RED MOUNTAIN UNDERGROUND GOLD PROJECT
VOLUME 3 | CHAPTER 8
NOISE EFFECTS ASSESSMENT

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8 NOISE EFFECTS ASSESSMENT

8.1 Introduction

IDM Mining Ltd. (IDM, the Proponent) proposes to develop and operate the Red Mountain Underground Gold Project (the Project) located in northwest British Columbia (BC), approximately 15 km northeast of Stewart in the Bitter Creek watershed, a tributary of the Bear River. The proposed Project will extract high-grade gold and silver ore from an underground facility in the high alpine. Ore will be processed at a separate facility, lower down in the middle of the valley at a place known as Bromley Humps. The mine will take approximately 18 months to construct and is currently planned to be in operation for six years. Figure 8.1-1, Figure 8.1-2, and Figure 8.1-3 provide an overview of the Project's components and their locations within the Bitter Creek valley.

Noise is an aspect of the environment that may be altered by the proposed Project. This chapter presents the effects assessment for the noise intermediate component (IC) and highlights potential effects that could result on other identified valued components (VCs), including:

- Wildlife and Wildlife Habitat (Chapter 16);
- Social VCs (Chapter 20), including:
  - Recreational Values; and
  - Current Use of Lands and Resources for Traditional Purposes;
- Cultural and Heritage Resources (Chapter 21); and
- Human Health (Chapter 22).

This chapter provides the regulatory and policy context within which the Noise Effects Assessment occurs, the characterization of existing noise conditions near the Project, the estimation and modelling of Project-related sound levels to determine potential effects, the identification of applicable and effective mitigation measures, and the characterization of any residual effects predicted to remain after the application of mitigation measures. The chapter concludes with an assessment of any potential cumulative effects associated with predicted changes in noise levels.

Figure 8.1-1: Project Overview

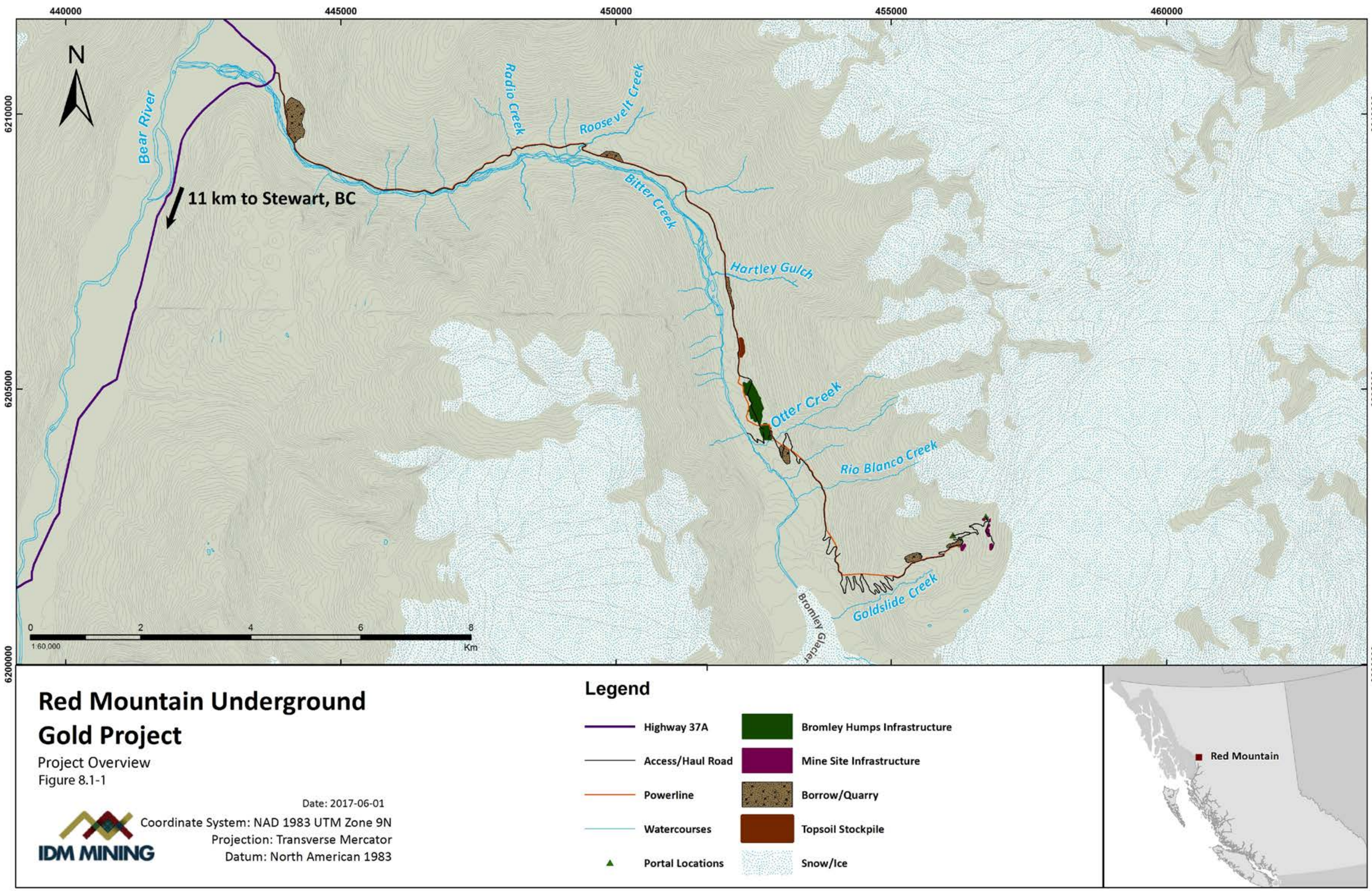


Figure 8.1-2: Project Footprint – Bromley Humps

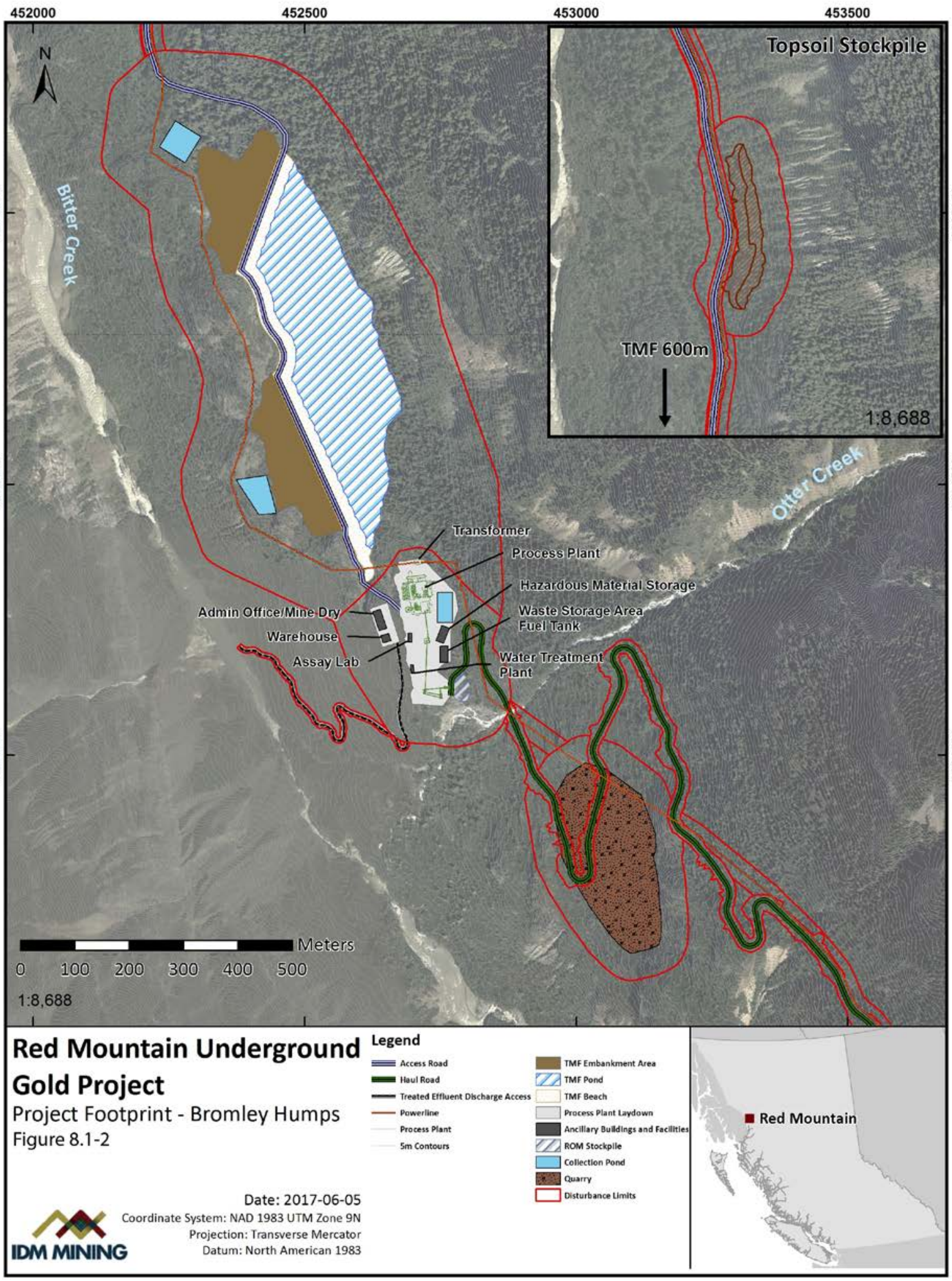
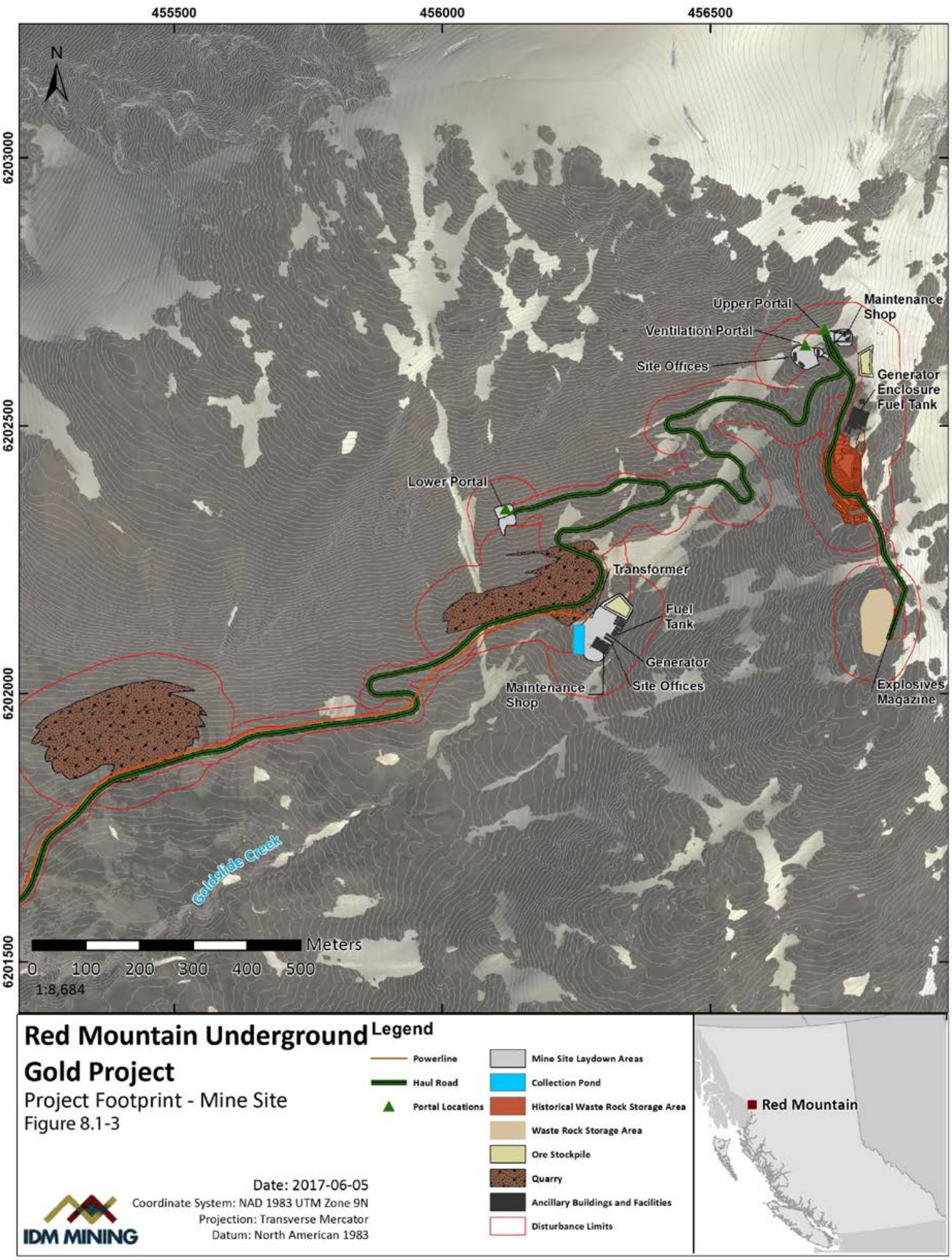


Figure 8.1-3: Project Footprint – Mine Site



8.2 Regulatory and Policy Setting

The Application Information Requirements (AIR) for the Project, approved by the British Columbia Environmental Assessment Office (EAO) in March 2017, outlines the requirements of the Noise Effects Assessment to meet both the provincial and federal environmental assessment requirements under the *BC Environmental Assessment Act* (2002) (BCEAA) and the *Canadian Environmental Assessment Act, 2012* (CEAA 2012). To inform the regulatory and policy setting for the Project, the following references were reviewed:

- Guidance for Evaluating Human Health Impacts in Environmental Assessment (Health Canada 2011);
- Effects of Noise and Reverberation on Speech (Levitt and Webster 1991);
- BC OGC (British Columbia Oil and Gas Commission). 2009. British Columbia Noise Control Best Practices Guideline. March 2009. Fort St. John, BC;
- Noise Control. Prepared by the Alberta Energy and Utilities Board (Alberta EUB. 2007. Directive 038);
- Using a change in percentage highly annoyed with noise as a potential health effect measure for projects under the Canadian Environmental Assessment Act (Michaud, Bly, and Keith 2008);
- Environmental Code of Practice for Metal Mines (Environment Canada 2009);
- Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures (ISO) 1996-1:2003 (ISO1996:2);
- Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO 9613-2:1996 [ISO9613:2]); and
- Guidelines for Community Noise (WHO 1999).

The regulation of noise in Canada by federal, provincial, and municipal governments does not provide a specific set of enforceable noise thresholds or standards for mine development projects in terms of wildlife, human, or other environmental effects. Instead, noise effects assessments rely on widely accepted international standards from recognized regulatory bodies such as the International Organization for Standardization (ISO) and the World Health Organization (WHO). For the mining industry, Environment Canada (EC) released the Environmental Code of Practice for Metal Mines (EC 2009), which includes recommended environmental protection practices for the complete mine life cycle. Within this document, EC provides recommendations on acceptable levels of ambient noise from mining operations and blasting events as well as measures to control noise in the mining industry.

The regulatory setting for ambient noise levels refer to off-site effects. Noise levels in the workplace are regulated by WorkSafeBC and the Health, Safety, and Reclamation Code for Mines in BC. Given that off-duty workers will not be housed in camps at the site, this Noise Effects Assessment does not consider these regulations; although they will be considered for establishing worker health and safety requirements for the Project.

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

8.3 Scope of the Assessment

8.3.1 Information Sources

This Noise Effects Assessment is primarily based on widely accepted methods and standards developed by ISO, including the central guidance documents for the characterization and calculation of sound and noise attenuation:

- ISO 1996-1:2003 – Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures; and
- ISO 9613-2: 1996 – Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.

Federal guidance documents were also reviewed to inform the scope and assessment of potential noise effects, including:

- Guidance for Evaluating Human Health Impacts in Environmental Assessment (Health Canada 2011); and
- Environmental Code of Practice for Metal Mines (EC 2009).

Finally, baseline reports and Environmental Assessment Certificate Application submissions for the Kemess Underground Project (ERM 2016) and the Brucejack Gold Mine Project (ERM 2014) near the Project location were reviewed to understand the expectations and concerns of government and stakeholders during previous assessments.

8.3.2 Input from Consultation

IDM is committed to open and honest dialogue with regulators, Aboriginal Groups, community members, stakeholders, and the public.

IDM conducted consultation with regulators and Aboriginal Groups through the Working Group led by EAO. Where more detailed and technical discussions were warranted, IDM and Working Group members, including sometimes NLG representatives, held topic-focused discussions, the results of which were brought back to EAO and the Working Group.

Further consultation with Aboriginal Groups, community members, stakeholders, and the public has been conducted as outlined by the Section 11 Order and Environmental Impact Statement Guidelines issued for the Project. The results of those consultation efforts relevant to the assessment of potential effects of the Project on Noise have been summarized in Table 8.3-1.

More information on IDM's consultation efforts with Aboriginal Groups, community members, stakeholders, and the public can be found in Chapter 3 (Information Distribution and Consultation Overview), Part C (Aboriginal Consultation), Part D (Public Consultation), and Appendices 27-A (Aboriginal Consultation Report) and 28-A (Public Consultation Report). A record of the Working Group's comments and IDM's responses can be found in the comment-tracking table maintained by EAO.

Table 8.3-1: Summary of Consultation Feedback on Noise

Topic (VC, IC, Sub-Component)	Feedback by*				Consultation Feedback	Response
	NLG	G	P/S	O		
Noise		X			Health Canada suggested that "resident and user complains" be used a primary measurement indicator for the Noise IC.	"Resident and user complaints" has been included as a primary measurement indicator for the assessment of noise.
Noise		X			Health Canada asked IDM to include temporary or seasonal sensitive human receptor locations such as hunting camps or ceremonials areas in the Noise assessment.	IDM is not aware of any temporary or seasonal sensitive human receptor locations in the Bitter Creek valley. Noise modeling has shown that noise will be limited to the Project footprint.
Noise		X			Health Canada suggested that potential sources of tonal and impulsive noise be included in the assessment of Noise.	The potential effects of tonal and impulsive noise have been included in the effects assessment.
Noise		X			The BC Ministry of Environment (MOE) requested that Noise be included under the Environmental Pillar due to its potential effects on Wildlife.	Wildlife has been identified as an assessment endpoint for the IC Noise.
Noise		✓			MOE requested the objectives or limits to noise that would be applied in the assessment to minimize the noise-related effects on Wildlife.	Objectives and limits applied are discussed in Section 8.5.1.1 and further discussed in the Wildlife and Wildlife Habitat Effects Assessment (Chapter 16).

*NLG = Nisga'a Lisims Government;
G = Government - Provincial or federal agencies;
P/S = Public/Stakeholder - Local government, interest groups, tenure and license holders, members of the public;
O = Other

8.3.3 Valued and Intermediate Components, Assessment Endpoints, and Measurement Indicators

Project construction and mining activities will introduce noise to the surrounding environment, which has the potential to effects wildlife and human noise receptors in the vicinity. Noise was selected as an IC for its potential effects to Wildlife, social VCs, Cultural and Heritage Resources, and Human Health.

The primary measurement indicators for noise were selected as the A-weighted sound pressure level (in dBA) at potentially affected receptors and peak noise levels and vibration from blasting events (see Table 8.3-2).

Table 8.3-2: Measurement Indicators for Noise

Intermediate Component	Primary Measurement Indicators	Indicator Rationale
Noise	• A-weighted sound pressure level (in dBA) at potentially affected wildlife and human receptors. • Peak noise levels and vibration from blasting events.	The Project has the potential to change ambient sound levels, and the potential change can adversely affect the nearest sensitive receptors. Due to the remote location of the Project, IDM is not aware of any sensitive human receptors. Noise modelling will support the effects assessment of receptor VCs, including Wildlife, social VCs, Cultural and Heritage Resources, and Human Health.

8.3.4 Project-Specific Baseline Studies

There were no Project-specific baseline studies conducted for the Noise Effects Assessment. The characterization of baseline noise to support the assessment relied on existing data, methods, and assumptions accepted to define baseline conditions for oil and gas activities in similar remote locations. This characterization of baseline noise has been accepted and verified at other mining projects in the region.

As outlined in Chapter 6 (Effects Assessment Methodology), IDM has not conducted primary traditional use or traditional ecological knowledge (TEK) surveys in support of the Project due to the preferences of Nisga’a Nation, as represented by NLG, and EAO’s and the Canadian Environmental Assessment Agency’s direction for comparatively low levels of engagement with the other Aboriginal Groups potentially affected by the Project. IDM has committed to using TEK where that information is publicly available. As no TEK relevant to this effects assessment was publicly available at the time of writing, no TEK has been incorporated.

8.3.4.1 Data Sources

Many previous mining environmental assessments in the region have been conducted by Rescan/ERM, and the recently completed applications for the Kemess Underground Project (ERM 2016) and Brucejack Gold Mine Project (ERM 2014) relied on the recommended baseline noise levels from the Alberta Energy and Utilities Board (EUB), as defined in Directive 38. This level for the average rural ambient sound level is also referenced in the BC OGC Guideline. The data sources used for the Noise Effects Assessment were:

- Noise Control prepared by the Alberta Energy and Utilities Board (Alberta EUB 2007) Directive 038; and
- BC OGC's British Columbia Noise Control Best Practices Guideline (March 2009).

During consultation with Aboriginal Groups, stakeholders, community members, and the public, IDM did not obtain any specific information regarding local knowledge related to current noise conditions.

8.3.5 Assessment Boundaries

The following sections identify the spatial and temporal boundaries applicable to the Noise Effects Assessment. There are no administrative or technical boundaries applicable.

8.3.5.1 Spatial Boundaries

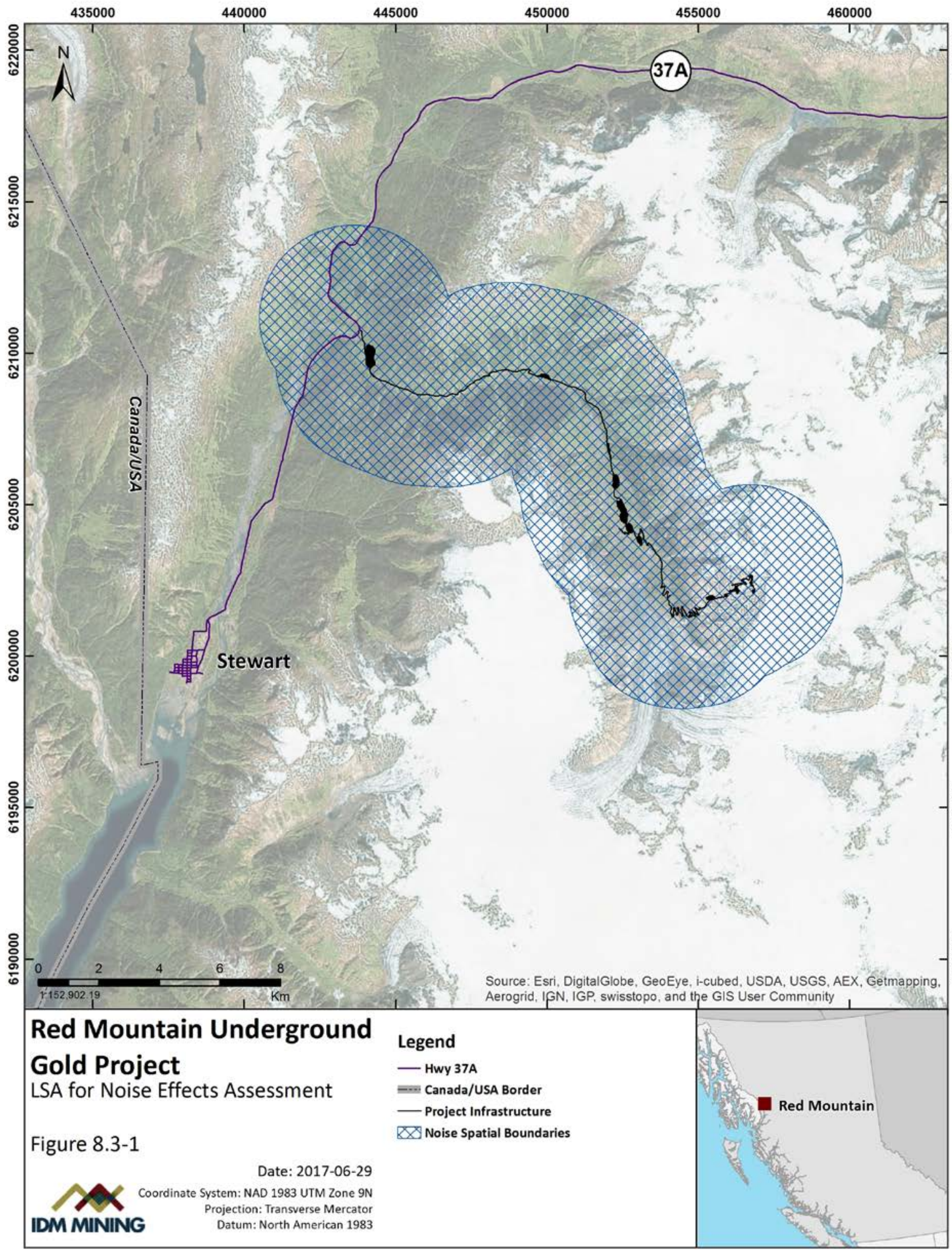
The noise local study area (LSA) and modelling domain was selected to allow for a 3-kilometer (km) buffer around the proposed Project footprint, including the Access Road, and is shown in Figure 8.3-1. This LSA was selected to encompass the extents of changes in background noise levels and doubles the distance at which guidelines issued by the BC Oil and Gas Commission (BC OGC; 2009) limit the effects of noise from industrial development.

Noise effects attenuate relatively quickly and measurable differences were not anticipated or predicted to occur beyond the identified LSA. Therefore, no larger regional study area was selected for the noise assessment.

8.3.5.2 Temporal Boundaries

The Noise Effects Assessment considers the potential noise effects from the Construction, Operation, and Closure and Reclamation Phases of the Project. The primary noise effects from mining activities and blasting will occur during these project phases. The noise emitted by activities during the Post-Closure Phase will be substantially lower.

Figure 8.3-1: LSA for Noise Effects Assessment



8.4 Existing Conditions

8.4.1 Overview of Existing Conditions

The Bitter Creek valley is a relatively remote and undisturbed area. The noises in this area are typically characterized by natural noise sources, such as wildlife and wind, and transient noise from anthropogenic sources, such as recreational, traditional land use activities, or mineral exploration.

8.4.2 Past and Current Projects and Activities

There are no past or current projects near the Bitter Creek valley that are known to significantly affect noise in this remote location. Current recreational access and exploratory activities near the Project site would not have a significant effect on baseline noise levels in this remote location.

8.4.3 Baseline Characterization

Due to the remote location of the Bitter Creek valley, it is expected that regional baseline noise levels are low. The Alberta EUB Directive 038 (Alberta EUB 2007) provides an estimated ambient noise level in rural areas that is applicable to environmental assessments involving remote locations where no baseline noise monitoring has been performed. The baseline noise estimates from Alberta EUB have been used in other assessment of mineral development projects in BC. The estimated baseline night time noise levels for rural areas of 35 dBA (L_n) will be used for the Project. Daytime ambient sound levels (Ld) are commonly 10 dBA L_{eq} higher than night time levels (WHO 1999).

The use of this recommended baseline level has been confirmed by baseline monitoring for several other development projects in the region, including the Kitsault Mine Project (AMEC 2011) and the Schaft Creek Mine Project (RTEC 2008). Background noise monitoring levels at these locations ranged from 31 – 40 dBA, comparable to those estimated and recommended by the Alberta EUB. This indicates that use of the guidance recommended baseline level to describe existing conditions and baseline noise levels for the noise assessment is appropriate for the Project, which is similarly situated in an area that shares the following common traits with these other projects:

- Remote, undeveloped locations;
- Located in complex terrain in steep valleys dominated by forest cover at lower elevations; and rock, snow, and ice at higher elevations;
- No specific anthropogenic sources of noise can be identified near the site beyond limited access for recreational or commercial activities along the Access Road from Highway 37A; and
- Located within the same Biogeoclimatic zone in BC and subject to similar seasonal climatic regimes impacting the attenuation of noise.

8.5 Potential Effects

8.5.1 Methods

The assessment of noise and blasting-related effects from the Project uses predictive methods to quantify the noise, instantaneous noise levels, and vibration at receptors situated within the noise assessment study boundaries. To identify and quantify potential effects the following tasks were completed:

- A review of Project data and information (e.g., site plans, equipment specifications) to identify potential noise sources and blasting locations;
- Gathering and identification of potential sensitive receptor locations or receptors of interest from other disciplines, such as Wildlife or Human Health;
- The development of separate noise model runs for Construction and Operation to calculate potential noise levels from construction and mining activities;
- Noise model runs to account for potential effects from blasting; and
- Comparison of resultant levels to applicable Project thresholds at specific receptor locations and identification of the spatial extent of potential effects.

8.5.1.1 Noise Modelling Methodology

SoundPLAN, version 7.4, was used to model the effect of the significant Project noise sources. SoundPLAN calculates sound level emissions based on ISO 9613-2: 1996 - *Acoustics - Attenuation of sound during propagation outdoors – Part 2: General method of calculation*.

The noise model considered the following factors:

- Sound Power Levels (PWL);
- Distance attenuation;
- Source-receptor geometry;
- Ground and air (atmospheric) attenuation; and
- Temperature and wind effects on noise propagation.

To predict noise emissions from the Construction and Operation phases, the PWL for each relevant source of noise was determined based on an existing acoustical database that includes actual on-site measurements for identical or similar equipment. All noise sources and their PWL are provided in the Noise Modelling Report (Appendix 8-A).

The noise model was used to predict A-weighted equivalent continuous sound levels (LA_{eq}) for the continuous emission of noise during the Project Construction and Operation Phases. Equivalent continuous sound levels are the average sound energy (in units of dBA) occurring over a specified period of time at a given receptor. The A-weighting accounts for the relative loudness of sounds in air as perceived by the human ear, and is the common measurement applied in environmental noise assessments.

For the blast scenarios, the instantaneous noise level is quantified using the L_{peak} metric. The L_{peak} is a measure of air-blast overpressure that might affect receptor locations within the model domain.

The noise study modelling scenarios considered were for: 1. Construction Phase; 2. Operation Phase; 3. Blasting (Appendix 8-A). The blasting scenario considers multiple potential blast locations to provide a composite prediction of potential effects. However, the effects from the blasts would be intermittent and restricted to only a small portion of the construction period as each Project component is completed.

Information provided by other disciplines was used to select key sensitive receptors that were considered in the noise modelling study. Of these receptors, the nearest human receptor was identified as a recreational hiking trail area at the top of Ore Mountain. The Bitter Creek fish spawning area was also identified as a receptor for consideration, but this was primarily to identify potential vibration effects from blasting.

Sound propagation contour maps were developed to identify the extent of potential effects so that these could be used in the Wildlife and Wildlife Habitat Effects Assessment (Chapter 16). The contour maps also indicate the extent of the Project sound propagation (Appendix 8-A).

Noise limits from the Environmental Code of Practice for Metal Mines (EC 2009) were considered for the assessment (Table 8.5-1). Further indicators of noise effects on humans recommended by Health Canada (i.e., sleep disturbance, complaints, and high annoyance) were not considered in the Noise Effects Assessment because of the lack of permanent human residential dwellings near the Project site and the relatively low noise level predictions at the identified receptors.

Table 8.5-1: Noise Criteria Considered for Noise Assessment

Indicator	Description	Criteria Threshold
L_d – Daytime noise level	In residential areas adjacent to mine sites, the LA_{eq} from mining activities should not exceed the criteria threshold. Ambient noise can also affect wildlife, so sites in remote locations should also work to meet these objectives for off-site ambient noise levels.	55 dBA
L_n – Nighttime noise level		45 dBA
L_{peak} - blasting	Mines in areas where ground vibration and noise from blasting are not regulated should design their blasts so that the criteria are not exceeded at or beyond the boundaries of the mine property.	128 dB

Indicator	Description	Criteria Threshold
mm/s – vibration	No explosive is to be detonated that produces, or is likely to produce, a peak particle velocity greater than the threshold in a spawning bed during the period of egg incubation.	12.5 mm/s

Source: Environmental Code of Practice for Metal Mines (Environment Canada 2009.

8.5.2 Project Interactions

It is anticipated that several proposed Project components or activities have the potential to emit noise (see Table 8.5-2).

Table 8.5-2: Potential Project Interactions, Noise

Project Component or Activity	Potential Interaction with Noise
Construction Phase	
Construct Access Road and Haul Road from Highway 37A to the Upper Portal	Sound generated by construction equipment and vehicles
Install Powerline from substation tie-in to the Lower Portal laydown area	Sound generated by construction equipment and vehicles
Excavate and secure Lower Portal entrance and access tunnel	Sound generated by construction equipment, vehicles, and blasting
Construct Mine Site water management infrastructure, including talus quarries and the portal collection pond, dewatering systems, and water diversion, collection and discharge ditches, and swales.	Sound generated by construction equipment and vehicles
Install and fill Fuel Tanks at Mine Site	Sound generated by construction activities
Construct Explosives Magazine	Sound generated by construction equipment and vehicles
Construct other Mine Site ancillary buildings and facilities	Sound generated by construction equipment and vehicles
Initiate underground lateral development and cave gallery excavation	Sound from blasting
Temporarily stockpile waste and ore in portal area	Sound generated by construction equipment and vehicles
Install construction and permanent ventilation systems and underground water pumps	Sound generated by construction activities
Transport and deposit waste rock to Waste Rock Storage Area (WRSA)	Sound generated by construction equipment and vehicles
Clear and prepare the Tailings Management Facility (TMF) basin and Process Plant site pad	Sound generated by construction equipment and vehicles

Project Component or Activity	Potential Interaction with Noise
Excavate rock and till from the TMF basin and local borrows/quarries for construction activities (e.g., dam construction for the TMF)	Sound generated by construction equipment and vehicles
Establish water management facilities, including diversion ditches for the TMF and Process Plant	Sound generated by construction equipment and vehicles
Construct the TMF	Sound generated by construction equipment and vehicles
Construct the Process Plant and Run of Mine Stockpile location	Sound generated by construction equipment and vehicles
Construct water treatment facilities and test facilities	Sound generated by construction equipment and vehicles
Construct Bromley Humps ancillary buildings and facilities, the Fuel Tank, Waste Storage Area, and Hazardous Materials Storage Area	Sound generated by construction equipment and vehicles
Commence milling to ramp up to full production	Sound generated by milling activities
Operation Phase	
Use Access Road for personnel transport, haulage, and delivery of goods	Sound generated by operations equipment and vehicles
Maintain Access Road and Haul Road, including grading and plowing as necessary	Sound generated by operations equipment and vehicles
Maintain Powerline right-of-way from substation tie-in to portal entrance, including brushing activities as necessary	Sound generated by operations equipment and vehicles
Continue underground lateral development, including dewatering	Noise from blasting
Haul waste rock from the declines to the WRSA for disposal (waste rock transport and storage)	Sound generated by operations equipment and vehicles
Extract ore from the underground load-haul-dump transport to Bromley Humps to Run of Mine Stockpile (ore transport and storage)	Sound generated by operations equipment and vehicles
Pump process water from the TMF (reclaim water) to supply the Process Plant	Sound generated by operational equipment and vehicles
Pump tailings and waste water to the TMF for disposal	Sound generated by operational equipment and vehicles
Closure and Reclamation	
Use and maintain Access Road for personnel transport, haulage, and removal of decommissioned components until road is decommissioned and reclaimed.	Sound generated by decommissioning equipment and vehicles
Install bulkhead(s) in the declines and ventilation exhaust raise	Sound generated by decommissioning equipment and vehicles
Decommission and reclaim Lower Portal area and Powerline	Sound generated by decommissioning equipment and vehicles

Project Component or Activity	Potential Interaction with Noise
Decommission and reclaim Haul Road	Sound generated by decommissioning equipment and vehicles
Decommission and reclaim all remaining mine infrastructure (Mine Site and Bromley Humps, except TMF) in accordance with Closure and Reclamation (Volume 2, Chapter 5)	Sound generated by decommissioning equipment and vehicles
Construct the closure spillway	Sound generated by decommissioning equipment and vehicles
Remove discharge water line and water treatment plant	Sound generated by decommissioning equipment and vehicles
Decommission and reclaim Access Road	Sound generated by decommissioning equipment and vehicles

8.5.3 Discussion of Potential Effects

The potential effects identified for noise were assessed in a noise modelling study (Appendix 8-A). The predicted noise levels for each scenario considered (construction, operations, and blasting) are provided in Figure 8.5-1, Figure 8.5-2, and Figure 8.5-3. Elevated noise levels (in LA_{eq}) are predicted near to the Project footprint (see Figure 8.1-1), with the effects of noise dissipating quickly outside the immediate area of the mine. Project activity associated with the Construction, Operation, and Closure and Reclamation Phases are predicted to have similar magnitude of predicted noise levels.

No permanent or seasonal human receptor locations were identified within the noise modelling area (i.e., the LSA). Noise from mining or related activities would not affect the nearest community of residents at Stewart. At the recreational hiking trail at the top of Ore Mountain, identified as a key recreational human receptor, noise levels from the Project are not expected to be distinguishable from the assumed background (35 dBA).

Elevated noise levels are concentrated around the Process Plant and the mine portals. Around these primary areas of noise generation, noise levels are not expected to exceed 45 dBA, the nighttime noise criteria threshold, beyond approximately 950 metres (m) from the noise sources during construction and 1.2 kilometres (km) during operations. Noise levels are at or below the assumed background level, 35 dBA, near the outer spatial extent of the LSA. The predicted noise levels along the Access and Haul Road network are attenuated away from the road alignment so that the area influenced by the alignment is much smaller than those affected by other Project noise sources at the Process Plant and mine portals.

The predicted peak instantaneous levels for noise (L_{peak}) resulting from potential intermittent blast events meets the noise criteria threshold outside the immediate blast areas considered during construction. Vibration levels at the Bitter Creek fish spawning area were predicted to be 2 millimetres per second (mm/s), well below the criteria threshold identified for effects to spawning areas. Each individual blast or blasting location would be intermittent and restricted to only a small portion of the construction period as each Project is completed. Further assessment of vibration effects to Fish is not considered.

The potential effects of continuous noise and blast events, such as disturbance and habitat loss, are discussed in Chapter 16 (Wildlife and Wildlife Habitat Effects Assessment).

Figure 8.5-1: Noise Contour Map (Construction)

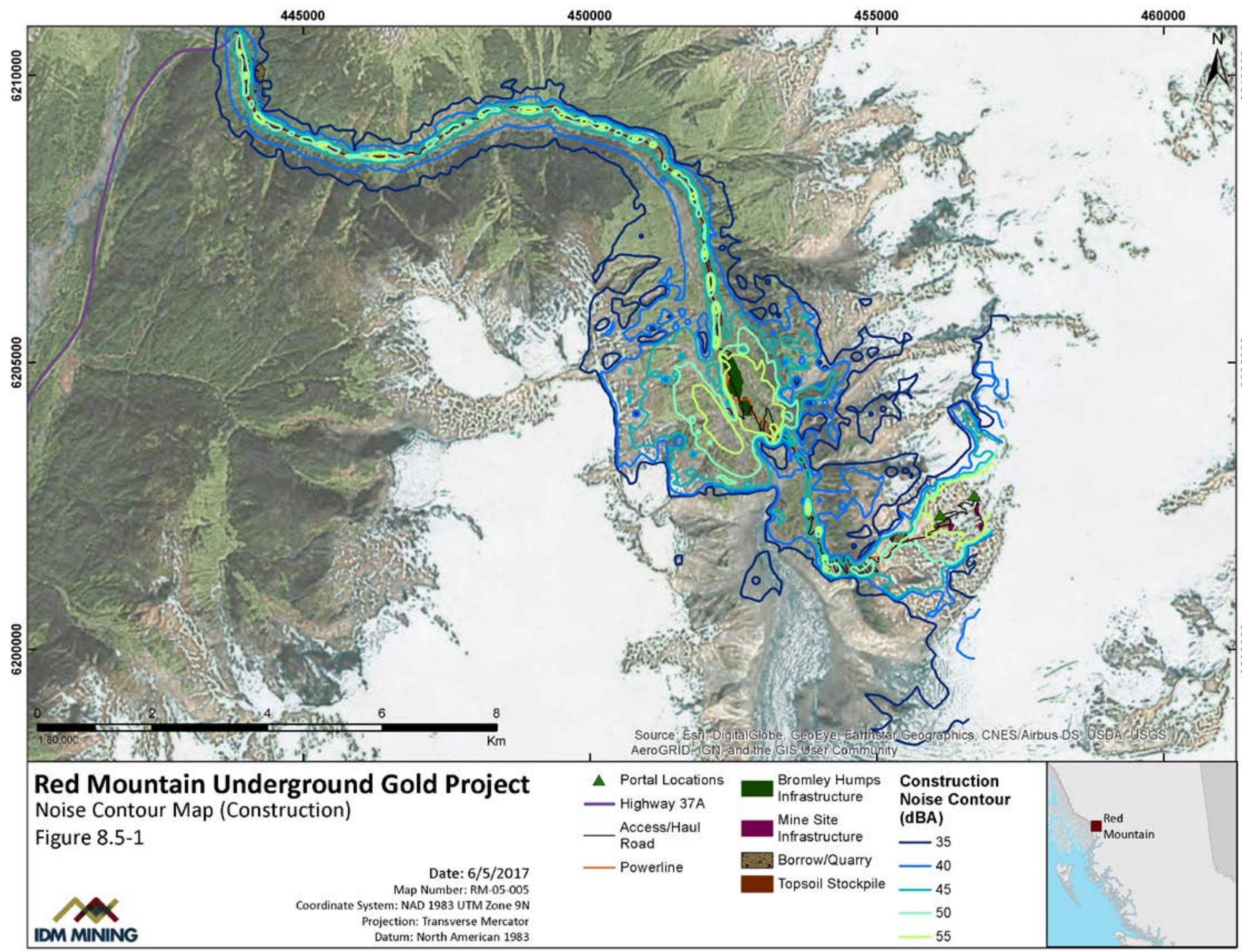


Figure 8.5-2: Noise Contour Map (Operation)

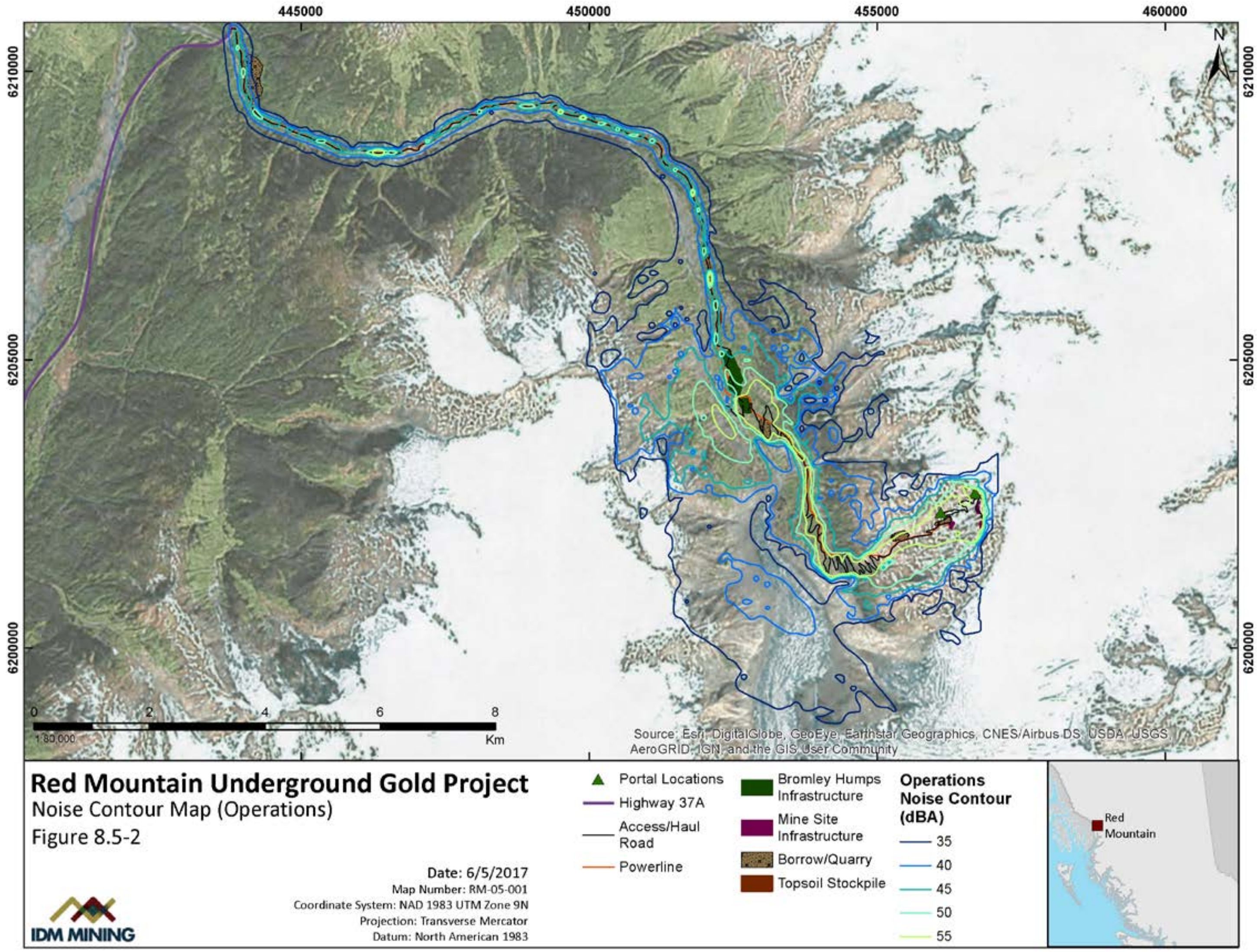
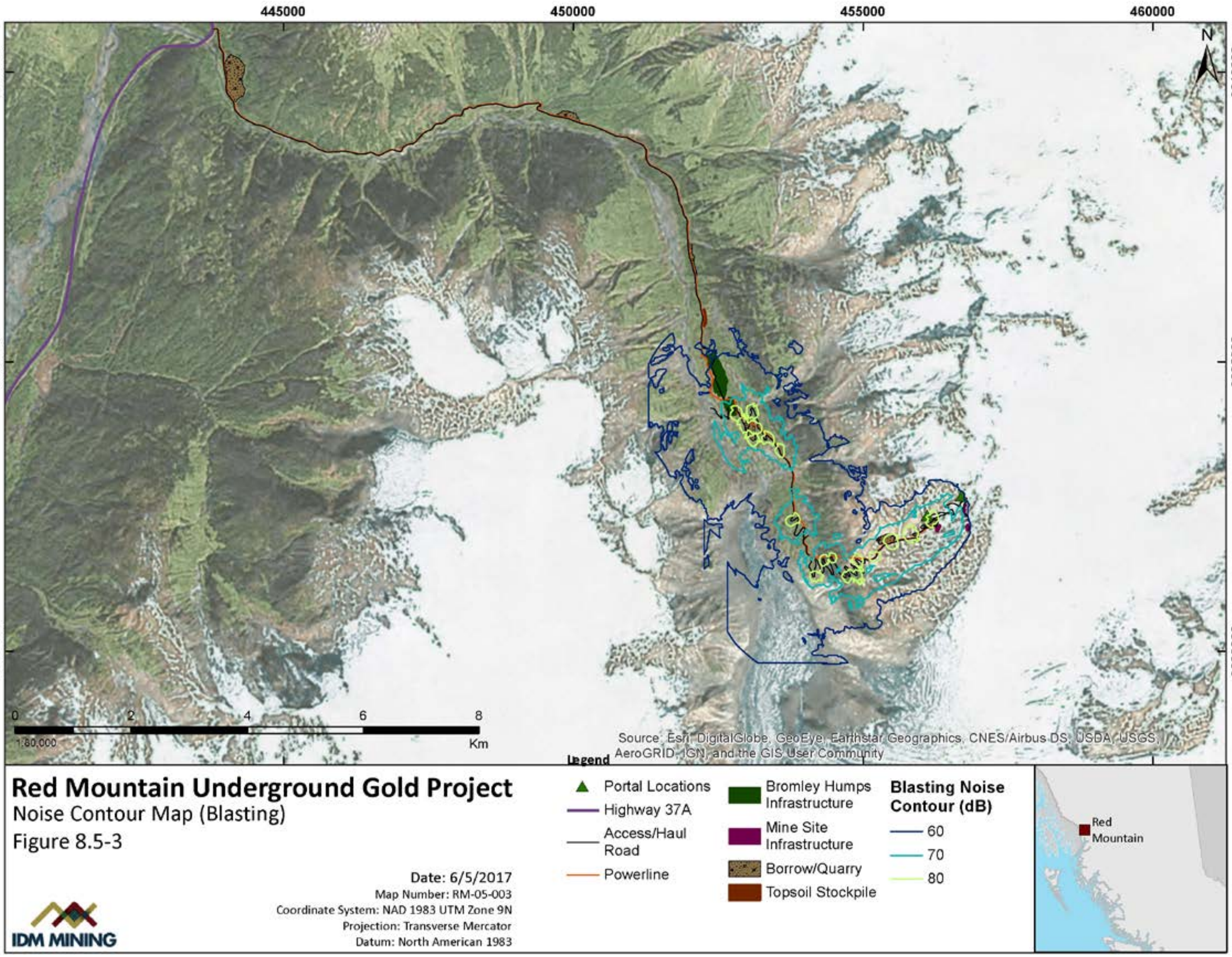


Figure 8.5-3: Noise Contour Map (Blasting)



8.6 Mitigation Measures

8.6.1 Key Mitigation Approaches

Results from the review of best management practices, guidance documents, and mitigation measures conducted for similar projects, as well as professional judgment for the Project-specific effects and most suitable management measures, were considered in determining the mitigation measures. The approach to the identification of mitigation measures subscribed to the mitigation hierarchy, as described in the Environmental Mitigation Policy for British Columbia (http://www.env.gov.bc.ca/emop/).

Potential Project-related changes to Noise will be reduced through mitigation measures, management plans, and adaptive management. If mitigation measures were considered entirely effective, potential Project-related effects to the Noise IC were not identified as residual effects.

Noise control typically consists of mitigation strategies that focus on controlling noise at the source, controlling the noise pathway, and controlling noise at the receptor. As the assessment of noise levels predicted a limited spatial effect, noise mitigation measure recommendations focus on best practices, primarily related to controlling noise at the source and controlling the noise pathway. Approaches to manage and mitigate noise will rely primarily on:

- Design mitigation; and
- Best Management Practices (BMPs).

Technical and economic feasibility constraints dictated the highest level on the hierarchy that could be achieved for each potential effect and the identification of mitigation measures for managing these effects.

8.6.2 Environmental Management and Monitoring Plans

IDM will implement a Noise Abatement Plan (Volume 5, Chapter 29) to mitigate the potential Project effects related to noise.

8.6.3 Effectiveness of Mitigation Measures

The primary Project effect on the Noise IC is an increase in noise levels. The anticipated effectiveness of mitigation measures to minimize the potential for significant adverse effects is evaluated and classified as follows:

- Low effectiveness: Proposed measure is experimental, or has not been applied in similar circumstances.

- Moderate effectiveness: Proposed measure has been successfully implemented, but perhaps not in a directly comparable situation.

- High effectiveness: Proposed measure has been successfully applied in similar situations.

- Unknown effectiveness: Proposed measure has unknown effectiveness because it has not been implemented elsewhere in a comparable project or environment.

The measures proposed for mitigating potential effects on the Noise IC from increases in noise generation and levels, along with their effectiveness and uncertainty are summarized using Table 8.6-1. This table also identifies the residual effects that will be carried forward for residual effects characterization and significance determination.

In general, mitigation measures have moderate (i.e., the effect is moderately changed) or high (i.e., the effect is practically eliminated) effectiveness ratings. The timing for the mitigation measures to become effective is immediate as these measures are part of the Project design or rely on avoidance or prevention of effect through BMPs or regulatory requirements.

The proposed mitigation measures include standard measures that are known to be effective (based on relevant/applicable experience with other mining projects), and therefore the uncertainty associated with their use is low. Any uncertainty associated with the effectiveness of the proposed mitigation measures will be addressed through the Noise Abatement Plan.

Table 8.6-1: Proposed Mitigation Measures and Their Effectiveness

VC/IC	Potential Effects	Mitigation Measures	Rationale	Applicable Phase(s)	Effectiveness[1]	Uncertainty[2]	Residual Effect
Noise	Increase in noise levels	Underground mining will result in significant reductions in noise emitted by the Project for excavating and hauling waste rock.	Reduces noise levels	Construction, Operation, Closure and Reclamation	High	Low	Yes
		Noise Abatement Plan, including regular equipment maintenance, noise reduction policy, and no idle policy	Reduces noise levels and noise generation		High to Moderate	Low	
		The design of the Access Road and Haul Road has been optimized to minimize distance travelled, which will reduce noise, dust, and emissions associated with Construction and Operation.	Reduces noise generation	Construction, Operation, Closure and Reclamation	Moderate	Low	
		Impulse events, such as blasting, will be limited to certain times of the day. Instantaneous charge per delay will be minimized to suit blast.	Reduces noise generation	Construction, Operation	Low	Low	

[1]Effectiveness: Low = measure unlikely to result in effect reduction; Moderate = measure has a proven track record of partially reducing effects; High = measure has documented success (e.g., industry standard; use in similar projects) in substantial effect reduction
[2]Uncertainty: Low = proposed measure has been successfully applied in similar; Moderate = proposed measure has been successfully implemented, but perhaps not in a directly comparable situation; High = situations proposed measure is experimental, or has not been applied in similar circumstances

8.7 Residual Effects Characterization

8.7.1 Summary of Residual Effects

Due to the nature of noise, mitigation measures typically only reduce noise rather than completely eliminating it. Therefore, in relation to baseline conditions, the mitigation measures do not completely eliminate the potential for a measurable change in noise and mitigation measures are typically classified as low or moderate effectiveness without completely removing the noise source.

8.7.2 Methods

The characterization of the residual effect of increased Noise levels from the Project relies on the noise modelling study and criteria summarized in Section 8.5. The complete noise modelling assessment is provided in Appendix 8-A. The noise modelling study is used to inform the characterization of the residual effect on Noise in Table 8.7-1.

8.7.2.1 Residual Effects Criteria

Table 8.7-1: Characterization of Residual Effect from an Increase in Noise Level

Criteria	Characterization for Noise
Magnitude	In regard to Noise, the magnitude is determined by comparing predicted noise levels with the guidelines set in the Environmental Code of Practice for Metal Mines (see Section 8.5.1.1). The magnitude of the effect is negligible, low, moderate or high according to the following descriptions: • **Negligible (N)**: no detectable change from baseline conditions. • **Low (L)**: noise levels are predicted to remain below the guidelines. • **Moderate (M)**: noise levels are predicted to be equal to or slightly above the guidelines. • **High (H)**: noise levels are significantly above the ambient air quality objectives.
Geographical Extent	• **Discrete (D)**: effect is limited to the Project area within the modelled fenceline. • **Local (L)**: effect is limited to the LSA, within the modelling domain, such that predicted Noise effects are at or near baseline conditions at the domain extents. • **Regional (R)**: effect extends beyond the LSA and modelling domain.
Duration	• **Short term (ST)**: effect lasts less than 18 months (during the Construction Phase of the Project). • **Long- term (LT)**: effect lasts greater than 18 months and less than 22 years (encompassing Operation, Closure and Reclamation, and Post-Closure Phases). • **Permanent (P)**: effect lasts more than 22 years.
Frequency	• **One time (O)**: effect is confined to one discrete event. • **Sporadic (S)**: effect occurs rarely and at sporadic intervals. • **Regular (R)**: effect occurs on a regular basis. • **Continuous (C)**: effect occurs constantly.

Criteria	Characterization for Noise
Reversibility	• **Reversible (R)**: effect can be reversed. • **Partially reversible (PR)**: effect can be partially reversed. • **Irreversible (I)**: effect cannot be reversed, is of permanent duration.
Context	• **High (H)**: the receiving noise environment, as measured by baseline noise levels, are well below the established noise guidelines. • **Neutral (N)**: the receiving noise environment, as measured by baseline noise levels, are at or near the established noise guidelines. • **Low (L)**: the receiving noise environment as measured by baseline noise levels, is already above the established noise guidelines.

8.7.2.2 Assessment of Likelihood

Likelihood refers to the probability of the predicted residual effect occurring and has been assessed based on the definitions and thresholds provided in Chapter 6.

Increased noise levels due to Project activities cannot be eliminated through mitigation, so the likelihood rating for Noise residual effect is high as per the definitions provided below.

8.7.3 Noise Residual Effects Assessment

Although there is a high likelihood of noise effects occurring, the modelled noise and blasting effects from the Project are predicted to meet the *Environmental Code of Practice for Metal Mines* sound-level guidelines for daytime, nighttime, and blasting operations.

8.7.3.1 Characterization of Residual Effect

The residual effect of an increase in noise levels is predicted to be largely restricted to the Project Footprint and will occur during the Construction, Operation, and Closure and Reclamation Phases of the Project (Table 8.7-2).

Table 8.7-2: Characterization of Residual Effect from an Increase in Noise Level

Criteria	Characterization for Noise
Magnitude	• **Moderate:** Noise levels are predicted to be equal to or slightly above the guidelines.
Geographical Extent	• **Local:** The effect on noise levels is near the Project footprint, such that at the limits of the LSA and modelling study area the effect will be indistinguishable from baseline noise levels.
Duration	• **Long-Term:** Noise will be produced at the Project site for the duration of the Construction, Operation, and Closure and Reclamation Phases.
Frequency	• **Continuous:** Sources of noise will operate on a regular basis.
Reversibility	• **Reversible:** Noise levels would be anticipated to return to baseline levels following mine closure.

Criteria	Characterization for Noise
Context	• **High:** baseline noise levels are assumed to be at or near levels defined for pristine, remote locations, and well below limits for effects to human or wildlife receptors.

8.7.3.2 Likelihood

Project effects on noise levels have a high likelihood of occurrence (i.e., the effects have at least an 80% chance of occurrence).

8.7.3.3 Confidence and Risk

The Noise model conforms to international standards for the assessment of noise impacts and used Project design information and expected sound power levels to predict the impact of Project activities on noise levels. Proposed mitigation measures represent established best management practices that have been proven effective in reducing noise impacts. Given the approach applied in this assessment, there is a High confidence in the conclusions of the assessment.

Table 8.7-3: Confidence Ratings and Definitions

Confidence Rating	Quantitative Threshold
High	There is a good understanding of the cause-effect relationship between the Project and a VC, and all necessary data are available to support the assessment. The effectiveness of the selected mitigation measures is moderate to high. There is a low degree of uncertainty associated with data inputs and/or modelling techniques, and variation from the predicted effect is expected to be low. Given the above, there is high confidence in the conclusions of the assessment.
Moderate	The cause-effect relationships between the Project and a VC are not fully understood (e.g., there are several unknown external variables or data for the Project area are incomplete). The effectiveness of mitigation measures may be moderate or high. Modelling predictions are relatively confident. Based on the above, there is a moderate confidence in the assessment conclusions
Low	Cause-effect relationships between the Project and a VC are poorly understood. There may be several unknown external variables and/or data for the Project area is incomplete. The effectiveness of the mitigation measures may not yet be proven. Modelling results may vary considerably given the data inputs. There is a high degree of uncertainty in the conclusions of the assessment.

8.7.4 Summary of Noise Residual Effects

Although there is a high likelihood of noise effects occurring, the modelled noise and blasting effects from the Project are predicted to meet the *Environmental Code of Practice for Metal Mines* sound-level guidelines for daytime, nighttime, and blasting operations.

Table 8.7-4: Summary of Noise Residual Effects

Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization Criteria *(Magnitude, Geographic Extent, Duration, Frequency, Reversibility, Context)*	Likelihood *(High, Moderate, Low)*
Increase in Noise Level	Construction Operation Closure and Reclamation	Design Mitigation and BMPs See Table 8.6-1.	The magnitude of the effect is predicted to be moderate and have a local geographical extent within the LSA. The effect is anticipated to occur continuously throughout the Construction, Operation, and Closure and Reclamation Phases, but is reversible after mine closure, when it would be anticipated that levels would return to baseline levels for the remote location. Context is high.	High

8.8 Cumulative Effects

8.8.1 Review Residual Effects

The residual effect to Noise identified in the effects assessment is increased noise levels.

8.8.2 Cumulative Effects Assessment Boundaries

8.8.2.1 Spatial Boundaries

Since Project predicted noise levels generally attenuate to baseline levels assumed for a remote location at the extents of the Project modelling domain, the spatial boundaries of the Noise cumulative effects assessment have been set as the same extents as the LSA and noise modelling domain.

8.8.2.2 Temporal Boundaries

The temporal boundaries for the Noise cumulative effects assessment include the Project Construction, Operation, and Closure and Reclamation Phases.

The threshold date for incorporating any new future developments in the cumulative effects assessment is 2029. This represents the final anticipated year of the mine life after the Closure and Reclamation Phase is complete.

8.8.3 Identifying Past, Present or Reasonably Foreseeable Projects and/or Activities

Table 8.8-1 outlines the past, present, and reasonably foreseeable projects considered in the Noise cumulative effects assessment.

Table 8.8-1: List of Projects and Activities Included in the Cumulative Effects Assessment

Project/Activity	Location	Proponent	Project Life
Bitter Creek Hydro Project	Bitter Creek valley, 15 km northeast of Stewart	Bridge Power	Proposed

8.8.4 Potential Cumulative Effects and Mitigation Measures

8.8.4.1 Increased Noise Levels

The Bitter Creek Hydro Project will be located in the same vicinity as the proposed Project. It is anticipated that both construction and operations noise emissions will occur at the Bitter Creek Hydro Project. A perceptible cumulative effect could occur if noise levels from the Bitter Creek Hydro Project match or exceed the noise levels from the proposed Project at a particular receptor. It is reasonable to assume that potential noise sources at the Bitter Creek Hydro Project will be mitigated using many of the same best management practices that will be used at the proposed Project.

8.8.5 Cumulative Effects Interaction Matrix

Table 8.8-2 provides a cumulative effects interaction matrix that summarizes the potential cumulative interactions between the residual effect of the proposed Project on Noise and each past, current, and foreseeable future project presented in Section 8.8.3.

Table 8.8-2: Interaction with Effects of other Past, Present, or Reasonably Foreseeable Future Projects and Activities

Residual Effects of the Project on Noise	Future Projects and Activities
	Bitter Creek Hydro Project
Increased Noise Levels	Y

Notes:
Y = Yes, interaction exists between the residual effect of the Project and the other past, current, or future project/activity
N = No, interaction does not exist between the residual effect of the Project and the other past, current, or future project/activity

8.8.6 Cumulative Effects Characterization

8.8.6.1 Increased Noise Levels

No further noise modelling was conducted to evaluate the potential increase to noise as a result of the proposed Project and the Bitter Creek Hydro Project.

Predicted noise levels are measured in decibels. Decibels (dB) are measured using a logarithmic scale, meaning that additional or cumulative sources are not added arithmetically. For example, if two noise sources are each producing 90 dB right next to each other, the combined noise sound levels will only increase slightly: by 3 dB at the source (a 3dB change is the minimum change that is perceptible to the human ear) to 93 dB. If a source is added that has a sound power level that is 10 dB less than the existing source, then there will be no difference in the predicted noise levels from the existing source at noise receptors.

Assuming that the Bitter Creek Hydro Project would use equipment and processes, such as blasting, during construction that are similar to the proposed Project, it would be expected to generate similar maximum noise levels. With similar noise levels being generated, it is unlikely that the cumulative effect would increase the magnitude, duration, reversibility, context, or frequency of the Project's predicted Noise effect because the combined effect at a receptor is likely to be dictated by the most significant noise source(s) nearest that location. Therefore, the likely cumulative effect on Noise between the proposed Project and the Bitter Creek Hydro Project is to increase the geographic extent of the noise effects as dictated by the sources operating at the Bitter Creek Hydro Project site. Again, given that the site is likely to use similar equipment and processes, it would be anticipated that the geographical extent of these effects from the Bitter Creek Hydro Project would remain local and the magnitude similar to those predicted for the Project.

8.8.7 Summary of Cumulative Effects Assessment

Residual cumulative effects, characterization criteria, likelihood, and confidence evaluations of the Noise cumulative effects assessment are summarized in Table 8.8-3.

Table 8.8-3: Summary of Noise Residual Cumulative Effects Assessment

Project Phase	IC	Residual Cumulative Effect	Characterization Criteria *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*
Construction	Noise	Increased noise levels	The magnitude of the cumulative effect is predicted to be moderate and affect a local geographical extent within the LSA. The effect has the potential to occur throughout the duration of overlapping project schedules, but is reversible after the end of Project Closure and Reclamation when it would be anticipated that levels would return to baseline levels for the remote location. Confidence is high; risk is low. Context is high.	High

8.9 Follow-up Program

The Noise Abatement Plan (Chapter 29) will include a noise monitoring program that will allow for real-time verification of the modelling results and the effectiveness of applied mitigation measures.

8.10 Conclusion

Noise created during the construction, operation, and closure and reclamation of the Project will result in moderate magnitude residual effects to Noise in the Bitter Creek valley, but those noise levels are predicted to meet the *Environmental Code of Practice for Metal Mines* sound-level guidelines for daytime, nighttime, and blasting operations.

The proposed Bitter Creek Hydro Project has the potential to cumulatively interact with Noise in the Bitter Creek valley. However, it is unlikely that the cumulative effect would increase the magnitude, duration, geographic extent, reversibility, context, or frequency of the Project's predicted Noise effects because the combined effect at a receptor is likely to be dictated by the most significant noise source(s) nearest that location.

As stated in the previous section, the Noise Abatement Plan (Chapter 29) will include a noise monitoring program that will allow for real-time verification of the modelling results and the effectiveness of applied mitigation measures.

This chapter is linked to the potential effects of the Project on other related ICs and VCs, including those identified and evaluated in the following chapters:

- Wildlife and Wildlife Habitat (Chapter 16);
- Social VCs (Chapter 20), including:
  - Recreational Values; and
  - Current Use of Lands and Resources for Traditional Purposes;
- Cultural and Heritage Resources (Chapter 21); and
- Human Health (Chapter 22).

8.11 References

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