill	The Quesnel River (QR) Mill is located in an area defined by the polygon in Figure 20.2-4, [NAD83 Zone: 10, Easting: 581717 Northing: 5836772].

ABBREVIATIONS

Terminology used in this document has been defined where it is first used, while the following list has been presented to assist readers that choose to review only portions of the document.

Abbreviation	Description
BC	British Columbia
FSTSF	Filtered Stack Tailings Storage Facility
Ha	hectare
HDS	high-density sludge
Km	kilometre
kV	kilovolt
L	Litre
LHD	Load Haul Dump Loader
M	Metre
NWP	Northwest Zone Pit
ODV	Osisko Development Corp.
Project	Cariboo Gold Project
QR Mill	Quesnel River Mill
T	tonne
TSF	tailings storage facility
WRSF	waste rock storage facility
WTS	Water treatment system

1. PROJECT OVERVIEW AND LOCATION

The Cariboo Gold Project (the Project) is an underground gold mine with a maximum production capacity of 1,793,404 tonnes per year (less than 5,000 tonnes per day maximum) for an operations period of up to 16 years (with an additional 1-year Construction Phase, 2-year Closure Phase, and minimum 10-year Post-Closure Phase). Ore will be crushed and concentrated at the Mine Site Complex before concentrate is trucked 115 km from the Mine Site Complex on existing roads to the existing Quesnel River Mill (QR Mill) for milling.

The Project is in the District of Wells and Cariboo Regional District, British Columbia (BC). The Mine Site is located at [NAD83 Zone: 10, Easting: 595581 Northing: 5884069].

The QR Mill is located 115 km from the Mine Site, 58 km southeast of Quesnel, and 18 km northwest directly of Likely, BC. The QR Mill is located at [NAD83 Zone: 10, Easting: 581717 Northing: 5836772].

2. PROJECT COMPONENTS

The following Project components (Mine Site, Transportation Routes, Quesnel River Mill, and Transmission Line) are shown on the overview map (Figure 20.2-1).

2.1. Mine Site (Figures 20.2-2, 20.2-3)

The Mine Site consists of underground infrastructure within the maximum underground footprint (Figure 20.2-2) and surface infrastructure within the proposed Mine Site Certification Boundary surface footprint (Figure 20.2-3). The proposed Mine Site Certification Boundary (Figure 20.2-3) will be a maximum of 159.6 ha and is located 80 km east of Quesnel, BC, immediately adjacent to the Community of Wells.

2.1.1. Mine Site Access

Access to the Mine Site will be from Quesnel on Highway 26 (Figure 20.2-1). Access includes:

- A new mine access bypass crossing Highway 26 near Wells to the Mine Site Complex. Access to the Island Mountain Portal will also be along Highway 26.
- A new 24-m clear span bridge structure over the Willow River will be installed at the entrance of the Mine Site access road to Highway 26.
- A new Camp Access Road, which will connect the mine laydown area with the new Worker Accommodation.
- The existing 2.2 km long Bonanza Ledge Site waste rock storage facility (WRSF) Access Road (also referred to herein as A Road), which will be used for hauling waste rock and ore-sorter rejects from the Cow Portal to the Bonanza Ledge Site WRSF. The A Road from the existing Cow Portal to Highway 26, will be used as follows:
    - For the first four years of the Project, all traffic will use A Road from Bonanza Ledge Site to Highway 26, to the QR Mill, including haul trucks (to a maximum of 25 haul trucks per day), deliveries (e.g., supplies, fuel, etc.); and personnel;
    - From Year 4 to the end of mine life, Bonanza Ledge Site access for two to four light (pick-up) trucks per day, and monthly deliveries (e.g., for the water treatment plant).
- The existing B Road from the Mine Site Complex to where it connects to the A Road (for the fibre optic line maintenance only).
- The existing Emergency WRSF Access Road (also referred to as C Road) from the Mine Site Complex to the Bonanza Ledge Site, for emergency and maintenance access only.
- Access to the Island Mountain Portal will also be along Highway 26.

2.1.2. Surface Infrastructure

Surface infrastructure in the surface footprint (Figure 20.2-3) at the Mine Site Complex includes:

- Services Building containing a Surface Concentrator and ancillary facilities;
- Mine offices;
- Maintenance shop;
- Warehouse;
- Laydown Areas for additional storage;
- 200-person Worker Accommodation;
- Sewage and septic works;
- Five locations of Intake Ventilation Raises (and associated Escapeways, as needed) to surface, including Valley, Cow, Lowhee, Mosquito, and Shaft (and associated Exhaust Raise);
- Fuel storage and handling facilities, including:
  - Three 40,000 litre (L) diesel storage reservoirs for powering generators during construction;
  - Fiver 80,000 L propane storage tanks, one located near each of the (five) ventilation intake raises;
  - One propane storage tank, located near the worker accommodation kitchen;
  - Two 50,000 L diesel fuel reservoirs located at the Mine Site Laydown Area; and
  - One 20,000 L gasoline reservoir located at the Mine Laydown Area;
- Willow River clearspan bridge, maximum of 24.0 m long and 13.8 m wide;
- Telecom and fibre-optic network;
- Mine changing room and mine rescue services;
- Access roads with a combined length of up to 18 km and parking for 80 spaces;
- Maximum 69 kilovolt (kV) Substation;
- Generators used during construction, and retained as backup during operations;
- Utilities; and
- Security fence and access gate.

Activities in the surface footprint areas will also include equipment laydown, staging, and movement. Construction material needs will be sourced from waste rock and from licensed third-party off-site locations.

Surface infrastructure in the surface footprint (Figure 20.2-3) at the Bonanza Ledge Site includes:

- An existing Power Plant (including three generators and one fuel tank);
- A new crusher, screening plant and ore sorter (up to 4 years into the Operations Phase only);
- Existing Garage, Warehouse, and Mine Office (for up to 4 years into the Operations Phase only); and
- Fuel storage and handling facilities, including:
    - 50,000 L of diesel fuel reservoir located at the Bonanza Ledge Site Power Plant for power generation;
    - 35,000 L of diesel fuel reservoir located at the Bonanza Ledge Site Power Plant for operation equipment;
    - 40,000 L of gasoline reservoir located at the Bonanza Ledge Power Plant Site for small service equipment and pick-up trucks located at the Bonanza Ledge Site;
    - 50,000 L of diesel fuel reservoir located at the Cow Portal for power generation; and
    - 35,000 L of diesel fuel reservoir located at the Cow Portal for operation equipment.

2.1.3. Temporary Accommodations

Osisko Development Corp. (ODV) has existing accommodations (Camp A and Camp B) close to the current ODV office on Ski Hill Road within 500 m of the Mine Site Complex, as well as the existing Ballarat camp (an ODV-owned camp, located 6.6 km east/southeast of the Mine Site Complex, as shown on Figure 20.2-1). ODV plans to use these accommodations, along with existing housing in Wells (Hubs Hotel, Osisko houses, and apartments) temporarily during Project construction only, until the Worker Accommodation is complete at the Mine Site Complex.

2.1.4. Underground Related Structures

Underground related structures (Figure 20.2-2) include:

- Three Portals: Island Mountain Portal, Valley Portal, and Cow Portal (existing) with entrance (tunnel) dimensions of 5.3 m by 5.3 m each;
- Underground mining infrastructure, including:
    - Underground crusher;
    - A Rail-Veyor© system (conveyor system);
    - Underground main garages in Valley and Shaft Zones;
    - Underground Waste Hauling Route;
    - Explosive Magazine Storage;

- Sumps, pumps, and pumping stations;
- Charging bays for the electric machinery;
- Lunchrooms and refuges;
- Warehouse storage;
- Raw and clean water reservoirs;
- Communication network; and
- Electrical distribution and sub-station.

- Underground equipment, including:
  - Two-boom Jumbo Drill;
  - Production drill;
  - Bolter;
  - Underground haul truck (battery electric haul truck);
  - Load Haul Dump Loader (LHD);
  - Electric Roadheader; and
  - Service and support equipment.

2.1.5. Stockpile and Waste Storage

Stockpile and waste storage facilities (Figure 20.2-3) include:

- Temporary overburden and soil stockpile - located at the existing Bonanza Ledge Site with a total volume of up to 300,000 cubic metres [m^3];
- Bulk Fill Area – located at the Mine Site Complex with a total capacity of up to 1.5 Mt of waste rock;
- Liner between historic waste rock and new infrastructure at the Mine Site Complex; and
- Lined WRSF – located at the existing Bonanza Ledge Site with a total capacity of up to 9.5 Mt.

2.1.6. Water Supply, Management, and Treatment

Water supply, water management and water treatment structures and facilities (Figure 20.2-3) include:

- A new Water Treatment System (WTS) at the Mine Site Complex including a conventional high-density sludge (HDS) lime neutralization and ferric coprecipitation system;
- An existing Water Treatment Plant at the Bonanza Ledge Site, to treat WRSF contact water;
- Non-contact water diversions;
- Contact water management structures;

- Existing ditches and culverts along access roads;
- Potable water storage and supply (two options);
- Freshwater supply (for Services Building and camp facility);
- Firewater pumping station and distribution;
- Mine Site Sediment Pond at the Mine Site Complex;
- Treated Discharge Line to Jack of Clubs Lake;
- Diffuser effluent discharge system at the end of the Treated Discharge Line to Jack of Clubs Lake;
- Sediment Control Pond at Bonanza Ledge WRSF;
- South Sump at Bonanza Ledge WRSF;
- Existing discharge point to Lowhee Creek;

  Flood Management Reservoir (located in historical underground workings, with associated surface and underground pipelines and pumps

2.2. Transportation Route (Figures 20.2-1)

Transportation of concentrate between the Mine Site and the QR Mill site will occur along 56 kilometres (km) of Highway 26 and 59 km of the 500 Nyland Lake Forest Service Road, a forest service road maintained by West Fraser Mills Ltd.

Transportation of workers, goods, and service providers to Wells from Quesnel, BC, will occur along Highway 26. A new highway bypass will be built before Wells to enable traffic to exit the highway before the community.

Transportation of workers and goods to the QR Mill from Quesnel will occur along Highway 26 and the 500 Nyland Lake Road, and for workers only along the Quesnel Hydraulic Road to 2700 Road and the 500 Nyland Lake Road.

2.3. Quesnel River Mill (Figure 20.2-4)

The Quesnel River Mill is located 115 km from the Mine Site, on the Quesnel River Mine property, which has historically produced gold. Infrastructure will be located within the maximum surface footprint (137.2 ha) shown in Figure 20.2-4.

2.3.1. Surface Infrastructure

Surface infrastructure will include:

- Existing Quesnel River Mill with upgrades including:
  - A covered 5,500 t concentrate storage area;
  - A haul truck dump, hopper, and conveyor to by-pass the existing crushing circuit;

- A pre-aeration tank added to the existing leach circuit;
- Replacement of the existing carbon elution and electrowinning circuits;
- Replacement of existing cyanide destruction tanks;
- Addition of a tailings dewatering circuit; and
- Upgrades as required within the existing QR Mill.

- There is currently one diesel storage reservoir and one gasoline storage reservoir installed at the QR Mill, as well as another reservoir for the mill emergency generator. The existing reservoirs will be inspected and re-used for the Project if they meet current fuel storage standards and regulations.
- Existing worker accommodation to be used then replaced with new worker accommodation to house up to 40 people.
- Potential upgrades to sewage and septic works.
- Existing offices.

2.3.2. Tailings Management

Tailings Management Facilities will include:

- A Filtered Stack Tailings Storage Facility (FSTSF) that will be developed at the location of the existing Quesnel Mill Tailings Storage Facility (QR TSF). It will reach a maximum height of 15 m from the toe of the FSTSF to its crest and will store 3.4 Mt of filtered tailings over the existing tailings and waste rock in the existing TSF.

2.3.3. Water Supply, Management, and Treatment

Water supply, water management, and water treatment structures and facilities (Figure 20.2-4) include:

- FSTSF and its Ephemeral Pond (to be located at the site of the existing QR TSF once the TSF drawdown is complete and the geomembrane installed on the surface of the existing tailings and sides of the facility);
- New sediment pond;
- The existing Main Zone Pit;
- The existing North Seepage Collection Pond;
- The existing South Seepage Collection Pond (to be enlarged to increase flood storage, provide process water storage, and collect FSTSF seepage);
- The existing Northwest Zone Pit (NWP) for freshwater supply;
- The existing well for potable water supply;

- Contact and non-contact water conveyance infrastructure including diversions, spillways, pumps, and pipelines to separately manage these volumes; and
- The existing and expanded WTS components.

2.4. Transmission Line (Figures 20.2-5 to 20.2-15)

A 69 kV, three-phase transmission line from Barlow Substation, near Quesnel to the Mine Site Complex will be constructed using existing and/or upgraded access roads. The route will be located north of Highway 26 and will parallel existing forestry roads and previously disturbed areas. The duration of the operation of the Transmission Line to support the Project will be 16 years and will be decommissioned in years 17 and 18. Other key features of the proposed transmission line are outlined below:

- The Transmission Line will have a maximum right of way dimension of 40 m in width and 69.3 km in length within the corridor presented in Figures 20.2-5 to 20.5-15. The Transmission Line corridor dimensions are 69.5 km in length and variable width, ranging from 100 m at the narrowest width to 610 m at the maximum width.
- The Transmission Line will include two types of access roads: existing roads (existing without requiring upgrades) and upgraded roads (existing roads requiring upgrades such as clearing and re-grading). There are no new roads (newly constructed roads for the purpose of the Project) proposed for the Transmission Line.
- The area of disturbance for each access road is assumed to average 15 m, including 5 m road width, with an additional 5 m of clearing on either side.

3. MITIGATION BY DESIGN

The following mitigation measures were incorporated into the design of the Project by area.

3.1. Mine Site

- Maximizing the use of existing infrastructure and brownfield sites to limit the amount of new disturbance attributable to the project. Excess waste rock (i.e., beyond that used as fill material at the Mine Site Complex) and ore sorter waste will be backfilled as cemented rock fill for underground road maintenance, and excess will be transported to the Bonanza Ledge site (an existing brownfield site) for storage.
- A highway bypass will be built to separate mine transportation activities from the town and avoid traffic going to town and associated noise and dust.
- A WTS will be used for treating contact water at the Mine Site, prior to discharge into Jack of Clubs Lake.
- An existing Water Treatment Plant at the Bonanza Ledge Site will be used for treating water from the Sediment Control Pond and South Sump at the Bonanza Ledge Site, and the dewatering inflow from the Cow Portal area in Years 1 to 3); prior to discharge into Lowhee Creek.
- Visual quality was considered in the design of the Services Building to blend in with the surrounding environment, and associated landscaping and replanting program.
- Waste rock will be transported underground from the Mine Site Complex to the Cow Portal, which will reduce surface dust, noise, and lighting impacts associated with surface transportation of waste rock from the Mine Site Complex to the Bonanza Ledge Site.
- Electric Roadheaders will be used underground to reduce the use of explosives and generation of explosive residue in the water, combustion gas in the air, and vibration caused by blasting.
- Electric and automated underground equipment and haul trucks will be used to reduce emissions, improve energy efficiency, minimize noise emission on surface, and maximize safety for personnel.
- The processing design for the Project uses a 2-step concentrating strategy which provides several important benefits from an environmental perspective:
    - The first step of concentrating the mineralized material will be done by ore sorting technology. The ore sorter is able to separate the mineralized material from the barren material by a simple mechanical process that doesn't require any water or use of

chemicals and can work at a size fraction from 10 mm to 32 mm (i.e., grinding is not required). Using this technology reduces the amount of ore requiring processing by 30% to 40%. In the first two years, before the flotation circuit is operational, ore sorting will be undertaken and will reduce the number of trucks required to transport the concentrate to the QR Mill of the same factor (30% to 40% less trucks).

- The second step of concentrating is flotation. Through the use of flotation, another 80% to 85% of barren rock from the mineralized material can be separated. By using this strategy only 13% of all mined ore is sent to QR Mill as concentrate (and produces tailings that will be stored on surface). This approach further reduces water consumption, chemical and energy requirements compared to traditional processing for gold (the lixiviation stage).

- In Years 4 to 16, crushing will be conducted underground to reduce surface disturbance, and ore will be transported by a vertical conveyor directly inside the mill to reduce noise and dust emitted at surface. During this time, no equipment will be required at surface to transport ore to the concentrator, minimizing equipment on surface which substantially reduces noise and dust emissions.
- Flotation tailings will be used for paste backfill, thus eliminating the need for surface tailings disposal at the Mine Site (in proximity of the community of Wells) and reducing the size of the WRSF at the Bonanza Ledge site. Having no tailings disposal facility on surface has considerable benefits from an environmental and risk perspective, with no structure retaining mine tails and water required.

3.2. Quesnel River Mill

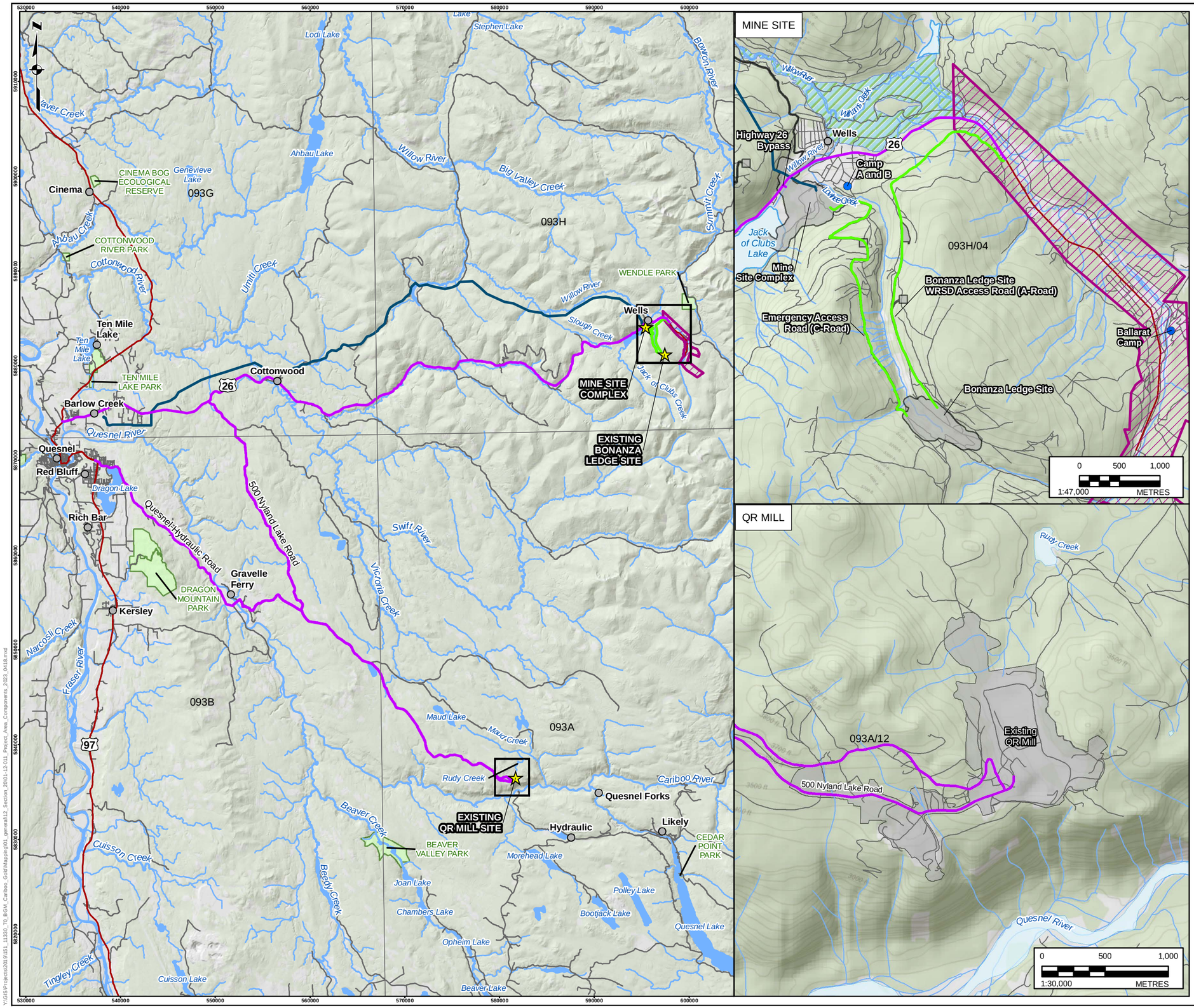
- The Project footprint has been reduced by incorporating the use of an existing site and mill.
- A WTS will be utilized to treat contact water prior to discharge.
- The Project will incorporate filtered stack tailings on top of the existing TSF that will eliminate the need to expand the footprint required to manage tailings and use the new produced tails to help with the reclamation of the old tailings pond. The use of filtered tailings, when placed over top of the existing tailings, will avoid importing material from a borrow site and help ongoing desaturation of the existing tailings (beyond the initial TSF drawdown period during construction), thereby contributing to reclamation of the existing TSF.

3.3. Transmission Line

- The routing and footprint were optimized to avoid Wendle Provincial Park and to minimize disturbance to critical habitat for woodland caribou and ungulate winter ranges.
- Routing of the transmission line maximized the utilization of existing disturbance corridors and reduced the need to create new access roads since planned access is facilitated via

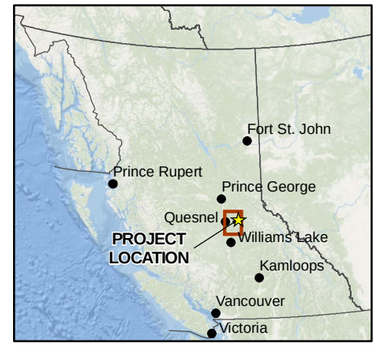
roads used previously for logging.

- Construction and use of a transmission line are anticipated to result in reduced GHG emissions, given the reduction in the requirement for local diesel-power generators through the Operations phase.



LEGEND

- POPULATED COMMUNITY
- PROJECT INFRASTRUCTURE LOCATION
- TEMPORARY EARLY CONSTRUCTION CAMP
- ROAD
- HIGHWAY
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- TRANSPORTATION ROUTE
- TRANSPORTATION ROUTE (MINE SITE ACCESS ROADS)
- TRANSMISSION LINE ROUTE
- SURFACE DISTURBANCE AREA



REFERENCE(S)

1.WATER FEATURES, TRANSPORTATION FEATURES OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. CITIES/TOWNS, INDIAN RESERVES, FEDERAL LANDS AND PARK/PROTECTED AREAS OBTAINED FROM BC MINISTRY OF FORESTS, LANDS NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
3. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM Zone 10N

0 5 10 15
1:400,000 KILOMETRES

CARIBOO GOLD PROJECT

OVERVIEW OF MAJOR PROJECT COMPONENTS

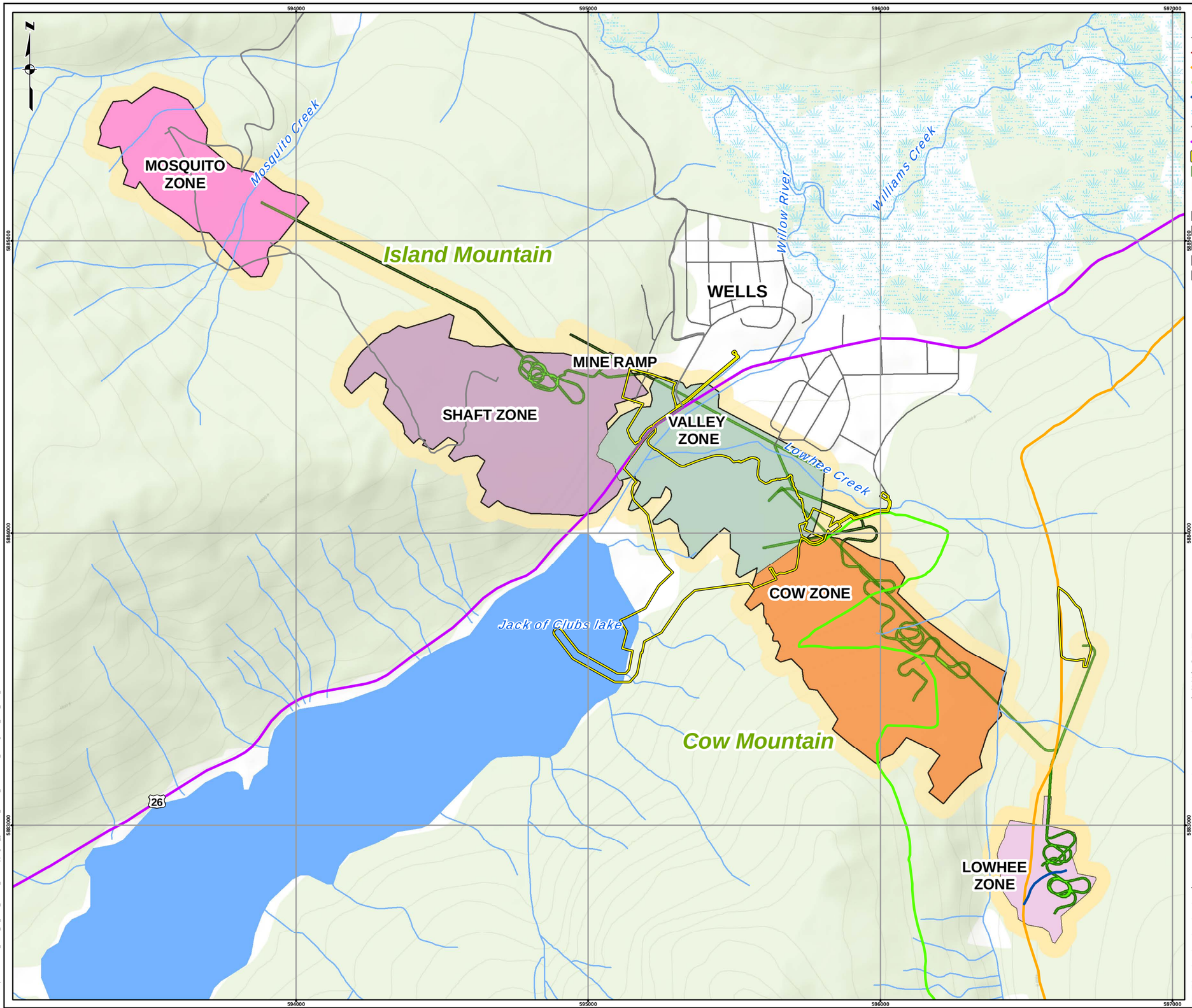
REV.	DESCRIPTION	DATE	INITIALS
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PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

25mm

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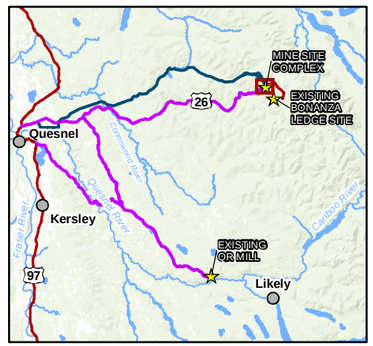


LEGEND

- ROAD
- HIGHWAY
- A ROAD (EXISTING)
- C ROAD (EXISTING)
- LOWHEE ROAD (EXISTING)
- WETLAND
- EXISTING MINE SITE ROAD
- TRANSPORTATION ROUTE
- SURFACE DISTURBANCE
- UNDERGROUND INFRASTRUCTURE
- UNDERGROUND FOOTPRINT

UNDERGROUND MINE

- SHAFT ZONE
- COW ZONE
- VALLEY ZONE
- MOSQUITO ZONE
- LOWHEE ZONE



REFERENCE(S)

1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
2. BASE DATA SOURCE: ESRI, GEOBASE, NRCAN, AND THE GIS USER COMMUNITY
3. BASE DATA SOURCE: ESRI, GEOBASE, NRCAN, AND THE GIS USER COMMUNITY.
4. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM ZONE 10N

0 100 200 300 400 Meters

1:13,000 METRES

CARIBOO GOLD PROJECT

SIMPLIFIED ORE DEPOSITS AND UNDERGROUND INFRASTRUCTURE

REV.	DESCRIPTION	DATE	INITIALS
A		2/17/2023	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	20.2-2

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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Wells

Mine Site Complex

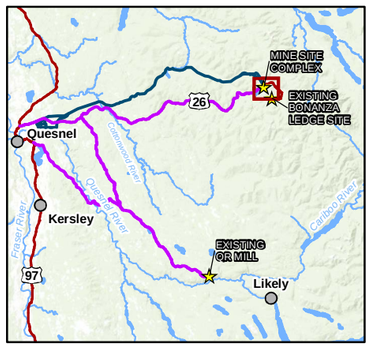
Jack of Clubs Lake

26

District Of Wells Boundary

LEGEND

- HIGHWAY
- TRANSPORTATION ROUTE
- TRANSMISSION LINE CORRIDOR
- UNDERGROUND MINE AREA
- MAXIMUM SURFACE FOOTPRINT
- UNDERGROUND FOOTPRINT
- BARKERVILLE HISTORIC TOWN AND PARK
- DISTRICT OF WELLS BOUNDARY



REFERENCE(S)

1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
2. HILLSHADE DERIVED FROM LIDAR DATA FLOWN BY MCELHANNAY CONSULTANTS LTD. JUNE 27, 2016.
3. BASE DATA SOURCE: ESRI, GEOBASE, NRCAN, AND THE GIS USER COMMUNITY.
4. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM ZONE 10N

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CARIBOO GOLD PROJECT

MINE SITE SURFACE AND UNDERGROUND FOOTPRINTS

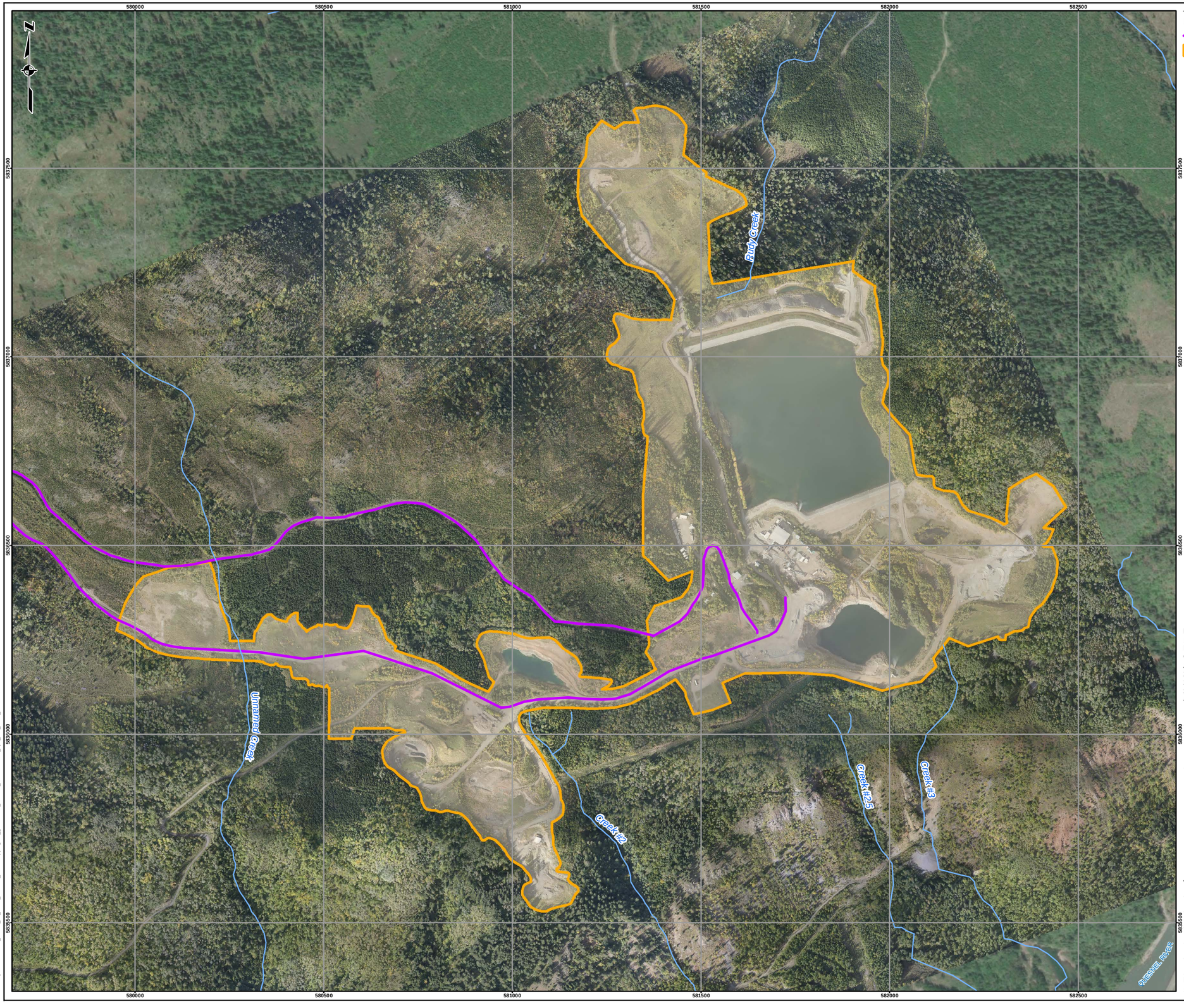
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PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-3**

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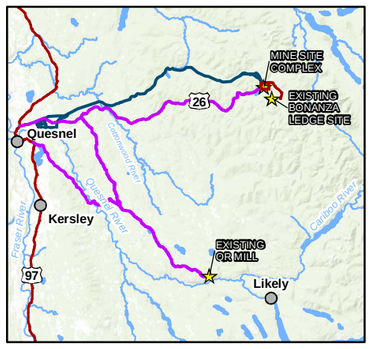
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

25mm
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LEGEND

- TRANSPORTATION ROUTE
- MAXIMUM SURFACE FOOTPRINT



REFERENCE(S)

1. TRAILS, WATER FEATURES, ROADS, MUNICIPAL BOUNDARY, PARK/PROTECTED AREAS, BARKERVILLE HISTORIC TOWN/PARK, CITIES (INSET), PROVINCIAL BORDERS (INSET) OBTAINED FROM THE B.C. MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
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NAD83 CSRS
UTM ZONE 10N

0 100 200 300 400 500
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CARIBOO GOLD PROJECT

QR MILL MAXIMUM SURFACE FOOTPRINT

REV.	DESCRIPTION	DATE	INITIALS
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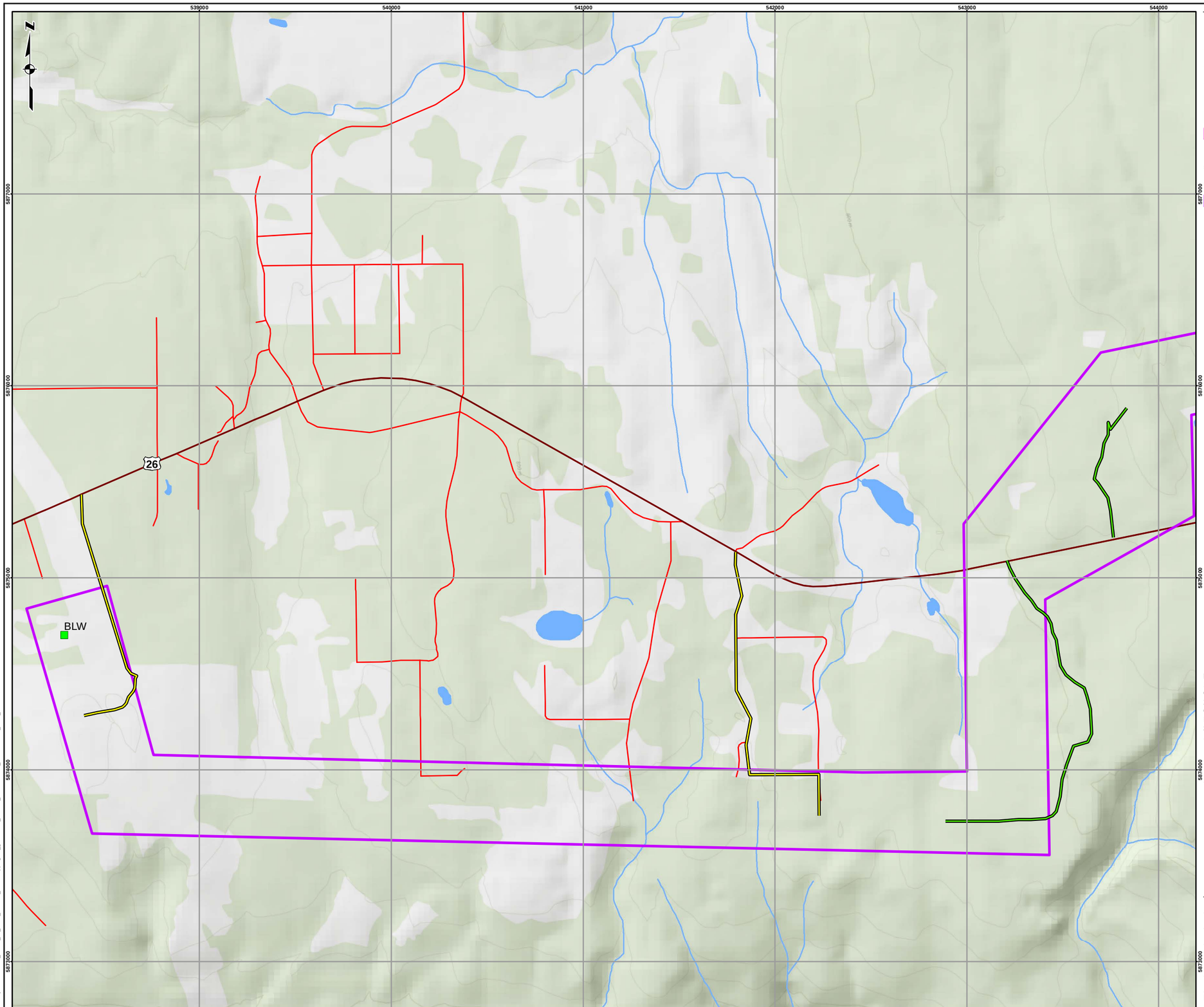
PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-4**

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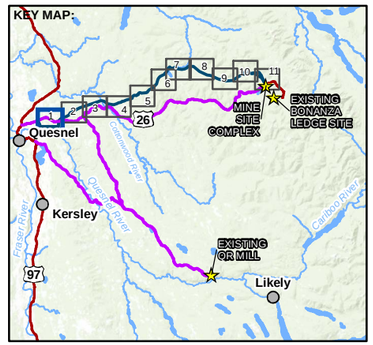
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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



REFERENCE(S)

1.WATER FEATURES, TRANSPORTATION FEATURES OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. CITIES/TOWNS, INDIAN RESERVES, FEDERAL LANDS AND PARK/PROTECTED AREAS OBTAINED FROM BC MINISTRY OF FORESTS, LANDS NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT.
3. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 1 OF 11

REV.	DESCRIPTION	DATE	INITIALS
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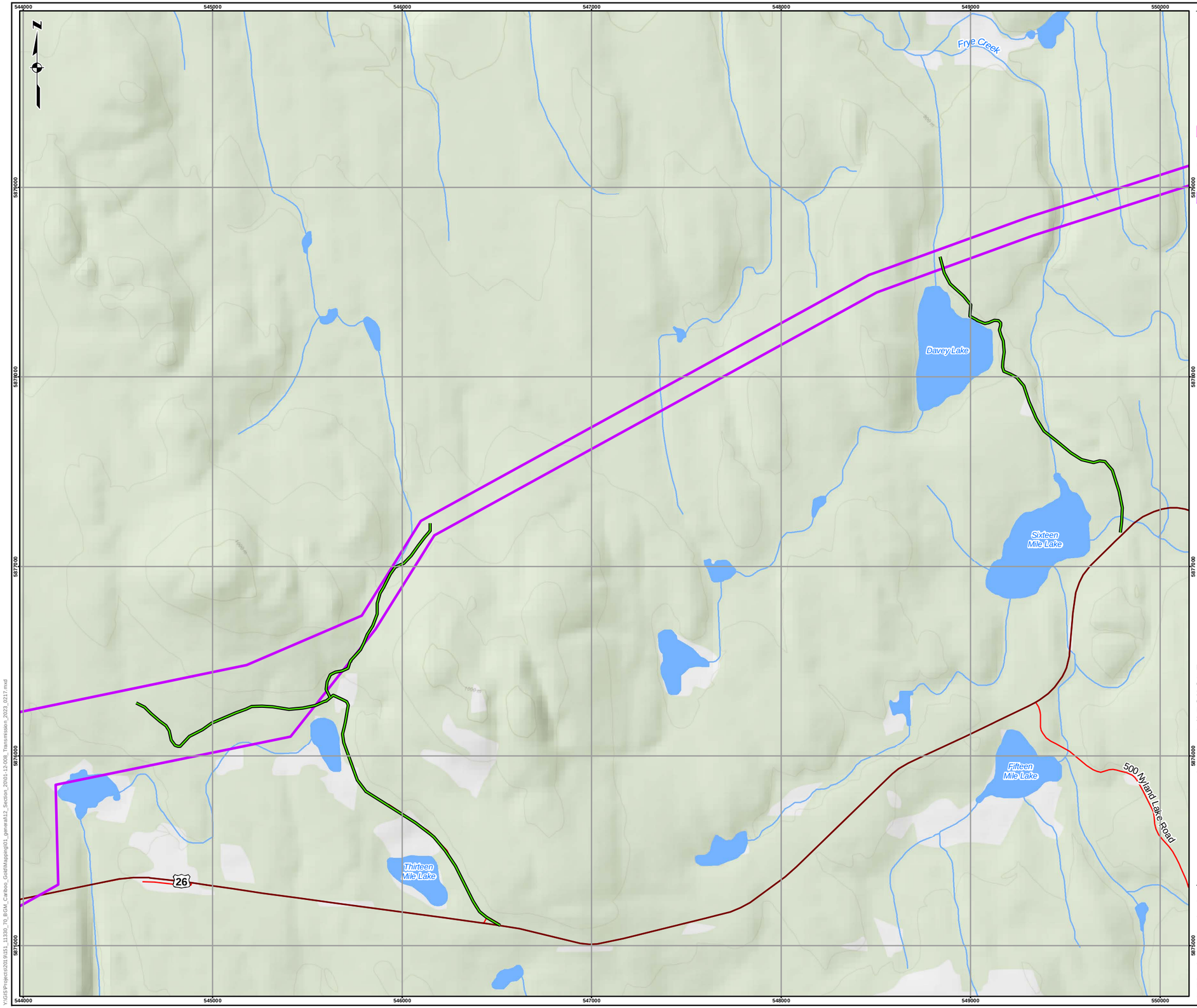
PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-5**

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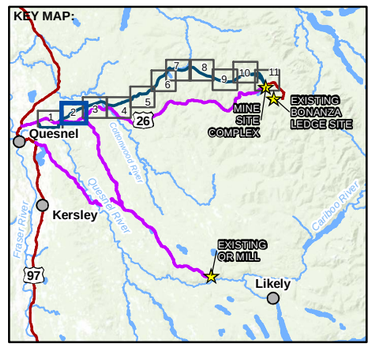
25mm

0



LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



REFERENCE(S)

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NAD83 CSRS
UTM Zone 10N

0 0.5 1
1:20,000 KILOMETRES

CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 2 OF 11

REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	20.2-6

Y:\GIS\Projects\201 9\151_11330_70_BGM_Cariboo_Gold\Mapping\01_general\12_Section_20\01-12-008_Transmission_2023_0217.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

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Cottonwood River

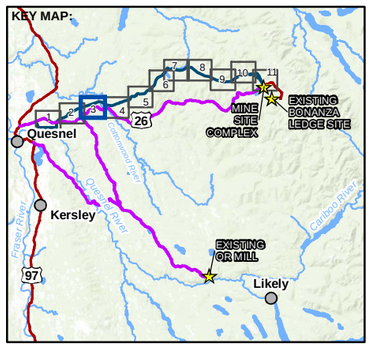
Frye Creek

Sixteen Mile Lake

26

LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



REFERENCE(S)

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3. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM Zone 10N

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1:20,000 KILOMETRES

CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 3 OF 11

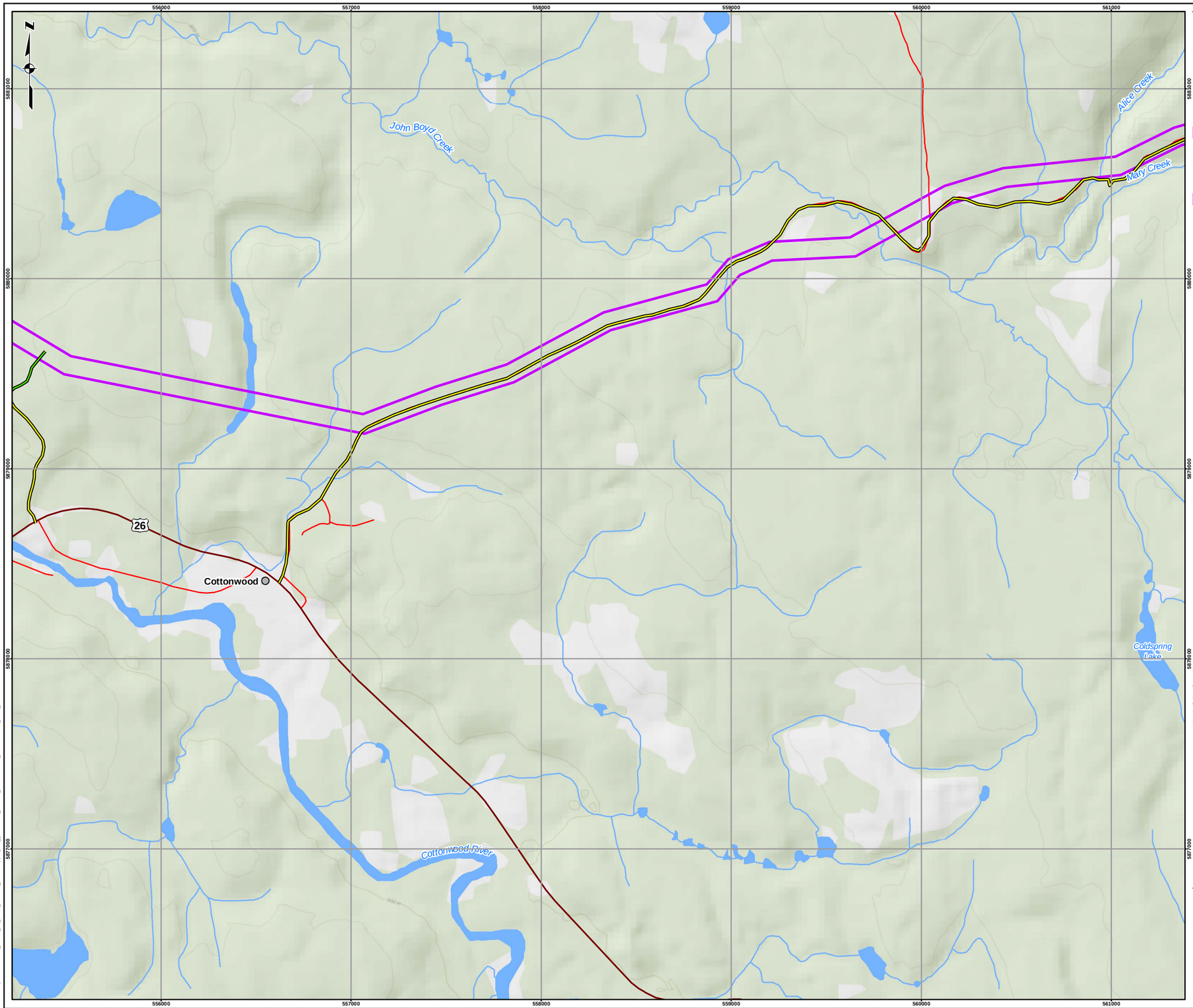
REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-7**

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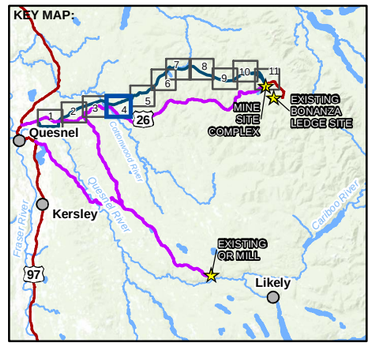
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

0 25mm



LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



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NAD83 CSRS
UTM Zone 10N

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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 4 OF 11

REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

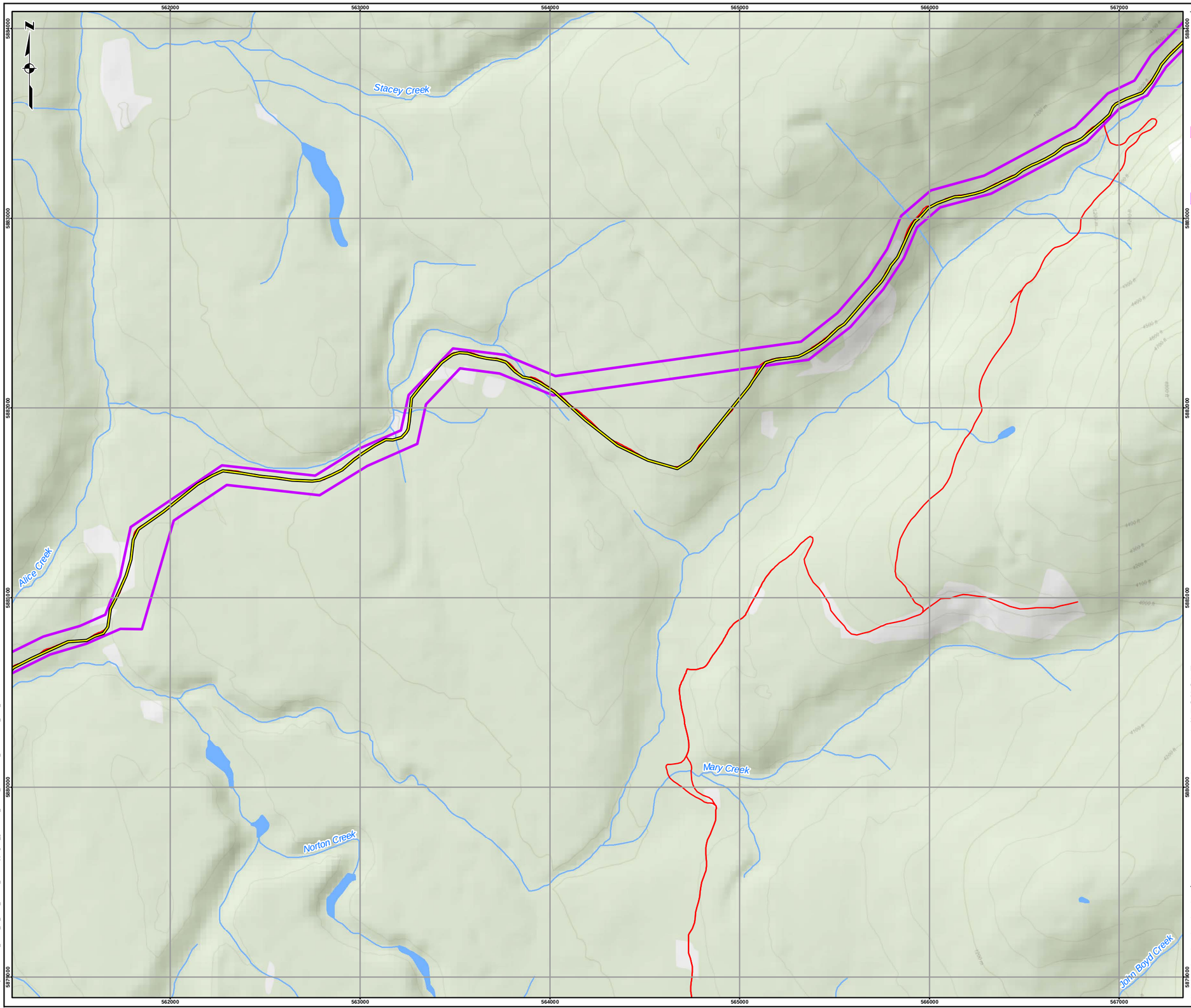
PROJECT NO.	PHASE	REV.	FIGURE
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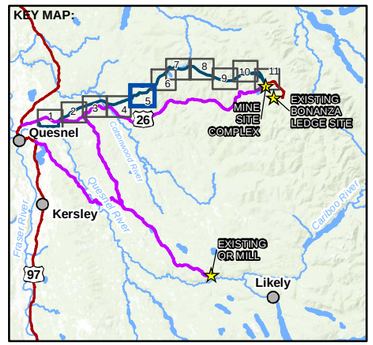
25mm

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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



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NAD83 CSRS
UTM Zone 10N

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1:20,000 KILOMETRES

CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 5 OF 11

REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

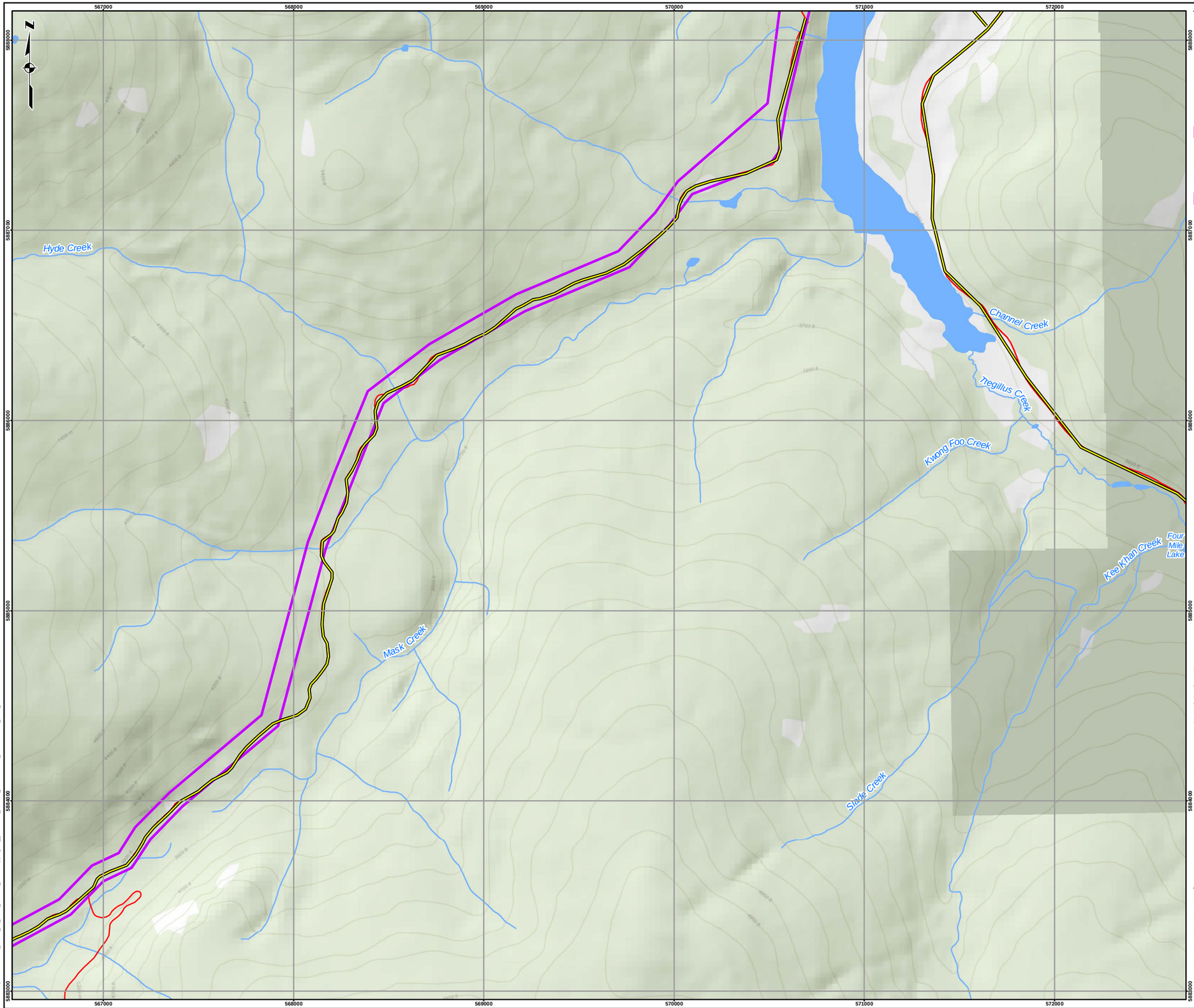
PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	20.2-9

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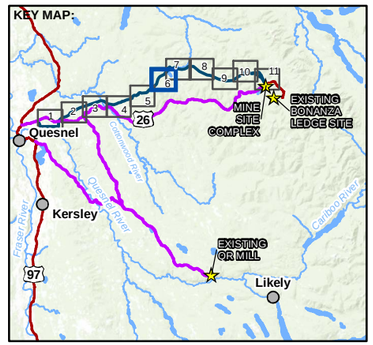
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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



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NAD83 CSRS
UTM Zone 10N

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1:20,000 KILOMETRES

CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 6 OF 11

REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-10**

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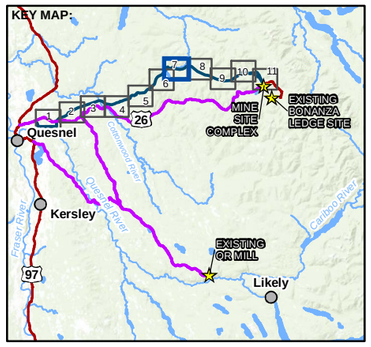
5890000 5889000 5888000 5887000 5886000

Aura Fina Creek
Hogshead Creek
Tregillus Creek
Rucheon Creek
Hyde Creek
Channel Creek
Kwong Foo Creek

LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR

KEY MAP:



REFERENCE(S)

1.WATER FEATURES, TRANSPORTATION FEATURES OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
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NAD83 CSRS
UTM Zone 10N

0 0.5 1
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CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 7 OF 11

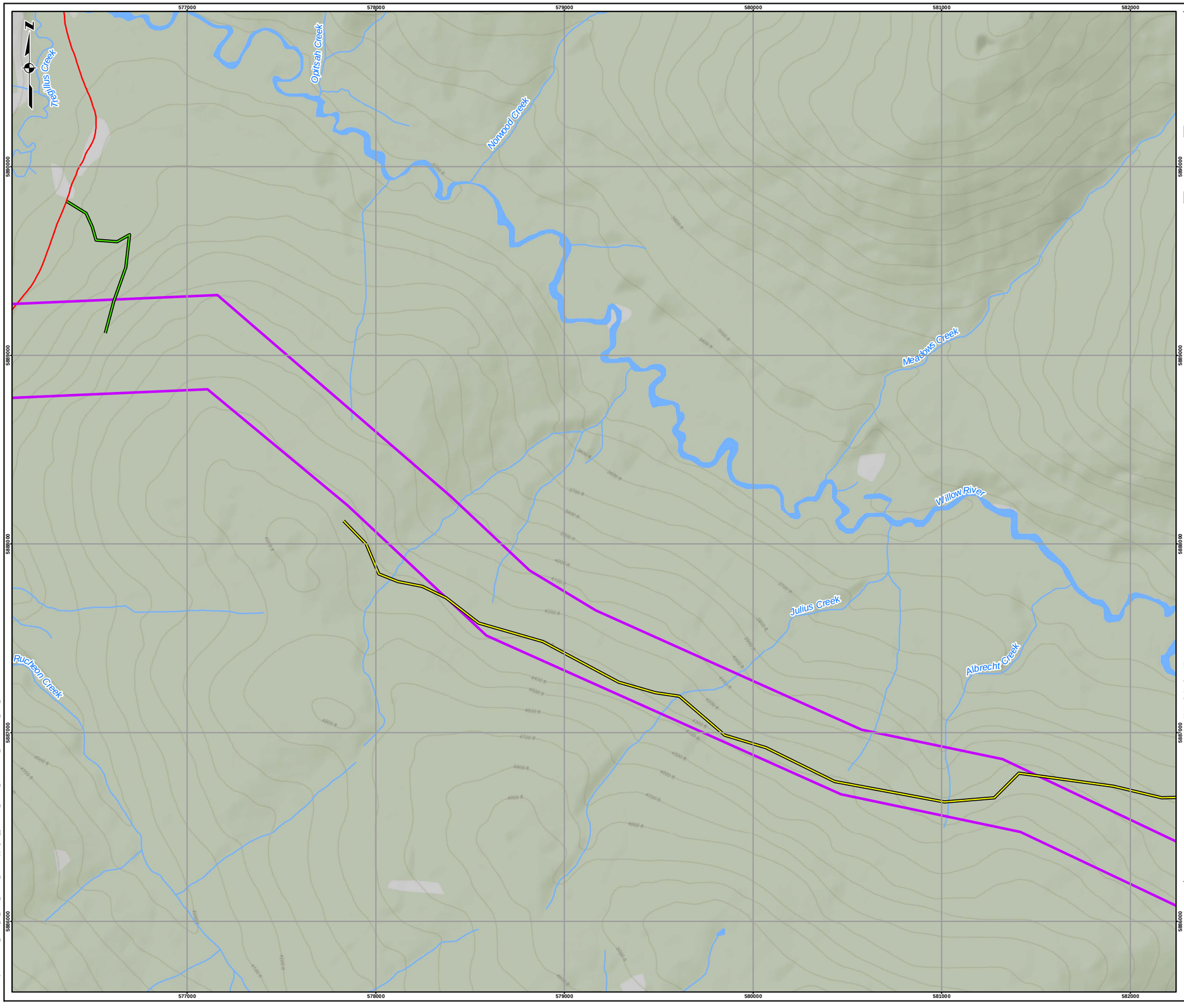
REV.	DESCRIPTION	DATE	INITIALS
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PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-11**

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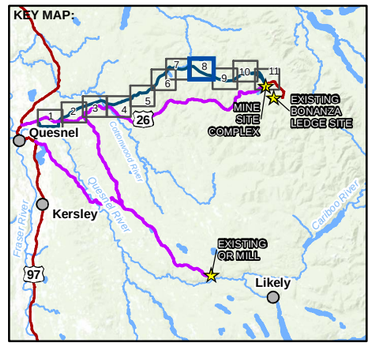
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0 25mm



LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



REFERENCE(S)

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3. INSET BASE SOURCE: ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS.

NAD83 CSRS
UTM Zone 10N

0 0.5 1
1:20,000 KILOMETRES

CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 8 OF 11

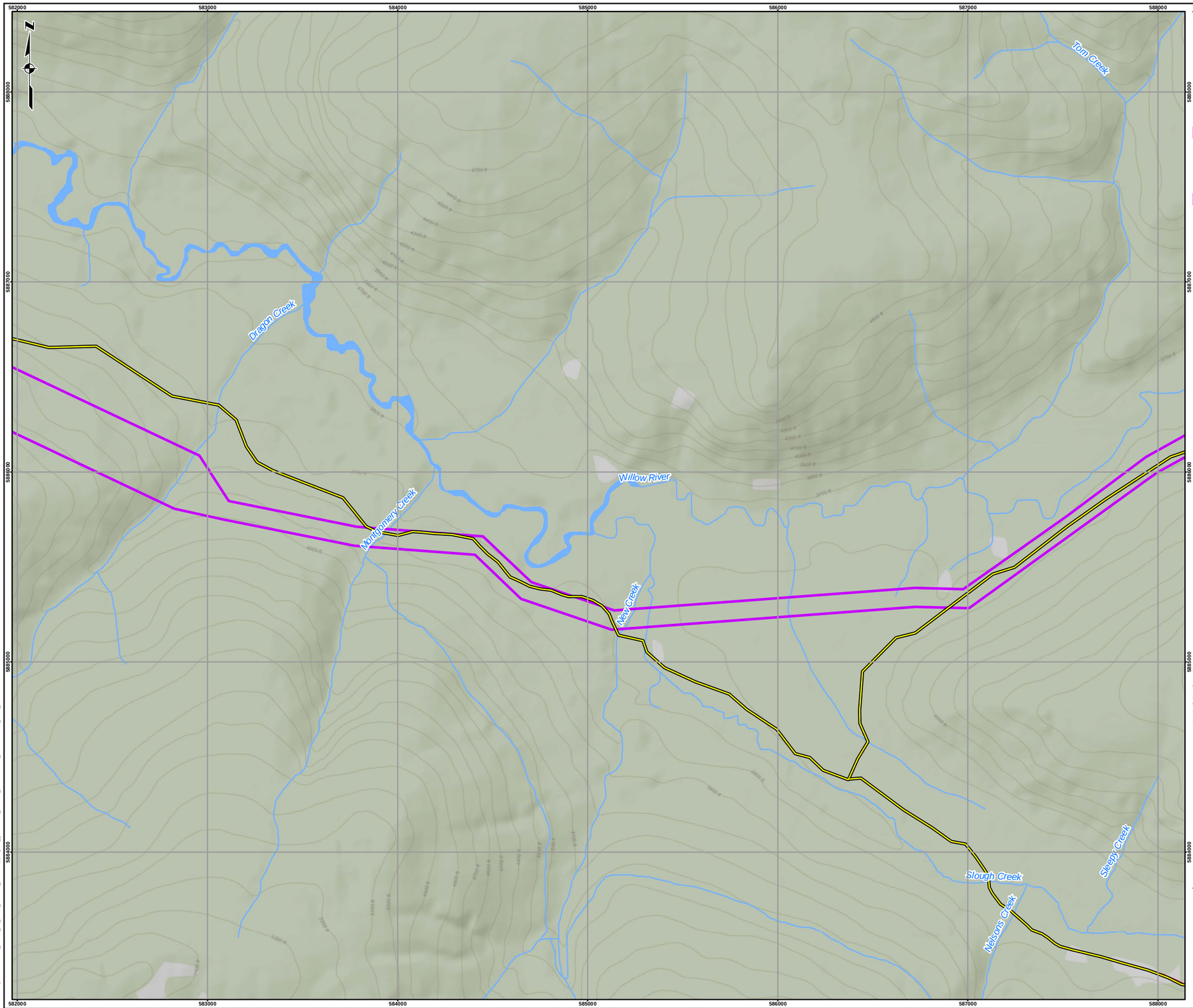
REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-12**

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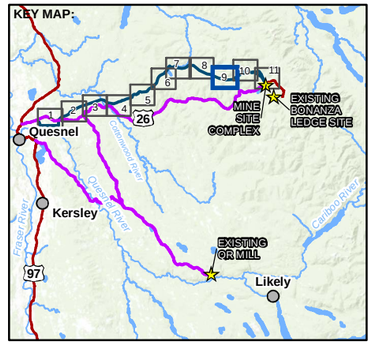
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0 25mm



LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
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NAD83 CSRS
UTM Zone 10N

0 0.5 1
1:20,000 KILOMETRES

CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 9 OF 11

REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-13**

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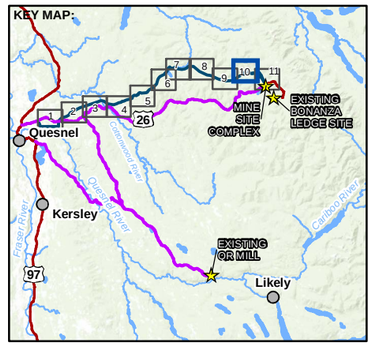
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5890000 5889000 5888000 5887000 5886000

Tom Creek
Harris Crabbie Creek
Willow River
Porcupine Creek
Cornish Creek
Peep O'Day Creek
Coulter Creek

LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
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- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR



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NAD83 CSRS
UTM Zone 10N

0 0.5 1
KILOMETRES
1:20,000

CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 10 OF 11

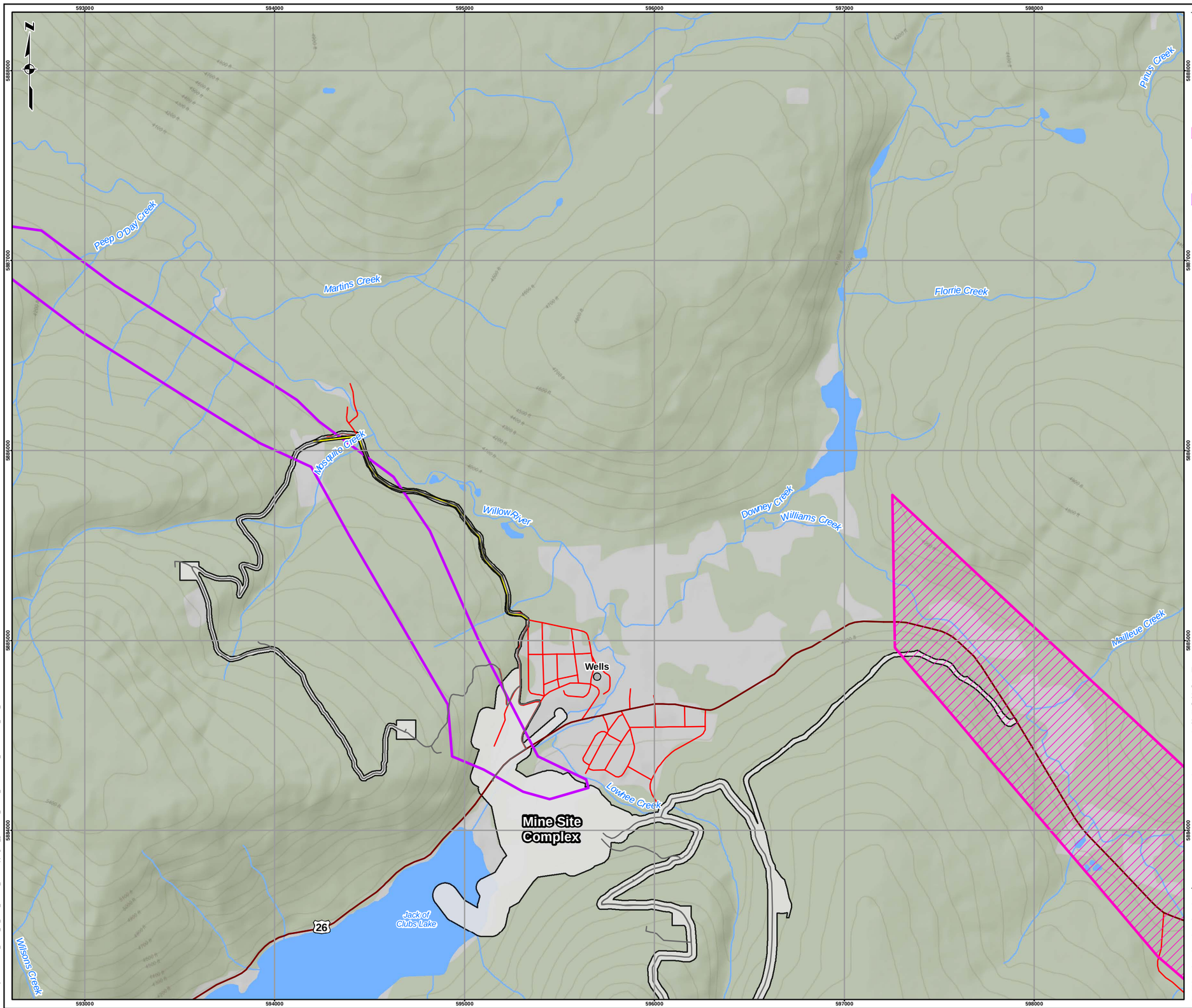
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A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
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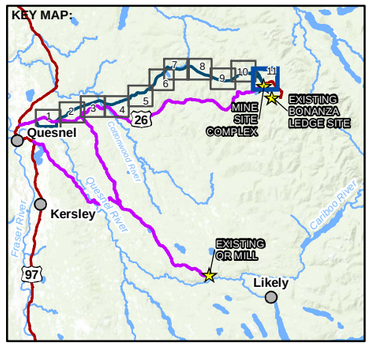
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LEGEND

- POPULATED COMMUNITY
- HIGHWAY
- EXISTING ACCESS ROADS
- WATERCOURSE
- WATERBODY
- PARKS/PROTECTED AREA
- BARKERVILLE HISTORIC TOWN AND PARK
- BARLOW SUBSTATION
- TRANSMISSION LINE ACCESS ROAD (EXISTING)
- TRANSMISSION LINE ACCESS ROAD (UPGRADE)
- TRANSMISSION LINE CORRIDOR
- MINE SITE SURFACE INFRASTRUCTURE



REFERENCE(S)

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NAD83 CSRS
UTM Zone 10N

0 0.5 1
1:20,000 KILOMETRES

CARIBOO GOLD PROJECT

TRANSMISSION LINE ROUTE
PAGE 11 OF 11

REV.	DESCRIPTION	DATE	INITIALS
A		9/14/2022	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	B	**20.2-15**

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APPENDIX C WATER QUALITY PREDICTIONS

Appendix C: Projected Water Quality Screening
Table C-1: Predicted Water Quality at Lowhee Creek Station LC-3.9 for Construction, Operations, Closure, and Post-Closure (Active Case) Phases

Parameter	Unit	Water Quality Guidelines						LC 3.9							LC-3.9							
		BC Long-term Chronic Guidelines for the Protection of[1,2,3]:				Human Health Guidelines		Max	Max	Max	P50	Min	Min	P50	P50	P50	P50	P50	P50	P75	P75	P75
		Aquatic Life	Aquatic Life 80%	Wildlife	Livestock	Recreational	Drinking Water	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March
Exposure and Toxicity Modifying Factors																						
pH	-	6.5 - 9.0	-	-	5.0 - 9.5	-	7.0 - 10.5[4]	8.4	8.4	8.4	8.3	8.0	8.0	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.4	8.4
Temperature[2]	°C	-	-	-	-	-	-	5.0	5.0	5.0	5.0	10	10.0	15	15	10	10	5.0	5.0	5.0	5.0	5.0
Hardness, as $CaCO_3$	mg/L	-	-	-	-	-	-	506	506	506	99	64	64	99	99	99	99	99	99	506	506	506
Dissolved organic carbon	mg/L	-	-	-	-	-	-	1.3	1.1	1.3	2.6	5.2	3.3	2.8	1.7	2.1	2.7	2.4	1.0	1.3	1.1	1.3
Major Ions																						
Bromide	mg/L	-	-	-	-	-	-	0.025	0.025	0.025	0.024	0.022	0.022	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Calcium	mg/L	-	-	-	1,000	-	-	145	145	145	25	19	19	25	25	25	25	25	25	31	31	31
Fluoride	mg/L	1.2 - 2.0[5]	-	1	1.0[n]	30	1.5[4]	0.36	0.36	0.36	0.075	0.038	0.038	0.075	0.075	0.075	0.075	0.075	0.075	0.12	0.12	0.12
Magnesium	mg/L	-	-	-	-	-	-	35	35	35	9.0	4.0	4.0	9.0	9.0	9.0	9.0	9.0	9.0	14	14	14
Potassium	mg/L	-	-	-	-	-	-	911	911	911	129	11	11	129	129	129	129	129	129	258	258	258
Sodium	mg/L	-	-	-	-	4,000	200[C, 4]	19	19	19	3.0	1.1	1.1	3.0	3.0	3.0	3.0	3.0	3.0	4.7	4.7	4.7
Sulphate	mg/L	218 - 429[5]	174 - 343	-	1,000[W, LW]	10,000	500[C, 4]	107	107	107	70	8.0	8	70	70	70	70	70	70	79	79	79
Total alkalinity, as CaCO	mg/L	-	-	-	-	-	-	93	93	93	75	42	42	75	75	75	75	75	75	81	81	81
Nutrients																						
Nitrate	mg-N/L	3.0	2	100	100	200	10[4]	1.1	1.1	1.1	0.36	0.0093	0.01	0.36	0.36	0.36	0.36	0.36	0.36	0.74	0.74	0.74
Nitrite	mg-N/L	0.10 - 0.20[5]	0.08 - 0.16	10	10	20	1[4]	0.070	0.070	0.070	0.022	0.00085	0.001	0.022	0.022	0.022	0.022	0.022	0.022	0.050	0.050	0.050
Total ammonia	mg-N/L	0.48 - 1.1[m]	0.38 - 0.88	-	-	-	-	**0.66**[Min]	**0.66**[Min]	**0.66**[Min]	0.17	0.0056	0.01	0.17	0.17	0.17	0.17	0.17	0.17	**0.40**[90% Min]	**0.40**[90% Min]	**0.40**[90% Min]
Total phosphorus	mg-P/L	-	-	-	-	-	-	0.13	0.13	0.13	0.050	0.020	0.020	0.050	0.050	0.050	0.050	0.050	0.050	0.090	0.090	0.090
Dissolved phosphorus	mg-P/L	-	-	-	-	-	-	0.13	0.13	0.13	0.050	0.020	0.020	0.050	0.050	0.050	0.050	0.050	0.050	0.090	0.090	0.090
Total Metals																						
Aluminum	µg/L	-	-	5,000	5,000	190,000	9,500[3]	80	80	80	40	40	40	40	40	40	40	40	40	50	50	50
Antimony	µg/L	9.0	7	-	-	120	6[4]	4.6	4.6	4.6	0.42	0.19	0.19	0.42	0.42	0.42	0.42	0.42	0.42	0.73	0.73	0.73
Arsenic	µg/L	5.0	4.0	25[l]	25[l]	200	10[4]	2.0	2.0	2.0	0.81	0.26	0.26	0.81	0.81	0.81	0.81	0.81	0.81	1.3	1.3	1.3
Barium	µg/L	1,000	800	-	-	40,000	2,000[4]	718	718	718	525	70	70	525	525	525	525	525	525	582	582	582
Beryllium	µg/L	0.13	0.10	-	100[W]	100	5[3]	**0.50**[Min]	**0.50**[Min]	**0.50**[Min]	**0.40**[Min]	**0.30**[Min]	**0.30**[Min]	**0.40**[Min]	**0.40**[Min]	**0.40**[Min]	**0.40**[Min]	**0.40**[Min]	**0.40**[Min]	**0.40**[Min]	**0.40**[Min]	**0.40**[Min]
Bismuth	µg/L	-	-	-	-	-	-	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Boron	µg/L	1,200	980	5,000	5,000	100,000	5,000[3]	80	80	80	50	30	30	50	50	50	50	50	50	50	50	50
Cadmium	µg/L	-	-	-	80[W]	140	7[4]	0.051	0.051	0.051	0.041	0.0090	0.009	0.041	0.041	0.041	0.041	0.041	0.041	0.044	0.044	0.044
Chromium	µg/L	1.0[f]	0.80	-	50[W,LW(f)]	1,000	50[4]	**1.1**[Min]	**1.1**[Min]	**1.1**[Min]	0.52	0.42	0.42	0.52	0.52	0.52	0.52	0.52	0.52	0.60	0.60	0.60
Cobalt	µg/L	4.0	3.2	-	1,000[W, LW]	20	1[3]	**1.7**[DW]	**1.7**[DW]	**1.7**[DW]	**1.3**[DW]	0.17	**0.2**	**1.3**[DW]	**1.3**[DW]	**1.3**[DW]	**1.3**[DW]	**1.3**[DW]	**1.3**[DW]	**1.4**[DW]	**1.4**[DW]	**1.4**[DW]
Copper	µg/L	-	-	300	300	40,000	2,000[4]	2.0	2.0	2.0	1.1	0.60	0.6	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Iron	µg/L	1,000	800	-	-	56,000	2,800[3]	220	220	220	50	40	40	50	50	50	50	50	50	60	60	60
Lead	µg/L	5.1 - 20[5]	4.1 - 16	100	100	100	5[4]	0.66	0.66	0.66	0.24	0.18	0.18	0.24	0.24	0.24	0.24	0.24	0.24	0.27	0.27	0.27
Lithium	µg/L	-	-	-	-	-	-	8,540	8,540	8,540	190	0	0	190	190	190	190	190	190	770	770	770
Manganese	µg/L	886 - 2,832[5]	709 - 2,266	-	-	2,400	120[4]	**1,733**[BHMn, DW]	**1,733**[BHMn, DW]	**1,733**[BHMn, DW]	**186**[DW]	4.0	**4**	**186**[DW]	**186**[DW]	**186**[DW]	**186**[DW]	**186**[DW]	**186**[DW]	**425**[DW]	**425**[DW]	**425**[DW]
Mercury	µg/L	0.010	0.01	-	3.00	20.00	1[4]	**0.012**[Min]	**0.012**[Min]	**0.012**[Min]	0.0053	0.0029	0.0029	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0070	0.0070	0.0070
Molybdenum	µg/L	7,600	6,080	34[g]	16[g]	1,760	88[3]	14	14	14	1.3	0.42	0.4	1.3	1.3	1.3	1.3	1.3	1.3	2.4	2.4	2.4
Nickel	µg/L	68 - 150[5]	54 - 120	-	1,000[W, LW]	1,600	80[3]	9.1	9.1	9.1	6.8	0.60	0.6	6.8	6.8	6.8	6.8	6.8	6.8	7.5	7.5	7.5
Selenium	µg/L	2.0	1.6	2.0	30	200	10[3]	**1.9**[90% Min]	**1.9**[90% Min]	**1.9**[90% Min]	0.52	0.48	0.48	0.52	0.52	0.52	0.52	0.52	0.52	0.61	0.61	0.61
Silicon	µg/L	-	-	-	-	-	-	3,220	3,220	3,220	2,460	1,800	1,800	2,460	2,460	2,460	2,460	2,460	2,460	2,700	2,700	2,700
Silver	µg/L	0.050 - 1.5[5]	0.04 - 1.2	-	-	376	18.8[5]	0.024	0.024	0.024	0.010	0.0090	0.009	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.011
Strontium	µg/L	-	-	-	-	140,000	7000[3]	**7,260**[DW]	**7,260**[DW]	**7,260**[DW]	460	110	110	460	460	460	460	460	460	1,050	1,050	1,050
Thallium	µg/L	0.80	0.6	-	-	-	-	0.15	0.15	0.15	0.089	0.072	0.072	0.089	0.089	0.089	0.089	0.089	0.089	0.096	0.096	0.096
Tin	µg/L	-	-	-	-	48000	2,400[5]	0.60	0.60	0.60	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.30	0.30	0.30
Titanium	µg/L	-	-	-	-	-	-	5.2	5.2	5.2	4.5	3.8	3.8	4.5	4.5	4.5	4.5	4.5	4.5	4.8	4.8	4.8
Uranium	µg/L	8.5	6.8	-	200[W, LW]	400	20[4]	2.3	2.3	2.3	0.64	0.32	0.32	0.64	0.64	0.64	0.64	0.64	0.64	0.95	0.95	0.95
Vanadium	µg/L	-	-	-	-	344	17.2[5]	1.7	1.7	1.7	0.54	0.48	0.48	0.54	0.54	0.54	0.54	0.54	0.54	0.63	0.63	0.63
Zinc	µg/L	7.5 - 188[5]	6.0 - 150	-	2,000	60,000	3,000[3]	6.8	6.8	6.8	4.7	2.4	2.4	4.7	4.7	4.7	4.7	4.7	4.7	5.3	5.3	5.3
Dissolved Metals																						
Aluminum	µg/L	50[5]	40	-	-	-	-	6.0	6.0	6.0	5.0	3.0	3.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Antimony	µg/L	-	-	-	-	-	-	4.6	4.6	4.6	0.40	0.20	0.20	0.40	0.40	0.40	0.40	0.40	0.40	0.70	0.70	0.70
Arsenic	µg/L	-	-	-	-	-	-	2.0	2.0	2.0	0.76	0.26	0.26	0.76	0.76	0.76	0.76	0.76	0.76	1.3	1.3	1.3
Barium	µg/L	-	-	-	-	-	-	717	717	717	525	68	68	525	525	525	525	525	525	580	580	580
Beryllium	µg/L	-	-	-	-	-	-	0.50	0.50	0.50	0.40	0.34	0.34	0.40	0.40	0.40	0.40	0.40	0.40	0.43	0.43	0.43
Bismuth	µg/L	-	-	-	-	-	-	0.25	0.25	0.25	0.23	0.19	0.19	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24
Boron	µg/L	-	-	-	-	-	-	85	85	85	45	28	28	45	45	45	45	45	45	48	48	48
Cadmium	µg/L	0.15 - 0.46[5]	0.12 - 0.37	-	-	-	-	0.051	0.051	0.051	0.041	0.0090	0.009	0.041	0.041	0.041	0.041	0.041	0.041	0.044	0.044	0.044

Parameter	Unit	Water Quality Guidelines						LC 3.9							LC-3.9								
		BC Long-term Chronic Guidelines for the Protection of [1,2,3]:				Human Health Guidelines		Max	Max	Max	P50	Min	Min	P50	P50	P50	P50	P50	P50	P75	P75	P75
		Aquatic Life	Aquatic Life 80%	Wildlife	Livestock	Recreational	Drinking Water	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March
Chromium	µg/L	-	-	-	-	-	-	1.1	1.1	1.1	0.52	0.40	0.40	0.52	0.52	0.52	0.52	0.52	0.52	0.60	0.60	0.60
Cobalt	µg/L	-	-	-	-	-	-	1.7	1.7	1.7	1.3	0.17	0.2	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4
Copper	µg/L	0.5 - 2.3[3]	0.4 - 1.8	-	-	-	-	**1.3**[Min]	**1.3**[Min]	**1.3**[Min]	0.91	0.50	0.50	0.91	**0.91**[80% Min]	0.91	0.91	0.91	**0.91**[Min]	**0.98**[Min]	**0.98**[Min]	**0.98**[Min]
Iron	µg/L	350	280	-	-	-	-	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Lead	µg/L	-	-	-	-	-	-	0.66	0.66	0.66	0.23	0.14	0.14	0.23	0.23	0.23	0.23	0.23	0.23	0.26	0.26	0.26
Lithium	µg/L	-	-	-	-	-	-	8,540	8,540	8,540	190	0	0	190	190	190	190	190	190	770	770	770
Manganese	µg/L	-	-	-	-	-	-	1,732	1,732	1,732	182	2.0	2	182	182	182	182	182	182	424	424	424
Mercury	µg/L	-	-	-	-	-	-	0.012	0.012	0.012	0.0053	0.0029	0.0029	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0070	0.0070	0.0070
Molybdenum	µg/L	-	-	-	-	-	-	14	14	14	1.3	0.40	0.4	1.3	1.3	1.3	1.3	1.3	1.3	2.4	2.4	2.4
Nickel	µg/L	-	-	-	-	-	-	9.1	9.1	9.1	6.7	0.60	0.6	6.7	6.7	6.7	6.7	6.7	6.7	7.5	7.5	7.5
Selenium	µg/L	-	-	-	-	-	-	1.9	1.9	1.9	0.52	0.48	0.48	0.52	0.52	0.52	0.52	0.52	0.52	0.61	0.61	0.61
Silicon	µg/L	-	-	-	-	-	-	3,080	3,080	3,080	2,320	1,680	1,680	2,320	2,320	2,320	2,320	2,320	2,320	2,540	2,540	2,540
Silver	µg/L	-	-	-	-	-	-	0.024	0.024	0.024	0.010	0.0070	0.007	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.011
Strontium	µg/L	-	-	-	-	-	-	7,260	7,260	7,260	460	110	110	460	460	460	460	460	460	1,050	1,050	1,050
Thallium	µg/L	-	-	-	-	-	-	0.15	0.15	0.15	0.090	0.070	0.070	0.090	0.090	0.090	0.090	0.090	0.090	0.10	0.10	0.10
Tin	µg/L	-	-	-	-	-	-	0.60	0.60	0.60	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.30	0.30	0.30
Titanium	µg/L	-	-	-	-	-	-	5.0	5.0	5.0	4.5	3.8	3.8	4.5	4.5	4.5	4.5	4.5	4.5	4.7	4.7	4.7
Uranium	µg/L	-	-	-	-	-	-	2.3	2.3	2.3	0.63	0.30	0.30	0.63	0.63	0.63	0.63	0.63	0.63	0.94	0.94	0.94
Vanadium	µg/L	-	-	-	-	-	-	1.7	1.7	1.7	0.53	0.48	0.48	0.53	0.53	0.53	0.53	0.53	0.53	0.62	0.62	0.62
Zinc	µg/L	-	-	-	-	-	-	6.6	6.6	6.6	4.6	2.4	2.4	4.6	4.6	4.6	4.6	4.6	4.6	5.3	5.3	5.3

Notes:

- = no guideline or no data; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; µg/L = micrograms per litre
CaCO3 = calcium carbonate; DOC = dissolved organic carbon; I = interim guideline, LW = livestock watering; Max = maximum; P50 = 50th Percentile; Min = minimum; P75 = 75th Percentile; W = working guideline; WQG = water quality guideline.

Values presented here are from the Bonanza Ledge Mine water quality predictions (Mavin Terra 2022). The predictions were applied as follows: maximum values to winter months (January to March), minimum values to freshet (May and June), and median values to the remaining months (April and July to December). Due to the uncertainties in using maximum predictions for the winter months, 75th percentile values are also presented for comparison.

[a] = Temperature values were assumed for each month (November to April = 5°C, May to June and September to October = 10°C, and July to August = 15°C)

[b] = guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (64 to 506 mg/L). The guideline is calculated based on the individual hardness value for each sample. For samples with hardness values greater than the upper limit of the established guideline hardness range, the upper limit of the established guideline hardness range was used for the purpose of guideline calculation.

[c] = guideline is based on an aesthetic objective.

[d] = guideline is chloride dependent. The guideline range shown is based on the chloride concentration range observed in the dataset (9.0 to 1,124 mg/L). The guideline is calculated based on the individual chloride concentration in each sample.

[e] = the ammonia guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (0.48 mg-N/L) is based on the combination of pH (8.4 and water temperature (5.0°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

[f] = guideline is for chromium VI.

[g] = guideline is protective of ruminant animals.

[h] = guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (8.0 to 8.4). The guideline is calculated based on the individual pH for each sample.

[i] = the copper guideline is calculated with the BC Biotic Ligand Model (BLM), based on temperature, pH, dissolved organic carbon (DOC), humic acid content (HA), calcium magnesium, sodium, potassium, sulphate, and alkalinity dependent. The guideline range shown is based on the temperature range observed in the dataset (5 to 15 °C), the pH range observed in the dataset (8.0 to 8.4), the DOC range observed in the dataset (1.0 to 5.2 mg/L), the assumed HA value of 10%, the Ca range observed in the dataset (19 to 145 mg/L), the magnesium range observed in the dataset (4.0 to 35 mg/L), the sodium range observed in the dataset (1.1 to 20 mg/L), the potassium range observed in the dataset (11 to 911 mg/L), the sulphate range observed in the dataset (8.0 to 107 mg/L), the chloride range observed in the dataset (9.0 to 1,124 mg/L), and the alkalinity range observed in the dataset (42 to 93 mg/L). The guideline is calculated based on the parameter values for each individual sample. Parameter values that exceeded the upper limit of their established ranges (72.94 mg/L for Ca, 18.4 mg/L for Mg, 156 mg/L for K, and 119.8 mg/L for Cl) were replaced with the upper limit of their parameter range for the purpose of guideline calcualtion.

[Min] = concentration is higher than the 30-day mean BC ENV aquatic life guideline or outside the recommended pH, DO or total alkalinity range.

[80% Min] = concentration is higher than 80% of the 30-day mean BC ENV aquatic life guideline.

[BHMin] = concentration is higher than the 30-day mean BC ENV aquatic life guideline calculated with baseline hardness.

[DW] = concentration is higher than the drinking water guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

[1] = British Columbia Ministry of Environment and Climate Change Strategy (BC ENV). 2021a. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C.

[2] = BC ENV. 2021b. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C.

[3] = BC ENV. 2017. B.C. Source Drinking Water Quality Guidelines: Guideline Summary. Water Quality Guideline Series, WQG-01. Prov. B.C., Victoria B.C.

[4] = Health Canada (HC). 2022. Guidelines for Canadian Drinking Water Quality—Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[5] = United States Environmental Protection Agency (US EPA). 2022. Regional Screening Levels - Resident Tap Water. Accessed March 2022 from: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Parameter	Unit	Water Quality Guidelines						LC 1.5					LC 1.5									
		BC Long-term Chronic Guidelines for the Protection of[1,2,3]:				Human Health Guidelines		Max	Max	Max	P50	Min	Min	P50	P50	P50	P50	P50	P50	P75	P75	P75
		Aquatic Life	Aquatic Life 80%	Wildlife	Livestock	Recreational	Drinking Water	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March
Exposure and Toxicity Modifying Factors																						
pH	-	6.5 - 9.0	-	-	-	-	7.0 - 10.5[4]	8.4	8.4	8.4	8.3	8.1	8.1	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Temperature[4]	°C	-	-	-	-	-	-	5.0	5.0	5.0	5.0	10	10	15	15	10	10	5.0	5.0	5.0	5.0	5.0
Hardness, as $CaCO_3$	mg/L	-	-	-	-	-	-	378	378	378	85	59	59	85	85	85	85	85	85	106	106	106
Dissolved organic carbon	mg/L	-	-	-	-	-	-	0.78	0.75	0.80	1.7	4.0	2.1	2.2	1.5	1.4	1.9	1.5	0.95	0.78	0.75	0.80
Major Ions																						
Bromide	mg/L	-	-	-	-	-	-	0.024	0.024	0.024	0.019	0.016	0.016	0.019	0.019	0.019	0.019	0.019	0.019	0.021	0.021	0.021
Calcium	mg/L	-	-	-	1,000	-	-	107	107	107	24	17	17	24	24	24	24	24	24	26	26	26
Fluoride	mg/L	1.1 - 1.9[5]	-	1	1	30	1.5[4]	0.26	0.26	0.26	0.057	0.026	0.026	0.057	0.057	0.057	0.057	0.057	0.057	0.083	0.083	0.083
Magnesium	mg/L	-	-	-	-	-	-	27	27	27	6.0	4.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	10	10	10
Potassium	mg/L	-	-	-	-	-	-	648	648	648	69	11	11	69	69	69	69	69	69	155	155	155
Sodium	mg/L	-	-	-	-	4,000	200[C, 4]	14	14	14	1.8	0.95	0.95	1.8	1.8	1.8	1.8	1.8	1.8	3.1	3.1	3.1
Sulphate	mg/L	218 - 429[5]	174 - 343	-	1,000(W, LW)	10,000	500[C, 4]	68	68	68	35	8.0	8.0	35	35	35	35	35	35	48	48	48
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	-	-	-	88	88	88	74	46	46	74	74	74	74	74	74	77	77	77
Nutrients																						
Nitrate	mg-N/L	3.0	2	100	100	200	10[4]	0.75	0.75	0.75	0.18	0.016	0.016	0.18	0.18	0.18	0.18	0.18	0.18	0.37	0.37	0.37
Nitrite	mg-N/L	0.10 - 0.20[6]	0.08 - 0.16	10	10	20	1[4]	0.050	0.050	0.050	0.011	0.00074	0.00074	0.011	0.011	0.011	0.011	0.011	0.011	0.024	0.024	0.024
Total ammonia	mg-N/L	0.48 - 0.9[5]	0.38 - 0.72	-	-	-	-	**0.47**[(90% Min)]	**0.47**[(90% Min)]	**0.47**[(90% Min)]	0.085	0.0048	0.0048	0.085	0.085	0.085	0.085	0.085	0.085	0.21	0.21	0.21
Total phosphorus	mg-P/L	-	-	-	-	-	-	0.090	0.090	0.090	0.040	0.020	0.020	0.040	0.040	0.040	0.040	0.040	0.040	0.070	0.070	0.070
Dissolved phosphorus	mg-P/L	-	-	-	-	-	-	0.090	0.090	0.090	0.040	0.020	0.020	0.040	0.040	0.040	0.040	0.040	0.040	0.070	0.070	0.070
Total Metals																						
Aluminum	µg/L	-	-	5,000	5,000	190,000	9,500[7]	50	50	50	40	30	30	40	40	40	40	40	40	40	40	40
Antimony	µg/L	9.0	7	-	-	120	6[4]	3.4	3.4	3.4	0.29	0.13	0.13	0.29	0.29	0.29	0.29	0.29	0.29	0.48	0.48	0.48
Arsenic	µg/L	5.0	4.0	25[1]	25[1]	200	10[4]	1.5	1.5	1.5	0.46	0.23	0.23	0.46	0.46	0.46	0.46	0.46	0.46	0.81	0.81	0.81
Barium	µg/L	1,000	800	-	-	40,000	2,000[4]	517	517	517	261	56	56	261	261	261	261	261	261	356	356	356
Beryllium	µg/L	0.13	0.10	-	100[W]	100	5[C]	**0.50**[(Min)]	**0.50**[(Min)]	**0.50**[(Min)]	**0.40**[(Min)]	**0.30**[(Min)]	**0.30**[(Min)]	**0.40**[(Min)]	**0.40**[(Min)]	**0.40**[(Min)]	**0.40**[(Min)]	**0.40**[(Min)]	**0.40**[(Min)]	**0.40**[(Min)]	**0.40**[(Min)]	**0.40**[(Min)]
Bismuth	µg/L	-	-	-	-	-	-	0.20	0.20	0.20	0.20	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Boron	µg/L	1,200	960	5,000	5,000	100,000	5,000[C]	70	70	70	40	20	20	40	40	40	40	40	40	50	50	50
Cadmium	µg/L	-	-	-	80[W]	140	7[4]	0.039	0.039	0.039	0.023	0.0090	0.0090	0.023	0.023	0.023	0.023	0.023	0.023	0.029	0.029	0.029
Chromium	µg/L	1.0[1]	0.80	-	50[W,LW(1)]	1,000	50[4]	**0.91**[(90% Min)]	**0.91**[(90% Min)]	**0.91**[(90% Min)]	0.46	0.31	0.31	0.46	0.46	0.46	0.46	0.46	0.46	0.52	0.52	0.52
Cobalt	µg/L	4.0	3.2	-	1,000[W, LW]	20	1[1]	**1.2**[(DW)]	**1.2**[(DW)]	**1.2**[(DW)]	0.64	0.16	0.16	0.64	0.64	0.64	0.64	0.64	0.64	0.87	0.87	0.87
Copper	µg/L	-	-	300	300	40,000	2,000[4]	1.1	1.1	1.1	0.75	0.54	0.54	0.75	0.75	0.75	0.75	0.75	0.75	0.86	0.86	0.86
Iron	µg/L	1,000	800	-	-	56,000	2,800[C]	120	120	120	50	40	40	50	50	50	50	50	50	60	60	60
Lead	µg/L	4.9 - 20[5]	3.9 - 16	100	100	100	5[4]	0.53	0.53	0.53	0.21	0.14	0.14	0.21	0.21	0.21	0.21	0.21	0.21	0.24	0.24	0.24
Lithium	µg/L	-	-	-	-	-	-	6,044	6,044	6,044	99	1.8	1.8	99	99	99	99	99	99	445	445	445
Manganese	µg/L	841 - 2,116[5]	673 - 1,695	-	-	2,400	120[4]	**1,227**[(Wkbc, DW)]	**1,227**[(Wkbc, DW)]	**1,227**[(Wkbc, DW)]	86	3.0	3.0	86	86	86	86	86	86	**236**[(DW)]	**236**[(DW)]	**236**[(DW)]
Mercury	µg/L	0.010	0.008	-	3.00	20.00	1[4]	**0.0096**[(80% Min)]	**0.0096**[(80% Min)]	**0.0096**[(80% Min)]	0.0044	0.0020	0.0020	0.0044	0.0044	0.0044	0.0044	0.0044	0.0044	0.0056	0.0056	0.0056
Molybdenum	µg/L	7,600	6,080	34[9]	16[9]	1,760	88[3]	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0
Nickel	µg/L	25 - 150[5]	20 - 120	-	1,000[W, LW]	1,600	80[3]	6.6	6.6	6.6	3.4	0.60	0.60	3.4	3.4	3.4	3.4	3.4	3.4	4.6	4.6	4.6
Selenium	µg/L	2.0	1.6	2.0	30	200	10[3]	1.5	1.5	1.5	0.49	0.35	0.35	0.49	0.49	0.49	0.49	0.49	0.49	0.54	0.54	0.54
Silicon	µg/L	-	-	-	-	-	-	2,430	2,430	2,430	2,040	1,290	1,290	2,040	2,040	2,040	2,040	2,040	2,040	2,200	2,200	2,200
Silver	µg/L	0.050 - 1.5[5]	0.04 - 1.2	-	-	376	18.8[5]	0.021	0.021	0.021	0.010	0.0060	0.0060	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.011
Strontium	µg/L	-	-	-	-	140,000	7000[3]	5,140	5,140	5,140	280	70	70	280	280	280	280	280	280	630	630	630
Thallium	µg/L	0.80	0.6	-	-	-	-	0.13	0.13	0.13	0.090	0.050	0.050	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
Tin	µg/L	-	-	-	-	48000	2,400[5]	0.49	0.49	0.49	0.22	0.11	0.11	0.22	0.22	0.22	0.22	0.22	0.22	0.26	0.26	0.26
Titanium	µg/L	-	-	-	-	-	-	4.9	4.9	4.9	4.2	3.4	3.4	4.2	4.2	4.2	4.2	4.2	4.2	4.4	4.4	4.4
Uranium	µg/L	8.5	6.8	-	200[W, LW]	400	20[4]	1.9	1.9	1.9	0.49	0.32	0.32	0.49	0.49	0.49	0.49	0.49	0.49	0.73	0.73	0.73
Vanadium	µg/L	-	-	-	-	344	17.2[5]	1.4	1.4	1.4	0.48	0.37	0.37	0.48	0.48	0.48	0.48	0.48	0.48	0.52	0.52	0.52
Zinc	µg/L	7.5 - 188[5]	6.0 - 150	-	2,000	60,000	3,000[3]	4.9	4.9	4.9	3.0	1.8	1.8	3.0	3.0	3.0	3.0	3.0	3.0	4.1	4.1	4.1
Dissolved Metals																						
Aluminum	µg/L	50[5]	40	-	-	-	-	5.0	5.0	5.0	5.0	3.0	3.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Antimony	µg/L	-	-	-	-	-	-	3.4	3.4	3.4	0.30	0.10	0.10	0.30	0.30	0.30	0.30	0.30	0.30	0.50	0.50	0.50
Arsenic	µg/L	-	-	-	-	-	-	1.5	1.5	1.5	0.45	0.23	0.23	0.45	0.45	0.45	0.45	0.45	0.45	0.81	0.81	0.81
Barium	µg/L	-	-	-	-	-	-	516	516	516	260	54	54	260	260	260	260	260	260	354	354	354
Beryllium	µg/L	-	-	-	-	-	-	0.48	0.48	0.48	0.40	0.26	0.26	0.40	0.40	0.40	0.40	0.40	0.40	0.42	0.42	0.42
Bismuth	µg/L	-	-	-	-	-	-	0.24	0.24	0.24	0.18	0.14	0.14	0.18	0.18	0.18	0.18	0.18	0.18	0.20	0.20	0.20
Boron	µg/L	-	-	-	-	-	-	70	70	70	40	20	20	40	40	40	40	40	40	50	50	50
Cadmium	µg/L	0.14 - 0.46[5]	0.11 - 0.37	-	-	-	-	0.039	0.039	0.039	0.023	0.0090	0.0090	0.023	0.023	0.023	0.023	0.023	0.023	0.029	0.029	0.029
Chromium	µg/L	-	-	-	-	-	-	0.91	0.91	0.91	0.46	0.29	0.29	0.46	0.46	0.46	0.46	0.46	0.46	0.52	0.52	0.52
Cobalt	µg/L	-	-	-	-	-	-	1.2	1.2	1.2	0.63	0.16	0.16	0.63	0.63	0.63	0.63	0.63	0.63	0.87	0.87	0.87
Copper	µg/L	0.4 - 1.9[5]	0.3 - 1.5	-	-	-	-	**0.90**[(Min)]	**0.90**[(Min)]	**0.90**[(Min)]	0.61	0.40	0.40	0.61	0.61	0.61	0.61	0.61	**0.61**[(Min)]	**0.77**[(Min)]	**0.77**[(Min)]	**0.77**[(Min)]
Iron	µg/L	350	40	-	-	-	-	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Lead	µg/L	-	-	-	-	-	-	0.53	0.53	0.53	0.21	0.10	0.10	0.21	0.21	0.21	0.21	0.21	0.21	0.24	0.24	0.24
Lithium	µg/L	-	-	-	-	-	-	6,040	6,040	6,040	100	0	0	100	100	100	100	100	100	450	450	450
Manganese	µg/L	-	-	-	-	-	-	1,226	1,226	1,226	83	2.0	2.0	83	83	83	83	83	83	234	234	234
Mercury	µg/L	-	-	-	-	-	-	0.0096	0.0096	0.0096	0.0044	0.0020	0.0020	0.0044	0.0044	0.0044	0.0044	0.0044	0.0044	0.0056	0.0056	0.0056

Parameter	Unit	Water Quality Guidelines						LC 1.5					LC 1.5										
		BC Long-term Chronic Guidelines for the Protection of[1,2,3]:				Human Health Guidelines		Max	Max	Max	P50	Min	Min	P50	P50	P50	P50	P50	P50	P75	P75	P75	
		Aquatic Life	Aquatic Life 80%	Wildlife	Livestock	Recreational	Drinking Water	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	
Molybdenum	µg/L	-	-	-	-	-	-	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	
Nickel	µg/L	-	-	-	-	-	-	6.6	6.6	6.6	3.4	0.60	0.60	3.4	3.4	3.4	3.4	3.4	3.4	4.6	4.6	4.6	
Selenium	µg/L	-	-	-	-	-	-	1.5	1.5	1.5	0.49	0.35	0.35	0.49	0.49	0.49	0.49	0.49	0.49	0.54	0.54	0.54	
Silicon	µg/L	-	-	-	-	-	-	2,240	2,240	2,240	1,890	1,210	1,210	1,890	1,890	1,890	1,890	1,890	1,890	2,080	2,080	2,080	
Silver	µg/L	-	-	-	-	-	-	0.020	0.020	0.020	0.0090	0.0050	0.0050	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.010	0.010	0.010	
Strontium	µg/L	-	-	-	-	-	-	5,140	5,140	5,140	280	70	70	280	280	280	280	280	280	630	630	630	
Thallium	µg/L	-	-	-	-	-	-	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
Tin	µg/L	-	-	-	-	-	-	0.50	0.50	0.50	0.20	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.20	0.30	0.30	0.30	
Titanium	µg/L	-	-	-	-	-	-	4.9	4.9	4.9	4.2	3.4	3.4	4.2	4.2	4.2	4.2	4.2	4.2	4.4	4.4	4.4	
Uranium	µg/L	-	-	-	-	-	-	1.9	1.9	1.9	0.48	0.31	0.31	0.48	0.48	0.48	0.48	0.48	0.48	0.71	0.71	0.71	
Vanadium	µg/L	-	-	-	-	-	-	1.4	1.4	1.4	0.48	0.35	0.35	0.48	0.48	0.48	0.48	0.48	0.48	0.52	0.52	0.52	
Zinc	µg/L	-	-	-	-	-	-	4.9	4.9	4.9	3.0	1.8	1.8	3.0	3.0	3.0	3.0	3.0	3.0	4.1	4.1	4.1	

Notes:

- = no guideline or no data; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; µg/L = micrograms per litre
CaCO3 = calcium carbonate; DOC = dissolved organic carbon; I = interim guideline, LW = livestock watering; Max = maximum; P50 = 50th Percentile; Min = minimum; P75 = 75th Percentile; W = working guideline; WQG = water quality guideline.
Values presented here are from the Bonanza Ledge Mine water quality predictions (Mavin Terra 2022). The predictions were applied as follows: maximum values to winter months (January to March), minimum values to freshet (May and June), and median values to the remaining months (April and July to December). Due to the uncertainties in using maximum predictions for the winter months, 75th percentile values are also presented for comparison.

[a] = Temperature values were assumed for each month (November to April = 5°C, May to June and September to October = 10°C, and July to August = 15°C)

[b] = guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (64 to 506 mg/L). The guideline is calculated based on the individual hardness value for each sample. For samples with hardness values greater than the upper limit of the established guideline hardness range, the upper limit of the established guideline hardness range was used for the purpose of guideline calculation.

[c] = guideline is based on an aesthetic objective.

[d] = guideline is chloride dependent. The guideline range shown is based on the chloride concentration range observed in the dataset (9.0 to 1,124 mg/L). The guideline is calculated based on the individual chloride concentration in each sample.

[e] = the ammonia guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (0.48 mg-N/L) is based on the combination of pH (8.4 and water temperature (5.0°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the

[f] = guideline is for chromium VI.

[g] = guideline is protective of ruminant animals.

[h] = guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (8.0 to 8.4). The guideline is calculated based on the individual pH for each sample.

[i] = the copper guideline is calculated with the BC Biotic Ligand Model (BLM), based on temperature, pH, dissolved organic carbon (DOC), humic acid content (HA), calcium, magnesium, sodium, potassium, sulphate, and alkalinity dependent. The guideline range shown is based on the temperature range observed in the dataset (5 to 15 °C), the pH range observed in the dataset (8.0 to 8.4), the DOC range observed in the dataset (1.0 to 5.2 mg/L), the assumed HA value of 10%, the Ca range observed in the dataset (19 to 145 mg/L), the magnesium range observed in the dataset (4.0 to 35 mg/L), the sodium range observed in the dataset (1.1 to 20 mg/L), the potassium range observed in the dataset (11 to 911 mg/L), the sulphate range observed in the dataset (8.0 to 107 mg/L), the chloride range observed in the dataset (9.0 to 1,124 mg/L), and the alkalinity range observed in the dataset (42 to 93 mg/L). The guideline is calculated based on the parameter values for each individual sample. Parameter values that exceeded the upper limit of their established ranges (72.94 mg/L for Ca, 18.4 mg/L for Mg, 156 mg/L for K, and 119.8 mg/L for Cl) were replaced with the upper limit of their parameter range for the purpose of guideline calcualtion.

(MAC) = concentration is higher than the 30-day mean BC ENV aquatic life guideline or outside the recommended pH, DO or total alkalinity range.

(80% MAC) = concentration is higher than 80% of the 30-day mean BC ENV aquatic life guideline.

(BHMAC) = concentration is higher than the 30-day mean BC ENV aquatic life guideline calculated with baseline hardness.

(DW) = concentration is higher than the drinking water guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as

[1] = British Columbia Ministry of Environment and Climate Change Strategy (BC ENV). 2021a. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C.

[2] = BC ENV. 2021b. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C.

[3] = BC ENV. 2017. B.C. Source Drinking Water Quality Guidelines: Guideline Summary. Water Quality Guideline Series, WQG-01. Prov. B.C., Victoria B.C.

[4] = Health Canada (HC). 2022. Guidelines for Canadian Drinking Water Quality—Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[5] = United States Environmental Protection Agency (US EPA). 2022. Regional Screening Levels - Resident Tap Water. Accessed March 2022 from: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Table C3: Predicted Water Quality at Lowhee Creek Station LC-3.9 during the Post-Closure (Passive Care) Phase

Parameter	Unit	Water Quality Guidelines						LC 3.9											
		BC Long-term Chronic Guidelines for the Protection of[1,2,3]:				Human Health Guidelines		January	February	March	April	May	June	July	August	September	October	November	December
		Aquatic Life	Aquatic Life 80%	Wildlife	Livestock	Recreational	Drinking Water												
Exposure and Toxicity Modifying Factors																			
pH[a]	-	6.5 - 9.0	-	-	5.0 - 9.5	-	7.0 - 10.5[4]	6.8	6.8	7.1	7.2	7.2	7.3	7.1	7.2	7.1	7.3	7.1	6.9
Temperature[b]	°C	-	-	-	-	-	-	5.0	5.0	5.0	5.0	10	10	15	15	10	10	5.0	5.0
Hardness, as $CaCO_3$	mg/L	-	-	-	-	-	-	181	181	82	155	62	75	77	145	137	126	240	316
Dissolved organic carbon[a]	mg/L	-	-	-	-	-	-	1.3	1.1	1.3	2.6	5.2	3.3	2.8	1.7	2.1	2.7	2.4	1.0
Major Ions																			
Chloride	mg/L	150	120	600	600	5,000	250	0.0	0.0	0.0	8.5	2.2	2.9	3.6	13	3.6	5.7	5.2	8.6
Sulphate	mg/L	218 - 429[c]	174 - 343	-	1,000[W; LW]	10,000	500[d, 4]	**535**[Mn, DW]	**535**[Mn, DW]	63	78	8.2	11.0	11.4	76	73	72	**537**[Mn, DW]	**549**[Mn, DW]
Nutrients																			
Nitrate	mg-N/L	3.0	2.4	100	100	200	10[4]	0.43	0.43	0.027	0.03	0.0029	0.0034	0.0033	0.027	0.028	0.027	0.42	0.42
Nitrite	mg-N/L	0.020 - 0.20[e]	0.016 - 0.16	10	10	20	1[4]	**0.026**[Mn]	**0.026**[Mn]	0.0017	0.0016	0.00054	0.00055	0.00054	0.0017	0.0016	0.0017	0.026	0.026
Total ammonia	mg-N/L	1.9[f]	1.5	-	-	-	-	0.21	0.21	0.012	0.012	0.0034	0.0035	0.0035	0.012	0.012	0.012	0.20	0.20
Total phosphorus	mg-P/L	-	-	-	-	-	-	0.14	0.14	0.060	0.073	0.021	0.023	0.024	0.071	0.069	0.068	0.15	0.16
Total Metals																			
Aluminum	µg/L	-	-	5,000	5,000	190,000	9,500[3]	180	180	80	110	53	58	59	105	104	98	204	234
Antimony	µg/L	9.0	7.2	-	-	120	6[4]	0.38	0.38	0.24	1.3	0.24	0.44	0.46	1.2	1.1	0.90	1.3	2.4
Arsenic	µg/L	5.0	4.0	25(I)	25(I)	200	10[4]	1.2	1.2	0.3	**8.1**[Mn]	0.89	2.3	2.5	**7.0**[Mn]	**6.5**[Mn]	**5.1**[Mn]	**7.9**[Mn]	**16**[Mn]
Beryllium	µg/L	0.13	0.10	-	100[W]	100	5[5]	**0.50**[Mn]	**0.50**[Mn]	**0.50**[Mn]	**0.49**[Mn]	**0.40**[Mn]	**0.40**[Mn]	**0.40**[Mn]	**0.50**[Mn]	**0.49**[Mn]	**0.49**[Mn]	**0.49**[Mn]	**0.49**[Mn]
Cadmium	µg/L	-	-	-	80(W)	140	7[4]	0.13	0.13	0.023	0.028	0.0094	0.010	0.011	0.028	0.027	0.026	0.13	0.14
Chromium	µg/L	1.0[g]	0.80	-	50[W,LW(g)]	1,000	50[4]	0.66	0.66	0.51	**1.3**[Mn]	0.49	0.64	0.66	**1.1**[Mn]	**1.2**[Mn]	**0.99**[80% Mn]	**1.3**[Mn]	**2.1**[Mn]
Cobalt	µg/L	4.0	3.2	-	1,000[W; LW]	20	1[3]	**7.3**[Mn, DW]	**7.3**[Mn, DW]	0.92	**1.0**[DW]	0.18	0.21	0.21	**1.0**[DW]	**1.0**[DW]	**1.0**[DW]	**7.2**[Mn, DW]	**7.3**[Mn, DW]
Copper	µg/L	-	-	300	300	40,000	2,000[4]	1.2	1.2	0.80	1.4	0.65	0.75	0.76	1.3	1.2	1.1	1.7	2.2
Iron	µg/L	1,000	800	-	-	56,000	2,800[5]	410	410	150	173	67	77	75	164	189	170	435	445
Lead	µg/L	5.0 - 17[c]	4.0 - 14	100	100	100	5[4]	0.36	0.36	0.25	0.33	0.19	0.21	0.21	0.32	0.33	0.30	0.43	0.51
Manganese	µg/L	878 - 1,995[c]	702 - 1,596	-	-	2,400	120[4]	**641**[DW]	**641**[DW]	70	94	5.1	9.8	10.3	91	88	85	**649**[DW]	**670**[DW]
Mercury	µg/L	0.010	0.008	-	3.00	20.00	1[4]	0.0064	0.0064	0.0046	0.0046	0.0027	0.0027	0.0027	0.0046	0.0045	0.0046	0.0063	0.0063
Molybdenum	µg/L	7,600	6,080	34[h]	16[h]	1,760	88[3]	0.94	0.94	0.51	1.3	0.41	0.56	0.58	1.2	1.1	1.0	1.6	2.5
Nickel	µg/L	66 - 150[c]	53 - 120	-	1,000[W; LW]	1,600	80[3]	36	36	4.4	4.8	0.64	0.73	0.74	4.8	4.7	4.6	36	36
Selenium	µg/L	2.0	1.6	2.0	30	200	10[3]	0.57	0.57	0.51	0.64	0.50	0.52	0.52	0.62	0.60	0.58	0.67	0.81
Silver	µg/L	0.050 - 1.5[c]	0.04 - 1.2	-	-	376	18.8[5]	0.012	0.012	0.010	0.010	0.0090	0.0090	0.0090	0.010	0.010	0.010	0.012	0.012
Uranium	µg/L	8.5	6.8	-	200[W; LW]	400	20[4]	0.81	0.81	0.43	0.93	0.37	0.46	0.47	0.86	0.81	0.73	1.2	1.7
Zinc	µg/L	7.5 - 177[c]	6.0 - 142	-	2,000	60,000	3,000[3]	19	19	4.2	5.5	2.0	2.2	2.3	5.3	5.2	5.0	20	21
Dissolved Metals																			
Aluminum	µg/L	50[i]	40	-	-	-	-	5.0	5.0	5.0	34	6.3	11.4	12.2	30	27	23	30	**60**[Mn]
Cadmium	µg/L	0.15 - 0.46[c]	0.12 - 0.36	-	-	-	-	0.13	0.13	0.022	0.027	0.0094	0.0103	0.0105	0.027	0.026	0.025	0.13	0.14
Copper	µg/L	0.40 - 1.6[j]	0.32 - 1.3	-	-	-	-	**1.1**[Mn]	**1.1**[Mn]	**0.57**[Mn]	**1.1**[Mn]	0.54	0.64	0.65	**1.0**[Mn]	**0.98**[Mn]	**0.90**[80% Mn]	**1.5**[Mn]	**2.1**[Mn]
Iron	µg/L	350	280	-	-	-	-	15	15	15	18	15	16	16	18	17	17	17	21

Notes:

- = no guideline or no data; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; µg/L = micrograms per litre

CaCO3 = calcium carbonate; DOC = dissolved organic carbon; I = interim guideline, LW = livestock watering; W = working guideline; WQG = water quality guideline.

Values presented here are mean monthly predictions.

[a] = Baseline pH and dissolved organic carbon are presented in this table and were used for the purpose of guideline calculation.

[b] = Temperature values were assumed for each month (November to April = 5°C, May to June and September to October = 10°C, and July to August = 15°C)

[c] = guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (64 to 316 mg/L). The guideline is calculated based on the individual hardness value for each sample. For samples with hardness values greater than the upper limit of the established guideline hardness range, the upper limit of the established guideline hardness range was used for the purpose of guideline calculation.

[d] = guideline is based on an aesthetic objective.

[e] = guideline is chloride dependent. The guideline range shown is based on the chloride concentration range observed in the dataset (0 to 13 mg/L). The guideline is calculated based on the individual chloride concentration in each sample.

[f] = the ammonia guideline is pH and temperature dependent. A pH of 7.5 and a temperature of 10 °C were used to calcualte an ammonia guideline of 1.9 mg-N/L.

[g] = guideline is for chromium VI.

[h] = guideline is protective of ruminant animals.

[i] = guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (6.8 to 7.3). The guideline is calculated based on the individual pH for each sample.

[j] = the copper guideline is calculated with the BC Biotic Ligand Model (BLM), based on hardness, pH, and dissolved organic carbon (DOC). The guideline range shown is based on predicted hardness, a pH of 7.5, and median monthly baseline DOC.

[Mn] = concentration is higher than the 30-day mean BC ENV guideline or outside the recommended pH, DO or total alkalinity range.

[80% Mn] = concentration is higher than 80% of the 30-day mean BC ENV guideline.

[DW] = concentration is higher than the drinking water guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

[1] = British Columbia Ministry of Environment and Climate Change Strategy (BC ENV). 2021a. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C.

[2] = BC ENV. 2021b. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C.

[3] = BC ENV. 2017. B.C. Source Drinking Water Quality Guidelines: Guideline Summary. Water Quality Guideline Series, WQG-01. Prov. B.C., Victoria B.C.

[4] = Health Canada (HC). 2022. Guidelines for Canadian Drinking Water Quality—Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[5] = United States Environmental Protection Agency (US EPA). 2022. Regional Screening Levels - Resident Tap Water. Accessed March 2022 from: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Parameter	Unit	Water Quality Guidelines						LC 1.5											
		BC Long-term Chronic Guidelines for the Protection of[1,2,3]:				Human Health Guidelines		January	February	March	April	May	June	July	August	September	October	November	December
		Aquatic Life	Aquatic Life 80%	Wildlife	Livestock	Recreational	Drinking Water												
Exposure and Toxicity Modifying Factors																			
pH[a]	-	6.5 - 9.0	-	-	5.0 - 9.5	-	7.0 - 10.5[4]	7.8	8.0	8.0	8.0	7.7	7.9	8.0	8.1	8.0	7.8	7.8	7.8
Temperature[x]	°C	-	-	-	-	-	-	5.0	5.0	5.0	5.0	10	10	15	15	10	10	5.0	5.0
Hardness, as $CaCO_3$	mg/L	-	-	-	-	-	-	149	149	76	110	55	60	61	105	101	95	176	225
Dissolved organic carbon[a]	mg/L	-	-	-	-	-	-	0.78	0.75	0.80	1.7	4.0	2.1	2.2	1.5	1.4	1.9	1.5	1.0
Major Ions																			
Chloride	mg/L	150	120	600	600	5,000	250	0.0	0.0	0.0	8.5	2.2	2.9	3.6	13	3.6	5.7	5.2	8.6
Sulphate	mg/L	218 - 429[c]	174 - 343	-	1,000[W, LW]	10,000	500[d, 4]	**354**[(Mn)]	**354**[(Mn)]	33	40	6.5	7.7	7.9	39	38	37	**357**[(Mn)]	**365**[(80% Mn)]
Nutrients																			
Nitrate	mg-N/L	3.0	2.4	100	100	200	10[4]	0.29	0.29	0.017	0.018	0.0043	0.0045	0.0045	0.018	0.018	0.018	0.29	0.29
Nitrite	mg-N/L	0.020 - 0.20[e]	0.016 - 0.16	10	10	20	1[4]	**0.018**[(80% Mn)]	**0.018**[(80% Mn)]	0.0010	0.0010	0.00053	0.00053	0.00053	0.0010	0.0010	0.0010	0.017	0.017
Total ammonia	mg-N/L	1.9[f]	1.5	-	-	-	-	0.14	0.14	0.0068	0.0069	0.0029	0.0030	0.0030	0.0069	0.0070	0.0069	0.14	0.13
Total phosphorus	mg-P/L	-	-	-	-	-	-	0.10	0.10	0.050	0.056	0.020	0.021	0.022	0.055	0.054	0.053	0.10	0.11
Total Metals																			
Aluminum	µg/L	-	-	5,000	5,000	190,000	9,500[3]	160	160	60	74	41	44	44	72	71	68	171	190
Antimony	µg/L	9.0	7	-	-	120	6[4]	0.33	0.33	0.22	0.73	0.15	0.23	0.24	0.66	0.60	0.52	0.75	1.5
Arsenic	µg/L	5.0	4.0	25[l]	25[l]	200	10[4]	0.85	0.85	0.26	4.0	0.45	1.1	1.1	3.4	3.1	2.4	3.9	**9.0**[(Mn)]
Beryllium	µg/L	0.13	0.10	-	100[W]	100	5[5]	**0.50**[(Mn)]	**0.50**[(Mn)]	**0.40**[(Mn)]	**0.40**[(Mn)]	**0.30**[(Mn)]	**0.30**[(Mn)]	**0.30**[(Mn)]	**0.40**[(Mn)]	**0.39**[(Mn)]	**0.40**[(Mn)]	**0.50**[(Mn)]	**0.49**[(Mn)]
Cadmium	µg/L	-	-	-	80[W]	140	7[4]	0.090	0.090	0.015	0.018	0.0092	0.0096	0.0097	0.017	0.017	0.016	0.091	0.095
Chromium	µg/L	1.0[g]	0.80	-	50[W,LW(g)]	1,000	50[4]	0.64	0.64	0.46	**0.82**[(80% Mn)]	0.33	0.40	0.40	0.76	0.76	0.68	**0.94**[(80% Mn)]	**1.4**[(Mn)]
Cobalt	µg/L	4.0	3.2	-	1,000[W, LW]	20	1[3]	**4.8**[(Mn, DW)]	**4.8**[(Mn, DW)]	0.51	0.57	0.11	0.13	0.13	0.56	0.55	0.54	**4.8**[(Mn, DW)]	**4.9**[(Mn, DW)]
Copper	µg/L	-	-	300	300	40,000	2,000[4]	1.0	1.0	0.63	0.90	0.56	0.60	0.61	0.86	0.83	0.79	1.2	1.6
Iron	µg/L	1,000	800	-	-	56,000	2,800[5]	390	390	110	121	63	67	66	117	128	119	401	401
Lead	µg/L	3.3 - 12[c]	3.8 - 9.8	100	100	100	5[4]	0.35	0.35	0.23	0.27	0.13	0.14	0.14	0.26	0.27	0.25	0.38	0.43
Manganese	µg/L	612 - 1,594[c]	677 - 1,275	-	-	2,400	120[4]	**420**[(DW)]	**420**[(DW)]	34	46	3.9	5.9	6.1	44	43	41	**426**[(DW)]	**440**[(DW)]
Mercury	µg/L	0.010	0.008	-	3.00	20.00	1[4]	0.0053	0.0053	0.0040	0.0040	0.0019	0.0019	0.0019	0.0040	0.0040	0.0040	0.0053	0.0053
Nickel	µg/L	25 - 150[c]	20 - 120	-	1,000[W, LW]	1,600	80[3]	24	24	2.4	2.6	0.62	0.66	0.66	2.6	2.6	2.5	24	24
Selenium	µg/L	2.0	1.6	2.0	30	200	10[3]	0.55	0.55	0.46	0.52	0.35	0.36	0.36	0.51	0.50	0.49	0.60	0.68
Silver	µg/L	0.050 - 1.5[c]	0.04 - 1.2	-	-	376	18.8[5]	0.012	0.012	0.0090	0.0090	0.0070	0.0070	0.0070	0.0090	0.0089	0.0090	0.012	0.012
Uranium	µg/L	8.5	6.8	-	200[W, LW]	400	20[4]	0.90	0.90	0.39	0.63	0.31	0.34	0.35	0.59	0.56	0.53	1.1	1.4
Zinc	µg/L	7.5 - 109[c]	6.0 - 87	-	2,000	60,000	3,000[3]	13	13	3.1	3.7	1.4	1.5	1.6	3.6	3.6	3.5	14	15
Dissolved Metals																			
Aluminum	µg/L	50[h]	40	-	-	-	-	5.0	5.0	5.0	19	5.0	7.2	7.4	17	15	13	16	36
Cadmium	µg/L	0.020 - 0.38[c]	0.11 - 0.31	-	-	-	-	0.089	0.089	0.015	0.018	0.0092	0.0096	0.0096	0.017	0.017	0.016	0.090	0.093
Copper	µg/L	0.3 - 1.2[i]	0.24 - 0.96	-	-	-	-	**0.89**[(Mn)]	**0.89**[(Mn)]	**0.49**[(Mn)]	**0.75**[(Mn)]	0.38	0.42	0.42	**0.71**[(Mn)]	**0.68**[(Mn)]	**0.64**[(Mn)]	**1.1**[(Mn)]	**1.5**[(Mn)]
Iron	µg/L	350	280	-	-	-	-	15	15	15	16	15	15	15	16	16	16	16	18

Notes:
- = no guideline or no data; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; µg/L = micrograms per litre
CaCO3 = calcium carbonate; DOC = dissolved organic carbon; I = interim guideline, LW = livestock watering; W = working guideline; WQG = water quality guideline.
Values presented here are mean monthly predictions.
[a] = Baseline pH and dissolved organic carbon are presented in this table and were used for the purpose of guideline calculation
[b] = Temperature values were assumed for each month (November to April = 5 °C, May to June and September to October = 10°C, and July to August = 15°C)
[c] = guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (64 to 316 mg/L). The guideline is calculated based on the individual hardness value for each sample. For samples with hardness values greater than the upper limit of the established guideline hardness range, the upper limit of
[d] = guideline is based on an aesthetic objective.
[e] = guideline is chloride dependent. The guideline range shown is based on the chloride concentration range observed in the dataset (0 to 13 mg/L). The guideline is calculated based on the individual chloride concentration in each sample.
[f] = the ammonia guideline is pH and temperature dependent. A pH of 7.5 and a temperature of 10 °C were used to calcualte an ammonia guideline of 1.9 mg-N/L.
[g] = guideline is for chromium VI.
[h] = guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (6.8 to 7.3). The guideline is calculated based on the individual pH for each sample.
[i] = the copper guideline is calculated with the BC Biotic Ligand Model (BLM), based on hardness, pH, and dissolved organic carbon (DOC). The guideline range shown is based on predicted hardness, a pH of 7.5, and median monthly baseline DOC.
[Mn] = concentration is higher than the 30-day mean BC ENV guideline or outside the recommended pH, DO or total alkalinity range.
[80% Mn] = concentration is higher than 80% of the 30-day mean BC ENV guideline.
[DW] = concentration is higher than the drinking water guideline.
Bolded concentrations are higher than water quality guidelines.
above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

[1] = British Columbia Ministry of Environment and Climate Change Strategy (BC ENV). 2021a. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C.
[2] = BC ENV. 2021b. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C.
[3] = BC ENV. 2017. B.C. Source Drinking Water Quality Guidelines: Guideline Summary. Water Quality Guideline Series, WQG-01. Prov. B.C., Victoria B.C.
[4] = Health Canada (HC). 2022. Guidelines for Canadian Drinking Water Quality—Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.
[5] = United States Environmental Protection Agency (US EPA). 2022. Regional Screening Levels - Resident Tap Water. Accessed March 2022 from: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Table C5: Predicted Water Quality at Stouts Gulch Station SG-1.35 during the Post-Closure (Passive Care) Phase

Parameter	Unit	Water Quality Guidelines						SG 1.35											
		BC Long-term Chronic Guidelines for the Protection of[1,2,3]:				Human Health Guidelines		January	February	March	April	May	June	July	August	September	October	November	December
		Aquatic Life	Aquatic Life 80%	Wildlife	Livestock	Recreational	Drinking Water												
Exposure and Toxicity Modifying Factors																			
pH[a]	-	6.5 - 9.0	-	-	5.0 - 9.5	-	7.0 - 10.5[4]	7.2	7.2	7.3	7.3	7.1	7.3	7.4	7.7	7.3	7.6	7.5	7.5
Temperature[x]	°C	-	-	-	-	-	-	5.0	5.0	5.0	5.0	10	10	15	15	10	10	5.0	5.0
Hardness, as $CaCO_3$	mg/L	-	-	-	-	-	-	197	197	65	114	30	39	40	106	103	95	236	282
Dissolved organic carbon[a]	mg/L	-	-	-	-	-	-	1.6	1.5	1.3	3.8	5.3	3.6	3.5	1.6	3.2	2.9	2.5	1.9
Major Ions																			
Chloride	mg/L	150	120	600	600	5,000	250	0.0	0.0	0.0	8.5	2.2	2.9	3.6	13.0	3.6	5.7	5.2	8.6
Sulphate	mg/L	128 - 429[c]	102 - 343	-	1,000[W, LW]	10,000	500[d, 4]	**419**[(80% Mn)]	**419**[(80% Mn)]	103	113	4.9	6.8	7.0	111	109	109	**422**[(80% Mn)]	**430**[(Mn)]
Nutrients																			
Nitrate	mg-N/L	3.0	2.4	100	100	200	10[4]	0.14	0.14	0.0	0.017	0.0049	0.0052	0.0052	0.017	0.018	0.017	0.14	0.14
Nitrite	mg-N/L	0.02 - 0.20[e]	0.016 - 0.16	10	10	20	1[4]	0.0081	0.0081	0.0010	0.0010	0.00056	0.00056	0.00056	0.0010	0.0010	0.0010	0.0080	0.0079
Total ammonia	mg-N/L	1.9[f]	1.5	-	-	-	-	0.061	0.061	0.0069	0.0070	0.0028	0.0028	0.0	0.0070	0.0072	0.0070	0.060	0.060
Total phosphorus	mg-P/L	-	-	-	-	-	-	0.080	0.080	0.030	0.039	0.011	0.012	0.013	0.037	0.037	0.035	0.087	0.095
Total Metals																			
Aluminum	µg/L	-	-	5,000	5,000	190,000	9,500[3]	210	210	90	110	32	36	36	107	106	103	225	243
Antimony	µg/L	9.0	7.2	-	-	120	6[4]	0.67	0.67	0.16	0.90	0.11	0.24	0.26	0.77	0.73	0.62	1.3	2.0
Arsenic	µg/L	5.0	4.0	25[(i)]	25[(i)]	200	10[4]	1.4	1.4	0.43	**5.7**[(Mn)]	0.64	1.6	1.7	**4.8**[(80% Mn)]	**4.7**[(80% Mn)]	3.7	**5.9**[(Mn)]	**11**[(Mn)]
Beryllium	µg/L	0.13	0.10	-	100[W]	100	5[5]	**0.27**[(Mn)]	**0.27**[(Mn)]	**0.16**[(Mn)]	**0.16**[(Mn)]	0.040	0.040	0.040	**0.16**[(Mn)]	**0.16**[(Mn)]	**0.16**[(Mn)]	**0.27**[(Mn)]	**0.27**[(Mn)]
Cadmium	µg/L	-	-	-	80[W]	140	7[4]	0.12	0.12	0.037	0.041	0.0093	0.010	0.010	0.040	0.039	0.039	0.13	0.13
Chromium	µg/L	1.0[(g)]	0.80	-	50[W,LW(g)]	1,000	50[4]	0.41	0.41	0.36	**0.87**[(80% Mn)]	0.22	0.33	0.33	0.77	**0.81**[(80% Mn)]	0.69	**0.87**[(80% Mn)]	**1.3**[(Mn)]
Cobalt	µg/L	4.0	3.2	-	1,000[W, LW]	20	1[3]	**5.9**[(Mn, DW)]	**5.9**[(Mn, DW)]	**1.5**[(DW)]	**1.6**[(DW)]	0.17	0.18	0.19	**1.6**[(DW)]	**1.6**[(DW)]	**1.6**[(DW)]	**5.9**[(Mn, DW)]	**6.0**[(Mn, DW)]
Copper	µg/L	-	-	300	300	40,000	2,000[4]	1.2	1.2	1.0	1.4	0.63	0.70	0.71	1.3	1.3	1.2	1.5	1.9
Iron	µg/L	1,000	800	-	-	56,000	2,800[5]	590	590	240	255	75	81	80	248	265	253	604	609
Lead	µg/L	4.0 - 15[c]	3.2 - 12	100	100	100	5[4]	0.30	0.30	0.23	0.29	0.11	0.12	0.12	0.27	0.28	0.27	0.35	0.40
Manganese	µg/L	736 - 1,845[c]	589 - 1,476	-	-	2,400	120[4]	**491**[(DW)]	**491**[(DW)]	**121**[(DW)]	**137**[(DW)]	7.5	11	11	**134**[(DW)]	**132**[(DW)]	**131**[(DW)]	**498**[(DW)]	**512**[(DW)]
Mercury	µg/L	0.010	0.008	-	3.00	20.00	1[4]	0.0057	0.0057	0.0052	0.0052	0.0041	0.0041	0.0041	0.0052	0.0051	0.0052	0.0057	0.0056
Molybdenum	µg/L	7,600	6,080	34[(h)]	16[(h)]	1,760	88[3]	1.5	1.5	0.35	0.91	0.23	0.33	0.34	0.81	0.78	0.70	1.9	2.5
Nickel	µg/L	25 - 150[c]	20 - 120	-	1,000[W, LW]	1,600	80[3]	31	31	8.2	8.5	1.0	1.1	1.1	8.4	8.3	8.3	31	31
Selenium	µg/L	2.0	1.6	2.0	30	200	10[3]	0.44	0.44	0.29	0.38	0.22	0.23	0.23	0.36	0.36	0.34	0.51	0.59
Silver	µg/L	0.050 - 1.5[c]	0.04 - 1.2	-	-	376	18.8[5]	0.010	0.010	0.0080	0.0080	0.0040	0.0040	0.0040	0.0080	0.0079	0.0080	0.010	0.010
Uranium	µg/L	8.5	6.8	-	200[W, LW]	400	20[4]	0.72	0.72	0.23	0.57	0.13	0.19	0.20	0.51	0.49	0.44	1.0	1.3
Zinc	µg/L	7.5 - 151[c]	6.0 - 121	-	2,000	60,000	3,000[3]	16	16	5.7	6.6	2.6	2.7	2.7	6.4	6.3	6.2	17	17
Dissolved Metals																			
Aluminum	µg/L	50[(i)]	40	-	-	-	-	5.0	5.0	3.0	23	3.6	7.1	7.6	19	18	15	22	40
Cadmium	µg/L	0.087 - 0.45[c]	0.069 - 0.36	-	-	-	-	0.12	0.12	0.037	0.040	0.0093	0.0099	0.010	0.040	0.039	0.039	0.12	0.13
Copper	µg/L	0.4 - 1.3[j]	0.32 - 1.0	-	-	-	-	**1.0**[(Mn)]	**1.0**[(Mn)]	**0.90**[(Mn)]	**1.3**[(80% Mn)]	0.60	0.66	0.67	**1.2**[(Mn)]	**1.2**[(Mn)]	**1.1**[(Mn)]	**1.3**[(Mn)]	**1.6**[(Mn)]
Iron	µg/L	350	280	-	-	-	-	15	15	15	17	15	15	15	17	16	16	17	18

Notes:

- = no guideline or no data; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; µg/L = micrograms per litre

CaCO3 = calcium carbonate; DOC = dissolved organic carbon; I = interim guideline, LW = livestock watering; W = working guideline; WQG = water quality guideline.

Values presented here are mean monthly predictions.

[a] = Baseline pH and dissolved organic carbon are presented in this table and were used for the purpose of guideline calculation .

[b] = Temperature values were assumed for each month (November to April = 5 °C, May to June and September to October = 10 °C, and July to August = 15°C)

[c] = guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (64 to 316 mg/L). The guideline is calculated based on the individual hardness value for each sample. For samples with hardness values greater than the upper limit of the established guideline hardness range, the upper limit

[d] = guideline is based on an aesthetic objective.

[e] = guideline is chloride dependent. The guideline range shown is based on the chloride concentration range observed in the dataset (0 to 13 mg/L). The guideline is calculated based on the individual chloride concentration in each sample.

[f] = the ammonia guideline is pH and temperature dependent. A pH of 7.5 and a temperature of 10 °C were used to calcualte an ammonia guideline of 1.9 mg-N/L.

[g] = guideline is for chromium VI.

[h] = guideline is protective of ruminant animals.

[i] = guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (6.8 to 7.3). The guideline is calculated based on the individual pH for each sample.

[j] = the copper guideline is calculated with the BC Biotic Ligand Model (BLM), based on hardness, pH, and dissolved organic carbon (DOC). The guideline range shown is based on predicted hardness, a pH of 7.5, and median monthly baseline DOC.

[Mn] = concentration is higher than the 30-day mean BC ENV guideline or outside the recommended pH, DO or total alkalinity range.

[80% Mn] = concentration is higher than 80% of the 30-day mean BC ENV guideline.

[DW] = concentration is higher than the drinking water guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision ***after*** comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

[1] = British Columbia Ministry of Environment and Climate Change Strategy (BC ENV). 2021a. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C.

[2] = BC ENV. 2021b. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C.

[3] = BC ENV. 2017. B.C. Source Drinking Water Quality Guidelines: Guideline Summary. Water Quality Guideline Series, WQG-01. Prov. B.C., Victoria B.C.

[4] = Health Canada (HC). 2022. Guidelines for Canadian Drinking Water Quality—Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[5] = United States Environmental Protection Agency (US EPA). 2022. Regional Screening Levels - Resident Tap Water. Accessed March 2022 from: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Table C6: Predicted Water Quality at Stouts Gulch Station SG-0.25 during the Post-Closure (Passive Care) Phase

Parameter	Unit	Water Quality Guidelines						SG 0.25											
		BC Long-term Chronic Guidelines for the Protection of[1,2,3]:				Human Health Guidelines													
		Aquatic Life	Aquatic Life 80%	Wildlife	Livestock	Recreational	Drinking Water	January	February	March	April	May	June	July	August	September	October	November	December
Exposure and Toxicity Modifying Factors																			
pH[a]	-	6.5 - 9.0	-	-	5.0 - 9.5	-	7.0 - 10.5[4]	7.5	7.5	7.9	7.6	7.5	7.4	7.6	8.0	7.8	7.8	7.7	7.6
Temperature[x]	°C	-	-	-	-	-	-	5.0	5.0	5.0	5.0	10	10	15	15	10	10	5.0	5.0
Hardness, as $CaCO_3$	mg/L	-	-	-	-	-	-	139	139	58	89	31	37	37	83	83	78	165	187
Dissolved organic carbon[a]	mg/L	-	-	-	-	-	-	1.3	1.2	1.2	3.5	4.9	3.4	3.1	1.5	2.8	2.9	2.2	1.5
Major Ions																			
Chloride	mg/L	150	120	600	600	5,000	250	0.0	0.0	0.0	8.5	2.2	2.9	3.6	13	3.6	5.7	5.2	8.6
Sulphate	mg/L	218 - 429[c]	174 - 343	-	1,000[W, LW]	10,000	500[d, 4]	223	223	66	72	4.6	5.9	6.0	71	71	70	227	231
Nutrients																			
Nitrate	mg-N/L	3.0	2.4	100	100	200	10[4]	0.085	0.085	0.018	0.018	0.0089	0.0091	0.0091	0.018	0.019	0.018	0.085	0.085
Nitrite	mg-N/L	0.02 - 0.20[e]	0.016 - 0.16	10	10	20	1[4]	0.0047	0.0047	0.0012	0.0012	0.00074	0.00074	0.00074	0.0012	0.0012	0.0012	0.0047	0.0047
Total ammonia	mg-N/L	1.9[f]	1.5	-	-	-	-	0.042	0.042	0.012	0.012	0.0076	0.0077	0.0077	0.012	0.012	0.012	0.042	0.042
Total phosphorus	mg-P/L	-	-	-	-	-	-	0.060	0.060	0.020	0.026	0.011	0.012	0.012	0.025	0.025	0.024	0.065	0.069
Total Metals																			
Aluminum	µg/L	-	-	5,000	5,000	190,000	9,500[3]	110	110	70	83	21	24	24	80	81	78	121	130
Antimony	µg/L	9.0	7.2	-	-	120	6[4]	0.36	0.36	0.11	0.57	0.081	0.17	0.18	0.48	0.48	0.41	0.76	1.1
Arsenic	µg/L	5.0	4.0	25[f]	25[f]	200	10[4]	0.80	0.80	0.33	3.6	0.46	1.1	1.16	3.0	3.1	2.5	3.7	**6.1**[Mn]
Beryllium	µg/L	0.13	0.10	-	100[W]	100	5[5]	**0.18**[Mn]	**0.18**[Mn]	**0.11**[80% Mn]	**0.11**[80% Mn]	0.020	0.020	0.020	**0.11**[80% Mn]	**0.11**[80% Mn]	**0.11**[80% Mn]	**0.18**[Mn]	**0.18**[Mn]
Cadmium	µg/L	-	-	-	80[W]	140	7[4]	0.067	0.067	0.025	0.027	0.0082	0.0087	0.0087	0.027	0.027	0.026	0.068	0.070
Chromium	µg/L	1.0[g]	0.80	-	50[W,LW(g)]	1,000	50[4]	0.34	0.34	0.28	0.60	0.15	0.21	0.22	0.53	0.57	0.49	0.63	**0.85**[80% Mn]
Cobalt	µg/L	4.0	3.2	-	1,000[W, LW]	20	1[3]	**3.1**[DW]	**3.1**[DW]	**1.0**[DW]	**1.0**[DW]	0.12	0.13	0.13	**1.0**[DW]	**1.0**[DW]	**1.0**[DW]	**3.1**[DW]	**3.2**[DW]
Copper	µg/L	-	-	300	300	40,000	2,000[4]	1.1	1.1	0.80	1.0	0.62	0.67	0.67	1.0	1.0	1.0	1.3	1.5
Iron	µg/L	1,000	800	-	-	56,000	2,800[5]	320	320	180	190	53	58	57	185	197	189	331	334
Lead	µg/L	4.0 - 10[c]	3.2 - 8.3	100	100	100	5[4]	0.25	0.25	0.16	0.20	0.075	0.084	0.084	0.19	0.20	0.18	0.28	0.31
Manganese	µg/L	741 - 1,429[c]	593 - 1,143	-	-	2,400	120[4]	**256**[DW]	**256**[DW]	78	88	5.0	7.1	7.3	86	86	84	**263**[DW]	**270**[DW]
Mercury	µg/L	0.010	0.0080	-	3.00	20.00	1[4]	0.0049	0.0049	0.0044	0.0044	0.0032	0.0032	0.0032	0.0044	0.0044	0.0044	0.0049	0.0049
Molybdenum	µg/L	7,600	6,080	34[h]	16[h]	1,760	88[3]	0.82	0.82	0.26	0.61	0.17	0.24	0.25	0.54	0.54	0.48	1.1	1.4
Nickel	µg/L	25 - 150[c]	20 - 120	-	1,000[W, LW]	1,600	80[3]	16	16	5.4	5.6	0.82	0.86	0.86	5.6	5.5	5.5	16	16
Selenium	µg/L	2.0	1.6	2.0	30	200	10[3]	0.33	0.33	0.25	0.31	0.19	0.20	0.21	0.29	0.29	0.28	0.38	0.42
Silver	µg/L	0.050 - 1.5[c]	0.04 - 1.2	-	-	376	18.8[5]	0.0090	0.0090	0.0070	0.0070	0.0040	0.0040	0.0040	0.0070	0.0070	0.0070	0.0090	0.0090
Uranium	µg/L	8.5	6.8	-	200[W, LW]	400	20[4]	0.54	0.54	0.23	0.44	0.12	0.16	0.16	0.40	0.40	0.37	0.72	0.88
Zinc	µg/L	7.5 - 80[c]	6.0 - 64	-	2,000	60,000	3,000[3]	8.6	8.6	4.0	4.6	1.8	1.9	1.9	4.5	4.4	4.3	9.0	9.4
Dissolved Metals																			
Aluminum	µg/L	50[f]	40	-	-	-	-	4.0	4.0	3.0	15	4.1	6.4	6.7	13	13	11	15	24
Cadmium	µg/L	0.089 - 0.34[c]	0.071 - 0.27	-	-	-	-	0.066	0.066	0.025	0.027	0.0082	0.0086	0.0087	0.027	0.027	0.026	0.067	0.069
Copper	µg/L	0.4 - 1.3[j]	0.32 - 1.0	-	-	-	-	**0.91**[Mn]	**0.91**[Mn]	**0.74**[Mn]	**0.97**[80% Mn]	0.56	0.60	0.61	**0.93**[Mn]	**0.92**[Mn]	**0.89**[80% Mn]	**1.1**[Mn]	**1.3**[Mn]
Iron	µg/L	350	280	-	-	-	-	15	15	15	16	15	15	15	16	16	16	16	17

Notes:

- = no guideline or no data; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; µg/L = micrograms per litre

CaCO3 = calcium carbonate; DOC = dissolved organic carbon; I = interim guideline, LW = livestock watering; W = working guideline; WQG = water quality guideline.

Values presented here are mean monthly predictions.

[a] = Baseline pH and dissolved organic carbon are presented in this table and were used for the purpose of guideline calculation .

[b] = Temperature values were assumed for each month (November to April = 5 °C, May to June and September to October = 10 °C, and July to August = 15 °C)

[c] = guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (64 to 316 mg/L). The guideline is calculated based on the individual hardness value for each sample. For samples with hardness values greater than the upper limit of the established guideline hardness range, the upper limit

[d] = guideline is based on an aesthetic objective.

[e] = guideline is chloride dependent. The guideline range shown is based on the chloride concentration range observed in the dataset (0 to 13 mg/L). The guideline is calculated based on the individual chloride concentration in each sample.

[f] = the ammonia guideline is pH and temperature dependent. A pH of 7.5 and a temperature of 10 °C were used to calcualte an ammonia guideline of 1.9 mg-N/L.

[g] = guideline is for chromium VI.

[h] = guideline is protective of ruminant animals.

[i] = guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (6.8 to 7.3). The guideline is calculated based on the individual pH for each sample.

[j] = the copper guideline is calculated with the BC Biotic Ligand Model (BLM), based on hardness, pH, and dissolved organic carbon (DOC). The guideline range shown is based on predicted hardness, a pH of 7.5, and median monthly baseline DOC.

[Mn] = concentration is higher than the 30-day mean BC ENV guideline or outside the recommended pH, DO or total alkalinity range.

[80% Mn] = concentration is higher than 80% of the 30-day mean BC ENV guideline.

[DW] = concentration is higher than the drinking water guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

[1] = British Columbia Ministry of Environment and Climate Change Strategy (BC ENV). 2021a. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C.

[2] = BC ENV. 2021b. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C.

[3] = BC ENV. 2017. B.C. Source Drinking Water Quality Guidelines: Guideline Summary. Water Quality Guideline Series, WQG-01. Prov. B.C., Victoria B.C.

[4] = Health Canada (HC). 2022. Guidelines for Canadian Drinking Water Quality—Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[5] = United States Environmental Protection Agency (US EPA). 2022. Regional Screening Levels - Resident Tap Water. Accessed March 2022 from: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

APPENDIX D SUPPLEMENTAL ACCOUSTIC EFFECTS ASSESSMENT DUE TO PROJECT CHANGES

MEMO

SECTION 7.3 – ACOUSTIC VALUED COMPONENT SUPPLEMENTARY EFFECTS ASSESSMENT

TO: Katherine St James, BC Environmental Assessment Office

FROM: Carolyn Ropp, B.Sc. and Kana Ganesh, M.Sc., PhD, P.Eng. - Acoustics

SUBJECT: Cariboo Gold Project – Supplementary Acoustic Effects Assessment Due to Project Changes

DATE: April 18, 2023

INTRODUCTION

Osisko Development Corp. (ODV) submitted the revised Environmental Assessment Certificate Application (the Revised Application) for the Cariboo Gold Project (the Project) to the Environmental Assessment Office (EAO) in October 2022. Section 7.3 of the Revised Application presented the effects assessment for the Acoustic Valued Component (VC).

Subsequently, some changes proposed to the Project design and/or processes were identified from the Revised Application submitted to the EAO in October 2022; these changes are summarized in Attachment A based on information provided by ODV (V. Gauthier February 15, 2023 personal communication).

This Supplementary Effect Assessment (SEA) identifies and assesses the corresponding effects on the Acoustic VC and provides an update to Section 7.3 – Acoustic Valued Component Effects Assessment.

The Project changes that impact the Acoustic VC (both Section 7.3 and Appendix 7.3-2, identified as Technical Data Report or TDR in the Revised Application) are discussed and assessed in this supplementary assessment. The changes in Section 7.3 as well as Appendix 7.3-2 (TDR) are identified with reference to the corresponding sections.

APPENDIX 7.3.2 (TDR) SECTION 1 – INTRODUCTION

This section of the TRD noted the key Project components with the potential to disturb the existing acoustical environment. The following changes are noted as additional components that could disturb the existing acoustic environment:

- Cariboo Gold Mine (Mine Site) – an underground mine producing at an average of 4,750 tonnes per day (tpd) of ore located in the District of Wells, BC. The changes indicate that the mine will now be producing up to 4,900 tpd.

- Transportation Route (to Mine Site changes)
    - Year 1 to 4 of the Project, transportation of ore between the Mine Site (Bonanza Ledge Site) and the QR Mill will use the internal A Road, then approximately 59 km of Highway 26 (this represents an extension of 3 km further than in the Revised Application), and then a similar distance along the 500 Nyland Lake Road; transportation of workers, as well as goods and services, will be from Quesnel to both the Mine Site and Bonanza Ledge Site using Highway 26 and A Road.
    - Year 4 to 16, ore is transported between the Mine Site and QR Mill along Highway 26 and 500 Nyland Lake Road, and transportation of goods and personnel to the Mine Site will be as previously described in the TDR. Transportation of goods and services to Bonanza Ledge only will continue using the extension of Highway 26 and A Road to access the site.

APPENDIX 7.3.2 (TDR) SECTION 1.2 – PROJECT OVERVIEW

This section of the Appendix 7.3.2 (TDR) provided the overall Project development schedule considered in the noise assessment. The production rate provided in the Revised Application was as follows:

- Year 1: 1,500 tonnes per day (tpd)
- Years 2 to 16: 4,750 tpd

The production rate change is as follows:

- Year 1 to 4: 1,500 tpd
- Years 4 to 16: maximum of 4,900 tpd.

Since the original assessment was based on a max capacity of 4,750 tpd, the change of maximum capacity to 4,900 tpd results in a 3% production increase. It is understood that there are no corresponding changes to land equipment or processes planned.

In addition, Appendix 7.3.2 (TDR) mentioned that the start of operations in Year 1 would include the commissioning of the flotation circuit within the Services Building; this phase includes mining, processing, hauling, and shipping at a reduced rate of 1,500 tpd.

The Project changes will ramp up tonnage in two phases: Phase 1 starting with 1,500 tpd of ore sorting followed by Phase 2 with a maximum of 4,900 tpd of ore sorting.

In Phase 1 (Years 1 to 4), the ore will be processed in two stages at two sites: the Bonanza Ledge Site for mobile crushing, screening, and ore sorting, and QR Mill for further refining. With the Project changes, commissioning of the flotation circuit within the Services Building will not occur until Year 4.

The assessment presented in Revised Application considered the worst-case scenario of 4,750 tpd. The increase to 4,900 tpd is minimal, as no new equipment is introduced, and the Revised Application used maximum equipment sound power levels. Therefore, no corresponding increase in sound level is anticipated.

REVISED APPLICATION SECTION 7.3.2.2.2 AND APPENDIX 7.3.2 (TDR) SECTION 1.3.2 – OPERATIONS PHASE

In Section 1.3.2 of the Revised Application, the Operations Phase was listed as occurring during Years 1 to 16 (16 Years) and the operations scenario assessed for the Mine Site was during the maximum mine waste rock and mineralized material production (Year 7) with a capacity of 4,750 tpd in Years 2 to 16. As mentioned above, the Operations Phase is proposed to change as follows:

- Phase 1 – Year 1 to 4: 1,500 tpd where preliminary ore processing occurs at the Bonanza Ledge Site.
- Phase 2 – Years 4 to 16: 4,900 tpd where preliminary ore processing occurs at the Services Building at the Mine Site Complex.

It was discussed in Section 7.3.2.2.2 (and Section 7.3.4.1) and in Appendix 7.3.2 (TDR) of the Revised Application that Year 1 of operations, which includes a production of 1,500 tpd, would be acoustically less significant when compared to Year 7, in which up to 4,750 tpd (now 4,900 tpd) was planned and where the Mine Site Complex and waste transportation to the Bonanza Ledge waste rock storage facility (WRSF) was also at maximum capacity. Therefore, compliance was considered for a predictable worst-case scenario of 4,750 tpd.

With the Project changes, a predictable worst-case operational scenario is when there is potential overlap in Year 4, where the Phase 1 operations at the Bonanza Ledge Site are occurring at the same time as the Phase 2 operations at the Mine Site Complex. This can occur during the transition period as production at one location is winding down and the other is gearing up, and thus noise generating equipment is operating in both locations.

The Project changes include waste rock haulage changes, additional components at the Bonanza Ledge Site, revisions to transportation route and access roads, inclusion of the Lowhee Zone, revisions to ventilation and exhaust raises, and changes in maximum production rate. Due to these changes, the following items in Section 7.3.2.2.2.1 of the Revised Application will change as noted below:

- Item 4 (update): Surface activities along the Bonanza Ledge Site WRSF access roads will now run from the Cow Portal to the Bonanza Ledge Site, primarily resulting from haulage of waste rock to the Bonanza Ledge Site. ODV's proposed construction of an underground haul route removes the aboveground B Road haul route.
- Item 5 (update): With the Project changes, surface activities at the Bonanza Ledge site will include the following during Years 1 to 4: mobile crushing, screening, and ore sorting; transportation of ore; delivery of goods; a wastewater treatment plant (sludge truck movement); and dumping and handling of mine waste rock. In Years 4 to 16, surface activities will consist primarily of dumping and handling of mine waste rock, and monthly delivery of goods and services (i.e., sludge truck).

- Item 10 (new): Addition of portal activities at the Cow Portal located east of the Mine Site Complex, primarily resulting from ventilation and movement of equipment in and out of the Portal.

Section 7.3.2.2.2.3 of the Revised Application lists the haul routes associated with the Operations Phase (Year 1 to 16). As mentioned previously, ODV has made changes to haul routes with changes from Year 1 to 4 and then from Years 4 to 16.

REVISED APPLICATION SECTION 7.3.2.1 AND APPENDIX 7.3.2 (TDR) SECTION 2.2.1 – SPATIAL BOUNDARIES

The extent of the area in which there may be potential for noise and vibration impacts from the Project, and associated changes (i.e., Transportation Route Extension) are described below and shown in Figure A (previously Figure 1.1 in Appendix 7.3.2 [TDR] and Figure 7.3-1 in Section 7.3 of the Revised Application).

Figure A shows both the previous Local Assessment Area (LAA) and Regional Assessment Area (RAA), and corresponding changes.

- There were two receptors along the LAA that were moved to new LAA locations (LAA3_03 and LAA3_04 now LAA3_03N and LAA3_04N) due to the revised LAA.

- There were three receptors in the RAA that were moved to the new RAA locations (RAA3_03, RAA3_04 and RAA3_06 now RAA3_03N, RAA3_04N, and RAA3_06N) due to the corresponding revised RAA.

- Additionally, one new LAA and one new RAA receptor were added (LAA3_08N and RAA3_09N) due to changes in the LAA and RAA.

REVISED APPLICATION APPENDIX 7.3.2 (TDR) SECTION 2.6.1 - OPERATIONS SCENARIO

Sources that are being removed, added, or relocated as per the Project changes, along with their operating mode (e.g., stationary or mobile) and operating scenario considered in the assessment (2023 changes), are provided in Table 1. Additional details are provided in Attachment A (revised Table B-2a from Appendix 7.3.2 [TDR] of the Revised Application) and are shown in Figure B (previously Figure 7.3-3 in Section 7.3 and Figure 2.2 in Appendix 7.3.2 [TDR] of the Revised Application).

Table 1 Summary of Noise Sources – Operations Scenario

SOURCE ID	DESCRIPTION	CHANGE FROM PREVIOUS	OPERATIONAL YEARS	SOUND POWER LEVEL (dB)[5]	SOUND POWER LEVEL (dBA)[5]	REMARKS (# UNITS, P/L/A[1]), R[2], T[3])
O_MINE_VINT_05	Ventilation Raise Intake (Lowhee Zone)	Added	1 to 2	118	103	1, P
O_MINE_VEXH_01	Ventilation Raise Exhaust (Mosquito Zone)	Removed	--	116	101	1, P
O_MINE_VEXH_01	Ventilation Raise Exhaust (Shaft Zone)	Added	1 to 16	116	101	1, P
O_MINE_VEXH_04	Portal Exhaust (Cow Zone)	Added	1 to 16	139	124	1, P
O_MINE_DOZR_01[4]	Surface support (Dozer) at Valley Mountain Portal	Removed	--	124	110	1, P
O_MINE_LOAD_02[4]	Surface Support (Loader) at Valley Mountain Portal	Removed	--	124	110	1, P
O_MINE_GENS_01	1000 kW Generator at Cow Portal	Added	1 to 4	99	97	1, P
O_MINE_GENS_02	1000 kW Generator at Cow Portal	Added	1 to 4	99	97	1, P
O_MINE_TRSF_01	2MVA Transformer at Cow Portal[6]	Added	1 to 16	85	76	1, P, T
O_MINE_TRSF_02	2MVA Transformer at Cow Portal[6]	Added	1 to 16	85	76	1, P, T
O_MINE_TRSF_03	2MVA Transformer at Cow Portal[6]	Added	1 to 16	85	76	1, P, T
O_MINE_TRSF_04	2MVA Transformer at Cow Portal[6]	Added	1 to 16	85	76	1, P, T
O_MINE_GENS_07	1000 kW Generator at Bonanza Ledge Site	Added	1 to 4 (Emergency 1 to 16)	99	97	1, P
O_MINE_GENS_08	1000 kW Generator at Bonanza Ledge Site	Added	1 to 4 (Emergency 1 to 16)	99	97	1, P
O_MINE_GENS_09	1000 kW Generator at Bonanza Ledge Site	Added	1 to 4 (Emergency 1 to 16)	99	97	1, P
O_MINE_TRSF_05	2MVA Transformer at Bonanza Ledge Site[6]	Added	1 to 4	85	76	1, P, T
O_MINE_TRSF_06	2MVA Transformer at Bonanza Ledge Site[6]	Added	1 to 4	85	76	1, P, T
O_MINE_TRSF_07	2MVA Transformer at Bonanza Ledge Site[6]	Added	1 to 4	85	76	1, P, T
O_MINE_TKLO_02	Load Out of Ore at Ore Sorter (Bonanza Ledge)	Added	1 to 4	116	109	1, P, R
O_MINE_TKID_03	Truck Idling at Loading of Ore (Bonanza Ledge)	Added	1 to 4	109	101	1, P, R
O_MINE_CRSH_01	Crusher at Bonanza Ledge Site	Added	1 to 4	119	115	1, P, R
O_MINE_SORE_01	Ore Sorter at Bonanza Ledge Site	Added	1 to 4	120	113	1, P
O_MINE_SCRN_01	Screening Plant at Bonanza Ledge Site	Added	1 to 4	121	97	1, P

SOURCE ID	DESCRIPTION	CHANGE FROM PREVIOUS	OPERATIONAL YEARS	SOUND POWER LEVEL (dB)[5]	SOUND POWER LEVEL (dBA)[5]	REMARKS (# UNITS, P/L/A[1]), R[2], T[3])
O_MINE_DLTK_02	Delivery Trucks Haul Route to Bonanza Ledge Site	Added	1 to 4	107	104	1, L
O_MINE_WRSF_01	WRSF Haul Route	Moved	4 to 16	120	107	3, L
O_HLRT_ORTK_03	Ore Delivery Trucks Haul Route	Added	1 to 4	117	108	1, L

Note: [1]P/L/A – Where: P – generally operations in one location, L – generally operates along a set path as a moving point along a line. A – generally operates within a defined area at any point within that area.
[2]R – Source is not considered to operate for a full hour, during day or nighttime operation. All other sources are assumed to operate for the entire hour (day/night).
[3]T – tonal adjustment (5 dB).
[4] Includes Broadband Backup Alarm in Sound Power Levels.
[5] The sound power levels are listed in decibel units (dB) and A-weighted decibel units (dBA).
[6] Transformer sound power level calculations are provided in Attachment B.
ID = Identification, kW = kilowatt; MVA = megavolt-ampere

As previously discussed, a maximum worst-case scenario for the operations scenario will be in Year 4 where Phase 1, with processing of ore at the Bonanza Ledge Site, and Phase 2, with processing of ore at the Mine Site Complex, could be occurring simultaneously while one process is winding down and the other is gearing up. For the purpose of this assessment, both Phase 1 and Phase 2 are considered at full capacity.

In addition, proposed changes to the Transportation Routes and access roads resulted in a change in the previously modelled WRSF haul route, ore haul routes, and delivery routes. These are also considered and discussed below.

Waste Haul Route

Previously, in the operations scenario, the above ground haul route for the Bonanza Ledge WRSF (O_MINE_WRSF) was from the Valley Portal along A Road and B Road to the Bonanza Ledge Site. With the proposed underground waste hauling route (Mine Site Complex to Cow Portal), the need for the surface haul route via the B Road is eliminated. Thus, trucks hauling waste rock surfacing at the Cow Portal and continuing along a portion of the existing A Road to the Bonanza Ledge WRSF was used in the revised 2023 operations scenario.

Ore and Delivery Transportation Routes

The revisions to the Transportation Routes for ore and delivery trucks are as follows:

- In the first four years (Years 1 to 4), trucks hauling ore, deliveries, and personnel will travel along A Road to Highway 26 and on to either the Mine Site Complex, QR Mill, or Quesnel.
- From Years 4 to 16, trucks hauling waste rock will travel underground to the Cow Portal and along the A Road to Bonanza Ledge. Only light vehicles and monthly deliveries will continue along Highway 26 to the A Road and then along the A Road to the Bonanza Ledge Site (i.e., added delivery truck route O_MINE_DLTK_02).

With the 2023 worst case operations scenario being Year 4, consisting of a hybrid of ore processing between the Bonanza Ledge Site and Mine Site Complex, the following ore truck transportation routes were considered:

- O_HLRT_ORTK_01 – Ore Delivery Trucks Haul Route (From Mine Complex Site to QR Mill Site, 2 trucks/hr) – remains as previously modelled (Years 4 to 16).
- O_HLRT_ORTK_02 – Ore Delivery Trucks Haul Route (Around Services Building Area, 2 trucks/hr) – remains as previously modelled (Years 4 to 16).
- O_HLRT_ORTK_03 – Ore Delivery Trucks Haul Route (From Bonanza Ledge Site to Mine Site Complex, 1 truck/hr) – added as per ODV changes (Years 1 to 4).

SECTION 2.6.2 - CONSTRUCTION SCENARIO

Sources that are being removed, added, or relocated as per the Project changes, along with their operating mode (e.g., stationary or mobile) and operating scenario considered in the assessment, are provided in Table 2. Additional details are provided in Attachment B (revised Table B-2b in Appendix 7.3.2 [TDR] of the Revised Application) and are shown in Figure C (previously Figure 7.3-4 in Section 7.3 and Figure 2.3 in Appendix 7.3.2 [TDR] of the Revised Application).

Table 2 Summary of Noise Sources – Construction Scenario

SOURCE ID	DESCRIPTION	UPDATE	SOUND POWER LEVEL (dB)[5]	SOUND POWER LEVEL (dBA)[5]	REMARKS (# UNITS, P/L/A[1]), R[2], T[3])
C_MINE_GENS_03	1000 kW Generator at Island Mountain Portal	Removed	99	97	1, P
C_MINE_GENS_04	1000 kW Generator at Island Mountain Portal	Removed	99	97	1, P
C_MINE_GENS_07	1000 kW Generator at Bonanza Ledge Site	Added	99	97	1, P
C_MINE_GENS_08	1000 kW Generator at Bonanza Ledge Site	Added	99	97	1, P
C_MINE_GENS_09	1000 kW Generator at Bonanza Ledge Site	Added	99	97	1, P
C_MINE_TRSF_05	2 MVA Transformer at Bonanza Ledge Site 6	Added	85	76	1, P, T
C_MINE_TRSF_06	2 MVA Transformer at Bonanza Ledge Site 6	Added	85	76	1, P, T
C_MINE_TRSF_07	2 MVA Transformer at Bonanza Ledge Site 6	Added	85	76	1, P, T
C_MINE_WRTK_01	Water Truck Haul Route	Moved	112	103	1, L
C_MINE_EXTK_02	Explosive Truck Haul Route	Added	107	104	1, L
C_MINE_DLTK_02	Delivery Trucks Haul Route to Bonanza Ledge Site	Added	107	104	1, L

SOURCE ID	DESCRIPTION	UPDATE	SOUND POWER LEVEL (dB)[5]	SOUND POWER LEVEL (dBA)[5]	REMARKS (# UNITS, P/L/A[1]), R[2], T[3])
C_MINE_WRSF_01	WRSF Haul Route	Moved	120	107	3, L

Note: [1]P/L/A – Where: P – generally operations in one location, L – generally operates along a set path as a moving point along a line. A – generally operates within a defined area at any point within that area.
[2]R – Source is not considered to operate for a full hour, during day or nighttime operation. All other sources are assumed to operate for the entire hour (day/night).
[3]T – tonal adjustment (5 dB).
[4] Includes Broadband Backup Alarm in Sound Power Levels.
[5] The sound power levels are listed in decibel units (dB) and A-weighted decibel units (dBA).
[6] Transformer sound power level calculations are provided in Attachment B.
ID = Identification, kW = kilowatt; MVA = megavolt-ampere

The revisions as part of the Project changes included removing the two (2) generators located at the Island Mountain Portal and changes in the Transportation Routes and access roads. The changes in transportation routes and access roads resulted in a change to the previously modelled construction WRSF haul route and delivery routes.

Water Truck Route

In the previously assessed (Revised Application) construction scenario, the water truck travelled from the Island Mountain Portal to the Mine Site Complex, then along A Road and B Road to the Bonanza Ledge Site. With the removal of B Road as a haul route, the water truck route will travel from Island Mountain Portal, along Highway 26 to A Road, and along A Road to the Bonanza Ledge Site.

Delivery Transportation Routes

Deliveries to the Cow Portal or Bonanza Ledge Site, which includes explosives, will also extend travel down the Transportation Route along Highway 26 to A Road and along A Road to the Bonanza Ledge Site. The added delivery to the Bonanza Ledge Site is captured with the added explosive and delivery truck route (EXTK_02 and DLTK_02).

Waste Haul Route

The previously (Revised Application) modelled WRSF haul route went from the Valley Portal along A Road and B Road and then to the Bonanza Ledge Site. With the proposed removal of B Road as a haul route, and the addition of the underground waste hauling route, the WRSF trucks will surface at the Cow Portal and continue along a portion of the existing A Road to Bonanza Ledge Site.

REVISED APPLICATION SECTION 7.3.4.2 – VALUED COMPONENTS

As indicated in the above sections, the Project changes would add or change potential Project interactions (Table 7.3-6 of the Revised Application). These Project changes would have potential interaction with the acoustic environment (noise), and therefore have the potential to increase audible noise and Low Frequency Noise (LFN) that could cause noise induced hearing loss, noise induced sleep disturbance, interference with speech comprehension/communication, and human health effects as discuss in the Revised Application.

REVISED APPLICATION SECTION 7.3.4.4 DISCUSSION OF POTENTIAL EFFECTS AND APPENDIX 7.3.2 (TDR) SECTION 3 – IMPACT ASSESSMENT

Section 7.3.4.4 and Appendix 7.3.2 (TDR- Section 3) of the Revised Application provided the noise impact assessment results and described the potential effects of the Project. The Project changes only relate to changes at the Mine Site and thus the updated results presented below are also restricted to the Mine Site. In Section 7.3 and Appendix 7.3.2 (TDR) of the Revised Application, two representative receptors from the Mine Site were presented. These are the same receptors used in the 2023 assessment. The results from the remaining receptors can be found in Attachment B.

AUDIBLE NOISE FROM OPERATIONS

In Section 7.3.4.4.1.2 (Table 7.3-9) and Appendix 7.3.2 (TDR - Section 3.1.1; Table 3-1) of the Revised Application, the predicted sound levels for the operations scenario at two (2) receptors near the mine were presented, comparing compliance limits with Health Canada (HC) Guidelines (HC 2017). Table 3 below presents the updated results based on the Project changes.

Table 3 Predicted Sound Level at Points of Reception – Operations (Health Canada Guidelines)

POR ID	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN % HA	EFFECT ASSESSMENT
R3_09	51.4	53.3	55.5	6.5	1.8	No Effect, No Further Mitigation
R1_05	50.1	54.8	56.1	6.5	2.0	No Effect, No Further Mitigation

Note: ADJ: Adjusted in accordance with HC guidelines; ID = Identification; POR = Point of Reception; %HA = percent of Health Canada guideline.

The updated results show compliance with HC Guideline limits; control mitigation was assumed to be in place, as discussed in Section 7.3 and Appendix 7.3.2 (TDR) of the Revised Application and updated later in this memo.

In Section 7.3.4.4.1.2 (Table 7.3-10) and Appendix 7.3.2 (Section 3.1.2; Table 3-2) of the Revised Application, the predicted sound levels for the operations scenario at two (2) receptors near the mine were presented, comparing compliance limits with Environment Canada's Environmental Code of Practice for Metal Mines (ECPMM) Guidelines (Environment Canada 2009). Table 4 below provides the updated results based on the Project changes.

Table 4 Predicted Sound Level at Points of Reception – Operations (ECPMM Guidelines)

POR ID	THE PROJECT CONTRIBUTED SPL AT POR DAY/NIGHT (L_{EQ} – dBA)	PERFORMANCE LIMIT DAY/NIGHT (dBA)	COMPLIANCE WITH CRITERIA (YES/NO)
R3_09	43 / 43	55 / 45	Yes
R1_05	45 / 45	55 / 45	Yes

Note: SPL: Sound Pressure Level; dBA = A-weighted decibel units; ID = Identification; POR = Point of Reception; Leq = Equivalent Sound Pressure Level

The updated results still show compliance with ECPMM Guidelines. Figure D (previously Figure 3.1 in Appendix 7.3.2 [TDR] and Figure 7.3-5 in Section 7.3 of the Revised Application) provides the equivalent sound level contours for Project operations in the Mine Site area during daytime hours.

AUDIBLE NOISE FROM CONSTRUCTION

In Section 7.3.4.4.1.1 (Table 7.3-7) and Appendix 7.3.2 (TDR- Section 3.2.1; Table 3-3) of the Revised Application, the predicted sound levels for the Construction Phase scenario at two (2) receptors near the mine were presented comparing compliance limits with HC Guidelines (HC 2017). Table 5 below is the updated results based on the Project changes.

Table 5 Predicted Sound Level at Points of Reception – Construction (Health Canada Guidelines)

POR ID	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN % HA	EFFECT ASSESSMENT
R3_09	51.4	54.1	56.0	6.5	2.0	No Effect, No Further Mitigation
R1_05	50.1	54.6	55.9	6.5	2.4	No Effect, No Further Mitigation

Note: ADJ: Adjusted in accordance with HC guidelines; ID = Identification; POR = Point of Reception; %HA = percent of Health Canada Guideline

The updated results show compliance with HC Guideline limits; control mitigation was assumed to be in place, as discussed in Section 7.3 and Appendix 7.3.2 (TDR) of the Revised Application and updated later in this memo.

In Section 7.3.4.4.1.1 (Table 7.3-8) and Appendix 7.3.2 (TDR-Section 3.2.2; Table 3-4) of the Revised Application, the predicted sound levels for the construction scenario at two (2) receptors near the mine were presented comparing compliance limits with ECPMM Guidelines (Environment Canada 2009). Table 6 below is the updated results based on the Project changes.

Table 6 Predicted Sound Level at Points of Reception – Construction (ECPMM Guidelines)

POR ID	THE PROJECT CONTRIBUTED SPL AT POR DAY/NIGHT (L_{EQ} – dBA)	PERFORMANCE LIMIT DAY/NIGHT (dBA)	COMPLIANCE WITH CRITERIA (YES/NO)
R3_09	44 / 44	55 / 45	Yes
R1_05	45 / 45	55 / 45	Yes

Note: SPL: Sound Pressure Level; dBA = A-weighted decibel units; ID = Identification; POR = Point of Reception; Leq = Equivalent Sound Pressure Level

The updated results still show compliance with ECPMM Guidelines. Figure E (previously Figure 3.2 in Appendix 7.3.2 [TDR] of the Revised Application) provides the equivalent sound level contours for the Project Construction Phase for the Mine Site area during daytime hours.

LOW FREQUENCY NOISE FROM OPERATIONS AND CONSTRUCTION PHASE

In Section 7.3.4.4.1.3 (Table 7.3-11) and Appendix 7.3.2 (TDR- Section 3.3.1; Table 3-5) of the Revised Application, the predicted sound levels for the operations scenario at two (2) receptors near the mine were presented comparing compliance limit endpoints as discussed in Section 7.3 of the Revised Application. As indicated in the updated results shown in Table 7 below, based on the Project changes, the low frequency noise (LFN) effects from the Project remain greater than the limit of 20 dB, therefore, tonal components were reviewed. The tonal components are below 250 Hz; therefore, the LFN effects from the Project changes are not a concern as per guidelines.

Table 7 Predicted Low Frequency Sound Level at Points of Reception – Operations

POR ID	THE PROJECT CONTRIBUTED SPL AT POR (L_{EQ} – dBA)	THE PROJECT CONTRIBUTED SPL AT POR (L_{EQ} – dBC)	DIFFERENCE (dBC-dBA)	LIMIT FOR DIFFERENCE (dB)	IS dBC – dBA > 20 (YES/NO)	IS THERE TONAL BELOW 250 Hz (YES/NO)	COMPLIANCE WITH CRITERIA (YES/NO)
R3_09	43	68	24	20	Yes	No	Yes
R1_05	45	72	27	20	Yes	No	Yes

Note: SPL: Sound Pressure Level; dBA = A-weighted decibel units; dBC = C-weighted decibel units; ID = Identification; POR = Point of Reception; Leq = Equivalent Sound Pressure Level; Hz = Hertz

In Section 7.3.4.4.1.4 (Table 7.3-12) and Appendix 7.3.2 (TDR Section 3.3.2; Table 3-6) of the Revised Application, the predicted sound levels for the construction scenario at two (2) receptors near the mine were presented comparing compliance limit endpoints as discussed in Section 7.3 of the Revised Application. As indicated in the updated results shown in Table 8 below, based on the Project changes, the LFN effects remain greater than the limit of 20 dB, therefore, tonal components were reviewed. The tonal components are below 250 Hz; therefore, the LFN effects from the Project changes are not a concern.

Table 8 Predicted Low Frequency Sound Level at Points of Reception – Construction

POR ID	THE PROJECT CONTRIBUTED SPL AT POR (L_{EQ} – dBA)	THE PROJECT CONTRIBUTED SPL AT POR (L_{EQ} – dBC)	DIFFERENCE (dBC-dBA)	LIMIT FOR DIFFERENCE (dB)	IS dBC – dBA > 20 (YES/NO)	IS THERE TONAL BELOW 250 Hz (YES/NO)	COMPLIANCE WITH CRITERIA (YES/NO)
R3_09	45	61	16	20	No	No	Yes
R1_05	45	63	18	20	No	No	Yes

Note: SPL: Sound Pressure Level; dBA = A-weighted decibel units; dBC = C-weighted decibel units; ID = Identification; POR = Point of Reception; Leq = Equivalent Sound Pressure Level; Hz = Hertz

ADDITIONAL CONSIDERATIONS

In Section 7.3.4.4.4 and Appendix 7.3.2 (TDR- Section 3.6) of the Revised Application, there were additional assessments conducted and included in Attachment E of Appendix 7.3.2 (TDR) of the Revised Application. The changes and impacts associated with the Project changes were also included in this supplementary assessment, and included:

Appendix 7.3.2 (TDR) - Section E1: Assessment of Operations Phase Noise in accordance with BC Oil and Gas Commission (OGC) Permissible Sound Level

The updated predicted sound levels for the operations scenario for all receptors are presented in a table provided in Attachment B (revised Table E-1 of the Revised Application). The most impacted receptor remains R1_05, with a cumulative predicted sound level of 54 dBA during the daytime and 47 dBA during the nighttime, which is within the BC OGC permissible sound level (PSL) limits of 58 dBA during the day and 48 dBA during the night (as determined in revised Table E-1 included in Attachment B; OGC 2018). In addition, as shown in revised Table E-1, the cumulative predicted sound levels comply with the PSL at all receptors during operations; thus, noise control measures above what were already previously identified in the TDR report are not required.

Appendix 7.3.2 (TDR) - Section E2: Assessment of potential use of additional sources such as a roadheader instead of blasting during construction and pile driving for bridge construction

The impacts with the additional sources such as the roadheader and pile driving with the Project changes as mentioned above are noted below:

Assessment Using Heath Canada Guidelines

The updated predicted sound levels for the construction scenario with the addition of the roadheader and the piling activities are presented in Attachment B in revised Table E-2a comparing sound levels to compliance limits of HC Guidelines (HC 2017). The results with the Project changes still show compliance with HC Guideline limits and no significant added contribution to actual sound levels.

Assessment Using ECPMM Guidelines

The overall sound levels at the representative points of reception (PORs) for the predictable worst-case Operations Phase scenario for the Project with the additional two sources (roadheader and piling activities) and the Project changes are summarized in revised Table E-2b (Attachment B), and still show compliance with limits of ECPMM Guidelines (Environment Canada 2009).

Assessment Using BC Oil and Gas Commission Guidelines

Even though BC OGC guidelines does not provide specific noise limits for construction activities, for completeness, the use of the roadheader and pile driving construction activities were compared against BC OCG guidelines.

The predicted sound levels for the construction scenario with the addition of the roadheader, the pile driving activities, and the Project changes, are presented in revised Table E-2c (Attachment B), which compares these levels to PSL limits of BC OGC Noise Guidelines identified in revised Table E-1 above (OGC 2018).

The highest predicted sound level of 54 dBA during the daytime and 46 dBA during the nighttime is still within the BC OGC PSL limits of 58 dBA during the day and 48 dBA during the night.

Low Frequency Noise from Construction

The A-weighted and C-weighted sound level due to the construction of the Project with the additional Project sources is shown in revised Table E-2d (Attachment B). The highest predicted sound level difference between dBA and dBC is still 24 dB, which is more than the limit of 20 dB. Therefore, tonal components below 250 Hz were verified in accordance with the BC OCG guideline. The verification showed that there were no tonal components below 250 Hz noted. Therefore, the LFN effects from the Project are not a potential concern. In addition, as discussed during the Application review process, a monitoring requirement was considered for LFN, and is still a recommendation.

Impulsive and Vibration Noise

The Project changes have no impacts on impulsive and vibration noise from construction equipment and thus no changes are required from the assessment in the Revised Application, and the predicted sound levels at the closest receptors will remain in compliance with the sound level limits without the need for additional noise control measures or vibration control measures beyond those already stated in Appendix 7.3.2 (TDR).

Appendix 7.3.2 (TDR) - Section E3: Assessment of Health Canada Noise-Induced Hearing Loss, Noise-Induced Sleep Disturbance, Interference with Speech Comprehension, and Potential Human Health Effects

Noise Induced Hearing Loss

As per HC Guidelines, there is no known risk of permanent hearing loss associated with sound levels below 70 dBA, regardless of the exposure (HC 2017). As indicated in revised Table E-2b (Attachment B), the highest predicted sound levels with the Project changes are 51 dBA at R3_09, which is less than 70 dBA, therefore, risk of noise induced hearing loss from the Project is not identified.

Noise Induced Sleep Disturbance

The highest predicted daytime and nighttime hourly sound levels at the window of R3_09 are 51 dBA and 44 dBA, respectively. The HC Guidelines define sleep disturbance by saying “for estimating the likelihood of sleep disturbance on any given night”; this implies sleep disturbance should only be addressed during nighttime hours (HC 2017). The highest predicted nighttime hourly sound level is 44 dBA (R3_09) and meets the thresholds noted in Appendix 7.3.2, Attachment E, Table E3-1; therefore, with the Project changes, noise-induced sleep disturbance is not likely.

Interference with Speech Comprehension

Speech comprehension effects could be a concern if sound levels are greater than 55 dBA. Given the Project sound levels with the Project changes remain less than 55 dBA (Refer revised Table E-2b in Attachment B) outdoors, interference with speech comprehension is still not expected.

Potential Human Health Effects

The results in the revised tables with the Project changes show that the %HA (highly annoyed) is still less than 6.5; therefore, potential human health effects are minimal.

REVISED APPLICATION SECTION 7.3.7.1 – SUMMARY OF RESIDUAL EFFECTS AND APPENDIX 7.3.2 (TDR) SECTION 4 – NOISE AND VIBRATION MITIGATION AND MANAGEMENT

PROPOSED MITIGATION MEASURES

The mitigation measures provided In Section 7.3.7.1 (Table 7.3-13) and Appendix 7.3.2 (TDR Section 4.1 and Section 4.2) of the Revised Application were still used and assumed in the assessment to demonstrate compliance with the guidelines discussed in Section 7.3 of the Revised Application.

However, the following additional mitigation measures for the Operations Phase (Valued Component – Noise – Audible Noise, Low Frequency Noise) can be used to demonstrate compliance:

- Transformers (2MVA) used at the Cow Portal and Bonanza Ledge Site will be no more than 100 dBA of total sound power level.
- Fans at ventilation raises and portal exhausts will have at least the following sound attenuation:
    - Portal Exhaust (Cow Zone) Fan sound levels will be below 106 dBA (116 dBA – 10 dB); and
    - Ventilation Raise Exhaust (Shaft Zone) Fan sound levels will be below 104 dBA (124 dBA – 20 dB).

The Project with the proposed changes is considered consistent with the summary of the residual effects presented in the Revised Application.

2022 APPLICATION SECTION 5 – CONCLUSIONS CHANGES

As shown in the above sections, the operations noise and construction noise associated with the Project with the proposed changes shows compliance with HC Guidelines, BC OCG Guidelines, and ECPMM Guidelines with the recommended mitigation measures previously provided in the Revised Application and with the additional o mitigation measures provided in this memo. Therefore, the Summary of Residual Effects for Acoustics provided in Section 7.3 (Table 7.3-21) and the Cumulative Effects Assessment provided in Section 7.3 (Table 7.3-23) of the Revised Application remain unchanged.

CLOSURE

The acoustic analysis highlighted in this report is based on information obtained from ODV and its design team. The assessment represents the design conditions as provided at the time of the assessment, and the conclusions are the best judgment of the assessor based on current environmental standards. WSP Canada Inc., attests that to the best of our knowledge, the information presented in this memo is accurate.

Regards,



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REFERENCES

Environment Canada. 2009. Environmental Code of Practice for Metal Mines.

HC (Health Canada). 2017. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise.

OGC (British Columbia Oil and Gas Commission). 2018. British Columbia Noise Control Best Practices Guideline

Noise sources, sound levels, and the Bonanza Ledge haul route, associated with the Cariboo Gold Project (the Project) reflective of the Project changes from the October 2022 revised Environmental Assessment Certificate Application (the Revised Application) are outlined in Table A-1, Table A-2, and Table A-3, respectively.

Table A-1: Portal Noise Sources

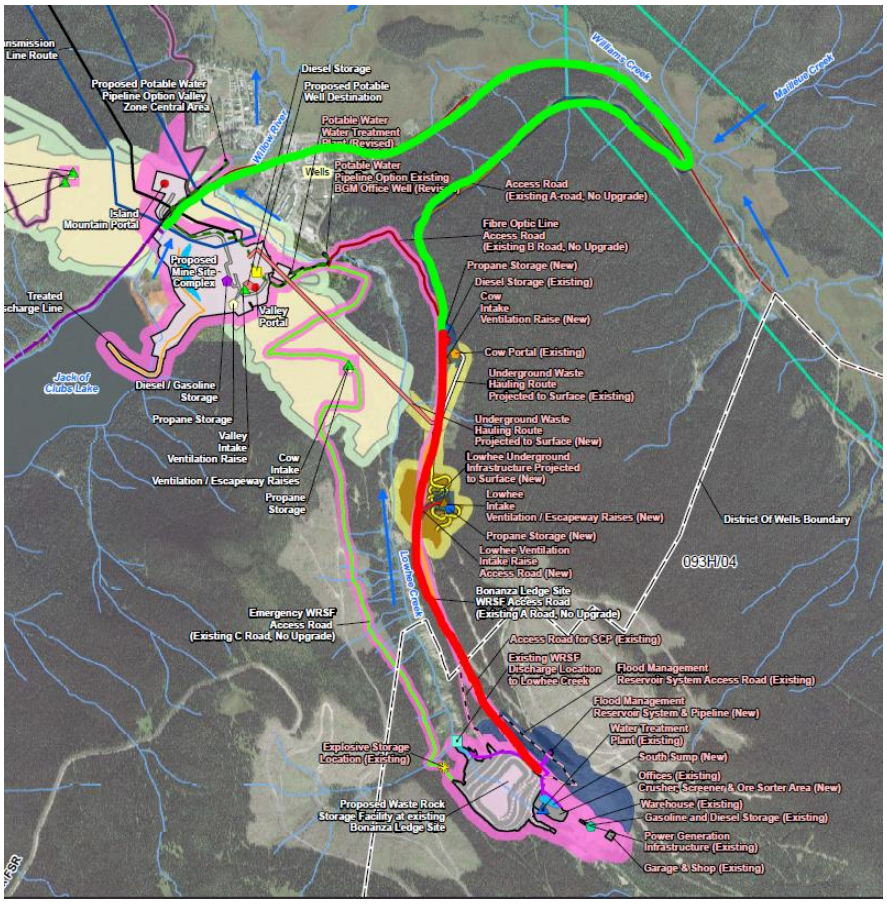
Portals	Construction Sources	Operation Sources
Island Mountain Portal	Excavator Articulated Truck (Earthwords Haul Route) Water Truck Haul Route	Ventilation Exhaust (Shaft Zone)
Valley Portal	2 generators Valley Portal Construction (Telehandler, Excavator, Forklift, Loader) Articulated Truck (Earthwords Haul Route) Explosives Truck Haul Route	Ventilation Exhaust (Valley Zone) Main mine access for personnel and consumables from Year 4 to end of life of mine
Cow Portal (new)	None	**Cow Portal is already built. For first 4 year, it will be the main mine access for all activities. For the rest of the life of mine, only 3 haul trucks full time. First 4 years there will be two generators and accompanying transformers there Rest of the life of mine, no generators
Bonanza Ledge	3 Generators and Transformers Trucks Idling Offices Warehouse (interior) Garage (interior)	Crusher (1st 4 years) (interior) Sorter (1st 4 Years) (interior) Trucks Idling

Table A-2: Sound Levels

Zones	Ventilation	Previous		Current*		Timeline Active	Comments
		Included (yes/no)	Sound Power Level (dBA)	Included (yes/no)	Sound Power Level (dBA)		
Mosquito Zone	Ventilation Raise Intake	yes	101	same location	93 (max)	Year 3-5	--
	Ventilation Raise Exhaust	yes	101	removed	--		--
Shaft Zone	Ventilation Raise Intake	yes	124	same location	91 (max)	Year 1-END	--
	Ventilation Raise Exhaust	no	--	new	--	Year 1-END	--

Zones	Ventilation	Previous		Current*		Timeline Active	Comments
		Included (yes/no)	Sound Power Level (dBA)	Included (yes/no)	Sound Power Level (dBA)		
Island Mountain Portal	Portal Exhaust (Shaft Zone)	yes	124	yes	None; minor traffic and airflow	Year 3-END	
Valley Zone	Ventilation Raise Intake	yes	116	same location	(80 max dba)	Year 3-END	Recommendation to mitigate to 80 dBA
	Ventilation Raise Exhaust	no	--	no	--	--	--
Valley Portal	Portal Exhaust (Valley Zone)	yes	116	Yes	Personnel and material access and equipment traffic	Year 3-END	No fans/exhausts located at this portal
Cow Zone	Ventilation Raise Intake 1	yes	102	same location	84 (max)	Year 6-END	--
	Ventilation Raise Exhaust	no	--	no	--	--	--
	Ventilation Raise Intake 2	no	--	no	--	--	4 existing fans (Howden 4800-VAX-2700) at 112 dBA and 1 existing fan (7200-VAX-2700) at 115 dBA; these fans will be moved underground for the Cariboo Gold Project
Cow Portal	Portal Exhaust (Cow Zone)	no	--	Yes	See comment ** Table A-1	Full life of mine – See comment ** in Table A-1	--
Lowhee Zone	Ventilation Raise Intake	no	--	new	93 (max)	Start to Year 2	--
	Ventilation Raise Exhaust	no	--	no	--		--

Table A-3: Bonanza Ledge Haul Route

Revised Application	With Project Changes
4 dump trucks going back and forth on A-Road and B-Road for construction and operation scenarios	▪ Green + Red road (First 4 years), which includes A-Road and Highway 26: All traffic will use this road including 18-25 haul trucks per day, personnel, and deliveries; ▪ Green + Red road (Year 4 to END), which includes A-Road and Highway 26: Only light vehicle access to Bonanza Ledge and monthly deliveries ▪ Red road (Full life of mine), which consists of A-Road from the Cow Portal to the Bonanza Ledge WRSF: 3 waste hauling trucks full time  **Figure A-1: Bonanza Ledge Haul Routes**

Cow Portal and Bonanza Ledge Transformers

Size: 2 MVA 2000 kVA
Cooling Class: Onan, Liquid Type

Estimated Frequency Spectra for Transformer - 2 MVA - ONAF

61	dBA	Nema Rating of Transformer (based on 2 MVA)	based on NEMA TR1-1993 (R2000), Table 0-2, immersed power transformers.
2.1	m	Length	
2.0	m	Width	
2.5	m	Height	
20.5	sq m	Assumed based on similar size transformer from WSP historical database.	

Correction Factors

Correction Factors	Octave Band Corrections, dB									Notes
	31.5	63	125	250	500	1K	2K	4K	8K	
C1	-1	5	7	2	2	-4	-9	-14	-21	Outdoor Location (or indoor location in a large mechanical room containing other pc of mechanical equip)
C2	-1	8	13	8	8	-1	-9	-14	-21	Indoor Locations in transformer valuts or small rooms (under about 5000ft3) with parallel walls etc.
C3	-1	8	13	12	12	6	1	-4	-11	Any location where a serious noise problem would result if the transformer should become noisy if above its NE

Reference: David A. Bies and Colin H. Hansen, "Engineering Noise Control" , 2005 (Table 11.27)

Sound Power Levels

Correction Factors	Sound Power Levels Calculated[1]									Combined (dB) [2]
	31.5	63	125	250	500	1K	2K	4K	8K	
C1 based (dB)	73	79	81	76	76	70	65	60	53	85
C2 based (dB)	73	82	87	82	82	73	65	60	53	90
C3 based (dB)	73	82	87	86	86	80	75	70	63	92

Notes:

[1] SPL = Average LpA (Nema Rating) + 10 * log10 (Estimated surface area) + C

[2] Transformers are sources that have tonal source characterstics and as per NPC-300 a 5 dB penalty should be included.

Table B-2a: Noise Source Summary - Operation

Noise Source ID	Noise Source Description	Source Type [1]	Cadna Sound Library ID	Source Coordinates (m) NAD 1983, UTM Zone 11U		Octave band sound power spectra (dB)									Overall dB	Overall dBA	Operating Scenario [2]	
				(x)	(y)	31.5	63	125	250	500	1K	2K	4K	8K			Day	Night
Mine Area																		
C_MINE_GENS_01	Mine - Construction - Generator (Valley Portal)	Point	GEN_1000	595643	5883960	81.1	81	94	92	89	91	92	90	79	99	97	60	60
C_MINE_GENS_02	Mine - Construction - Generator (Valley Portal)	Point	GEN_1000	595643	5883957	81	81	94	92	89	91	92	90	79	99	97	60	60
C_MINE_GENS_05	Mine - Construction - Generator (Construction Site)	Point	GEN_1000	595267	5884180	81	81	94	92	89	91	92	90	79	99	97	60	60
C_MINE_GENS_06	Mine - Construction - Generator (Construction Site)	Point	GEN_1000	595540	5884039	81	81	94	92	89	91	92	90	79	99	97	60	60
C_MINE_GENS_07	Mine - Construction - Generator (Bonanza Ledge)	Point	GEN_1000	597369	5881178	81	81	94	92	89	91	92	90	79	99	97	60	60
C_MINE_GENS_08	Mine - Construction - Generator (Bonanza Ledge)	Point	GEN_1000	597373	5881176	81	81	94	92	89	91	92	90	79	99	97	60	60
C_MINE_GENS_09	Mine - Construction - Generator (Bonanza Ledge)	Point	GEN_1000	597377	5881174	81	81	94	92	89	91	92	90	79	99	97	60	60
C_MINE_TRSF_05	Mine - Construction - 2 MVA Transformer (Bonanza Ledge)	Point	PORT_TRAN	597388	5881167	73	79	81	76	76	70	65	60	53	85	76	60	60
C_MINE_TRSF_06	Mine - Construction - 2 MVA Transformer (Bonanza Ledge)	Point	PORT_TRAN	597394	5881165	73	79	81	76	76	70	65	60	53	85	76	60	60
C_MINE_TRSF_07	Mine - Construction - 2 MVA Transformer (Bonanza Ledge)	Point	PORT_TRAN	597399	5881162	73	79	81	76	76	70	65	60	53	85	76	60	60
C_MINE_IPORT_01	Mine - Construction - Island Portal Construction (Excavator)	Area	EXCA_123	Varies	Varies	112	112	108	103	102	98	95	92	84	116	104	18	18
C_MINE_BFSF_01	Mine - Construction - Bulk Fill Storage Area (Excavator, Compactor, Dozer)	Area	EXCA_123++COMP_MOV++DOZR_D7	Varies	Varies	--	--	--	--	--	--	--	--	--	--	117	18	18
C_MINE_WTPC_01	Mine - Construction - WTP Construction (Scissor x2, Telehandler, Crane, Forklift, Skidsteer)	Area	SCIS_MOV++SCIS_MOV++CRN_261++TELE_55++FORK_MOV++SKID_MOV	Varies	Varies	--	--	--	--	--	--	--	--	--	--	106	18	18
C_MINE_VPORT_01	Mine - Construction - Valley Portal Construction (Telehandler, Excavator, Forklift, Loader)	Area	LOAD_988K++TELE_100++EXCA_325++FORK_MOV	Varies	Varies	--	--	--	--	--	--	--	--	--	--	113	18	18
C_MINE_CAMP_01	Mine - Construction - Camp Construction (Telehandler, Scissorlift)	Area	TELE_55++SCIS_MOV	Varies	Varies	--	--	--	--	--	--	--	--	--	--	100	18	18
C_MINE_VENT_01	Mine - Construction - Valley Ventilation (Dozer, Excavator, Scissor, Crane)	Area	DOZR_D7++EXCA_325++SCIS_MOV++CRN_261	Varies	Varies	--	--	--	--	--	--	--	--	--	--	117	18	18
C_MINE_VENT_02	Mine - Construction - Ventilation Raise (crane,dozer)	Area	DOZR_D7++CRN_261	Varies	Varies	--	--	--	--	--	--	--	--	--	--	117	18	18
C_MINE_SUBS_01	Mine - Construction - Substation (Scissor,Telehandler)	Area	SCIS_MOV++TELE_55	Varies	Varies	--	--	--	--	--	--	--	--	--	--	100	18	18
C_MINE_SBCN_01	Mine - Construction - Service Building (Forklift, Scissor x2, Crane, Skidsteer)	Area	FORK_MOV++SCIS_MOV++SCIS_MOV++SCIS_MOV++CRN_239++SKID_MOV	Varies	Varies	--	--	--	--	--	--	--	--	--	--	106	18	18
C_MINE_SBCN_02	Mine - Construction - Service Building (Excavator, Loader, Scissor x2, Crane)	Area	EXCA_325++SCIS_MOV++SCIS_MOV++CRN_350++LOAD_988K	Varies	Varies	--	--	--	--	--	--	--	--	--	--	113	18	18
C_MINE_SBCN_03	Mine - Construction - Service Building (forklift, telehandler, crane, scissor)	Area	CRN_261++SCIS_MOV++TELE_100++FORK_MOV	Varies	Varies	--	--	--	--	--	--	--	--	--	--	109	18	18
C_MINE_TKID_01	Mine - Construction - Trucks Idling @ WRSF	Point	TRK_IDL	596953	5881421	95	104	106	96	96	95	94	91	86	109	101	15	15
C_MINE_WRSF_01	Mine - Construction - WRSF Haul Route (Cow Portal to Bonanza Ledge)	Line	DUMP_MOV	Varies	Varies	116	116	112	103	101	103	100	96	88	120	107	3	3
C_MINE_WRTK_01	Mine - Construction - Water Truck Haul Route (Island Portal to Bonanza Ledge)	Line	WRTK_MOV	Varies	Varies	105	109	103	98	99	99	96	91	82	112	103	1	1
C_MINE_DPTK_01	Mine - Construction - Articulated Truck Earthworks Haul Route (Island Portal to Mine Site Complex)	Line	DUMP_MOV	Varies	Varies	116	116	112	103	101	103	100	96	88	120	107	1	1
C_MINE_DPTK_02	Mine - Construction - Articulated Truck Earthworks Haul Route (Valley Portal to Mine Site Complex)	Line	DUMP_MOV	Varies	Varies	116	116	112	103	101	103	100	96	88	120	107	1	1
C_MINE_DPTK_03	Mine - Construction - Articulated Truck Earthworks Haul Route (Cow Zone to Mine Site Complex)	Line	DUMP_MOV	Varies	Varies	116	116	112	103	101	103	100	96	88	120	107	2	2
QR Mill																		
C_MILL_FRKL_01	Mill - Construction - Forklift (Process Support)	Point	FORK_MOV	581672	5836548	84	101	88	92	89	87	86	80	70	102	93	18	18
C_MILL_SCIS_01	Mill - Construction - Scissor Lift	Point	SCIS_MOV	581446	5836577	106	106	104	90	91	88	87	86	77	110	95	18	18
C_MILL_SKID_01	Mill - Construction - Skid Steer (Process Support)	Point	SKID_MOV	581740	5836520	91	97	102	97	93	93	91	83	75	105	98	18	18
C_MILL_TELE_01	Mill - Construction - Telehandler (Surface Support)	Point	TELE_100	581734	5836495	107	107	101	94	93	106	94	82	75	112	107	18	18
C_MILL_DOME_01	Mill - Construction - Dome (Scissor, Loader x 2, Excavator, Compactor)	Area	SCIS_MOV++LOAD_988K++LOAD_988K++COMP_MOV++EXCA_325	Varies	Varies	--	--	--	--	--	--	--	--	--	--	114	18	18
C_MILL_DSTK_01	Mill - Construction - Drystack Facilty and WTP (Scissor x 3, Telehandler x 2, Crane)	Area	SCIS_MOV++SCIS_MOV++SCIS_MOV++TELE_55++TELE_100++CRN_261	Varies	Varies	--	--	--	--	--	--	--	--	--	--	109	18	18
Transportation Routes																		
C_MINE_DLTK_01	Mine - Construction - Delivery Trucks Haul Route (to Mine Site Complex)	Line	DELV_MOV	Varies	Varies	96	95	97	97	101	101	97	87	78	107	104	1	1
C_MINE_DLTK_02	Mine - Construction - Delivery Trucks Haul Route (Mine to Bonanza Ledge)	Line	DELV_MOV	Varies	Varies	96	95	97	97	101	101	97	87	78	107	104	1	1
C_MINE_EXTK_01	Mine - Construction - Explosives Truck Haul Route (to Valley Portal)	Line	DELV_MOV	Varies	Varies	96	95	97	97	101	101	97	87	78	107	104	1	1
C_MINE_EXTK_02	Mine - Construction - Explosives Trucks Haul Route (Mine to Bonanza Ledge)	Line	DELV_MOV	Varies	Varies	96	95	97	97	101	101	97	87	78	107	104	1	1
C_MILL_DLTK_01	Mill - Construction - Delivery Trucks Haul Route	Line	DELV_MOV	Varies	Varies	96	95	97	97	101	101	97	87	78	107	104	1	1
Transmission Line																		
C_TLIN_EXCA_01	Transmission Line - Constuction - Excavator	Point	EXCA_325	538202	5874595	114	114	118	106	102	103	98	90	88	121	108	30	30
C_TLIN_SCIS_01	Transmission Line - Constuction - Scissor Lift	Point	SCIS_MOV	538216	5874627	106	106	104	90	91	88	87	86	77	110	95	30	30
C_TLIN_CRAN_01	Transmission Line - Constuction - Crane	Point	CRN_350	538198	5874620	108	108	107	101	102	101	101	92	83	114	106	30	30
C_TLIN_DOZR_01	Transmission Line - Constuction - Dozer	Point	DOZR_D7	538225	5874608	111	111	112	108	105	107	104	114	103	119	117	30	30
C_TLIN_EXAC_02	Transmission Line - Construction - Excavator	Line	EXCA_325	Varies	Varies	114	114	118	106	102	103	98	90	88	121	108	1	1
C_TLIN_SCIS_02	Transmission Line - Construction - Scissor Lift	Line	SCIS_MOV	Varies	Varies	106	106	104	90	91	88	87	86	77	110	95	1	1
C_TLIN_CRAN_02	Transmission Line - Construction - Crane	Line	CRN_239	Varies	Varies	105	109	103	98	99	99	96	91	82	112	103	1	1
C_TLIN_DOZR_02	Transmission Line - Construction - Dozer	Line	DOZR_D7	Varies	Varies	111	111	112	108	105	107	104	114	103	119	117	1	1

Notes:

[1] Source type - Point - the PWL represents the overall level for the entire source. Line Source - mobile equipment that is modelled as a moving point source along a line, and the PWL is calculated from a single-vehicle passby.

[2] Daytime = 0700-2200 h and Nighttime = 2200 - 0700h. For point sources - the number indicates the number of minutes per hour the source is operating in a worst-case hour. For line sources - the number indicates the number of trucks during a worst-case hour.

Table B-2b: Noise Source Summary - Operation

Noise Source ID	Noise Source Description	Source Type [1]	Cadna Sound Library ID	Source Coordinates (m) NAD 1983, UTM Zone 11U		Octave band sound power spectra (dB)									Overall dB	Overall dBA	Number of Trucks [2]	
				(x)	(y)	31.5	63	125	250	500	1K	2K	4K	8K			Day	Night
Mine Area																		
O_MINE_TRSF_01	Mine - Operation - 2 MVA Transformer (Cow Portal)	Point	PORT_TRAN	596628	5883684	73	79	81	76	76	70	65	60	53	85	76	60	60
O_MINE_TRSF_02	Mine - Operation - 2 MVA Transformer (Cow Portal)	Point	PORT_TRAN	596635	5883685	73	79	81	76	76	70	65	60	53	85	76	60	60
O_MINE_CMDC_01	Mine - Operation - Cement Area Dust Collector	Point	DC_CEM	595575	5884035	108	108	108	102	92	83	71	65	60	113	97	60	60
O_MINE_OFVT_01	Mine - Operation - Office Ventilation	Point	EXF_OFF	595610	5884023	83	83	86	88	81	75	67	59	52	92	83	60	60
O_MINE_RSDC_01	Mine - Operation - Rock Sorter Area Dust Collector	Point	DC_ROCK	595550	5884113	103	103	103	96	90	77	66	60	52	108	92	60	60
O_MINE_WGVT_01	Mine - Operation - Warehouse & Garage Ventilation	Point	EXF_WARE	595591	5883988	95	95	93	95	88	82	74	66	59	101	90	60	60
O_MINE_TKLO_01	Mine - Operation - Load Out of Ore at Product Conveyor (Service Building)	Point	LOAD_OUT	595533	5884094	110	109	110	107	106	104	101	96	92	116	109	30	30
O_MINE_TKLO_02	Mine - Operation - Load Out of Ore at Ore Sorter (Bonanza Ledge)	Point	LOAD_OUT	597232	5881207	110	109	110	107	106	104	101	96	92	116	109	30	30
O_MINE_TKID_01	Mine - Operation - Truck Idling at Loading of Ore	Point	TRK_IDL	595534	5884091	95	104	106	96	96	95	94	91	86	109	101	30	30
O_MINE_TKID_02	Mine - Operation - Trucks Idling @ WRSF	Point	TRK_IDL	596953	5881421	95	104	106	96	96	95	94	91	86	109	101	15	15
O_MINE_TKID_03	Mine - Operation - Truck Idling at Loading of Ore (Bonanza Ledge)	Point	TRK_IDL	597237	5881205	95	104	106	96	96	95	94	91	86	109	101	30	30
O_MINE_WGVT_01	Mine - Operation - Warehouse & Garage Ventilation	Point	EXF_WARE	595591	5883988	95	95	93	95	88	82	74	66	59	101	90	60	60
O_MINE_WTPB_01	Mine - WTP Building Breakout Noise	V.Area	WTP_PUMP	Varies	Varies	81	81	81	83	82	84	77	70	59	90	86	60	60
O_MINE_SBBN_01	Mine - Services Building Breakout Noise	V.Area	MINE_BLG1	Varies	Varies	104	104	97	96	95	90	84	76	62	108	96	60	60
O_MINE_SBBN_02	Mine - Services Building 2 Breakout Noise	V.Area	MINE_BLG2	Varies	Varies	90	90	95	82	87	85	81	74	65	98	89	60	60
O_MINE_SBBN_03	Mine - Services Building 2 Breakout Noise	V.Area	MINE_BLG2	Varies	Varies	90	90	95	82	87	85	81	74	65	98	89	60	60
O_MINE_LOAD_01	Mine - Operation - Loader (Processing Support)	Point	LOAD_988K	595574	5883998	120	120	112	111	105	104	102	99	90	124	110	60	60
O_MINE_VEXH_01	Mine - Operation - Ventilation Raise Exhaust (Shaft Zone)	Point	SHAFT_FAN	594667	5884506	135	135	130	126	123	116	110	101	96	139	124	60	60
O_MINE_VEXH_02	Mine - Operation - Portal Exhaust (Shaft Zone)	Point	SHAFT_FAN	595184	5884495	135	135	130	126	123	116	110	101	96	139	124	60	60
O_MINE_VEXH_03	Mine - Operation - Portal Exhaust (Valley Zone)	Point	VALLEY_FAN	595652	5883959	127	127	122	118	115	108	102	93	88	131	116	60	60
O_MINE_VEXH_04	Mine - Operation - Portal Exhaust (Cow Zone)	Point	VALLEY_FAN	596690	5883614	127	127	122	118	115	108	102	93	88	131	116	60	60
O_MINE_VINT_01	Mine - Operation - Ventilation Raise Intake (Mosquito Zone)	Point	MOSQUITO_FAN	593553	5885361	112	112	107	103	100	93	87	78	73	116	101	60	60
O_MINE_VINT_02	Mine - Operation - Ventilation Raise Intake (Shaft Zone)	Point	SHAFT_FAN	594710	5884555	135	135	130	126	123	116	110	101	96	139	124	60	60
O_MINE_VINT_03	Mine - Operation - Ventilation Raise Intake (Valley Zone)	Point	VALLEY_FAN	595539	5883873	127	127	122	118	115	108	102	93	88	131	116	60	60
O_MINE_VINT_04	Mine - Operation - Ventilation Raise Intake (Cow Zone)	Point	COW_FAN	596137	5883556	114	114	109	105	102	95	89	80	75	118	103	60	60
O_MINE_VINT_05	Mine - Operation - Ventilation Raise Intake (Lowhee Zone)	Point	COW_FAN	596636	5882845	114	114	109	105	102	95	89	80	75	118	103	60	60
O_MINE_GENS_01	Mine - Operation - Generator (Cow Portal)	Point	GEN_1000	596635	5883690	81	81	94	92	89	91	92	90	79	99	97	60	60
O_MINE_GENS_02	Mine - Operation - Generator (Cow Portal)	Point	GEN_1000	596635	5883699	81	81	94	92	89	91	92	90	79	99	97	60	60
O_MINE_GENS_07	Mine - Construction - Generator (Bonanza Ledge)	Point	GEN_1000	597369	5881178	81	81	94	92	89	91	92	90	79	99	97	60	60
O_MINE_GENS_08	Mine - Construction - Generator (Bonanza Ledge)	Point	GEN_1000	597373	5881176	81	81	94	92	89	91	92	90	79	99	97	60	60
O_MINE_GENS_09	Mine - Construction - Generator (Bonanza Ledge)	Point	GEN_1000	597377	5881174	81	81	94	92	89	91	92	90	79	99	97	60	60
O_MINE_TRSF_01	Mine - Operation - 2 MVA Transformer (Cow Portal)	Point	PORT_TRAN	596628	5883684	73	79	81	76	76	70	65	60	53	85	76	60	60
O_MINE_TRSF_02	Mine - Operation - 2 MVA Transformer (Cow Portal)	Point	PORT_TRAN	596635	5883685	73	79	81	76	76	70	65	60	53	85	76	60	60
O_MINE_TRSF_03	Mine - Operation - 2 MVA Transformer (Cow Portal)	Point	PORT_TRAN	596628	5883678	73	79	81	76	76	70	65	60	53	85	76	60	60
O_MINE_TRSF_04	Mine - Operation - 2 MVA Transformer (Cow Portal)	Point	PORT_TRAN	596636	5883678	73	79	81	76	76	70	65	60	53	85	76	60	60
O_MINE_TRSF_05	Mine - Operation - 2 MVA Transformer (Bonanza Ledge)	Point	PORT_TRAN	597388	5881167	73	79	81	76	76	70	65	60	53	85	76	60	60
O_MINE_TRSF_06	Mine - Operation - 2 MVA Transformer (Bonanza Ledge)	Point	PORT_TRAN	597394	5881165	73	79	81	76	76	70	65	60	53	85	76	60	60
O_MINE_TRSF_07	Mine - Operation - 2 MVA Transformer (Bonanza Ledge)	Point	PORT_TRAN	597399	5881162	73	79	81	76	76	70	65	60	53	85	76	60	60
O_MINE_CRSH_01	Mine - Operation - Crusher (Bonanza Ledge)	Point	MINE_CRSH	597213	5881216	109	110	111	113	112	111	106	105	97	119	115	50	50
O_MINE_SCRN_01	Mine - Operation - Screen	Point	MINE_SCRN	597220	5881213	119	115	106	94	93	88	85	83	81	121	97	60	60
O_MINE_SORE_01	Mine - Operation - Ore Sorter	Point	MINE_OSRT	597226	5881209	106	116	113	104	113	107	104	99	92	120	113	60	60
O_HLRT_SLTR_01	Mine - Operation - WTP Slude Truck Movement (to Mine Site Complex WTP)	Line	SEMI_MOV	Varies	Varies	112	112	108	102	101	105	100	99	92	117	108	1	1
O_MINE_WRSF_01	Mine - Operation - WRSF Haul Route (Cow Portal to Bonanza Ledge)	Line	DUMP_MOV	Varies	Varies	116	116	112	103	101	103	100	96	88	120	107	3	3
QR Mill																		
O_MILL_ASSY_01	Mill - Operation - Assay Lab Fan	Point	MILL_ASSAY	581757	5836474	79	79	79	77	73	68	62	58	53	85	75	60	60
O_MILL_CYEX_01	Mill - Operation - Cyanide Exhaust Fan	Point	MILL_600	581709	5836549	69	69	69	65	53	43	32	26	18	74	59	60	60
O_MILL_DSEX_01	Mill - Operation - DryStack Building Fan	Point	MILL_DRYS	581630	5836504	90	90	93	95	88	82	74	66	59	99	90	60	60
O_MILL_EWEX_01	Mill - Operation - Electrowinning exhaust fan	Point	MILL_600	581711	5836547	69	69	69	65	53	43	32	26	18	74	59	60	60
O_MILL_KEXH_01	Mill - Operation - Carbon regeneration kiln exhaust	Point	MILL_CARB	581723	5836514	75	75	78	68	59	49	38	32	24	81	65	60	60
O_MILL_PEXH_01	Mill - Operation - Exhaust Fan #1	Point	MILL_EXF1_2	581724	5836515	90	90	93	95	88	82	74	66	59	99	90	60	60
O_MILL_PEXH_02	Mill - Operation - Exhaust Fan #2	Point	MILL_EXF1_2	581721	5836511	90	90	93	95	88	82	74	66	59	99	90	60	60
O_MILL_PEXH_03	Mill - Operation - Exhaust Fan #3	Point	MILL_EXF3_4	581731	5836527	99	99	97	99	92	86	78	70	63	105	94	60	60
O_MILL_PEXH_04	Mill - Operation - Exhaust Fan #4	Point	MILL_EXF3_4	581716	5836502	99	99	97	99	92	86	78	70	63	105	94	60	60
O_MILL_SMSB_01	Mill - Operation - SMBS Exhaust Fan	Point	MILL_600	581726	5836537	69	69	69	65	53	43	32	26	18	74	59	60	60
O_MILL_DOME_01	Mill - MegaDome Breakout Noise	V.Area	MILL_DOME	Varies	Varies	115	115	109	105	102	100	95	87	75	119	105	60	60
O_MILL_DOME_02	Mill - MegaDome Breakout Noise	V.Area	MILL_DOME	Varies	Varies	115	115	109	105	102	100	95	87	75	119	105	60	60

Table B-2b: Noise Source Summary - Operation

Noise Source ID	Noise Source Description	Source Type [1]	Cadna Sound Library ID	Source Coordinates (m) NAD 1983, UTM Zone 11U		Octave band sound power spectra (dB)									Overall dB	Overall dBA	Number of Trucks [2]	
				(x)	(y)	31.5	63	125	250	500	1K	2K	4K	8K			Day	Night
O_MILL_DOME_03	Mill - MegaDome Breakout Noise	V.Area	MILL_DOME	Varies	Varies	115	115	109	105	102	100	95	87	75	119	105	60	60
O_MILL_DOME_04	Mill - MegaDome Breakout Noise	V.Area	MILL_MILL	Varies	Varies	106	106	110	96	96	94	90	83	74	113	100	60	60
O_MILL_MILL_01	Mill - QR MILL Breakout Noise	V.Area	MILL_MILL	Varies	Varies	106	106	110	96	96	94	90	83	74	113	100	60	60
O_MILL_MILL_02	Mill - QR MILL Breakout Noise	V.Area	MILL_MILL	Varies	Varies	106	106	110	96	96	94	90	83	74	113	100	60	60
O_MILL_MILL_03	Mill - QR MILL Breakout Noise	V.Area	MILL_MILL	Varies	Varies	106	106	110	96	96	94	90	83	74	113	100	60	60
O_MILL_MILL_04	Mill - QR MILL Breakout Noise	V.Area	MILL_MILL	Varies	Varies	106	106	110	96	96	94	90	83	74	113	100	60	60
O_MILL_DRYB_01	Mill - Dry Stack Facility Breakout Noise	V.Area	MILL_DSTK	Varies	Varies	94	94	83	88	95	90	75	70	57	100	94	60	60
O_MILL_DRYB_02	Mill - Dry Stack Facility Breakout Noise	V.Area	MILL_DSTK	Varies	Varies	94	94	83	88	95	90	75	70	57	100	94	60	60
O_MILL_DRYB_03	Mill - Dry Stack Facility Breakout Noise	V.Area	MILL_DSTK	Varies	Varies	94	94	83	88	95	90	75	70	57	100	94	60	60
O_MILL_DRYB_04	Mill - Dry Stack Facility Breakout Noise	V.Area	MILL_DSTK	Varies	Varies	94	94	83	88	95	90	75	70	57	100	94	60	60
O_MILL_DRYB_05	Mill - Dry Stack Facility Breakout Noise	V.Area	MILL_DSTK	Varies	Varies	94	94	83	88	95	90	75	70	57	100	94	60	60
O_MILL_DRYB_06	Mill - Dry Stack Facility Breakout Noise	V.Area	MILL_DSTK	Varies	Varies	94	94	83	88	95	90	75	70	57	100	94	60	60
O_MILL_WTPB_01	Mill - WTP Breakout Noise	V.Area	MILL_WTP	Varies	Varies	83	83	82	84	83	84	78	72	61	91	87	60	60
O_MILL_WTPB_02	Mill - WTP Breakout Noise	V.Area	MILL_WTP	Varies	Varies	83	83	82	84	83	84	78	72	61	91	87	60	60
O_MILL_WTPB_03	Mill - WTP Breakout Noise	V.Area	MILL_WTP	Varies	Varies	83	83	82	84	83	84	78	72	61	91	87	60	60
O_MILL_WTPB_04	Mill - WTP Breakout Noise	V.Area	MILL_WTP	Varies	Varies	83	83	82	84	83	84	78	72	61	91	87	60	60
O_MILL_DOZR_01	Mill - Operation - Dozer (Surface Support)	Point	DOZR_D7	581714	5836455	111	111	112	108	105	107	104	114	103	119	117	60	60
O_MILL_FRKL_01	Mill - Operation - Forklift (Process Support)	Point	FORK_MOV	581672	5836548	84	101	88	92	89	87	86	80	70	102	93	60	60
O_MILL_LOAD_01	Mill - Operation - Loader (Surface Support)	Point	LOAD_988K	581653	5836480	120	120	112	111	105	104	102	99	90	124	110	60	60
O_MILL_SKID_01	Mill - Operation - Skid Steer (Process Support)	Point	SKID_MOV	581740	5836520	91	97	102	97	93	93	91	83	75	105	98	60	60
O_MILL_TELE_01	Mill - Operation - Telehandler (Surface Support)	Point	TELE_100	581734	5836495	107	107	101	94	93	106	94	82	75	112	107	60	60
O_MILL_TKID_01	Mill - Operation - Truck Idling at Dry Stack Tailings Facility Loadout Area	Point	DUMP_MOV	581593	5836538	116	116	112	103	101	103	100	96	88	120	107	15	15
O_MILL_COVY_01	Mill - Operation - Conveyor Transfer at Dry Stack Tailings Facility Loadout Area	Point	CONV_MOT	581609	5836528	90	102	90	96	101	88	84	82	74	106	99	60	60
O_MILL_TKLD_01	Mine - Operation - Truck Loadout to Tailings	Point	LOAD_OUT	581597	5836535	110	109	110	107	106	104	101	96	92	116	109	60	60
O_MILL_TKTL_01	Mill - Truck Haul Route from Dry Stack to Tailings Pond	Line	DUMP_MOV	Varies	Varies	116	116	112	103	101	103	100	96	88	120	107	1	1
Transportation Routes																		
O_HLRT_ORTK_01	Mine - Operation - Ore Delivery Trucks Haul Route (Mine Site Complex to QR Mill)	Line	SEMI_MOV	Varies	Varies	112	112	108	102	101	105	100	99	92	117	108	2	2
O_HLRT_ORTK_02	Mine - Operation - Ore Delivery Trucks Haul Route (Around Services Bldg Area)	Line	SEMI_MOV	Varies	Varies	112	112	108	102	101	105	100	99	92	117	108	2	2
O_HLRT_ORTK_03	Mine - Operation - Ore Delievery Trucks Haul Route (Bonanza Ledge)	Line	SEMI_MOV	Varies	Varies	112	112	108	102	101	105	100	99	92	117	108	1	1
O_MINE_DLTK_01	Mine - Operation - Delivery Trucks Haul Route (to Mine Site Complex)	Line	DELV_MOV	Varies	Varies	96	95	97	97	101	101	97	87	78	107	104	1	1
O_MINE_DLTK_02	Mine - Operation - Delivery Trucks Haul Route (Mine to Bonanza Ledge)	Line	DELV_MOV	Varies	Varies	96	95	97	97	101	101	97	87	78	107	104	1	1
O_MINE_EXTK_01	Mine - Operation - Explosives Truck Haul Route (Mine Site Complex)	Line	DELV_MOV	Varies	Varies	96	95	97	97	101	101	97	87	78	107	104	1	1
O_MILL_DLTK_01	Mill - Operation - Delivery Trucks Haul Route	Line	DELV_MOV	Varies	Varies	96	95	97	97	101	101	97	87	78	107	104	1	1
Transmission Line																		
O_TLIN_LINE_01	Operation - Transmission Line	Line	TRAN_LINE	Varies	Varies	56	65	70	69	69	63	58	53	46	75	69	60	60

Notes:

[1] Source type - Point - the PWL represents the overall level for the entire source. Line Source - mobile equipment that is modelled as a moving point source along a line, and the PWL is calculated from a single-vehicle passby.

[2] Daytime = 0700-2200 h and Nighttime = 2200 - 0700h. For point sources - the number indicates the number of minutes per hour the source is operating in a worst-case hour. For line sources - the number indicates the number of trucks during a worst-case hour.

Table C-2a: HA Summary of Results for Construction

POR ID [1]	DAY-NIGHT SOUND LEVEL Ldn, HC [DBA]					
	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN %HA	EFFECT ASSESSMENT
R1_05	50.1	54.6	55.9	6.5	2.4	No Effect, No Further Mitigation
R3_09	51.4	54.1	56.0	6.5	2.0	No Effect, No Further Mitigation
R8_03	49.6	53.3	54.8	6.5	2.0	No Effect, No Further Mitigation
R3_07	51.4	53.9	55.8	6.5	2.0	No Effect, No Further Mitigation
R11_03	52.7	54.3	56.6	6.5	2.0	No Effect, No Further Mitigation
R3_08	51.4	53.7	55.7	6.5	1.9	No Effect, No Further Mitigation
R3_06	51.4	53.4	55.5	6.5	1.8	No Effect, No Further Mitigation
R1_04	50.1	52.9	54.7	6.5	1.8	No Effect, No Further Mitigation
R3_05	51.4	53.1	55.4	6.5	1.7	No Effect, No Further Mitigation
R1_02	50.1	52.5	54.5	6.5	1.7	No Effect, No Further Mitigation
R11_04	52.7	53.4	56.1	6.5	1.7	No Effect, No Further Mitigation
R1_01	50.1	52.2	54.3	6.5	1.6	No Effect, No Further Mitigation
R1_03	50.1	52.1	54.2	6.5	1.5	No Effect, No Further Mitigation
R3_04	51.4	52.3	54.9	6.5	1.5	No Effect, No Further Mitigation
R3_03	51.4	52.0	54.7	6.5	1.4	No Effect, No Further Mitigation
R8_05	49.6	51.2	53.5	6.5	1.3	No Effect, No Further Mitigation
R8_04	49.6	51.1	53.4	6.5	1.3	No Effect, No Further Mitigation
R8_02	49.6	50.9	53.3	6.5	1.3	No Effect, No Further Mitigation
R3_02	51.4	51.1	54.3	6.5	1.2	No Effect, No Further Mitigation
R8_01	49.6	50.3	53.0	6.5	1.1	No Effect, No Further Mitigation
R3_01	51.4	50.4	54.0	6.5	1.0	No Effect, No Further Mitigation
R8_14	49.6	49.4	52.5	6.5	0.9	No Effect, No Further Mitigation
R8_08	49.6	48.7	52.2	6.5	0.8	No Effect, No Further Mitigation
R2_01	50.3	46.7	51.8	6.5	0.5	No Effect, No Further Mitigation
R8_11	49.6	45.7	51.1	6.5	0.4	No Effect, No Further Mitigation
R2_04	50.3	45.8	51.6	6.5	0.4	No Effect, No Further Mitigation
R8_12	49.6	45.1	50.9	6.5	0.4	No Effect, No Further Mitigation
R8_15	49.6	45.1	50.9	6.5	0.4	No Effect, No Further Mitigation
R2_02	50.3	45.4	51.5	6.5	0.4	No Effect, No Further Mitigation
R10_07	53.4	46.6	54.2	6.5	0.4	No Effect, No Further Mitigation
R8_10	49.6	44.4	50.7	6.5	0.3	No Effect, No Further Mitigation
R8_13	49.6	44.4	50.7	6.5	0.3	No Effect, No Further Mitigation
R11_01	52.7	45.6	53.5	6.5	0.3	No Effect, No Further Mitigation
R2_03	50.3	44.5	51.3	6.5	0.3	No Effect, No Further Mitigation
R11_05	52.7	45.5	53.5	6.5	0.3	No Effect, No Further Mitigation
LAA3_08N	51.6	44.8	52.4	6.5	0.3	No Effect, No Further Mitigation
R11_08	52.7	45.3	53.4	6.5	0.3	No Effect, No Further Mitigation
LAA3_01	51.4	44.5	52.2	6.5	0.3	No Effect, No Further Mitigation
R10_04	53.4	45.1	54.0	6.5	0.3	No Effect, No Further Mitigation
R2_05	50.3	43.7	51.1	6.5	0.3	No Effect, No Further Mitigation
R11_09	52.7	44.7	53.4	6.5	0.3	No Effect, No Further Mitigation
R10_06	53.4	44.8	53.9	6.5	0.3	No Effect, No Further Mitigation
R11_07	52.7	44.3	53.3	6.5	0.2	No Effect, No Further Mitigation
R8_09	49.6	42.9	50.4	6.5	0.2	No Effect, No Further Mitigation
R2_06	50.3	43.2	51.0	6.5	0.2	No Effect, No Further Mitigation

Table C-2a: HA Summary of Results for Construction

POR ID [1]	DAY-NIGHT SOUND LEVEL Ldn, HC [DBA]					
	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN %HA	EFFECT ASSESSMENT
R8_16	49.6	42.7	50.4	6.5	0.2	No Effect, No Further Mitigation
R10_05	53.4	44.2	53.9	6.5	0.2	No Effect, No Further Mitigation
R10_03	53.4	43.4	53.8	6.5	0.2	No Effect, No Further Mitigation
R11_10	52.7	43.1	53.2	6.5	0.2	No Effect, No Further Mitigation
R10_01	53.4	43.3	53.8	6.5	0.2	No Effect, No Further Mitigation
R10_02	53.4	43.0	53.7	6.5	0.2	No Effect, No Further Mitigation
R11_02	52.7	42.7	53.1	6.5	0.2	No Effect, No Further Mitigation
R8_06	49.6	41.3	50.2	6.5	0.2	No Effect, No Further Mitigation
R11_06	52.7	41.7	53.0	6.5	0.1	No Effect, No Further Mitigation
LAA3_06	51.6	41.1	52.0	6.5	0.1	No Effect, No Further Mitigation
R9_17	53.8	42.0	54.0	6.5	0.1	No Effect, No Further Mitigation
R9_12	53.8	41.9	54.0	6.5	0.1	No Effect, No Further Mitigation
R11_12	52.7	39.4	52.9	6.5	0.1	No Effect, No Further Mitigation
R9_20	53.8	39.8	53.9	6.5	0.1	No Effect, No Further Mitigation
R10_08	53.4	39.5	53.5	6.5	0.1	No Effect, No Further Mitigation
R9_07	53.8	39.6	53.9	6.5	0.1	No Effect, No Further Mitigation
LAA3_07	51.4	38.4	51.7	6.5	0.1	No Effect, No Further Mitigation
R9_02	53.8	39.0	53.9	6.5	0.1	No Effect, No Further Mitigation
R9_03	53.8	39.0	53.9	6.5	0.1	No Effect, No Further Mitigation
R9_10	53.8	39.0	53.9	6.5	0.1	No Effect, No Further Mitigation
R9_11	53.8	39.0	53.9	6.5	0.1	No Effect, No Further Mitigation
R9_18	53.8	38.9	53.9	6.5	0.1	No Effect, No Further Mitigation
LAA8_12	49.6	35.6	49.7	6.5	0.0	No Effect, No Further Mitigation
LAA3_03N	51.6	36.3	51.7	6.5	0.0	No Effect, No Further Mitigation
R10_09	53.4	37.0	53.5	6.5	0.0	No Effect, No Further Mitigation
R9_08	53.8	36.6	53.8	6.5	0.0	No Effect, No Further Mitigation
R8_07	49.6	34.2	49.7	6.5	0.0	No Effect, No Further Mitigation
R9_06	53.8	36.1	53.8	6.5	0.0	No Effect, No Further Mitigation
R9_01	53.8	35.8	53.8	6.5	0.0	No Effect, No Further Mitigation
R11_11	52.7	35.1	52.8	6.5	0.0	No Effect, No Further Mitigation
R5_05	42.8	30.6	43.0	6.5	0.0	No Effect, No Further Mitigation
R5_04	42.8	30.3	43.0	6.5	0.0	No Effect, No Further Mitigation
R9_04	53.8	35.2	53.8	6.5	0.0	No Effect, No Further Mitigation
R9_05	53.8	35.2	53.8	6.5	0.0	No Effect, No Further Mitigation
R9_09	53.8	34.6	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_19	49.6	32.5	49.7	6.5	0.0	No Effect, No Further Mitigation
R5_03	42.8	29.4	43.0	6.5	0.0	No Effect, No Further Mitigation
R5_02	42.8	29.4	43.0	6.5	0.0	No Effect, No Further Mitigation
LAA11_03	52.7	33.7	52.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_18	49.6	32.2	49.7	6.5	0.0	No Effect, No Further Mitigation
LAA10_03	53.4	33.7	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA10_01	53.4	33.2	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA9_07	53.8	33.1	53.8	6.5	0.0	No Effect, No Further Mitigation
R9_15	53.8	33.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA3_05	49.4	30.8	49.4	6.5	0.0	No Effect, No Further Mitigation

Table C-2a: HA Summary of Results for Construction

POR ID [1]	DAY-NIGHT SOUND LEVEL Ldn, HC [DBA]					
	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN %HA	EFFECT ASSESSMENT
R9_16	53.8	32.8	53.8	6.5	0.0	No Effect, No Further Mitigation
R4_02	51.6	31.4	51.6	6.5	0.0	No Effect, No Further Mitigation
R9_19	53.8	32.4	53.8	6.5	0.0	No Effect, No Further Mitigation
R4_03	51.6	31.3	51.6	6.5	0.0	No Effect, No Further Mitigation
R4_04	51.6	31.3	51.6	6.5	0.0	No Effect, No Further Mitigation
R4_05	51.6	31.1	51.6	6.5	0.0	No Effect, No Further Mitigation
LAA8_10	49.6	30.1	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_04	53.8	32.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_11	53.8	31.8	53.8	6.5	0.0	No Effect, No Further Mitigation
R4_01	51.6	30.7	51.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_05	53.8	31.3	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_11	49.6	29.2	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA10_02	53.4	30.9	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA3_02	51.4	29.9	51.5	6.5	0.0	No Effect, No Further Mitigation
LAA7_04	49.0	28.1	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA8_17	49.6	28.3	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA7_05	49.0	27.9	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA11_02	52.7	29.4	52.7	6.5	0.0	No Effect, No Further Mitigation
LAA10_07	53.4	29.6	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA8_16	49.6	27.6	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_12	53.8	29.3	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA11_01	52.7	28.8	52.7	6.5	0.0	No Effect, No Further Mitigation
LAA9_01	53.8	29.1	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_10	53.8	29.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA10_04	53.4	28.3	53.4	6.5	0.0	No Effect, No Further Mitigation
R5_01	42.8	23.5	42.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_02	49.6	26.5	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA8_09	49.6	25.8	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA7_02	49.0	25.5	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA8_03	49.6	25.7	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_06	53.8	27.4	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_04	49.6	24.9	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA10_06	53.4	26.3	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA7_03	49.0	24.1	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA8_01	49.6	24.3	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA8_08	49.6	24.1	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_03	53.8	26.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_05	49.6	23.5	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_26	53.8	24.9	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_09	53.8	24.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_13	53.8	24.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA7_07	49.0	21.8	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA9_19	53.8	23.7	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_02	53.8	23.5	53.8	6.5	0.0	No Effect, No Further Mitigation
R9_13	53.8	23.1	53.8	6.5	0.0	No Effect, No Further Mitigation

Table C-2a: HA Summary of Results for Construction

POR ID [1]	DAY-NIGHT SOUND LEVEL Ldn, HC [DBA]					
	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN %HA	EFFECT ASSESSMENT
LAA8_06	49.6	21.0	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_08	53.8	22.9	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_15	49.6	20.6	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_18	53.8	22.2	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA10_05	53.4	21.3	53.4	6.5	0.0	No Effect, No Further Mitigation
R6_05	49.4	19.4	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_03	49.4	19.4	49.4	6.5	0.0	No Effect, No Further Mitigation
LAA9_25	53.8	21.4	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_07	49.6	19.4	49.6	6.5	0.0	No Effect, No Further Mitigation
R9_14	53.8	21.1	53.8	6.5	0.0	No Effect, No Further Mitigation
R6_02	49.4	18.9	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_04	49.4	18.8	49.4	6.5	0.0	No Effect, No Further Mitigation
LAA7_01	49.0	18.1	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA8_14	49.6	18.1	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA7_06	49.0	17.8	49.0	6.5	0.0	No Effect, No Further Mitigation
R6_01	49.4	17.9	49.4	6.5	0.0	No Effect, No Further Mitigation
LAA9_14	53.8	19.8	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_13	49.6	17.5	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_15	53.8	19.2	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_24	53.8	18.2	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_20	53.8	18.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_21	53.8	17.6	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_16	53.8	17.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_22	53.8	17.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_23	53.8	15.9	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_17	53.8	15.4	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA3_04N	51.6	36.3	51.7	6.5	0.0	No Effect, No Further Mitigation

Table C-2b: HA Summary of Operation Sound Level

POR ID	DAY-NIGHT SOUND LEVEL Ldn, HC [DBA]					
	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN %HA	EFFECT ASSESSMENT
R1_05	50.1	54.8	56.1	6.5	2.5	No Effect, No Further Mitigation
R8_03	49.6	53.2	54.8	6.5	2.0	No Effect, No Further Mitigation
R1_04	50.1	53.4	55.0	6.5	2.0	No Effect, No Further Mitigation
R3_08	51.4	53.3	55.5	6.5	1.8	No Effect, No Further Mitigation
R3_09	51.4	53.3	55.5	6.5	1.8	No Effect, No Further Mitigation
R3_07	51.4	52.9	55.2	6.5	1.6	No Effect, No Further Mitigation
R1_01	50.1	52.3	54.3	6.5	1.6	No Effect, No Further Mitigation
R3_06	51.4	52.8	55.2	6.5	1.6	No Effect, No Further Mitigation
R1_03	50.1	52.3	54.3	6.5	1.6	No Effect, No Further Mitigation
R1_02	50.1	52.2	54.3	6.5	1.6	No Effect, No Further Mitigation
R3_05	51.4	52.6	55.1	6.5	1.5	No Effect, No Further Mitigation
R3_04	51.4	51.9	54.7	6.5	1.4	No Effect, No Further Mitigation
R8_05	49.6	51.2	53.5	6.5	1.3	No Effect, No Further Mitigation
R3_03	51.4	51.8	54.6	6.5	1.3	No Effect, No Further Mitigation
R8_04	49.6	51.0	53.4	6.5	1.3	No Effect, No Further Mitigation
R8_02	49.6	50.9	53.3	6.5	1.3	No Effect, No Further Mitigation
R8_01	49.6	50.3	53.0	6.5	1.1	No Effect, No Further Mitigation
R3_02	51.4	50.9	54.2	6.5	1.1	No Effect, No Further Mitigation
R3_01	51.4	50.4	54.0	6.5	1.0	No Effect, No Further Mitigation
R8_14	49.6	49.4	52.5	6.5	0.9	No Effect, No Further Mitigation
R8_08	49.6	48.7	52.2	6.5	0.8	No Effect, No Further Mitigation
R9_12	53.8	49.7	55.2	6.5	0.7	No Effect, No Further Mitigation
R9_17	53.8	49.7	55.2	6.5	0.7	No Effect, No Further Mitigation
R11_04	52.7	49.0	54.3	6.5	0.7	No Effect, No Further Mitigation
R11_05	52.7	49.0	54.3	6.5	0.7	No Effect, No Further Mitigation
R2_01	50.3	47.7	52.2	6.5	0.6	No Effect, No Further Mitigation
R11_03	52.7	48.1	54.0	6.5	0.6	No Effect, No Further Mitigation
R2_04	50.3	46.6	51.8	6.5	0.5	No Effect, No Further Mitigation
R2_02	50.3	46.4	51.8	6.5	0.5	No Effect, No Further Mitigation
R2_03	50.3	46.0	51.6	6.5	0.4	No Effect, No Further Mitigation
R9_20	53.8	47.5	54.7	6.5	0.4	No Effect, No Further Mitigation
R8_11	49.6	45.7	51.1	6.5	0.4	No Effect, No Further Mitigation
R8_12	49.6	45.1	50.9	6.5	0.4	No Effect, No Further Mitigation
R8_15	49.6	45.1	50.9	6.5	0.4	No Effect, No Further Mitigation
LAA3_05	49.4	44.9	50.7	6.5	0.4	No Effect, No Further Mitigation
R9_18	53.8	46.7	54.5	6.5	0.4	No Effect, No Further Mitigation
R9_10	53.8	46.6	54.5	6.5	0.4	No Effect, No Further Mitigation
R9_11	53.8	46.6	54.5	6.5	0.4	No Effect, No Further Mitigation
R2_05	50.3	45.0	51.4	6.5	0.4	No Effect, No Further Mitigation
R9_02	53.8	46.4	54.5	6.5	0.3	No Effect, No Further Mitigation
R9_03	53.8	46.3	54.5	6.5	0.3	No Effect, No Further Mitigation
R2_06	50.3	44.7	51.3	6.5	0.3	No Effect, No Further Mitigation
R8_10	49.6	44.4	50.7	6.5	0.3	No Effect, No Further Mitigation
R8_13	49.6	44.4	50.7	6.5	0.3	No Effect, No Further Mitigation

Table C-2b: HA Summary of Operation Sound Level

POR ID	DAY-NIGHT SOUND LEVEL Ldn, HC [DBA]					
	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN %HA	EFFECT ASSESSMENT
LAA3_06	51.6	44.4	52.3	6.5	0.3	No Effect, No Further Mitigation
R10_04	53.4	44.9	53.9	6.5	0.3	No Effect, No Further Mitigation
R8_09	49.6	42.9	50.4	6.5	0.2	No Effect, No Further Mitigation
LAA3_01	51.4	43.7	52.1	6.5	0.2	No Effect, No Further Mitigation
R8_16	49.6	42.8	50.4	6.5	0.2	No Effect, No Further Mitigation
R10_06	53.4	44.4	53.9	6.5	0.2	No Effect, No Further Mitigation
R11_09	52.7	44.0	53.3	6.5	0.2	No Effect, No Further Mitigation
R10_05	53.4	44.0	53.8	6.5	0.2	No Effect, No Further Mitigation
R9_08	53.8	43.8	54.2	6.5	0.2	No Effect, No Further Mitigation
R10_01	53.4	43.2	53.8	6.5	0.2	No Effect, No Further Mitigation
R10_03	53.4	43.2	53.8	6.5	0.2	No Effect, No Further Mitigation
R9_06	53.8	43.2	54.1	6.5	0.2	No Effect, No Further Mitigation
LAA3_07	51.4	42.1	51.9	6.5	0.2	No Effect, No Further Mitigation
R8_06	49.6	41.2	50.2	6.5	0.2	No Effect, No Further Mitigation
R10_02	53.4	42.8	53.7	6.5	0.2	No Effect, No Further Mitigation
R9_01	53.8	42.6	54.1	6.5	0.1	No Effect, No Further Mitigation
R11_01	52.7	42.1	53.1	6.5	0.1	No Effect, No Further Mitigation
R11_08	52.7	41.9	53.1	6.5	0.1	No Effect, No Further Mitigation
R11_10	52.7	41.9	53.1	6.5	0.1	No Effect, No Further Mitigation
R11_07	52.7	41.7	53.0	6.5	0.1	No Effect, No Further Mitigation
R9_04	53.8	41.4	54.0	6.5	0.1	No Effect, No Further Mitigation
R9_09	53.8	41.4	54.0	6.5	0.1	No Effect, No Further Mitigation
R11_06	52.7	40.7	53.0	6.5	0.1	No Effect, No Further Mitigation
R9_05	53.8	41.0	54.0	6.5	0.1	No Effect, No Further Mitigation
R11_02	52.7	40.1	52.9	6.5	0.1	No Effect, No Further Mitigation
R9_15	53.8	40.5	54.0	6.5	0.1	No Effect, No Further Mitigation
R9_16	53.8	40.4	54.0	6.5	0.1	No Effect, No Further Mitigation
R9_19	53.8	39.8	53.9	6.5	0.1	No Effect, No Further Mitigation
R11_12	52.7	39.3	52.9	6.5	0.1	No Effect, No Further Mitigation
R5_05	42.8	34.6	43.4	6.5	0.1	No Effect, No Further Mitigation
R5_04	42.8	34.4	43.4	6.5	0.1	No Effect, No Further Mitigation
R9_07	53.8	39.1	53.9	6.5	0.1	No Effect, No Further Mitigation
R5_03	42.8	34.0	43.3	6.5	0.1	No Effect, No Further Mitigation
LAA3_03N	51.6	37.7	51.8	6.5	0.1	No Effect, No Further Mitigation
R5_02	42.8	33.7	43.3	6.5	0.1	No Effect, No Further Mitigation
LAA7_05	49.0	35.9	49.2	6.5	0.1	No Effect, No Further Mitigation
LAA7_04	49.0	35.5	49.1	6.5	0.0	No Effect, No Further Mitigation
R10_09	53.4	37.1	53.5	6.5	0.0	No Effect, No Further Mitigation
LAA8_02	49.6	34.5	49.7	6.5	0.0	No Effect, No Further Mitigation
R5_01	42.8	31.4	43.1	6.5	0.0	No Effect, No Further Mitigation
LAA3_04N	51.6	37.7	51.8	6.5	0.1	No Effect, No Further Mitigation
R10_07	53.4	35.9	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA8_03	49.6	33.9	49.7	6.5	0.0	No Effect, No Further Mitigation
R4_02	51.6	34.8	51.7	6.5	0.0	No Effect, No Further Mitigation
R4_03	51.6	34.8	51.7	6.5	0.0	No Effect, No Further Mitigation

Table C-2b: HA Summary of Operation Sound Level

POR ID	DAY-NIGHT SOUND LEVEL Ldn, HC [DBA]					
	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN %HA	EFFECT ASSESSMENT
R8_07	49.6	33.8	49.7	6.5	0.0	No Effect, No Further Mitigation
R4_04	51.6	34.7	51.7	6.5	0.0	No Effect, No Further Mitigation
LAA8_18	49.6	33.7	49.7	6.5	0.0	No Effect, No Further Mitigation
LAA8_15	49.6	33.6	49.7	6.5	0.0	No Effect, No Further Mitigation
LAA8_19	49.6	33.6	49.7	6.5	0.0	No Effect, No Further Mitigation
R4_05	51.6	34.5	51.7	6.5	0.0	No Effect, No Further Mitigation
R4_01	51.6	34.4	51.7	6.5	0.0	No Effect, No Further Mitigation
LAA7_03	49.0	33.2	49.1	6.5	0.0	No Effect, No Further Mitigation
R11_11	52.7	34.4	52.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_01	49.6	32.8	49.7	6.5	0.0	No Effect, No Further Mitigation
LAA7_02	49.0	32.4	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA8_17	49.6	32.5	49.7	6.5	0.0	No Effect, No Further Mitigation
LAA8_12	49.6	32.2	49.7	6.5	0.0	No Effect, No Further Mitigation
LAA11_03	52.7	32.7	52.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_13	49.6	31.0	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA8_14	49.6	30.7	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA7_07	49.0	30.2	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA3_02	51.4	31.3	51.5	6.5	0.0	No Effect, No Further Mitigation
LAA10_01	53.4	32.1	53.4	6.5	0.0	No Effect, No Further Mitigation
R10_08	53.4	31.9	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA9_07	53.8	31.4	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA10_02	53.4	30.5	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA7_06	49.0	28.1	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA8_16	49.6	28.3	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA8_04	49.6	28.1	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA8_10	49.6	28.0	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA7_01	49.0	27.7	49.0	6.5	0.0	No Effect, No Further Mitigation
LAA9_05	53.8	29.7	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_11	53.8	29.7	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_04	53.8	29.4	53.8	6.5	0.0	No Effect, No Further Mitigation
R6_02	49.4	27.0	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_01	49.4	26.7	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_03	49.4	26.7	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_05	49.4	26.5	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_04	49.4	26.4	49.4	6.5	0.0	No Effect, No Further Mitigation
LAA11_02	52.7	27.9	52.7	6.5	0.0	No Effect, No Further Mitigation
LAA9_12	53.8	28.1	53.8	6.5	0.0	No Effect, No Further Mitigation
R9_13	53.8	28.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_10	53.8	27.9	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_05	49.6	25.9	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_01	53.8	27.8	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_19	53.8	27.8	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA10_03	53.4	27.0	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA9_06	53.8	27.1	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_03	53.8	26.6	53.8	6.5	0.0	No Effect, No Further Mitigation

Table C-2b: HA Summary of Operation Sound Level

POR ID	DAY-NIGHT SOUND LEVEL Ldn, HC [DBA]					
	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN %HA	EFFECT ASSESSMENT
LAA8_11	49.6	24.1	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA8_06	49.6	23.6	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_08	53.8	25.3	53.8	6.5	0.0	No Effect, No Further Mitigation
R9_14	53.8	24.8	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_26	53.8	24.5	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_18	53.8	24.4	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA11_01	52.7	23.9	52.7	6.5	0.0	No Effect, No Further Mitigation
LAA9_09	53.8	24.3	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_25	53.8	24.3	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_13	53.8	24.1	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_08	49.6	21.9	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_20	53.8	23.8	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_09	49.6	21.8	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA9_24	53.8	22.8	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_21	53.8	22.6	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA10_07	53.4	22.3	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA9_22	53.8	21.9	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_02	53.8	21.1	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_15	53.8	20.3	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA10_04	53.4	20.1	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA9_14	53.8	20.0	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA8_07	49.6	17.9	49.6	6.5	0.0	No Effect, No Further Mitigation
LAA10_06	53.4	18.9	53.4	6.5	0.0	No Effect, No Further Mitigation
LAA9_17	53.8	18.8	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_16	53.8	18.2	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA9_23	53.8	17.1	53.8	6.5	0.0	No Effect, No Further Mitigation
LAA10_05	53.4	15.9	53.4	6.5	0.0	No Effect, No Further Mitigation

Point of Reception ID	Point of Reception Description	Receptor Coordinates (m) NAD 1983, UTM Zone 11U		Receptor Height Above Grade (m)	Operation Sound Impact at POR [1] [2], dBA		Operation Sound Impact at POR [1] [2], dBC		Difference (dBC - dBA)		Limit for Difference[3], dB	Is dBC - dBA > 20?	Is there tonal below 250 Hz	Compliance with Criteria?
		X	Y		Day	Night	Day	Night	Day	Night				
Mine LAA Receptors														
LAA3_01	Mine - Local Assessment Area	593014	5887005	1.5	34	34	50	50	16	16	20	No	No	Yes
LAA3_02	Mine - Local Assessment Area	595553	5887092	1.5	21	21	46	46	24	24	20	Yes	No	Yes
LAA3_03N	Mine - Local Assessment Area	596444	5886205	1.5	30	30	58	58	28	28	20	Yes	No	Yes
LAA3_04N	Mine - Local Assessment Area	598176	5883082	1.5	19	19	44	44	25	25	20	Yes	No	Yes
LAA3_05	Mine - Local Assessment Area	598417	5879754	1.5	29	29	46	46	18	18	20	No	No	Yes
LAA3_06	Mine - Local Assessment Area	594791	5881649	1.5	28	28	53	53	25	25	20	Yes	No	Yes
LAA3_07	Mine - Local Assessment Area	593224	5883249	1.5	32	32	58	58	25	25	20	Yes	No	Yes
LAA3_08N	Mine - Local Assessment Area	599120	5885461	1.5	19	19	44	44	25	25	21	Yes	No	Yes
QR Mill LAA Receptors														
LAA7_01	QR Mill - Local Assessment Area	579772	5837929	1.5	21	21	56	56	35	35	20	Yes	No	Yes
LAA7_02	QR Mill - Local Assessment Area	581497	5839144	1.5	26	26	60	60	34	34	20	Yes	No	Yes
LAA7_03	QR Mill - Local Assessment Area	583210	5837935	1.5	27	27	62	62	35	35	20	Yes	No	Yes
LAA7_04	QR Mill - Local Assessment Area	583880	5836135	1.5	29	29	64	64	35	35	20	Yes	No	Yes
LAA7_05	QR Mill - Local Assessment Area	582384	5834683	1.5	30	30	64	64	35	35	20	Yes	No	Yes
LAA7_06	QR Mill - Local Assessment Area	579758	5834727	1.5	22	22	57	57	35	35	20	Yes	No	Yes
LAA7_07	QR Mill - Local Assessment Area	578480	5836396	1.5	24	24	58	58	34	34	20	Yes	No	Yes
Transportation/Transformer Line LAA Receptors														
LAA8_01	Transportation - Local Area Assessment	573671	5840413	1.5	16	16	50	50	34	34	20	Yes	No	Yes
LAA8_02	Transportation - Local Area Assessment	569202	5842395	1.5	18	18	47	47	29	29	20	Yes	No	Yes
LAA8_03	Transportation - Local Area Assessment	564382	5852211	1.5	18	18	46	46	28	28	20	Yes	No	Yes
LAA8_04	Transportation - Local Area Assessment	556543	5853839	1.5	12	12	40	40	28	28	20	Yes	No	Yes
LAA8_05	Transportation - Local Area Assessment	552733	5856793	1.5	10	10	41	41	31	31	20	Yes	No	Yes
LAA8_06	Transportation - Local Area Assessment	548054	5857165	1.5	7	7	40	40	33	33	20	Yes	No	Yes
LAA8_07	Transportation - Local Area Assessment	546893	5862686	1.5	2	2	25	25	23	23	20	Yes	No	Yes
LAA8_08	Transportation - Local Area Assessment	540931	5864094	1.5	6	6	23	23	17	17	20	No	No	Yes
LAA8_09	Transportation - Local Area Assessment	542662	5866570	1.5	5	5	27	27	21	21	20	Yes	No	Yes
LAA8_10	Transportation - Local Area Assessment	538751	5867737	1.5	12	12	24	24	13	13	20	No	No	Yes
LAA8_11	Transportation - Local Area Assessment	535853	5870247	1.5	8	8	23	23	15	15	20	No	No	Yes
LAA8_12	Transportation - Local Area Assessment	538882	5870840	1.5	16	16	29	29	13	13	20	No	No	Yes
LAA8_13	Transportation - Local Area Assessment	556163	5859164	1.5	15	15	38	38	23	23	20	Yes	No	Yes
LAA8_14	Transportation - Local Area Assessment	557902	5861579	1.5	14	14	41	41	26	26	20	Yes	No	Yes
LAA8_15	Transportation - Local Area Assessment	552702	5865248	1.5	17	17	36	36	19	19	20	No	No	Yes
LAA8_16	Transportation - Local Area Assessment	554457	5872548	1.5	12	12	33	33	21	21	20	Yes	No	Yes
LAA8_17	Transportation - Local Area Assessment	550648	5872722	1.5	16	16	35	35	19	19	20	No	No	Yes
LAA8_18	Transportation - Local Area Assessment	551639	5876096	1.5	17	17	35	35	18	18	20	No	No	Yes
LAA8_19	Transportation - Local Area Assessment	549031	5874339	1.5	17	17	34	34	17	17	20	No	No	Yes
LAA9_01	Transformer - Local Area Assessment	555391	5881366	1.5	21	21	34	34	12	12	20	No	No	Yes
LAA9_02	Transformer - Local Area Assessment	564590	5883695	1.5	15	15	32	32	17	17	20	No	No	Yes
LAA9_03	Transformer - Local Area Assessment	568611	5887990	1.5	20	20	36	36	15	15	20	No	No	Yes
LAA9_04	Transformer - Local Area Assessment	573519	5889778	1.5	23	23	37	37	14	14	20	No	No	Yes
LAA9_05	Transformer - Local Area Assessment	580479	5888408	1.5	23	23	39	39	16	16	20	No	No	Yes
LAA9_06	Transformer - Local Area Assessment	587389	5887425	1.5	21	21	43	43	22	22	20	Yes	No	Yes
LAA9_07	Transformer - Local Area Assessment	591998	5888677	1.5	25	25	47	47	22	22	20	Yes	No	Yes
LAA9_08	Transformer - Local Area Assessment	589873	5885432	1.5	19	19	46	46	27	27	20	Yes	No	Yes
LAA9_09	Transformer - Local Area Assessment	582655	5884369	1.5	18	18	33	33	15	15	20	No	No	Yes
LAA9_10	Transformer - Local Area Assessment	575175	5886795	1.5	22	22	37	37	15	15	20	No	No	Yes
LAA9_11	Transformer - Local Area Assessment	569599	5885062	1.5	23	23	36	36	13	13	20	No	No	Yes
LAA9_12	Transformer - Local Area Assessment	562699	5879763	1.5	22	22	35	35	13	13	20	No	No	Yes
LAA9_13	Transportation - Local Area Assessment	560919	5877285	1.5	18	18	35	35	18	18	20	No	No	Yes
LAA9_14	Transportation - Local Area Assessment	565573	5877344	1.5	14	14	35	35	21	21	20	Yes	No	Yes
LAA9_15	Transportation - Local Area Assessment	570932	5881730	1.5	14	14	36	36	22	22	20	Yes	No	Yes

Point of Reception ID	Point of Reception Description	Receptor Coordinates (m) NAD 1983, UTM Zone 11U		Receptor Height Above Grade (m)	Operation Sound Impact at POR [1] [2], dBA		Operation Sound Impact at POR [1] [2], dBC		Difference (dBC - dBA)		Limit for Difference[3], dB	Is dBC - dBA > 20?	Is there tonal below 250 Hz	Compliance with Criteria?
		X	Y		Day	Night	Day	Night	Day	Night				
LAA9_16	Transportation - Local Area Assessment	577627	5882026	1.5	12	12	37	37	25	25	20	Yes	No	Yes
LAA9_17	Transportation - Local Area Assessment	585611	5879570	1.5	12	12	40	40	28	28	20	Yes	No	Yes
LAA9_18	Transportation - Local Area Assessment	588078	5883822	1.5	18	18	44	44	26	26	20	Yes	No	Yes
LAA9_19	Transportation - Local Area Assessment	589956	5880495	1.5	21	21	50	50	28	28	20	Yes	No	Yes
LAA9_20	Transportation - Local Area Assessment	586133	5876458	1.5	17	17	41	41	24	24	20	Yes	No	Yes
LAA9_21	Transportation - Local Area Assessment	580551	5878596	1.5	16	16	39	39	23	23	20	Yes	No	Yes
LAA9_22	Transportation - Local Area Assessment	574897	5878182	1.5	16	16	38	38	22	22	20	Yes	No	Yes
LAA9_23	Transportation - Local Area Assessment	570341	5876799	1.5	11	11	36	36	25	25	20	Yes	No	Yes
LAA9_24	Transportation - Local Area Assessment	563886	5873965	1.5	16	16	36	36	20	20	20	No	No	Yes
LAA9_25	Transportation - Local Area Assessment	557852	5874963	1.5	18	18	37	37	19	19	20	No	No	Yes
LAA9_26	Transportation - Local Area Assessment	554535	5876771	1.5	18	18	35	35	17	17	20	No	No	Yes
LAA10_01	Transportation/Transformer - Local Area Assessment	544764	5873894	1.5	22	22	33	33	11	11	20	No	No	Yes
LAA10_02	Transportation/Transformer - Local Area Assessment	542170	5872279	1.5	21	21	31	31	11	11	20	No	No	Yes
LAA10_03	Transportation/Transformer - Local Area Assessment	537187	5873383	1.5	17	17	28	28	11	11	20	No	No	Yes
LAA10_04	Transportation/Transformer - Local Area Assessment	535769	5873108	1.5	10	10	24	24	14	14	20	No	No	Yes
LAA10_05	Transportation/Transformer - Local Area Assessment	532580	5873411	1.5	6	6	22	22	16	16	20	No	No	Yes
LAA10_06	Transportation/Transformer - Local Area Assessment	534168	5875647	1.5	9	9	24	24	15	15	20	No	No	Yes
LAA10_07	Transportation/Transformer - Local Area Assessment	536017	5876130	1.5	12	12	25	25	13	13	20	No	No	Yes
LAA11_01	Transportation/Transformer - Local Area Assessment	539606	5877538	1.5	14	14	27	27	13	13	20	No	No	Yes
LAA11_02	Transportation/Transformer - Local Area Assessment	544782	5878201	1.5	18	18	30	30	13	13	20	No	No	Yes
LAA11_03	Transformer - Local Area Assessment	548607	5880061	1.5	23	23	34	34	11	11	20	No	No	Yes
Receptors														
R1_01	Receptor in BLR1 Area	595795	5884301	1.5	42	42	72	72	30	30	20	Yes	No	Yes
R1_02	Receptor in BLR1 Area	595769	5884327	1.5	42	42	72	72	30	30	20	Yes	No	Yes
R1_03	Receptor in BLR1 Area	595698	5884366	1.5	42	42	72	72	30	30	20	Yes	No	Yes
R1_04	Receptor in BLR1 Area	595678	5884419	1.5	43	43	71	71	28	28	20	Yes	No	Yes
R1_05	Receptor in BLR1 Area	595628	5884406	1.5	45	45	72	72	27	27	20	Yes	No	Yes
R2_01	Receptor in BLR2 Area	595866	5884579	1.5	41	41	67	67	26	26	20	Yes	No	Yes
R2_02	Receptor in BLR2 Area	595914	5884557	1.5	40	40	67	67	27	27	20	Yes	No	Yes
R2_03	Receptor in BLR2 Area	595966	5884560	1.5	40	40	66	66	27	27	20	Yes	No	Yes
R2_04	Receptor in BLR2 Area	595894	5884518	1.5	40	40	68	68	28	28	20	Yes	No	Yes
R2_05	Receptor in BLR2 Area	596014	5884419	1.5	39	39	67	67	28	28	20	Yes	No	Yes
R2_06	Receptor in BLR2 Area	596085	5884440	1.5	38	38	66	66	27	27	20	Yes	No	Yes
R3_01	Receptor in BLR3 Area	595737	5884732	1.5	40	40	67	67	26	26	20	Yes	No	Yes
R3_02	Receptor in BLR3 Area	595681	5884710	1.5	41	41	67	67	26	26	20	Yes	No	Yes
R3_03	Receptor in BLR3 Area	595647	5884674	1.5	42	42	68	68	26	26	20	Yes	No	Yes
R3_04	Receptor in BLR3 Area	595606	5884674	1.5	42	42	68	68	26	26	20	Yes	No	Yes
R3_05	Receptor in BLR3 Area	595550	5884672	1.5	43	43	68	68	25	25	20	Yes	No	Yes
R3_06	Receptor in BLR3 Area	595510	5884681	1.5	43	43	68	68	25	25	20	Yes	No	Yes
R3_07	Receptor in BLR3 Area	595482	5884681	1.5	43	43	68	68	25	25	20	Yes	No	Yes
R3_08	Receptor in BLR3 Area	595348	5884685	1.5	43	43	68	68	24	24	20	Yes	No	Yes
R3_09	Receptor in BLR3 Area	595304	5884676	1.5	43	43	68	68	24	25	20	Yes	No	Yes
R4_01	Receptor in BLR4 Area	599128	5882940	1.5	18	18	47	47	29	29	20	Yes	No	Yes
R4_02	Receptor in BLR4 Area	599191	5883019	1.5	18	18	47	47	29	29	20	Yes	No	Yes
R4_03	Receptor in BLR4 Area	599297	5882913	1.5	18	18	47	47	29	29	20	Yes	No	Yes
R4_04	Receptor in BLR4 Area	599379	5882837	1.5	18	18	47	47	29	29	20	Yes	No	Yes
R4_05	Receptor in BLR4 Area	599485	5882743	1.5	18	18	47	47	29	29	20	Yes	No	Yes
R5_01	Receptor in BLR5 Area	599588	5881771	1.5	15	15	41	41	26	26	20	Yes	No	Yes
R5_02	Receptor in BLR5 Area	599605	5881810	1.5	17	17	46	46	29	29	20	Yes	No	Yes
R5_03	Receptor in BLR5 Area	599654	5881896	1.5	18	18	46	46	28	28	20	Yes	No	Yes
R5_04	Receptor in BLR5 Area	599638	5882105	1.5	18	18	46	46	28	28	20	Yes	No	Yes

Point of Reception ID	Point of Reception Description	Receptor Coordinates (m) NAD 1983, UTM Zone 11U		Receptor Height Above Grade (m)	Operation Sound Impact at POR [1] [2], dBA		Operation Sound Impact at POR [1] [2], dBC		Difference (dBC - dBA)		Limit for Difference[3], dB	Is dBC - dBA > 20?	Is there tonal below 250 Hz	Compliance with Criteria?
		X	Y		Day	Night	Day	Night	Day	Night				
R5_05	Receptor in BLR5 Area	599630	5882171	1.5	18	18	46	46	28	28	20	Yes	No	Yes
R6_01	Receptor in BLR6 Area	599217	5880546	1.5	10	10	33	33	23	23	20	Yes	No	Yes
R6_02	Receptor in BLR6 Area	599275	5880639	1.5	11	11	35	35	24	24	20	Yes	No	Yes
R6_03	Receptor in BLR6 Area	599338	5880721	1.5	10	10	35	35	24	24	20	Yes	No	Yes
R6_04	Receptor in BLR6 Area	599378	5880784	1.5	10	10	34	34	24	24	20	Yes	No	Yes
R6_05	Receptor in BLR6 Area	599422	5880855	1.5	10	10	35	35	25	25	20	Yes	No	Yes
R8_01	Receptor in BLR8 Area	537785	5869829	1.5	34	34	37	37	3	3	20	No	No	Yes
R8_02	Receptor in BLR8 Area	538229	5869470	1.5	35	35	37	37	3	3	20	No	No	Yes
R8_03	Receptor in BLR8 Area	538771	5869251	1.5	37	37	39	39	3	3	20	No	No	Yes
R8_04	Receptor in BLR8 Area	539133	5869226	1.5	35	35	37	37	3	3	20	No	No	Yes
R8_05	Receptor in BLR8 Area	539787	5869160	1.5	35	35	37	37	3	3	20	No	No	Yes
R8_06	Receptor in BLR8 Area	540275	5867528	1.5	25	25	30	30	5	5	20	No	No	Yes
R8_07	Receptor in BLR8 Area	541556	5866034	1.5	17	17	26	26	9	9	20	No	No	Yes
R8_08	Receptor in BLR8 Area	541482	5865495	1.5	32	32	35	35	3	3	20	No	No	Yes
R8_09	Receptor in BLR8 Area	541852	5865082	1.5	27	27	30	30	4	4	20	No	No	Yes
R8_10	Receptor in BLR8 Area	542406	5864989	1.5	28	28	31	31	3	3	20	No	No	Yes
R8_11	Receptor in BLR8 Area	542595	5864557	1.5	29	29	33	33	3	3	20	No	No	Yes
R8_12	Receptor in BLR8 Area	542538	5864274	1.5	29	29	32	32	3	3	20	No	No	Yes
R8_13	Receptor in BLR8 Area	550728	5856108	1.5	28	28	39	39	11	11	20	No	No	Yes
R8_14	Receptor in BLR8 Area	551084	5854837	1.5	33	33	42	42	9	9	20	No	No	Yes
R8_15	Receptor in BLR8 Area	552360	5855313	1.5	29	29	39	39	10	10	20	No	No	Yes
R8_16	Receptor in BLR8 Area	553505	5854196	1.5	26	26	41	41	14	14	20	No	No	Yes
R9_01	Receptor in BLR9 Area	554437	5878370	1.5	36	36	47	47	11	11	20	No	No	Yes
R9_02	Receptor in BLR9 Area	554568	5878192	1.5	40	40	50	50	10	10	20	No	No	Yes
R9_03	Receptor in BLR9 Area	554620	5878307	1.5	40	40	50	50	10	10	20	No	No	Yes
R9_04	Receptor in BLR9 Area	554834	5878539	1.5	35	35	46	46	11	11	20	No	No	Yes
R9_05	Receptor in BLR9 Area	555568	5878596	1.5	35	35	46	46	11	11	20	No	No	Yes
R9_06	Receptor in BLR9 Area	556501	5878593	1.5	37	37	47	47	10	10	20	No	No	Yes
R9_07	Receptor in BLR9 Area	556727	5878640	1.5	33	33	44	44	11	11	20	No	No	Yes
R9_08	Receptor in BLR9 Area	557642	5877452	1.5	37	37	48	48	11	11	20	No	No	Yes
R9_09	Receptor in BLR9 Area	557394	5877343	1.5	35	35	46	46	11	11	20	No	No	Yes
R9_10	Receptor in BLR9 Area	557846	5877147	1.5	40	40	50	50	10	10	20	No	No	Yes
R9_11	Receptor in BLR9 Area	558569	5876293	1.5	41	41	51	51	10	10	20	No	No	Yes
R9_12	Receptor in BLR9 Area	558510	5876231	1.5	43	43	53	53	9	9	20	No	No	Yes
R9_13	Receptor in BLR9 Area	558900	5875223	1.5	22	22	38	38	17	17	20	No	No	Yes
R9_14	Receptor in BLR9 Area	559478	5874867	1.5	18	18	37	37	18	18	20	No	No	Yes
R9_15	Receptor in BLR9 Area	561266	5875013	1.5	34	34	45	45	11	11	20	No	No	Yes
R9_16	Receptor in BLR9 Area	569020	5877394	1.5	34	34	46	46	12	12	20	No	No	Yes
R9_17	Receptor in BLR9 Area	570938	5880078	1.5	43	43	53	53	9	9	20	No	No	Yes
R9_18	Receptor in BLR9 Area	570998	5880200	1.5	40	40	50	50	10	10	20	No	No	Yes
R9_19	Receptor in BLR9 Area	588699	5882589	1.5	33	33	48	48	14	14	20	No	No	Yes
R9_20	Receptor in BLR9 Area	590466	5882050	1.5	41	41	52	52	11	11	20	No	No	Yes
R10_01	Receptor in BLR10 Area	534955	5874413	1.5	33	33	36	36	3	3	20	No	No	Yes
R10_02	Receptor in BLR10 Area	535099	5874517	1.5	33	33	36	36	3	3	20	No	No	Yes
R10_03	Receptor in BLR10 Area	535210	5874580	1.5	33	33	36	36	3	3	20	No	No	Yes
R10_04	Receptor in BLR10 Area	535360	5874543	1.5	35	35	38	38	3	3	20	No	No	Yes
R10_05	Receptor in BLR10 Area	535553	5874552	1.5	34	34	37	37	3	3	20	No	No	Yes
R10_06	Receptor in BLR10 Area	535835	5874552	1.5	34	34	37	37	3	3	20	No	No	Yes
R10_07	Receptor in BLR10 Area	537369	5874742	1.5	26	26	33	33	7	7	20	No	No	Yes
R10_08	Receptor in BLR10 Area	537388	5873784	1.5	22	22	31	31	9	9	20	No	No	Yes
R10_09	Receptor in BLR10 Area	538319	5873647	1.5	27	27	36	36	9	9	20	No	No	Yes
R11_01	Receptor in BLR11 Area	538844	5874466	1.5	32	32	40	40	8	8	20	No	No	Yes
R11_02	Receptor in BLR11 Area	539849	5874397	1.5	30	30	38	38	8	8	20	No	No	Yes
R11_03	Receptor in BLR11 Area	540073	5873946	1.5	38	38	45	45	7	7	20	No	No	Yes
R11_04	Receptor in BLR11 Area	540280	5873921	1.5	39	39	46	46	7	7	20	No	No	Yes
R11_05	Receptor in BLR11 Area	541818	5873863	1.5	39	39	46	46	7	7	20	No	No	Yes

Table C-3a: Predicted Low Frequency Sound Level at Points of Reception - Operation

Point of Reception ID	Point of Reception Description	Receptor Coordinates (m) NAD 1983, UTM Zone 11U		Receptor Height Above Grade (m)	Operation Sound Impact at POR [1] [2], dBA		Operation Sound Impact at POR [1] [2], dBC		Difference (dBC - dBA)		Limit for Difference[3], dB	Is dBC - dBA > 20?	Is there tonal below 250 Hz	Compliance with Criteria?
		X	Y		Day	Night	Day	Night	Day	Night				
R11_06	Receptor in BLR11 Area	542366	5874315	1.5	31	31	39	39	8	8	20	No	No	Yes
R11_07	Receptor in BLR11 Area	542710	5874822	1.5	32	32	39	39	7	7	20	No	No	Yes
R11_08	Receptor in BLR11 Area	544629	5875651	1.5	32	32	40	40	8	8	20	No	No	Yes
R11_09	Receptor in BLR11 Area	544840	5875286	1.5	34	34	39	39	5	5	20	No	No	Yes
R11_10	Receptor in BLR11 Area	545106	5875387	1.5	32	32	38	38	6	6	20	No	No	Yes
R11_11	Receptor in BLR11 Area	546040	5875687	1.5	24	24	34	34	9	9	20	No	No	Yes
R11_12	Receptor in BLR11 Area	547554	5875235	1.5	29	29	36	36	6	6	20	No	No	Yes

Notes:

[1] Daytime occurs from 0700-2200h. Night-time occurs from 2200-0700h.

[2] Predictable worst-case one hour equivalent sound level from all applicable sources operating as per scenarios listed in the report in dBA.

[3] Exclusionary limits from British Columbia Noise Control Best Practices Guideline, BC Oil and Gas Commission (OCG Guide)

Point of Reception ID	Point of Reception Description	Receptor Coordinates (m) NAD 1983, UTM Zone 11U		Construction Sound Impact at POR [1] [2], dBA		Construction Sound Impact at POR [1] [2], dBC		Difference (dBC - dBA)		Limit for Difference[3], dB	Is dBC - dBA > 20?	Is there tonal below 250 Hz?	Compliance with Criteria[3]?
		X	Y	Day	Night	Day	Night	Day	Night				
Mine LAA Receptors													
LAA3_01	Mine - Local Assessment Area	593014	5887005	35	35	50	50	15	15	20	No	No	Yes
LAA3_02	Mine - Local Assessment Area	595553	5887092	20	20	41	41	21	21	20	Yes	No	Yes
LAA3_03N	Mine - Local Assessment Area	596444	5886205	27	27	48	48	21	21	20	Yes	No	Yes
LAA3_04N	Mine - Local Assessment Area	598176	5883082	17	17	40	39	23	23	20	Yes	No	Yes
LAA3_05	Mine - Local Assessment Area	598417	5879754	14	14	34	34	20	20	20	No	No	Yes
LAA3_06	Mine - Local Assessment Area	594791	5881649	25	25	46	46	21	21	20	Yes	No	Yes
LAA3_07	Mine - Local Assessment Area	593224	5883249	28	28	50	50	21	21	20	Yes	No	Yes
LAA3_08N	Mine - Local Assessment Area	599120	5885461	20	20	43	43	22	22	21	Yes	No	Yes
QR Mill LAA Receptors													
LAA7_01	QR Mill - Local Assessment Area	579772	5837929	12	12	36	36	24	24	20	Yes	No	Yes
LAA7_02	QR Mill - Local Assessment Area	581497	5839144	19	19	41	41	22	22	20	Yes	No	Yes
LAA7_03	QR Mill - Local Assessment Area	583210	5837935	18	18	40	40	23	23	20	Yes	No	Yes
LAA7_04	QR Mill - Local Assessment Area	583880	5836135	22	22	43	43	22	22	20	Yes	No	Yes
LAA7_05	QR Mill - Local Assessment Area	582384	5834683	22	22	44	44	22	22	20	Yes	No	Yes
LAA7_06	QR Mill - Local Assessment Area	579758	5834727	11	11	36	36	25	25	20	Yes	No	Yes
LAA7_07	QR Mill - Local Assessment Area	578480	5836396	15	15	38	38	23	23	20	Yes	No	Yes
Transportation/Transformer Line LAA Receptors													
LAA8_01	Transportation - Local Area Assessment	573671	5840413	8	8	31	31	23	23	20	Yes	No	Yes
LAA8_02	Transportation - Local Area Assessment	569202	5842395	10	10	28	28	18	18	20	No	No	Yes
LAA8_03	Transportation - Local Area Assessment	564382	5852211	9	9	26	26	16	16	20	No	No	Yes
LAA8_04	Transportation - Local Area Assessment	556543	5853839	9	9	25	25	16	16	20	No	No	Yes
LAA8_05	Transportation - Local Area Assessment	552733	5856793	7	7	26	26	19	19	20	No	No	Yes
LAA8_06	Transportation - Local Area Assessment	548054	5857165	5	5	27	27	22	22	20	Yes	No	Yes
LAA8_07	Transportation - Local Area Assessment	546893	5862686	3	3	27	27	24	24	20	Yes	No	Yes
LAA8_08	Transportation - Local Area Assessment	540931	5864094	8	8	29	29	22	22	20	Yes	No	Yes
LAA8_09	Transportation - Local Area Assessment	542662	5866570	9	9	33	33	23	23	20	Yes	No	Yes
LAA8_10	Transportation - Local Area Assessment	538751	5867737	14	14	34	34	20	20	20	No	No	Yes
LAA8_11	Transportation - Local Area Assessment	535853	5870247	13	13	34	34	22	22	20	Yes	No	Yes
LAA8_12	Transportation - Local Area Assessment	538882	5870840	19	19	40	40	21	21	20	Yes	No	Yes
LAA8_13	Transportation - Local Area Assessment	556163	5859164	1	1	26	26	25	25	20	Yes	No	Yes
LAA8_14	Transportation - Local Area Assessment	557902	5861579	2	2	28	28	26	26	20	Yes	No	Yes
LAA8_15	Transportation - Local Area Assessment	552702	5865248	4	4	29	29	25	25	20	Yes	No	Yes
LAA8_16	Transportation - Local Area Assessment	554457	5872548	11	11	35	35	24	24	20	Yes	No	Yes
LAA8_17	Transportation - Local Area Assessment	550648	5872722	12	12	35	35	23	23	20	Yes	No	Yes
LAA8_18	Transportation - Local Area Assessment	551639	5876096	16	16	38	38	22	22	20	Yes	No	Yes
LAA8_19	Transportation - Local Area Assessment	549031	5874339	16	16	37	37	21	21	20	Yes	No	Yes
LAA9_01	Transformer - Local Area Assessment	555391	5881366	23	23	41	41	18	18	20	No	No	Yes
LAA9_02	Transformer - Local Area Assessment	564590	5883695	17	17	38	38	21	21	20	Yes	No	Yes
LAA9_03	Transformer - Local Area Assessment	568611	5887990	20	20	39	39	20	20	20	No	No	Yes
LAA9_04	Transformer - Local Area Assessment	573519	5889778	26	26	44	44	19	19	20	No	No	Yes
LAA9_05	Transformer - Local Area Assessment	580479	5888408	25	25	44	44	19	19	20	No	No	Yes
LAA9_06	Transformer - Local Area Assessment	587389	5887425	21	21	41	41	20	20	20	No	No	Yes
LAA9_07	Transformer - Local Area Assessment	591998	5888677	27	27	46	46	19	19	20	No	No	Yes
LAA9_08	Transformer - Local Area Assessment	589873	5885432	17	17	39	39	23	23	20	Yes	No	Yes
LAA9_09	Transformer - Local Area Assessment	582655	5884369	18	18	37	37	20	20	20	No	No	Yes
LAA9_10	Transformer - Local Area Assessment	575175	5886795	23	23	42	42	19	19	20	No	No	Yes
LAA9_11	Transformer - Local Area Assessment	569599	5885062	25	25	44	44	18	18	20	No	No	Yes
LAA9_12	Transformer - Local Area Assessment	562699	5879763	23	23	41	41	18	18	20	No	No	Yes
LAA9_13	Transportation - Local Area Assessment	560919	5877285	18	18	39	39	21	21	20	Yes	No	Yes
LAA9_14	Transportation - Local Area Assessment	565573	5877344	13	13	36	36	22	22	20	Yes	No	Yes
LAA9_15	Transportation - Local Area Assessment	570932	5881730	13	13	35	35	22	22	20	Yes	No	Yes
LAA9_16	Transportation - Local Area Assessment	577627	5882026	11	11	34	34	23	23	20	Yes	No	Yes
LAA9_17	Transportation - Local Area Assessment	585611	5879570	9	9	33	33	24	24	20	Yes	No	Yes
LAA9_18	Transportation - Local Area Assessment	588078	5883822	16	16	38	38	22	22	20	Yes	No	Yes
LAA9_19	Transportation - Local Area Assessment	589956	5880495	17	17	42	42	25	25	20	Yes	No	Yes
LAA9_20	Transportation - Local Area Assessment	586133	5876458	12	12	34	34	22	22	20	Yes	No	Yes

Point of Reception ID	Point of Reception Description	Receptor Coordinates (m) NAD 1983, UTM Zone 11U		Construction Sound Impact at POR [1] [2], dBA		Construction Sound Impact at POR [1] [2], dBC		Difference (dBC - dBA)		Limit for Difference[3], dB	Is dBC - dBA > 20?	Is there tonal below 250 Hz?	Compliance with Criteria[3]?
		X	Y	Day	Night	Day	Night	Day	Night				
LAA9_21	Transportation - Local Area Assessment	580551	5878596	11	11	33	33	22	22	20	Yes	No	Yes
LAA9_22	Transportation - Local Area Assessment	574897	5878182	11	11	33	33	22	22	20	Yes	No	Yes
LAA9_23	Transportation - Local Area Assessment	570341	5876799	10	10	33	33	24	24	20	Yes	No	Yes
LAA9_24	Transportation - Local Area Assessment	563886	5873965	12	12	33	33	22	22	20	Yes	No	Yes
LAA9_25	Transportation - Local Area Assessment	557852	5874963	15	15	37	37	22	22	20	Yes	No	Yes
LAA9_26	Transportation - Local Area Assessment	554535	5876771	19	19	40	40	22	22	20	Yes	No	Yes
LAA10_01	Transportation/Transformer - Local Area Assessment	544764	5873894	23	23	42	42	19	19	20	No	No	Yes
LAA10_02	Transportation/Transformer - Local Area Assessment	542170	5872279	21	21	40	40	19	19	20	No	No	Yes
LAA10_03	Transportation/Transformer - Local Area Assessment	537187	5873383	24	24	42	42	19	19	20	No	No	Yes
LAA10_04	Transportation/Transformer - Local Area Assessment	535769	5873108	18	18	38	38	20	20	20	No	No	Yes
LAA10_05	Transportation/Transformer - Local Area Assessment	532580	5873411	11	11	33	33	22	22	20	Yes	No	Yes
LAA10_06	Transportation/Transformer - Local Area Assessment	534168	5875647	16	16	39	39	22	22	20	Yes	No	Yes
LAA10_07	Transportation/Transformer - Local Area Assessment	536017	5876130	20	20	39	39	19	19	20	No	No	Yes
LAA11_01	Transportation/Transformer - Local Area Assessment	539606	5877538	19	19	39	39	20	20	20	No	No	Yes
LAA11_02	Transportation/Transformer - Local Area Assessment	544782	5878201	19	19	39	39	20	20	20	No	No	Yes
LAA11_03	Transformer - Local Area Assessment	548607	5880061	24	24	42	42	18	18	20	No	No	Yes
Receptors													
R1_01	Receptor in BLR1 Area	595795	5884301	42	42	61	61	19	19	20	No	No	Yes
R1_02	Receptor in BLR1 Area	595769	5884327	43	43	62	62	19	19	20	No	No	Yes
R1_03	Receptor in BLR1 Area	595698	5884366	42	42	61	61	19	19	20	No	No	Yes
R1_04	Receptor in BLR1 Area	595678	5884419	43	43	61	61	18	18	20	No	No	Yes
R1_05	Receptor in BLR1 Area	595628	5884406	45	45	63	63	18	18	20	No	No	Yes
R2_01	Receptor in BLR2 Area	595866	5884579	41	40	58	58	17	17	20	No	No	Yes
R2_02	Receptor in BLR2 Area	595914	5884557	39	39	57	57	18	18	20	No	No	Yes
R2_03	Receptor in BLR2 Area	595966	5884560	39	38	56	56	18	18	20	No	No	Yes
R2_04	Receptor in BLR2 Area	595894	5884518	40	39	58	58	19	18	20	No	No	Yes
R2_05	Receptor in BLR2 Area	596014	5884419	38	37	56	56	19	18	20	No	No	Yes
R2_06	Receptor in BLR2 Area	596085	5884440	37	37	55	55	18	18	20	No	No	Yes
R3_01	Receptor in BLR3 Area	595737	5884732	41	40	59	58	18	18	20	No	No	Yes
R3_02	Receptor in BLR3 Area	595681	5884710	41	41	59	59	18	18	20	No	No	Yes
R3_03	Receptor in BLR3 Area	595647	5884674	42	42	59	59	17	17	20	No	No	Yes
R3_04	Receptor in BLR3 Area	595606	5884674	42	42	60	60	17	17	20	No	No	Yes
R3_05	Receptor in BLR3 Area	595550	5884672	43	43	61	61	17	17	20	No	No	Yes
R3_06	Receptor in BLR3 Area	595510	5884681	43	43	61	61	17	17	20	No	No	Yes
R3_07	Receptor in BLR3 Area	595482	5884681	44	44	61	61	17	17	20	No	No	Yes
R3_08	Receptor in BLR3 Area	595348	5884685	44	44	61	61	17	17	20	No	No	Yes
R3_09	Receptor in BLR3 Area	595304	5884676	44	44	61	61	17	17	20	No	No	Yes
R4_01	Receptor in BLR4 Area	599128	5882940	15	14	38	38	23	23	20	Yes	No	Yes
R4_02	Receptor in BLR4 Area	599191	5883019	15	15	38	38	23	23	20	Yes	No	Yes
R4_03	Receptor in BLR4 Area	599297	5882913	15	15	38	38	23	23	20	Yes	No	Yes
R4_04	Receptor in BLR4 Area	599379	5882837	15	15	38	38	23	23	20	Yes	No	Yes
R4_05	Receptor in BLR4 Area	599485	5882743	15	15	38	38	23	23	20	Yes	No	Yes
R5_01	Receptor in BLR5 Area	599588	5881771	7	7	31	31	24	24	20	Yes	No	Yes
R5_02	Receptor in BLR5 Area	599605	5881810	13	13	37	37	24	24	20	Yes	No	Yes
R5_03	Receptor in BLR5 Area	599654	5881896	13	13	37	37	24	24	20	Yes	No	Yes
R5_04	Receptor in BLR5 Area	599638	5882105	14	14	38	37	24	23	20	Yes	No	Yes
R5_05	Receptor in BLR5 Area	599630	5882171	14	14	38	38	23	23	20	Yes	No	Yes
R6_01	Receptor in BLR6 Area	599217	5880546	2	2	25	25	24	24	20	Yes	No	Yes
R6_02	Receptor in BLR6 Area	599275	5880639	3	3	27	27	24	24	20	Yes	No	Yes
R6_03	Receptor in BLR6 Area	599338	5880721	3	3	27	27	24	24	20	Yes	No	Yes
R6_04	Receptor in BLR6 Area	599378	5880784	2	2	27	27	24	24	20	Yes	No	Yes
R6_05	Receptor in BLR6 Area	599422	5880855	3	3	27	27	24	24	20	Yes	No	Yes

Notes:

[1] Daytime occurs from 0700-2200h. Night-time occurs from 2200-0700h.

[2] Predictible worst-case one hour equivalent sound level from all applicable sources operating as per scenarios listed in the report in dBA/dBC.

[3] Exclusionary limits from British Columbia Noise Control Best Practices Guideline, BC Oil and Gas Commission (OCG Guide)

Table E-1a: Noise Receptor Permissible Sound Level Limits (PSL) from BC OGC - Operation Scenario

Point of Reception ID	Point of Reception Description	Dwelling Unit Density per Quarter Section of Land [1]	Proximity to Transportation (Category [2])	Nighttime Basic Sound Level (BSL) (dBA)	Daytime Adjustment (DA) (dBA)	Class A or B Adjustments [3] (dB)	Daytime PSL [4] (dBA)	Nighttime PSL [4] (dBA)	Daytime Ambient Sound Level [5] (dBA)	Nighttime Ambient Sound Level [5] (dBA)	Daytime Predicted Results [6] (dBA)	Nighttime Predicted Results [6] (dBA)	Daytime Cumulative Results [7] (dBA)	Nighttime Cumulative Results [7] (dBA)	Compliance (Yes/No)
Receptors															
R1_01	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	53	43	42	42	53	46	Yes
R1_02	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	53	43	42	42	53	46	Yes
R1_03	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	53	43	42	42	53	46	Yes
R1_04	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	53	43	43	43	53	46	Yes
R1_05	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	53	43	45	45	54	47	Yes
R2_01	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	53	43	41	41	53	45	Yes
R2_02	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	53	43	40	40	53	45	Yes
R2_03	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	53	43	40	40	53	45	Yes
R2_04	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	53	43	40	40	53	45	Yes
R2_05	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	53	43	39	39	53	44	Yes
R2_06	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	53	43	38	38	53	44	Yes
R3_01	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	53	43	40	40	53	45	Yes
R3_02	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	53	43	41	41	53	45	Yes
R3_03	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	53	43	42	42	53	45	Yes
R3_04	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	53	43	42	42	53	45	Yes
R3_05	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	53	43	43	43	53	46	Yes
R3_06	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	53	43	43	43	53	46	Yes
R3_07	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	53	43	43	43	53	46	Yes
R3_08	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	53	43	43	43	53	46	Yes
R3_09	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	53	43	43	43	53	46	Yes
R4_01	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	50	40	18	18	50	40	Yes
R4_02	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	50	40	18	18	50	40	Yes
R4_03	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	50	40	18	18	50	40	Yes
R4_04	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	50	40	18	18	50	40	Yes
R4_05	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	50	40	18	18	50	40	Yes
R5_01	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	50	40	15	15	50	40	Yes
R5_02	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	50	40	17	17	50	40	Yes
R5_03	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	50	40	18	18	50	40	Yes
R5_04	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	50	40	18	18	50	40	Yes
R5_05	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	50	40	18	18	50	40	Yes
R6_01	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	45	35	10	10	45	35	Yes
R6_02	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	45	35	11	11	45	35	Yes
R6_03	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	45	35	10	10	45	35	Yes
R6_04	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	45	35	10	10	45	35	Yes
R6_05	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	45	35	10	10	45	35	Yes
R8_01	Receptor in BLR8 Area	9 to 160	Category 2	48	10	0	58	48	53	43	34	34	53	44	Yes
R8_02	Receptor in BLR8 Area	9 to 160	Category 1	43	10	0	53	43	48	38	35	35	48	40	Yes
R8_03	Receptor in BLR8 Area	9 to 160	Category 1	43	10	0	53	43	48	38	37	37	48	40	Yes
R8_04	Receptor in BLR8 Area	9 to 160	Category 1	43	10	0	53	43	48	38	35	35	48	40	Yes
R8_05	Receptor in BLR8 Area	9 to 160	Category 1	43	10	0	53	43	48	38	35	35	48	40	Yes
R8_06	Receptor in BLR8 Area	9 to 160	Category 1	43	10	0	53	43	48	38	25	25	48	38	Yes
R8_07	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	17	17	45	35	Yes
R8_08	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	32	32	45	37	Yes
R8_09	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	27	27	45	36	Yes
R8_10	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	28	28	45	36	Yes
R8_11	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	29	29	45	36	Yes
R8_12	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	29	29	45	36	Yes
R8_13	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	28	28	45	36	Yes
R8_14	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	33	33	45	37	Yes
R8_15	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	29	29	45	36	Yes
R8_16	Receptor in BLR8 Area	1 to 8	Category 1	40	10	0	50	40	45	35	26	26	45	36	Yes

Table E-1a: Noise Receptor Permissible Sound Level Limits (PSL) from BC OGC - Operation Scenario

Point of Reception ID	Point of Reception Description	Dwelling Unit Density per Quarter Section of Land [1]	Proximity to Transportation (Category [2])	Nighttime Basic Sound Level (BSL) (dBA)	Daytime Adjustment (DA) (dBA)	Class A or B Adjustments [3] (dB)	Daytime PSL [4] (dBA)	Nighttime PSL [4] (dBA)	Daytime Ambient Sound Level [5] (dBA)	Nighttime Ambient Sound Level [5] (dBA)	Daytime Predicted Results [6] (dBA)	Nighttime Predicted Results [6] (dBA)	Daytime Cumulative Results [7] (dBA)	Nighttime Cumulative Results [7] (dBA)	Compliance (Yes/No)
R9_01	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	36	36	50	42	Yes
R9_02	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	40	40	50	43	Yes
R9_03	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	40	40	50	43	Yes
R9_04	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	35	35	50	41	Yes
R9_05	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	35	35	50	41	Yes
R9_06	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	37	37	50	42	Yes
R9_07	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	33	33	50	41	Yes
R9_08	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	37	37	50	42	Yes
R9_09	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	35	35	50	41	Yes
R9_10	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	40	40	50	43	Yes
R9_11	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	41	41	51	44	Yes
R9_12	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	43	43	51	45	Yes
R9_13	Receptor in BLR9 Area	1 to 8	Category 1	40	10	0	50	40	45	35	22	22	45	35	Yes
R9_14	Receptor in BLR9 Area	1 to 8	Category 1	40	10	0	50	40	45	35	18	18	45	35	Yes
R9_15	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	34	34	50	41	Yes
R9_16	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	34	34	50	41	Yes
R9_17	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	43	43	51	45	Yes
R9_18	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	40	40	50	43	Yes
R9_19	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	33	33	50	41	Yes
R9_20	Receptor in BLR9 Area	1 to 8	Category 2	45	10	0	55	45	50	40	41	41	51	44	Yes
R10_01	Receptor in BLR10 Area	9 to 160	Category 2	48	10	0	58	48	53	43	33	33	53	43	Yes
R10_02	Receptor in BLR10 Area	9 to 160	Category 2	48	10	0	58	48	53	43	33	33	53	43	Yes
R10_03	Receptor in BLR10 Area	9 to 160	Category 2	48	10	0	58	48	53	43	33	33	53	43	Yes
R10_04	Receptor in BLR10 Area	9 to 160	Category 2	48	10	0	58	48	53	43	35	35	53	44	Yes
R10_05	Receptor in BLR10 Area	9 to 160	Category 2	48	10	0	58	48	53	43	34	34	53	44	Yes
R10_06	Receptor in BLR10 Area	9 to 160	Category 2	48	10	0	58	48	53	43	34	34	53	44	Yes
R10_07	Receptor in BLR10 Area	9 to 160	Category 2	48	10	0	58	48	53	43	26	26	53	43	Yes
R10_08	Receptor in BLR10 Area	9 to 160	Category 1	43	10	0	53	43	48	38	22	22	48	38	Yes
R10_09	Receptor in BLR10 Area	1 to 8	Category 1	40	10	0	50	40	45	35	27	27	45	36	Yes
R11_01	Receptor in BLR11 Area	1 to 8	Category 1	40	10	0	50	40	45	35	32	32	45	37	Yes
R11_02	Receptor in BLR11 Area	1 to 8	Category 1	40	10	0	50	40	45	35	30	30	45	36	Yes
R11_03	Receptor in BLR11 Area	1 to 8	Category 1	40	10	0	50	40	45	35	38	38	46	40	Yes
R11_04	Receptor in BLR11 Area	1 to 8	Category 1	40	10	0	50	40	45	35	39	39	46	40	No
R11_05	Receptor in BLR11 Area	9 to 160	Category 1	43	10	0	53	43	48	38	39	39	49	42	Yes
R11_06	Receptor in BLR11 Area	1 to 8	Category 1	40	10	0	50	40	45	35	31	31	45	36	Yes
R11_07	Receptor in BLR11 Area	1 to 8	Category 2	45	10	0	55	45	50	40	32	32	50	41	Yes
R11_08	Receptor in BLR11 Area	1 to 8	Category 2	45	10	0	55	45	50	40	32	32	50	41	Yes
R11_09	Receptor in BLR11 Area	1 to 8	Category 2	45	10	0	55	45	50	40	34	34	50	41	Yes
R11_10	Receptor in BLR11 Area	1 to 8	Category 2	45	10	0	55	45	50	40	32	32	50	41	Yes
R11_11	Receptor in BLR11 Area	1 to 8	Category 2	45	10	0	55	45	50	40	24	24	50	40	Yes
R11_12	Receptor in BLR11 Area	1 to 8	Category 2	45	10	0	55	45	50	40	29	29	50	40	Yes

Notes:

[1] Quarter section refers to a quarter section with the affected dwelling at the centre (a 451 m radius). For quarter sections with various land uses or with mixed densities, the density chosen is then averaged for the area under consideration.

[2] Definition of transportation proximity category as per BC OGC as follows:

Category 1 - dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyover.

Category 2 - dwelling units more than 30 m but less than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.

Category 3 - dwelling units less than 30 m from heavily travelled roads and/or rail lines and/or subject to frequent aircraft layovers.

[3] Definition of Class A and B Adjustments as per BC OGC as follows:

Class A Adjustments are based on the nature of the activity (i.e. seasonal adjustment - wintertime conditions) and/or actual ambient sound levels . (The value should not exceed a maximum of 10 dBA.)

Class B Adjustments are applicable for temporary noise generating activities (i.e. Duration of Activities that are $\leq$ 60 days, 7 days , or 1 day).

(Activities that have a cumulative duration over any 12-month period of more than 60 days are not considered temporary and are given a value of 0.)

[4] As per the BC OGC the PSL is calculated as follows:

Daytime Permissible Sound Level (PSL) = Basic Sound Level (BSL) + Daytime Adjustment (DA) + Class A Adjustment + Class B Adjustment

Nighttime Permissible Sound Level (PSL) = Basic Sound Level (BSL) + Class A Adjustment + Class B Adjustment

[5] As per the BC OGC, in the absence of measurement, the nighttime ambient sound level is assumed to be five dBA less than the basic sound level and the daytime ambient sound level is assumed to be five dBA less than the basic sound level plus the daytime adjustment.

[6] The predicted sound level from operations scenario was taken from Table C-1.

[7] The cumulative results (Baseline and Operation) = 10log10(10^(0.1 x Baseline)+10^(0.1 x Operation)

Table E-2a: HA Summary of Results for Construction (with Roadheader and Piling Activities)

POR ID [1]	DAY-NIGHT SOUND LEVEL Ldn, HC [DBA]					
	ADJ BASELINE	ADJ PROJECT	CUMULATIVE	ALLOWABLE CHANGE IN %HA	ACTUAL CHANGE IN %HA	EFFECT ASSESSMENT
R3_09	51.4	59.5	60.2	6.5	5.2	No Effect, No Further Mitigation
R3_08	51.4	58.5	59.3	6.5	4.5	No Effect, No Further Mitigation
R1_05	50.1	58.0	58.7	6.5	4.4	No Effect, No Further Mitigation
R3_07	51.4	58.0	58.9	6.5	4.1	No Effect, No Further Mitigation
R3_06	51.4	57.4	58.4	6.5	3.7	No Effect, No Further Mitigation
R1_04	50.1	56.7	57.5	6.5	3.5	No Effect, No Further Mitigation
R3_05	51.4	56.9	58.0	6.5	3.4	No Effect, No Further Mitigation
R1_03	50.1	56.1	57.0	6.5	3.1	No Effect, No Further Mitigation
R1_02	50.1	55.5	56.6	6.5	2.8	No Effect, No Further Mitigation
R3_03	51.4	55.8	57.1	6.5	2.8	No Effect, No Further Mitigation
R3_04	51.4	55.7	57.1	6.5	2.8	No Effect, No Further Mitigation
R1_01	50.1	55.0	56.2	6.5	2.6	No Effect, No Further Mitigation
R3_02	51.4	54.8	56.4	6.5	2.3	No Effect, No Further Mitigation
R3_01	51.4	53.8	55.8	6.5	2.0	No Effect, No Further Mitigation
R2_01	50.3	47.6	52.1	6.5	0.6	No Effect, No Further Mitigation
R2_04	50.3	46.5	51.8	6.5	0.5	No Effect, No Further Mitigation
R2_02	50.3	46.1	51.7	6.5	0.5	No Effect, No Further Mitigation
R2_03	50.3	45.3	51.5	6.5	0.4	No Effect, No Further Mitigation
R2_05	50.3	44.3	51.2	6.5	0.3	No Effect, No Further Mitigation
LAA3_08N	51.6	44.8	52.4	6.5	0.3	No Effect, No Further Mitigation
LAA3_01	51.4	44.5	52.2	6.5	0.3	No Effect, No Further Mitigation
R2_06	50.3	43.7	51.1	6.5	0.3	No Effect, No Further Mitigation
LAA3_06	51.6	41.5	52.0	6.5	0.1	No Effect, No Further Mitigation
LAA3_07	51.4	38.5	51.7	6.5	0.1	No Effect, No Further Mitigation
LAA3_03N	51.6	36.3	51.7	6.5	0.0	No Effect, No Further Mitigation
R5_05	42.8	31.0	43.0	6.5	0.0	No Effect, No Further Mitigation
R5_04	42.8	30.7	43.0	6.5	0.0	No Effect, No Further Mitigation
R5_02	42.8	29.9	43.0	6.5	0.0	No Effect, No Further Mitigation
R5_03	42.8	29.9	43.0	6.5	0.0	No Effect, No Further Mitigation
R4_02	51.6	31.9	51.6	6.5	0.0	No Effect, No Further Mitigation
LAA3_05	49.4	30.9	49.4	6.5	0.0	No Effect, No Further Mitigation
R4_03	51.6	31.8	51.6	6.5	0.0	No Effect, No Further Mitigation
R4_04	51.6	31.8	51.6	6.5	0.0	No Effect, No Further Mitigation
R4_05	51.6	31.6	51.6	6.5	0.0	No Effect, No Further Mitigation
R4_01	51.6	31.3	51.6	6.5	0.0	No Effect, No Further Mitigation
LAA3_02	51.4	30.0	51.5	6.5	0.0	No Effect, No Further Mitigation
R5_01	42.8	23.7	42.8	6.5	0.0	No Effect, No Further Mitigation
R6_05	49.4	19.6	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_03	49.4	19.5	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_02	49.4	19.0	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_04	49.4	18.9	49.4	6.5	0.0	No Effect, No Further Mitigation
R6_01	49.4	18.1	49.4	6.5	0.0	No Effect, No Further Mitigation
LAA3_04N	51.6	36.3	51.7	6.5	0.0	No Effect, No Further Mitigation

Table E-2b: Predicted Sound Levels at Points of Reception (with Roadheader and Piling Activities) - ECPMM Guidelines

Point of Reception ID	Point of Reception Description	Receptor Coordinates (m) NAD 1983, UTM Zone 11U		Construction Sound Impact at POR [1] [2], dBA		Performance Limit [3], dBA		Construction Phase Compliance with Limit	Operation Phase Compliance with Limit
		X	Y	Day	Night	Day	Night		
Mine LAA Receptors									
LAA3_01	Mine - Local Assessment Area	593014	5887005	35	35	55	45	Yes	Yes
LAA3_02	Mine - Local Assessment Area	595553	5887092	20	20	55	45	Yes	Yes
LAA3_03N	Mine - Local Assessment Area	596444	5886205	29	27	55	45	Yes	Yes
LAA3_04N	Mine - Local Assessment Area	598176	5883082	20	17	55	45	Yes	Yes
LAA3_05	Mine - Local Assessment Area	598417	5879754	15	14	55	45	Yes	Yes
LAA3_06	Mine - Local Assessment Area	594791	5881649	27	25	55	45	Yes	Yes
LAA3_07	Mine - Local Assessment Area	593224	5883249	29	28	55	45	Yes	Yes
LAA3_08N	Mine - Local Assessment Area	599120	5885461	22	20	55	45	Yes	Yes
Receptors									
R1_01	Receptor in BLR1 Area	595795	5884301	46	42	55	45	Yes	Yes
R1_02	Receptor in BLR1 Area	595769	5884327	47	43	55	45	Yes	Yes
R1_03	Receptor in BLR1 Area	595698	5884366	47	42	55	45	Yes	Yes
R1_04	Receptor in BLR1 Area	595678	5884419	48	43	55	45	Yes	Yes
R1_05	Receptor in BLR1 Area	595628	5884406	49	45	55	45	Yes	Yes
R2_01	Receptor in BLR2 Area	595866	5884579	45	40	55	45	Yes	Yes
R2_02	Receptor in BLR2 Area	595914	5884557	43	39	55	45	Yes	Yes
R2_03	Receptor in BLR2 Area	595966	5884560	42	38	55	45	Yes	Yes
R2_04	Receptor in BLR2 Area	595894	5884518	43	39	55	45	Yes	Yes
R2_05	Receptor in BLR2 Area	596014	5884419	41	37	55	45	Yes	Yes
R2_06	Receptor in BLR2 Area	596085	5884440	40	37	55	45	Yes	Yes
R3_01	Receptor in BLR3 Area	595737	5884732	45	40	55	45	Yes	Yes
R3_02	Receptor in BLR3 Area	595681	5884710	46	41	55	45	Yes	Yes
R3_03	Receptor in BLR3 Area	595647	5884674	47	42	55	45	Yes	Yes
R3_04	Receptor in BLR3 Area	595606	5884674	47	42	55	45	Yes	Yes
R3_05	Receptor in BLR3 Area	595550	5884672	48	43	55	45	Yes	Yes
R3_06	Receptor in BLR3 Area	595510	5884681	49	43	55	45	Yes	Yes
R3_07	Receptor in BLR3 Area	595482	5884681	49	44	55	45	Yes	Yes
R3_08	Receptor in BLR3 Area	595348	5884685	50	44	55	45	Yes	Yes
R3_09	Receptor in BLR3 Area	595304	5884676	51	44	55	45	Yes	Yes
R4_01	Receptor in BLR4 Area	599128	5882940	18	14	55	45	Yes	Yes
R4_02	Receptor in BLR4 Area	599191	5883019	18	15	55	45	Yes	Yes
R4_03	Receptor in BLR4 Area	599297	5882913	18	15	55	45	Yes	Yes
R4_04	Receptor in BLR4 Area	599379	5882837	18	15	55	45	Yes	Yes
R4_05	Receptor in BLR4 Area	599485	5882743	17	15	55	45	Yes	Yes
R5_01	Receptor in BLR5 Area	599588	5881771	9	7	55	45	Yes	Yes
R5_02	Receptor in BLR5 Area	599605	5881810	16	13	55	45	Yes	Yes
R5_03	Receptor in BLR5 Area	599654	5881896	16	13	55	45	Yes	Yes
R5_04	Receptor in BLR5 Area	599638	5882105	16	14	55	45	Yes	Yes
R5_05	Receptor in BLR5 Area	599630	5882171	17	14	55	45	Yes	Yes
R6_01	Receptor in BLR6 Area	599217	5880546	2	2	55	45	Yes	Yes
R6_02	Receptor in BLR6 Area	599275	5880639	3	3	55	45	Yes	Yes
R6_03	Receptor in BLR6 Area	599338	5880721	4	3	55	45	Yes	Yes
R6_04	Receptor in BLR6 Area	599378	5880784	3	2	55	45	Yes	Yes
R6_05	Receptor in BLR6 Area	599422	5880855	4	3	55	45	Yes	Yes

Notes:

[1] Daytime occurs from 0700-2200h. Night-time occurs from 2200-0700h.

[2] Predictable worst-case one hour equivalent sound level from all applicable sources operating as per scenarios listed in the report in dBA.

[3] Exclusionary limits from Environmental Code of Practice for Metal Mines, Environment Canada (2009)

Table E-2c: Predicted Low Frequency Sound Level at Points of Reception - Construction

Point of Reception ID	Point of Reception Description	Dwelling Unit Density per Quarter Section of Land [1]	Proximity to Transportation (Category [2])	Nighttime Basic Sound Level (BSL) (dBA)	Daytime Adjustment (DA) (dBA)	Class A or B Adjustments [3] (dB)	Daytime PSL [4] (dBA)	Nighttime PSL [4] (dBA)	Daytime Baseline (dBA)	Nighttime Baseline (dBA)	Daytime Ambient Sound Level [5] (dBA)	Nighttime Ambient Sound Level [5] (dBA)	Daytime Cumulative Results (dBA)	Nighttime Cumulative Results (dBA)	Compliance (Yes/No)
Receptors															
R1_01	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	41	38	53	43	53	44	Yes
R1_02	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	41	38	53	43	53	44	Yes
R1_03	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	41	38	53	43	53	44	Yes
R1_04	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	41	38	53	43	53	44	Yes
R1_05	Receptor in BLR1 Area	9 to 160	Category 2	48	10	0	58	48	41	38	53	43	53	44	Yes
R2_01	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	47	43	53	43	54	46	Yes
R2_02	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	47	43	53	43	54	46	Yes
R2_03	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	47	43	53	43	54	46	Yes
R2_04	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	47	43	53	43	54	46	Yes
R2_05	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	47	43	53	43	54	46	Yes
R2_06	Receptor in BLR2 Area	9 to 160	Category 2	48	10	0	58	48	47	43	53	43	54	46	Yes
R3_01	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	43	36	53	43	53	44	Yes
R3_02	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	43	36	53	43	53	44	Yes
R3_03	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	43	36	53	43	53	44	Yes
R3_04	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	43	36	53	43	53	44	Yes
R3_05	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	43	36	53	43	53	44	Yes
R3_06	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	43	36	53	43	53	44	Yes
R3_07	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	43	36	53	43	53	44	Yes
R3_08	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	43	36	53	43	53	44	Yes
R3_09	Receptor in BLR3 Area	9 to 160	Category 2	48	10	0	58	48	43	36	53	43	53	44	Yes
R4_01	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	39	34	50	40	50	41	Yes
R4_02	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	39	34	50	40	50	41	Yes
R4_03	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	39	34	50	40	50	41	Yes
R4_04	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	39	34	50	40	50	41	Yes
R4_05	Receptor in BLR4 Area	1 to 8	Category 2	45	10	0	55	45	39	34	50	40	50	41	Yes
R5_01	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	28	26	50	40	50	40	Yes
R5_02	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	28	26	50	40	50	40	Yes
R5_03	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	28	26	50	40	50	40	Yes
R5_04	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	28	26	50	40	50	40	Yes
R5_05	Receptor in BLR5 Area	1 to 8	Category 2	45	10	0	55	45	28	26	50	40	50	40	Yes
R6_01	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	38	31	45	35	46	36	Yes
R6_02	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	38	31	45	35	46	36	Yes
R6_03	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	38	31	45	35	46	36	Yes
R6_04	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	38	31	45	35	46	36	Yes
R6_05	Receptor in BLR6 Area	1 to 8	Category 1	40	10	0	50	40	38	31	45	35	46	36	Yes

Notes:

[1] Quarter section refers to a quarter section with the affected dwelling at the centre (a 451 m radius). For quarter sections with various land uses or with mixed densities, the density chosen is then averaged for the area under consideration.

[2] Definition of transportation proximity category as per BC OGC as follows:

Category 1 - dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyover.

Category 2 - dwelling units more than 30 m but less than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.

Category 3 - dwelling units less than 30 m from heavily travelled roads and/or rail lines and/or subject to frequent aircraft layovers.

[3] Definition of Class A and B Adjustments as per BC OGC as follows:

Class A Adjustments are based on the nature of the activity (i.e. seasonal adjustment - wintertime conditions) and/or actual ambient sound levels . (The value should not exceed a maximum of 10 dBA.)

Class B Adjustments are applicable for temporary noise generating activities (i.e. Duration of Activities that are $\leq$ 60 days, 7 days , or 1 day).

(Activities that have a cumulative duration over any 12-month period of more than 60 days are not considered temporary and are given a value of 0.)

[4] As per the BC OGC the PSL is calculated as follows:

Daytime Permissible Sound Level (PSL) = Basic Sound Level (BSL) + Daytime Adjustment (DA) + Class A Adjustment + Class B Adjustment

Nighttime Permissible Sound Level (PSL) = Basic Sound Level (BSL) + Class A Adjustment + Class B Adjustment

[5] As per the BC OGC, in the absence of measurement, the nighttime ambient sound level is assumed to be five dBA less than the basic sound level and the daytime ambient sound level is assumed to be five dBA less than the basic sound level plus the daytime adjustment.

[6] The predicted sound level from construction scenario was taken from Table C-1.

Point of Reception ID	Point of Reception Description	Dwelling Unit Density per Quarter Section of Land [1]	Proximity to Transportation (Category [2])	Nighttime Basic Sound Level (BSL) (dBA)	Daytime Adjustment (DA) (dBA)	Class A or B Adjustments [3] (dB)	Daytime PSL [4] (dBA)	Nighttime PSL [4] (dBA)	Daytime Baseline (dBA)	Nighttime Baseline (dBA)	Daytime Ambient Sound Level [5] (dBA)	Nighttime Ambient Sound Level [5] (dBA)	Daytime Cumulative Results (dBA)	Nighttime Cumulative Results (dBA)	Compliance (Yes/No)

[7] The cumulative results (Baseline and Construction) = 10log10(10^(0.1 x Baseline)+10^(0.1 x Construction)

Table E-2d: Predicted Low Frequency Sound Level at Points of Reception - Construction (with Roadheader and Piling Activities)

Point of Reception ID	Point of Reception Description	Receptor Coordinates (m) NAD 1983, UTM Zone 11U		Construction Sound Impact at POR [1] [2], dBA		Construction Sound Impact at POR [1] [2], dBC		Difference (dBC - dBA)		Limit for Difference[3], dB	Is dBC - dBA > 20?	Is there tonal below 250 Hz?	Compliance with Criteria[3]?
		X	Y	Day	Night	Day	Night	Day	Night				
Mine LAA Receptors													
LAA3_01	Mine - Local Assessment Area	593014	5887005	35	35	50	50	15	15	20	No	No	Yes
LAA3_02	Mine - Local Assessment Area	595553	5887092	20	20	41	41	21	20	20	No	No	Yes
LAA3_03N	Mine - Local Assessment Area	596444	5886205	29	27	48	48	19	19	20	No	No	Yes
LAA3_04N	Mine - Local Assessment Area	598176	5883082	20	17	40	39	20	19	20	No	No	Yes
LAA3_05	Mine - Local Assessment Area	598417	5879754	15	14	35	34	20	20	20	No	No	Yes
LAA3_06	Mine - Local Assessment Area	594791	5881649	27	25	46	46	19	19	20	No	No	Yes
LAA3_07	Mine - Local Assessment Area	593224	5883249	29	28	50	50	21	21	20	Yes	No	Yes
LAA3_08N	Mine - Local Assessment Area	599120	5885461	22	20	43	43	21	21	21	Yes	No	Yes
Receptors													
R1_01	Receptor in BLR1 Area	595795	5884301	46	42	62	61	16	15	20	No	No	Yes
R1_02	Receptor in BLR1 Area	595769	5884327	47	43	62	62	15	15	20	No	No	Yes
R1_03	Receptor in BLR1 Area	595698	5884366	47	42	62	61	14	14	20	No	No	Yes
R1_04	Receptor in BLR1 Area	595678	5884419	48	43	62	61	14	13	20	No	No	Yes
R1_05	Receptor in BLR1 Area	595628	5884406	49	45	63	63	14	13	20	No	No	Yes
R2_01	Receptor in BLR2 Area	595866	5884579	45	40	59	58	14	13	20	No	No	Yes
R2_02	Receptor in BLR2 Area	595914	5884557	43	39	58	57	15	15	20	No	No	Yes
R2_03	Receptor in BLR2 Area	595966	5884560	42	38	57	56	15	14	20	No	No	Yes
R2_04	Receptor in BLR2 Area	595894	5884518	43	39	59	58	15	15	20	No	No	Yes
R2_05	Receptor in BLR2 Area	596014	5884419	41	37	56	56	16	15	20	No	No	Yes
R2_06	Receptor in BLR2 Area	596085	5884440	40	37	56	55	16	15	20	No	No	Yes
R3_01	Receptor in BLR3 Area	595737	5884732	45	40	59	58	14	13	20	No	No	Yes
R3_02	Receptor in BLR3 Area	595681	5884710	46	41	60	59	13	13	20	No	No	Yes
R3_03	Receptor in BLR3 Area	595647	5884674	47	42	60	59	13	12	20	No	No	Yes
R3_04	Receptor in BLR3 Area	595606	5884674	47	42	60	60	13	13	20	No	No	Yes
R3_05	Receptor in BLR3 Area	595550	5884672	48	43	61	61	13	12	20	No	No	Yes
R3_06	Receptor in BLR3 Area	595510	5884681	49	43	62	61	13	12	20	No	No	Yes
R3_07	Receptor in BLR3 Area	595482	5884681	49	44	62	61	13	12	20	No	No	Yes
R3_08	Receptor in BLR3 Area	595348	5884685	50	44	62	61	12	11	20	No	No	Yes
R3_09	Receptor in BLR3 Area	595304	5884676	51	44	62	61	11	10	20	No	No	Yes
R4_01	Receptor in BLR4 Area	599128	5882940	18	14	38	38	21	20	20	Yes	No	Yes
R4_02	Receptor in BLR4 Area	599191	5883019	18	15	39	38	21	20	20	Yes	No	Yes
R4_03	Receptor in BLR4 Area	599297	5882913	18	15	38	38	21	20	20	Yes	No	Yes
R4_04	Receptor in BLR4 Area	599379	5882837	18	15	38	38	21	20	20	Yes	No	Yes
R4_05	Receptor in BLR4 Area	599485	5882743	17	15	38	38	21	21	20	Yes	No	Yes
R5_01	Receptor in BLR5 Area	599588	5881771	9	7	32	31	23	23	20	Yes	No	Yes
R5_02	Receptor in BLR5 Area	599605	5881810	16	13	37	37	22	21	20	Yes	No	Yes
R5_03	Receptor in BLR5 Area	599654	5881896	16	13	37	37	22	21	20	Yes	No	Yes
R5_04	Receptor in BLR5 Area	599638	5882105	16	14	38	37	22	21	20	Yes	No	Yes
R5_05	Receptor in BLR5 Area	599630	5882171	17	14	38	38	21	21	20	Yes	No	Yes
R6_01	Receptor in BLR6 Area	599217	5880546	2	2	25	25	23	23	20	Yes	No	Yes
R6_02	Receptor in BLR6 Area	599275	5880639	3	3	27	27	24	24	20	Yes	No	Yes
R6_03	Receptor in BLR6 Area	599338	5880721	4	3	27	27	24	24	20	Yes	No	Yes
R6_04	Receptor in BLR6 Area	599378	5880784	3	2	27	27	24	24	20	Yes	No	Yes
R6_05	Receptor in BLR6 Area	599422	5880855	4	3	27	27	24	23	20	Yes	No	Yes

Notes:

[1] Daytime occurs from 0700-2200h. Night-time occurs from 2200-0700h.

[2] Predictible worst-case one hour equivalent sound level from all applicable sources operating as per scenarios listed in the report in dBA/dBC.

[3] Exclusionary limits from British Columbia Noise Control Best Practices Guideline, BC Oil and Gas Commission (OCG Guide)

APPENDIX E PHOTO-COMPOSITE IMAGES - GOLDFIELD'S DITCH VIEWPOINT

VP7 (Goldfields Ditch) – Existing Conditions 2019



VP7 (Goldfields Ditch) – Closure



CARIBOO GOLD PROJECT

LANDSCAPE PHOTOGRAPHS
AND SIMULATIONS
VP7 (GOLDFIELDS DITCH)
EXISTING CONDITIONS & CLOSURE

OSISKO DEVELOPMENT

REV.	DESCRIPTION	DATE	INITIALS
0		4/20/2023	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

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VP7 (Goldfields Ditch) – Existing Conditions 2019



VP7 (Goldfields Ditch) – Post-Closure



CARIBOO GOLD PROJECT

LANDSCAPE PHOTOGRAPHS
AND SIMULATIONS
VP7 (GOLDFIELDS DITCH)
EXISTING CONDITIONS & POST-CLOSURE

OSISKO DEVELOPMENT

REV.	DESCRIPTION	DATE	INITIALS
0		4/20/2023	M.Y

PROJECT NO.	PHASE	REV.	FIGURE
151-11330-70	00	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

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