19 Noise

The KSM Project (the Project) is located within a relatively undeveloped wilderness area and thus baseline noise levels are considered to be quite low. The construction and operation of the Project will introduce environmental noise sources largely in the form of construction equipment, haul vehicles, and blasting, as well as vehicle and helicopter traffic. The Health Canada *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise* (2011) states:

> *There are reasonable cause-and-effect associations linking noise exposure to hearing loss, sleep disturbance, interference with speech intelligibility, noise complaints and a high level of annoyance (World Health Organization 1999). Health Canada's advice is based on the expected changes between existing and predicted daytime and night-time sound levels (for construction, operation and decommissioning activities) at locations where people are or will be present, as well as on the characteristics of the noise (e.g., impulsive or tonal) or the type of community (e.g. urban, suburban or quiet rural areas).*

The objectives of this chapter are to report on noise levels that can be used to identify and assess potential human health effects due to noise at noise-sensitive human receptors near the Project location and to assess potential effects on wildlife.

In order to complete the noise effects assessment, data and guidelines from the following sources were used in addition to Project-related information:

- *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise,* Health Canada (2011);
- *Environment Code of Practice for Metal Mines,* Environment Canada (2012);
- BKL Consultants Ltd. in-house measurement data (2012);
- *BS 5228: Code of Practice for Noise and Vibration Control on Construction and Open Sites,* British Standards Institution (2009);
- *Road and Rail Noise: Effects on Housing,* Canada Mortgage and Housing Corporation (1986);
- *Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures,* International Organization for Standardization (ISO; 2003); and
- *Guidelines for Community Noise,* World Health Organization (WHO; 1999).

Full details of the assessment performed by BKL Consultants Ltd. are provided in Appendix 19-A.

19.1 Noise Setting

No baseline noise monitoring was conducted within the Project study area; however, given that the Project location is in a relatively undeveloped wilderness area with no noise impact relating to industrial activity, assumptions were made about baseline noise levels in accordance with Health Canada guidelines (2011). The most conservative of these options was chosen for a "quiet, rural area" as shown in Table 19.1-1 below.

Table 19.1-1. Estimated Baseline Noise Levels

Time Period	Noise Level (dBA)
Day (L_d)	35
Night (L_n)	25
Day-Night (L_{dn})	35

In support of the use of the above standards, noise baseline measurements taken at the neighbouring Brucejack Gold Mine Project are shown in Table 19.1-2. Since helicopter and aircraft traffic are sources of noise at the Brucejack Gold Mine Project area, L_{90} values are considered a better indication of the natural noise levels. Discrete events that occur from anthropogenic sources are not part of 90% of the measurement time period. The September/October monitoring period had higher values than the March monitoring period due to increased wind speeds and a high amount of rain. The average baseline value of 17 dB recorded during March would more accurately represent baseline noise levels during a day with calm winds and minimal precipitation.

Table 19.1-2. Brucejack Mine Measured Baseline L_{90} Noise Levels

	March 2012	September/October 2012
Station	Noise Level (dBA)	
S1	16.5	20.8
S2	17	43.8
S3	16.1	34.1
S4	17.5	37.7
S5	16.3	36.3
S6	20.4	39.5
Overall Average	35.8	

19.2 Historical Activities

Historical projects that are located within a 30 km radius of the Project include:

- the past-producing Eskay Creek Mine; and
- traffic using the Eskay Creek Mine Road and Highway 37.

The Eskay Creek Mine is no longer in production; as such there is limited maintenance traffic associated with this mine and it does not significantly contribute to the noise environment.

Highway 37 between the TCAR and Meziadin Junction currently has an average annual daily traffic volume of 799 vehicles per day, comprising approximately 40% heavy vehicles. As shown in the *Highways 37 and 37A Traffic Effects Assessment* (Appendix 22-C), the noise level at the closest receiver is currently noted to be well below acceptable limits.

19.3 Land Use Planning Objectives

The Project lies within both the Cassiar Iskut – Stikine Land and Resource Management Plan (CIS LRMP; BC MOE 2000) and the Nass South Sustainable Resource Management Plan (SRMP; BC ILMB 2012). The Mine Site will fall within the CIS LRMP, while the south and central portions of the regional study area fall within the Nass South SRMP. The management plans provide general management direction, and identify research and inventory priorities, economic priorities, as well as provide direction on plan implementation and monitoring. There are no specifically stated goals for noise levels in the Project area; however, noise levels could potentially affect wildlife. Wildlife-related management objectives of both the CIS LRMP and the Nass South SRMP are described in Table 18.3-1 of the wildlife effects assessment.

19.4 Spatial and Temporal Boundaries

19.4.1 Spatial Boundaries

The spatial boundary is defined as the area that could potentially be affected by noise emission sources associated with the Project, and it is also the model domain that is examined as part of this assessment. The spatial boundary considered in noise modelling includes the area enclosed by Coulter Creek on the west, Highway 37 in the east extending as far north as Teigen Lake, and south as far as Knipple Glacier, as shown in Figure 19.4-1.

19.4.2 Temporal Boundaries

A temporal boundary is the period of time when the Project has an effect on the environment. The temporal boundaries include the following four phases:

- **construction phase:** 5 years;
- **operation phase:** 51.5 year life of mine;
- **closure phase:** includes Project decommissioning and reclamation activities (3 years); and
- **post-closure phase:** includes ongoing reclamation activities and post-closure maintenance monitoring (250 years).

This study considers the Project at two points in time representing the estimated worst-case scenarios for both the construction and operation phases as follows:

- worst-case scenario construction phase: Year -1; and
- worst-case scenario operation phase: Year 4.

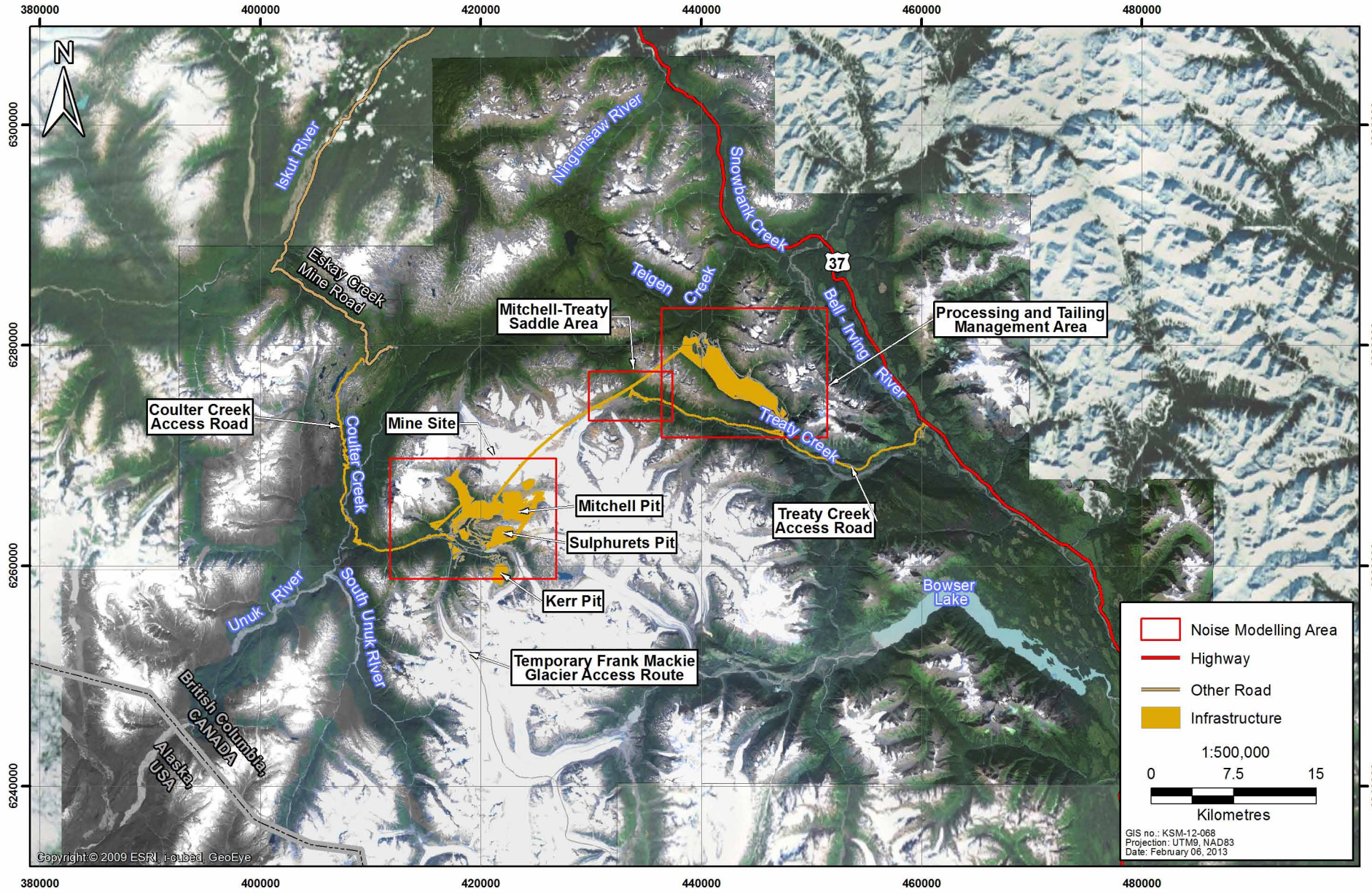


Figure 19.4-1

SEABRIDGE GOLD
KSM PROJECT

KSM Site Spatial Boundary of Study Area

Figure 19.4-1

Rescan Engineers & Scientists

For the five-year construction phase of the Project, Year -1 will be the most active in terms of total waste moved, total fuel usage (therefore highest diesel equipment activities), and amount of explosives used for blasting. For these reasons, Year -1 was selected for the assessment as the worst-case scenario for the construction phase.

Over the 51.5-year mine life, Year 4 was selected to represent the worst-case scenario in terms of highest amount of waste rock and ore moved, and explosives used. In terms of total fuel and electric power consumption, Year 3 is the worst-case, but only 1 and 4% more, respectively, than that in Year 4. Therefore, Year 4 was selected to represent the worst-case for operation.

Noise effects during closure and post-closure are anticipated to be less than for the construction and operation phases. Noise effects during closure and post-closure are therefore only discussed qualitatively.

19.5 Valued Components

Noise has been selected as a valued component (VC) because of its intrinsic importance to employees, local residents, and wildlife. Noise is defined as any undesirable sound that may irritate people, disturb rest or sleep, cause loss of hearing, or otherwise affect the quality of life of affected individuals (Health Insider 2002). Noise can result in psychological and physiological effects (e.g., stress), mental health effects, and effects on residential behaviour (WHO 1999).

The construction, operation, closure, and post-closure phases of the Project will produce a variety of noises including continuous noise from haul trucks, tonal noise from backup alarms, event noise from passing helicopters/vehicles, or impulse noise (non-continuous) from blasting in an open pit. Noise from mining activity will be continuous, specifically in the areas adjacent to the pits and the process plant. Closure and post-closure noise will be intermittent and related to treatment or reclamation and maintenance.

19.5.1 Valued Components Included in Assessment

Noise was identified as a VC in response to Aboriginal information provided in traditional knowledge/traditional use reports appended to Chapter 30 (Rescan 2010, 2012a, 2012b, 2012c, 2013), as well as in response to potential wildlife effects relating to noise.

Table 19.5-1 summarizes the rationale for noise as a VC selection.

19.5.2 Valued Components Excluded in Assessment

There was only one VC associated with noise considered in this assessment; therefore, no VC was excluded in the assessment.

19.6 Scoping of Potential Effects for Noise

Since noise is a broad term, it is important to select the measurable parameters in order to assess the potential effects of the Project on the receiving environment. The effects on noise levels were evaluated based on the appropriate parameters (L_d, L_n, L_{dn}, L_{peak}, L_{LF}, %HA) and each parameter was compared to the relevant objective, guideline, or standard.

Table 19.5-1. Identification and Rationale for Noise Valued Component Selection

Subgroup Wildlife, Human (if required)	Valued Component	Identified by*				Rationale for Inclusion
		F	G	P/S	O	
Human	Noise	x	x			Potential for loss of wildlife habitat due to noise from blasting, mining activities, helicopter traffic, and vehicle traffic resulting in loss of hunting areas and plant/berry collection sites. Noise affecting trap lines and cabins.
Wildlife	Noise	x	x	x	x	Potential for loss of wildlife habitat due to noise from blasting, mining activities, and helicopter and vehicle traffic

***F = First Nation; G = Government; P/S = Public/Stakeholder; O = Other (e.g., legislation, professional judgment).**

Potential effects of elevated noise levels could include sleep disturbance, interference with speech communication, complaints, high annoyance, noise-induced rattling, and loss of wildlife habitat.

A detailed scoping table is presented in Appendix 19-B indicating each major Project component's interaction with change in noise levels during the construction and operation, while a simplified version is presented in Table 19.6-1. Note that the phases in Appendix 19-B represent the entire duration of each of the phases.

Table 19.6-1. Potential Effects from Project Area on Noise

Project Region	Project Area	Change in Noise
Mine Site	Camp 3: Eskay Staging Camp	X
	Camp 7: Unuk North Camp	X
	Camp 8: Unuk South Camp	X
	Coulter Creek access road	X
	Mitchell operating camp	X
	McTagg Rock Storage Facility	X
	McTagg Twinned Diversion Tunnels	X
	McTagg Power Plant	X
	Mitchell Rock Storage Facility	X
	Camp 4: Mitchell North Camp (for Mitchell-Treaty Twinned Tunnels construction)	X
	Mitchell Ore Preparation Complex	X
	Mine Site Avalanche Control	X
	Iron Cap Block Cave Mine	X
	Mitchell Pit	X
	Mitchell Block Cave Mine	X
	Mitchell Diversion Tunnels	X

(continued)

Table 19.6-1. Potential Effects from Project Area on Noise (completed)

Project Region	Project Area	Change in Noise
Mine Site *(cont'd)*	Upper Sulphurets Power Plant	X
	Mitchell Truck Shop	X
	Water Storage Facility	X
	Camp 9: Mitchell Initial Camp	X
	Camp 10: Mitchell Secondary Camp	X
	Water Treatment and Energy Recovery Area	X
	Sludge Management Facilities	X
	Sulphurets laydown area	X
	Sulphurets-Mitchell Conveyor Tunnel	X
	Sulphurets Pit	X
	Kerr rope conveyor	X
	Kerr Pit	X
	Camp 2: Ted Morris Camp	X
	Explosives Manufacturing Facility	X
	Temporary Frank Mackie Glacier access route	X
	Camp 1: Granduc Staging Camp	X
Processing and Tailing Management Area	Mitchell-Treaty Twinned Tunnels	X
	Construction access adit	X
	Mitchell-Treaty Saddle Area	X
	Camp 6: Treaty Saddle Camp	X
	Camp 5: Treaty Plant Camp	X
	Treaty operating camp	X
	Treaty Ore Preparation Complex	X
	Concentrate Storage and Loadout	X
	North Cell Tailing Management Facility	X
	East Catchment Diversion	X
	Centre Cell Tailing Management Facility	X
	South Cell Tailing Management Facility	X
	Treaty Creek access road	X
	Camp 11: Treaty Marshalling Yard Camp	X
	Camp 12: Highway 37 Construction Camp	X
Off-site Transportation	Highway 37 and 37A	X

19.6.1 Construction

During the construction phase, potential Project noise effects are identified based on activities associated with different Project components (Mine Site, Processing and Tailing Management

Area [PTMA], access road, utilities, and tailing management) and the different Project phases (construction and operation). All the Project activities in Table 19.6-2 could potentially result in the any of the listed noise effects. Table 19.6-2 shows the effects that were assessed in the noise model for each receptor type.

Table 19.6-2. Assessed Effects from Project Noise on Human and Wildlife Receptors

Project Region	Receptors	Noise Effects					
		Sleep Disturbance	Speech Interference	Complaints	High Annoyance	Noise Induced Rattling	Loss of Wildlife Habitat
Mine Site	Mining Camps	X					
	Wildlife Receptors						X
PTMA	Mining Camps	X					
	Wildlife Receptors						X
General Area	Cabins	X	X	X	X	X	
	Wildlife Receptors						X

19.6.2 Operation

Noise during the operation phase can be broadly classified as steady, continuous noise typically associated with the continuous operation of stationary equipment (e.g., fans and generators). The character of the sound will be a low frequency droning type of sound that will vary with meteorological conditions because the sound will propagate over large distances before it reaches receptors. Mobile equipment during construction and operation will also sound fairly steady and continuous at the large setback distances that are being assessed.

Non-continuous noise from blasting will cause short-term noise impulses that may be an annoyance to the closest human receptors and wildlife. Blasting may also produce low-frequency noise-induced vibrations if uncontrolled, potentially causing Project property damage or triggering avalanches.

Limited blasting is expected during construction of the general site and the haul roads, however, regular blasting (estimated frequency of once per day) will be associated with both the construction and operation phases of the mine pits.

19.6.3 Closure

The noise level during the closure phase is expected to be much lower than that from the construction and operation phases; therefore, the closure phase is not assessed.

19.6.4 Post-closure

The noise level during the post-closure phase is expected to be much lower than that of the construction and operation phases; therefore, the post-closure phase is not assessed.

19.7 Potential for Residual Effects for Noise

There are three main ways that noise can adversely affect humans: through increased annoyance, sleep disturbance, and activity interference such as a reduction in speech intelligibility. Of the three, increased annoyance is the most common effect. Effects are generally related to the sum of all simultaneous activities and the duration of each activity, which are taken into account when using L_d and L_n metrics.

There are no legislated noise limits that apply to wildlife, but there is considerable academic and industrial monitoring research that provides guidance on the types of noise that can cause adverse effects to wildlife. In some cases, it is difficult to separate the effects of noise from the effects of human presence, while in other cases the effects of noise can be distinguished as a separate effect. The effects of noise on wildlife are dependent both on the type of noise and the wildlife species in question. Some species are thought to be particularly susceptible to noise disturbance, while other species may become acclimatized over time. Some species may be attracted by noise, particularly where they associate noise with human habitation. The *Environment Code of Practice for Metal Mines* (Environment Canada 2012) recommends that ambient noise from mining operations and its effect on wildlife should meet the objectives for residential areas: the sound pressure level from mining activities should not exceed 55 dBA during the day and 45 dBA at night. Therefore, this assessment has taken a conservative approach and modelled the sound pressure level at 45 dBA in wildlife habitat. Activity interference is not anticipated at any residential location due to the large distances from residences to the Project. The Health Canada guideline (2011) considers that adequate speech communication and minimal activity interference can be obtained with outdoor L_{dn} noise levels of 55 dBA.

Helicopter noise was only modelled for mountain goats, due to their sensitivity to helicopter disturbance. The helicopter noise level threshold of 75 dBA was selected based on threshold values identified for wildlife resulting in flight responses. This threshold level was also selected based on mountain goat sensitivity to helicopter overflights (Côté 1996; BC MOE 2010), rock breaking noises (Bears et al. 2012), and ungulate response to noise (Luz and Smith 1976; Manci et al. 1988).

The peak levels (L_{peak}) are presented for the instantaneous blasting noise, which is the maximum exposure due to blasting in the pits. As is described in greater detail in the Wildlife Effects Assessment (Chapter 18), two values were chosen for the blasting noise assessment: (1) a value where wildlife are expected to avoid habitat ("functional habitat loss"; 120 dB L_{peak}), and (2) a value where wildlife are expected to be disturbed and respond behaviourally ("disturbed habitat"; 108 dB L_{peak}). The blasting noise level threshold of 108 dB (L_{peak}) represents "disturbed habitat" and was selected based on a range of threshold values (85 to 108 dB) identified for mammals resulting in flight response, freezing, or strong startle response (Manci et al. 1988; Weisenberger et al. 1996; Reimers and Colman 2006). The threshold of 120 dB was selected to represent "functional habitat loss", and was selected based on a range of threshold values (120 dB to 128 dB) identified as physiologically harmful to humans (Ontario Ministry of Environment 1977; Environment Canada 2010).

Table 19.7-1 summarizes the potential effects of noise on human and wildlife receptors.

Table 19.7-1. Potential Effects from Project Noise on Human and Wildlife Receptors

Project Region	Project Components	Noise Effects					
		Sleep Disturbance	Speech Interference	Complaints	High Annoyance	Noise Induced Rattling	Loss of Wildlife Habitat
Mine Site	Camps (generators/incinerators, etc.)	X	X	X	X	X	X
	Blasting				X		X
	Primary Crushing	X	X	X	X	X	X
	Passenger Transportation	X	X	X	X	X	X
	Coulter Creek Access Road	X	X	X	X	X	X
	Mobile Mining Activities (hauling, grading, dumping, etc.)	X	X	X	X	X	X
PTMA	Camps (generator/incinerators etc.)	X	X	X	X	X	X
	Ore Processing Complex	X	X	X	X	X	X
	Passenger Transportation	X	X	X	X	X	X
	Treaty Creek Access Road	X	X	X	X	X	X
	Mobile Plant Activities (loading, grading, dumping, etc.)	X	X	X	X	X	X
General Area	Helicopter Flights - transportation and avalanche control				X		X
	Mitchell-Treaty Twinned Tunnels	X	X	X	X	X	X
	Highway 37	X	X	X	X	X	X

Table 19.7-2 summarizes the potential residual effects of the Project due to noise. Both the residual effects and the mitigation options will be described in greater detail in the following sections.

19.7.1 Sleep Disturbance

Health Canada advises that the recommendations and guidelines of the WHO (1999) regarding sleep disturbance be taken into consideration in the Environmental Assessment.

> *In quiet rural areas and susceptible populations such as those in hospitals, or convalescent or senior homes, Health Canada suggests that the WHO guideline levels not be exceeded. The WHO's Guidelines for Community Noise report a threshold for sleep disturbance of an indoor nighttime sound level (L_n) of no more than 30 dBA for continuous noise* (Health Canada 2011).

Table 19.7-2. Potential Residual Effects due to Noise

Valued Component	Timing Start	Project Area(s)	Component(s)	Description of Effect on Component(s)	Type of Project Mitigation	Project Mitigation Description	Potential Residual Effect	Description of Residuals
Noise	Construction	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Mine Camp	Sleep disturbance due to nighttime noise exposure from generators, and other mobile equipment operating nearby	Mangement Practices and Monitoring Plan	Reduce effect at receiver or reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then human health effects of sleep disturbance may be present
	Operation	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Mine Camp	Sleep disturbance due to nighttime noise exposure from generators, and other mobile equipment operating nearby		Reduce effect at receiver or reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then human health effects of sleep disturbance may be present
	Construction	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Offsite Receiver	Interfere with speech communication, such that speakers will need to increase their vocal effort or move closer to each other.		Reduce effect at receiver or reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then stress due to increased vocal effort may be caused
	Operation	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Offsite Receiver	Interfere with speech communication, such that speakers will need to increase their vocal effort or move closer to each other.		Reduce effect at receiver or reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then stress due to increased vocal effort may be caused
	Construction	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Offsite Receiver	Complaints about noise from local residents received		Reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then the proponent may receive complaints about noise levels
	Operation	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Offsite Receiver	Complaints about noise from local residents received		Reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then the proponent may receive complaints about noise levels
	Construction	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Offsite Receiver	Residents will become highly annoyed at noise levels		Reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then the proponent may receive complaints about noise levels
	Operation	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Offsite Receiver	Residents will become highly annoyed at noise levels		Reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then the proponent may receive complaints about noise levels
	Construction	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Offsite Receiver	Rattling of windows and other objects due to low frequency noise levels		Reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then the proponent may receive complaints about noise levels
	Operation	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Offsite Receiver	Rattling of windows and other objects due to low frequency noise levels		Reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then the proponent may receive complaints about noise levels
	Construction	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Local Wildlife Habitat	Loss of wildlife habitat		Reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then wildlife will be effected and may potentially abandon the area
	Operation	Mine Site PTMA Mitchell-Treaty Twinned Tunnels	Local Wildlife Habitat	Loss of wildlife habitat		Reduce noise at source or increase distance from source to receiver	Yes	If mitigation measures are required and not implemented, then wildlife will be effected and may potentially abandon the area

Health Canada also quotes the WHO (1999) for individual noise events: "For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dBA L_{AFmax} more than 10–15 times per night" (Health Canada 2011).

Sound is attenuated as it is transmitted indoors, and the amount of reduction mostly depends on whether windows are open or not. Health Canada suggests to assume an outdoor-to-indoor noise reduction of 15 dBA if windows are open and 27 dBA if windows are closed. The actual reduction depends on construction materials, geometry, etc. of the room.

Normally, noise effects are only assessed at human receptors not employed by the Project outside of the Project boundaries. However, Health Canada recommends the assessment of sleep disturbance at on-site mine camps as well.

19.7.1.1 Mitigation for Sleep Disturbance

In order to mitigate the potential effect of sleep disturbance, the following key mitigation measures should be considered during the detailed design phase:

- maximize distances from major noise sources to sleeping quarters to minimize noise; and
- calculate the noise dampening efficiency of building facade insulation and improve it so that predicted indoor L_{eq} are 30 dBA or less.

In addition, Health Canada (2011) advises the following mitigation measures to minimize nighttime noise:

- avoid the use of equipment that generates impulsive noise;
- minimize the need for reversing alarms;
- avoid dropping materials from a height;
- avoid metal-to-metal contact on equipment;
- if possible, schedule truck movements to avoid roads near mining camps; and
- avoid mobile plant clustering near residences and other sensitive receptors.

19.7.1.2 Potential for Residual Effects

Sleep disturbance includes the following effects of noise: difficulty falling asleep, awakenings, curtailed sleep duration, alterations of sleep stages or depth, and increased body movements during sleep.

Residual effects may be apparent if mitigation does not satisfy the noise attenuation requirements on all on-site worker camps. Table 19.7-2 summarizes the potential effects from Project components.

19.7.2 Interference with Speech Communication

If continuous Project noise indoors or outdoors is high enough, the Project could interfere with speech communication, such that speakers will need to increase their vocal effort or move closer

to each other. Health Canada advises that an indoor level of 40 dBA or an outdoor level of 55 dBA or greater would be required to affect speech comprehension (Health Canada 2011).

19.7.2.1 Mitigation for Interference with Speech Communications

In order to mitigate this potential effect, the following key mitigation measures should be considered during the detailed design phase:

- avoid the use of equipment that generates impulsive noise;
- minimize the need for reversing alarms;
- avoid dropping materials from a height;
- avoid metal-to-metal contact on equipment;
- if possible, schedule truck movements to avoid roads near mining camps; and
- avoid mobile plant clustering near residences and other sensitive receptors.

It should be noted that since these same mitigations can be used to reduce the number of complaints, the percentage of people highly annoyed, and rattling due to noise, the mitigation methods for each of those residual effects will not be summarized in this section as this would simply be a duplication of what is listed above.

19.7.2.2 Potential for Residual Effects

Noise could potentially reach levels that would inhibit people's ability to communicate through speech. Speakers may need to increase their vocal effort or move closer to the listener in order to be heard.

19.7.3 Complaints

Health Canada suggests, "The likelihood of a complaint is directly linked to the ability or willingness of an individual to make a complaint and his or her expectation that the complaint will result in noise reduction." Therefore, there is not always a strong link between the disturbance and the complaint. However, Health Canada suggests that "widespread complaints" become more likely above an L_{dn} of 62 dBA and that "several threats of legal action or strong appeals to authorities to stop noise" should be expected if the project L_{dn} is greater than 75 dBA (Health Canada 2011).

19.7.3.1 Potential for Residual Effects

Noise produced at the Project site has the potential to reach levels high enough to cause members of the public (primarily trappers in their cabins) to complain, and thus has the potential to cause a residual effect.

19.7.4 High Annoyance

The response to noise is subjective and is affected by many factors such as the:

- difference between the specific sound (sound from the Project) and the residual sound (noise in the absence of the specific sound);

- characteristics of the sound (e.g., if it contains tones, impulses, etc.);
- absolute level of sound;
- time of day;
- local attitudes to the Project; and
- expectations of quiet.

Health Canada suggests that the "Percent Highly Annoyed" or "%HA" metric, which is calculated using the adjusted L_{dn} (or Rating Level) pre- and post-Project, is "an appropriate indicator of noise-induced human health effects for project operational noise and for long-term construction noise exposure" (2011).

Health Canada suggests that adjustments should be made to account for more annoying sound characteristics: specifically if the sound at the receiver location can be characterized as having tones, impulses, or strong low-frequency content. The penalty for tones and regular impulsive sound is a +5 dBA adjustment to the sound pressure level. The penalty for highly impulsive noise is a +12 dBA adjustment. The penalties for high-energy impulsive sound (e.g., blasting) and sound with strong low-frequency content are variable and calculated according to the American National Standards Institute (ANSI) standard S12.9 - 2005/Part 4 (ANSI 2005). The penalty for sound with strong low-frequency content should only be considered if the C-weighted sound pressure level is more than 10 dB higher than the A-weighted sound pressure level.

Health Canada advises that "noise mitigation measures be considered when a change in the calculated %HA at any given receptor exceeds 6.5%" or if the project L_{dn} exceeds 75 dBA (Health Canada 2011).

19.7.4.1 Potential for Residual Effects

Noise produced at the Project site has the potential to reach levels high enough to cause members of the public (primarily trappers tending their trapping lines) to become highly annoyed at the effect the Project is having on their lives. For this reason, it has the potential to cause a residual effect.

19.7.5 Noise-induced Rattling

Health Canada references the ANSI standard (ANSI 2005), stating, "To prevent rattles from low-frequency noise and the associated annoyance from this effect, ANSI indicates that the (energy) sum of the sound levels in the 16-, 31.5- and 63-Hz octave bands be less than 70 dB." Health Canada advises implementing feasible mitigation measures if this criterion, based on if the low frequency sound level, or L_{LF}, is exceeded (Health Canada 2011).

19.7.5.1 Potential for Residual Effects

Noise produced at the Project site has the potential to reach levels high enough to cause rattling of windows and other objects and therefore has the potential to cause a residual effect.

19.7.6 Loss of Wildlife Habitat

It is assumed that if the sound pressure level from mining activities exceeds 55 dBA during the day (L_d) and 45 dBA at night (L_n), this may affect the habitat for the wildlife receptors at these

locations (Environment Canada 2012). Noise can be a sensory disturbance which eventually results in loss of wildlife habitat. In this chapter, the sensory disturbance has been generalized and referred to as loss of wildlife habitat herein after.

Helicopter noise may also affect mountain goats due to their sensitivity to helicopter disturbance. A helicopter noise level threshold of 75 dBA was selected based on threshold values identified for wildlife resulting in flight responses (Knight and Gutzwiller 1995; Efroymson and Sutter 2001).

Additionally, peak levels (L_{peak}) higher than 108 dB due to instantaneous blasting noise may have an effect on moose, mountain goat, grizzly bear, and black bear during construction and operation. The instantaneous noise level threshold of 108 dB (L_{peak}) was selected based on a range of threshold values (85 to 108 dB) identified for mammals resulting in flight response, freezing, or strong startle response (Manci et al. 1988; Weisenberger et al. 1996; Reimers and Colman 2006). At this level wildlife habitat is considered disturbed due to the behavioural response, while at levels above 120 dB it is considered functionally lost habitat.

In order to mitigate this potential effect, the following key mitigation measures should be considered during the detailed design phase:

- avoid the use of equipment that generates impulsive noise;
- minimize the need for reversing alarms;
- avoid dropping materials from a height;
- avoid metal-to-metal contact on equipment;
- if possible, schedule truck movements to avoid roads near mining camps;
- avoid mobile plant clustering near residences and other sensitive receptors;
- use blast mats to reduce noise levels;
- properly stagger delays for each blast pattern to minimize the number of charges being ignited simultaneously; and
- plan helicopter flight routes to avoid sensitive wildlife areas where possible.

19.7.6.1 Potential for Residual Effects

Each of the three types of noise sources present due to the Project (continuous noise from both stationary and mobile construction and operations equipment, intermittent or event noise from helicopter travel, and impulse noise from blasting) have the potential to cause an effect on wildlife in the area, possibly leading to a loss of wildlife habitat. For these reasons it has the potential to cause a residual effect.

19.8 Significance of Residual Effects for Noise

The following section provides a brief overview of the noise modelling that was completed, the results of that modelling compared to various guidelines, standards, and codes of practice, and a discussion of the potential for residual effects. For a more in-depth discussion of the modelling performed, please refer to the technical assessment found in Appendix 19-A.

Residual effects of the Project are described in terms of magnitude, geographic extent, duration, frequency, reversibility, context, probability, and confidence. These terms are referred to as the effects assessment descriptors (Table 19.8-1) and will be used to assess the significance of residual effects of noise. The significance of the residual effects of noise will be determined using the definition and logic in Table 19.8-1; however, professional judgment will also be used in determining the significance of the effect.

19.8.1 Residual Effects Descriptors for Noise

Residual effects descriptors as summarized in Table 19.8-1 are used to ascertain the significance of a residual effect.

19.8.2 Residual Effects Assessment for Noise

19.8.2.1 Residual Effects Assessment for Noise: Noise Modelling Methodology and Standards Used

Transportation and industrial noise levels were predicted using the ISO 9613-2 , NMPB-Routes-2008 (SETRA 2009a, 2009b), ANSI S12.17 (ANSI 1996), and ECAC Doc 29 standards implemented in the outdoor sound propagation software Cadna/A, version 4.2. Based on BKL Consultants Ltd.'s experience, sound reflections were not considered to be significant and were therefore not modelled.

ISO 9613-2 describes a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favourable for sound propagation. This standard was used to predict noise transmission from industrial sources.

NMPB-Routes-2008 is the newest version of the current European Union preferred road traffic noise prediction model. It specifies third-octave band sound power levels for roadways dependant on traffic volumes, average travel speed, percentage of heavy vehicles (i.e., trucks and buses), road gradient, and the flow conditions factor (continuous, accelerating, and decelerating vehicles). This standard was used to predict noise transmission from road traffic sources.

Blasting was modelled at three different blast sites. ANSI S12.17 (ANSI 1996), ISO 9613-2 (ISO 1996), and ANSI S12.9 Part 4 (ANSI 2005) were used to calculate blasting noise and annoyance factors. The blast noise level at receivers is dependent on the distance between the blast location and the receiver, the amount of explosive used, the depth at which each charge is buried, and the relevant diffraction over terrain surrounding the Mine Site. Terrain effects were calculated using ISO 9613-2 as implemented in Cadna/A. The worst-case for human and wildlife receptors respectively was presented in the results.

Helicopter noise was modelled as a "worst-case day" scenario using Integrated Noise Model software version 7.0c developed by the Federal Aviation Administration Office of Environment and Energy. It implements the following standards:

- SAE-AIR-1845;
- SAE-AIR-5662;

Table 19.8-1. Definitions of Significance Criteria for Noise Residual Effects

Timing *What phase of the Project is the effect associated with?*	**Magnitude** *(negligible, low, medium, high)*	**Geographic Extent** *(local, landscape, regional, beyond regional)*	**Duration** *(short-term, medium-term, long-term, far future)*	**Frequency** *(once, sporadic, regular, continuous)*	**Reversibility** *(reversible short-term, reversible long-term, or irreversible)*	**Context** *(ecological resilience and/or unique attributes) (low, neutral, high)*	**Probability** *(low, medium, high)*	**Confidence** *(low, medium, high)*	**Significance** *(Not Significant: minor, moderate; Significant: major)*	**Follow-Up Monitoring** *(Not required, required)*
Construction	**Negligible:** Noise level experience is more than 5 dB below the criteria or equivalent to baseline noise levels.	**Local.** The effect is limited to a small portion of the project footprint.	**Short term**. The effect lasts approximately 1 year or less.	**Once.** The effect occurs once during any phase of the project.	**Reversible short-term:** An effect that can be reversed relatively quickly.	**Low**. The valued component is considered to have little to no unique attributes and/or there is high resilience to imposed stresses.	**Low.** An effect is unlikely but could occur.	**Low** (< 50% confidence). The cause-effect relationship between the project and its interaction with the environment is poorly understood; data for the project area may be incomplete; uncertainty associated with synergistic and/or additive interactions between environmental effects may exist. High degree of uncertainty.	**Not Significant (minor).** Residual effects have no or low magnitude, local geographical extent, short or medium-term duration, and occur intermittently, if at all. There is a high level of confidence in the conclusions. The effects on the VC below all applicabel standards. Land use management objectives will be met. Follow-up monitoring is optional.	**Not Required**
Operations	**Low:** differs from the average value for baseline conditions to a small degree. Noise levels are < 5 dB below the criteria	**Landscape.** An effect covers the project footprint.	**Medium term.** The effect lasts from 1 – 11 years.	**Sporadic.** The effect occurs at sporadic or intermittent, intervals during any phase of the project.	**Reversible long-term:** An effect that can be reversed after many years.	**Neutral.** The valued component is considered to have some unique attributes, and/or there is neutral (moderate) resilience to imposed stresses.	**Medium.** An effect is likely but may not occur.	**Medium. (**50 – 80% confidence): The cause-effect relationship between the project and its interaction with the environment is not fully understood, or data for the project area is incomplete: moderate degree of uncertainty.	**Not Significant (moderate).** Residual effects have medium magnitude, local, landscape or regional geographic extent, are short-term to chronic (i.e., may persist into the far future), and occur at all frequencies. The effects on teh VC approaching or slightly above applicable standards. Ability of meeting land use management objectives may be impaired. Confidence in the conclusions is medium or low. Follow-up monitoring of these effects may be required.	**Required**
Closure	**Medium:** differs substantially from the average value for baseline conditions and is 0 – 5dB above limits set forth in acceptable criteria.	**Regional.** An effect extends beyond the project footprint to a broader regional area.	**Long term.** The effect lasts between 12 and 70 years.	**Regular.** The effect occurs on a regular basis during, any phase of the project.	**Irreversible.** The effect cannot be reversed.	**High.** The valued component is considered to be unique, and/or there is low resilience to imposed stresses.	**High**. An effect is highly likely to occur.	**High**. There is greater than 80% confidence in understanding the cause-effect relationship between the project and its interaction with the environment, and all necessary data is available for the project area. There is a low degree of uncertainty.	**Significant (Major).** Residual effects have high magnitude, regional or beyond regional geographic extent, are chronic (i.e., persist into the far future), and occur at all frequencies. Residual effects on VCs are consequential (i.e., standards will be exceeded frequently and over a large area). Ability to meet land use management objectives is impaired. Probability of the effect occurring is medium or high. Confidence in the conclusions can be high, medium, or low. Follow-up monitoring is required.	
Post-Closure	**High**: differs substantially from baseline conditions and is > 5dB above criteria.	**Beyond Regional**: The effect extends possibly across or beyond the province.	**Far Future: The** effect lasts more than 70 years.	**Continuous.** An effect occurs constantly during any phase of the Project.						

- SAE-ARP-866A;
- ECAC Doc 29; and
- ICAO Circular 205.

The acoustic properties of the ground surface can have a considerable effect on the propagation of noise. Flat non-porous surfaces such as concrete, asphalt, buildings, calm water, ice, etc. are highly reflective to noise, and according to ISO 9613-2 have a ground constant of G=0. Soft, porous surfaces such as foliage, loam, soft grass, unpacked snow, etc. are highly absorptive to noise, and have a ground constant of G=1. The ISO standard does not use intermediate ground constants.

Model calculations were performed in octave bands, considering ground cover, topography, and shielding objects (see following sections). Results are not sensitive to the ambient temperature and relative humidity; a temperature of 10ºC and relative humidity of 80% were used in the model settings. A moderate temperature inversion was assumed to represent typical, but not absolute, worst-case conditions.

The effects of wind gradients on outdoor sound propagation can cause variation in sound levels at a distance from the noise sources. When the receiver is upwind of the source, the wind will cause higher than normal attenuation that results in lower sound levels than would normally occur under calm conditions. Conversely, under downwind conditions the opposite effect would occur, resulting in higher than normal sound levels. Crosswinds do not have these effects and result in sound levels that are essentially the same as those for calm conditions. The ISO 9613-2 predicts sound attenuation under average meteorological conditions with downwind propagation.

Table 19.8-2 summarizes the different types of noise sources modelled.

Table 19.8-2. Noise Sources

Equipment Type	Noise Source	Phase		Source Characteristics			
		Construction	Operation	Intermittent	Continuous	Impulsive	Tonal
Fixed	Baghouses and ore processing facilities		X		X		
	Generators	X	X		X		
	Ventilation fans	X	X		X		
	Crushers		X	X			
	Blasting	X	X			X	
Mobile	All wheeled and tracked construction and passenger vehicles	X	X	X			
	Dump trucks tipping fill	X	X			X	
	Helicopters	X	X	X			
	Backup alarms	X	X				X

19.8.2.2 Residual Effect Assessment for Sleep Disturbance

Noise sources operational at night were included in the assessment of sleep disturbance. On-site camps were included in the assessment as per Health Canada recommendations. Continuous and intermittent noise sources are to a large extent randomised in placement and proximity to mining camps within the noise model. Results presented therefore represent a likely scenario, but these results may vary considerably with final Project configuration.

Criteria for sleep disturbance are given as an indoor sound pressure level. The aforementioned outdoor-to-indoor noise reductions were used under the assumption that off-site receptors would have windows open and on-site receptors would have the windows closed.

The noise model outcome predicted that no off-site human receivers would be above the L_n 45 dBA criteria in both the construction and operation phases. No increases above baseline are anticipated.

There are three on-site camps that are above the L_n 57 dBA criteria for sleep disturbance as shown in Table 19.8-3 below.

Table 19.8-3. Receivers with L_n> 57 dBA

Receiver	Ln (dBA)	Phase
Camp 5	67	Construction
Camp 6	62	Operation
Treaty Operating Camp	63	Operation

Figures 19.8-1 and 19.8-2 show the nighttime noise levels for the construction and operation phases.

19.8.2.3 Residual Effects Assessment for Interference with Speech Communication

Health Canada does not include on-site camps in any criteria published with the exception of sleep disturbance. Only off-site receptors (primarily camps for trappers) were evaluated for interference with speech communication, and none were found to receive noise levels above 55 dBA due to their large distance from primary mining activities.

Figures 19.8-3 and 19.8-4 show the daytime time-average noise levels for the construction and operation phases, excluding event noise from a helicopter passing by, and blasting.

19.8.2.4 Residual Effects Assessment for Complaints

Only off-site human receptors were evaluated for complaints potential. It was predicted that no off-site receivers would be above the L_{dn} 62 dBA criteria during either the construction or operation phases.

Figures 19.8-5 and 19.8-6 show the day-night noise levels for the construction and operation phases.

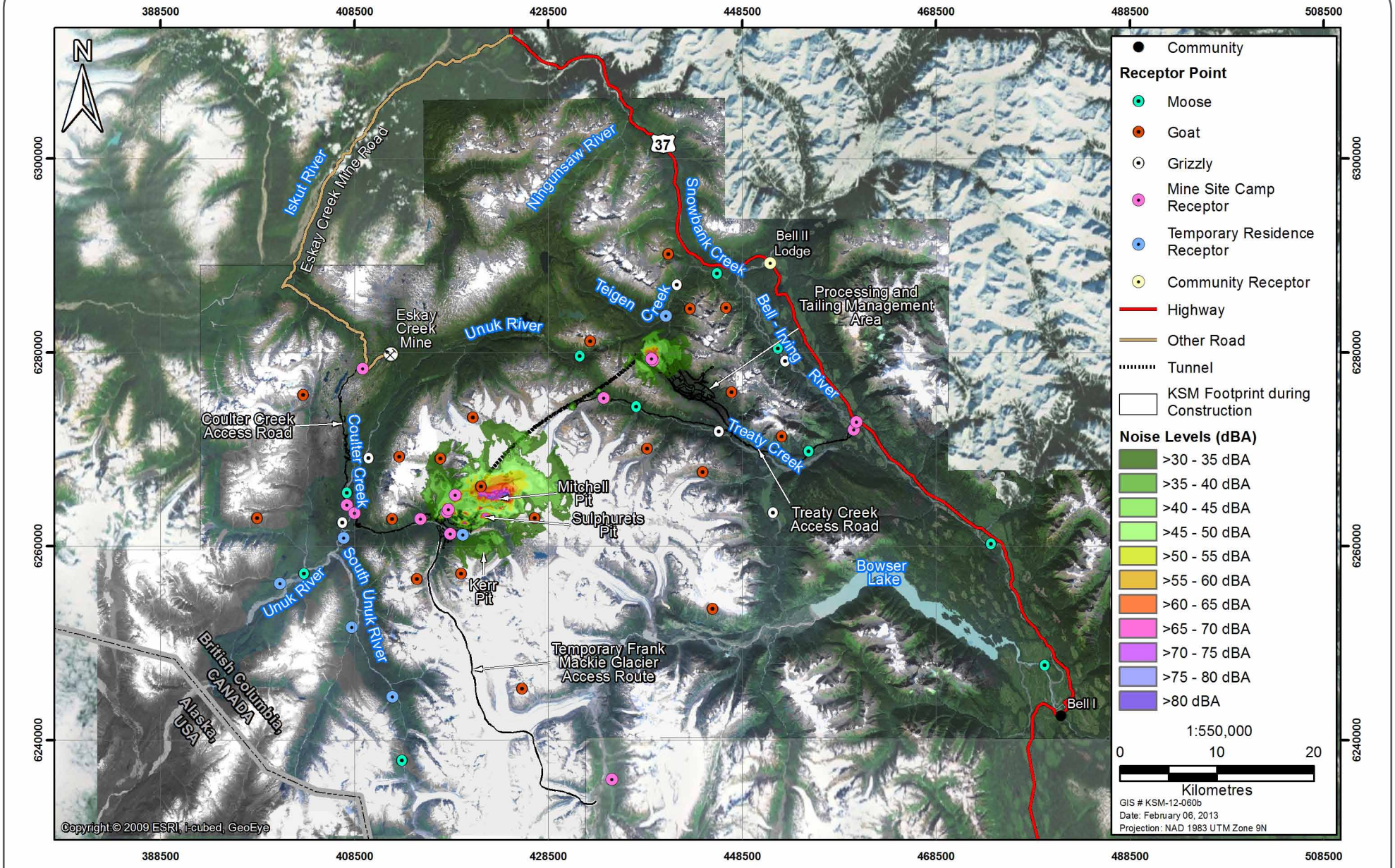


Figure 19.8-1

SEABRIDGE GOLD
KSM PROJECT

Predicted Nighttime Noise Levels during Year -1 (Construction)

Figure 19.8-1

Rescan
Engineers & Scientists

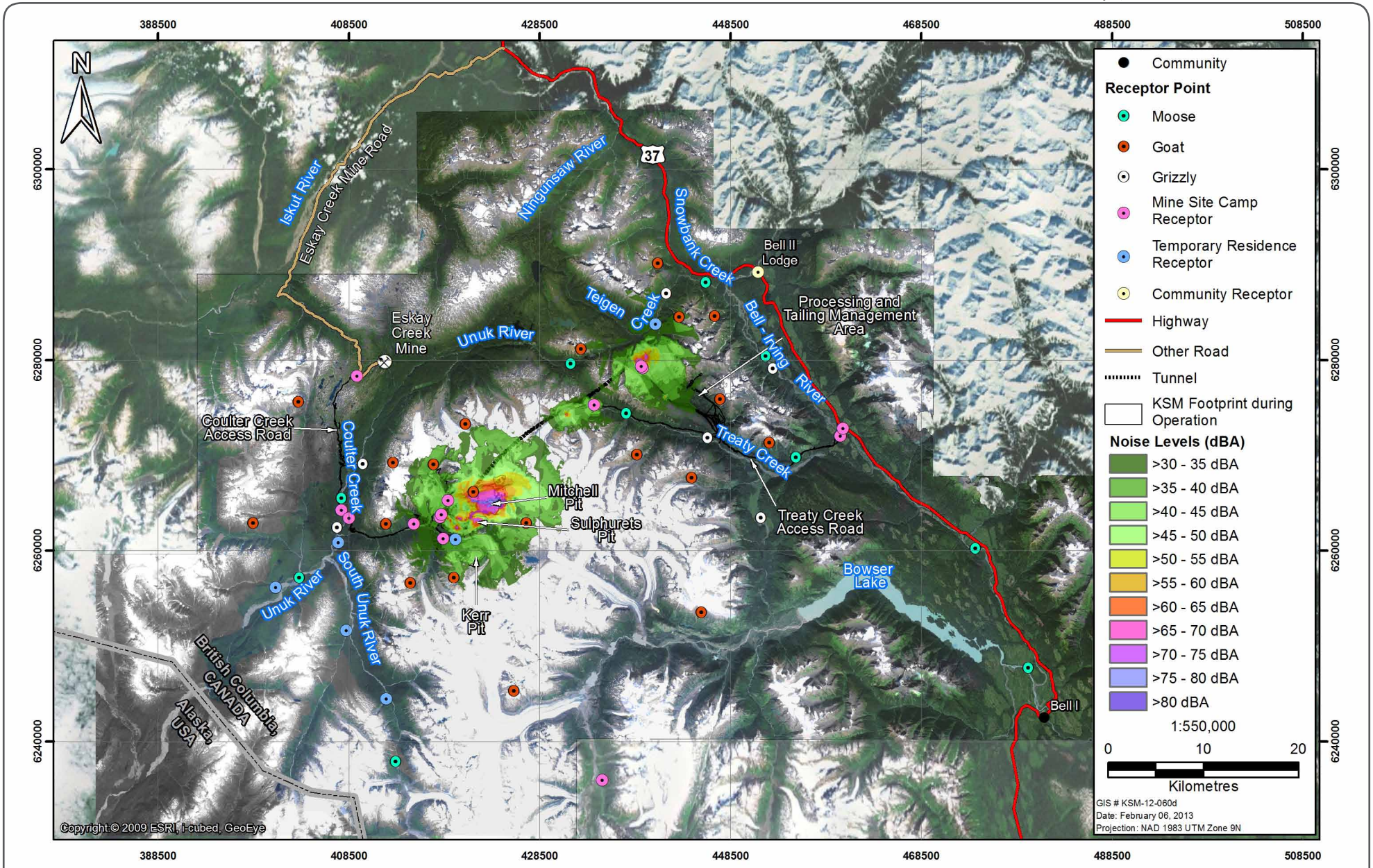


Figure 19.8-2

SEABRIDGE GOLD
KSM PROJECT

Predicted Nighttime Noise Levels during Year 4 (Operations)

Figure 19.8-2

Rescan
Engineers & Scientists

PROJECT # 868-016-07 GIS No. KSM-12-060a February 6, 2013

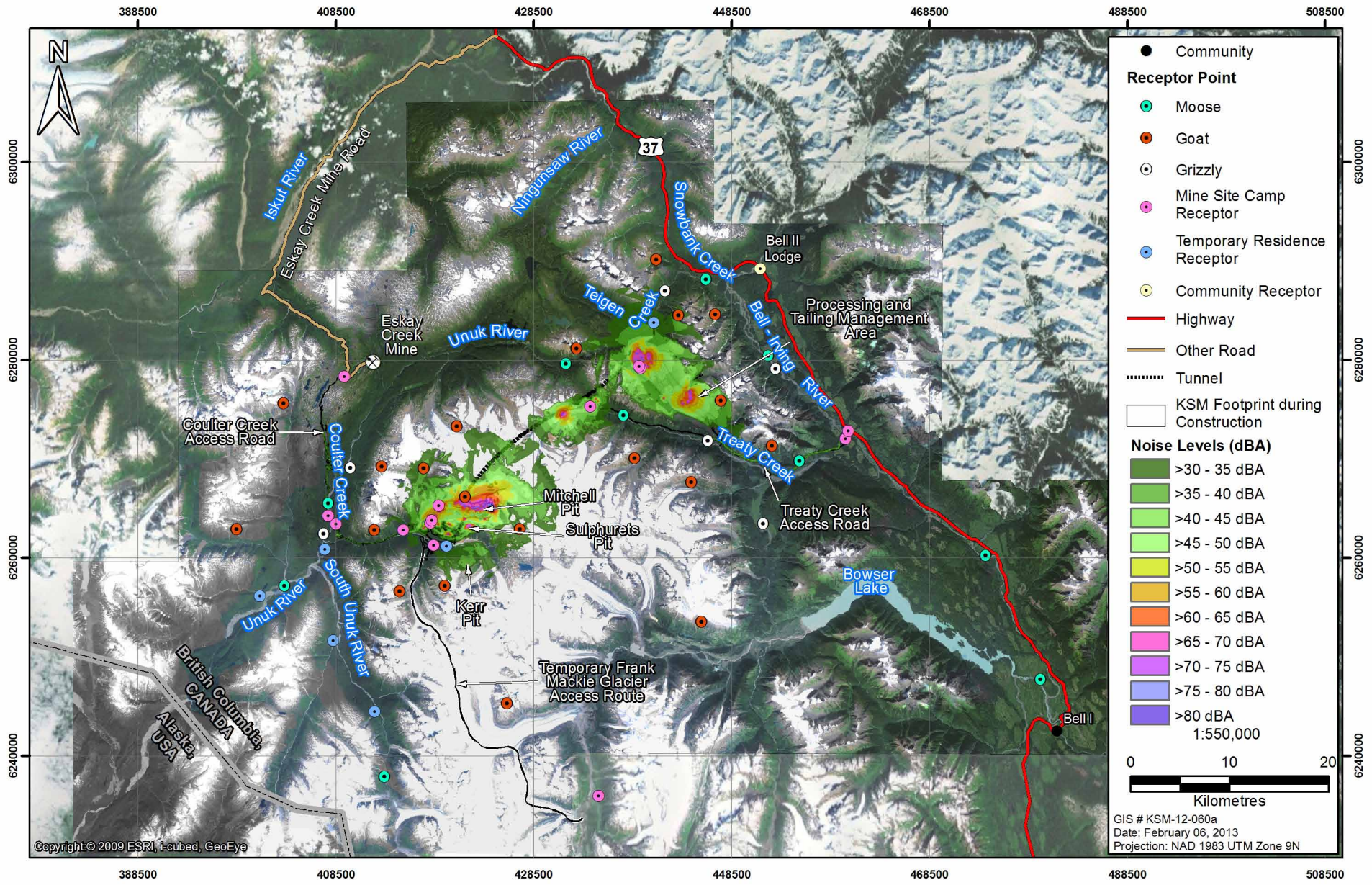


Figure 19.8-3

SEABRIDGE GOLD
KSM PROJECT

Predicted Daytime Noise Levels during Year -1 (Construction)

Figure 19.8-3

Rescan
Engineers & Scientists

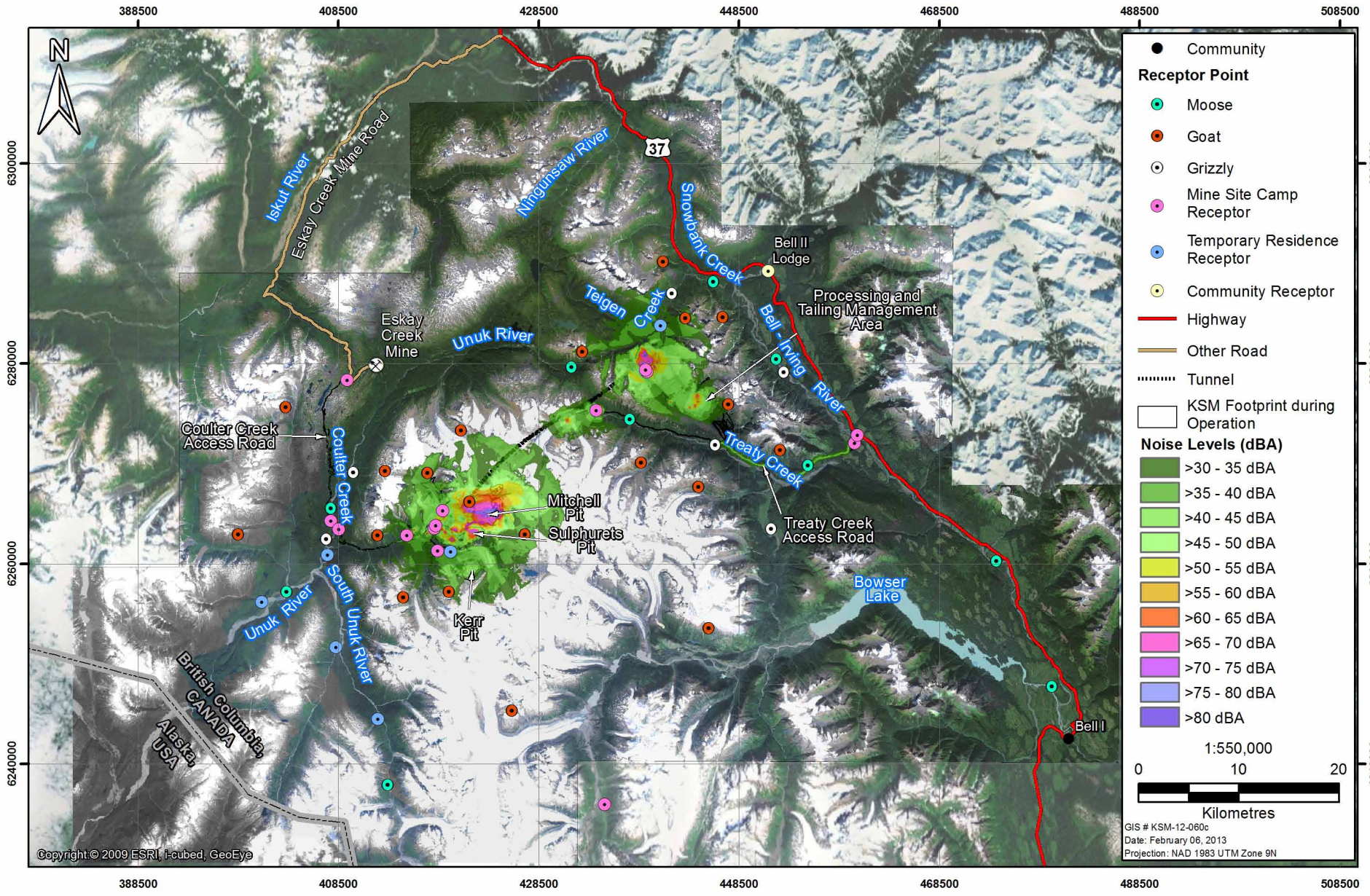


Figure 19.8-4

SEABRIDGE GOLD
KSM PROJECT

Predicted Daytime Noise Levels during Year 4 (Operations)

Figure 19.8-4

Rescan Engineers & Scientists

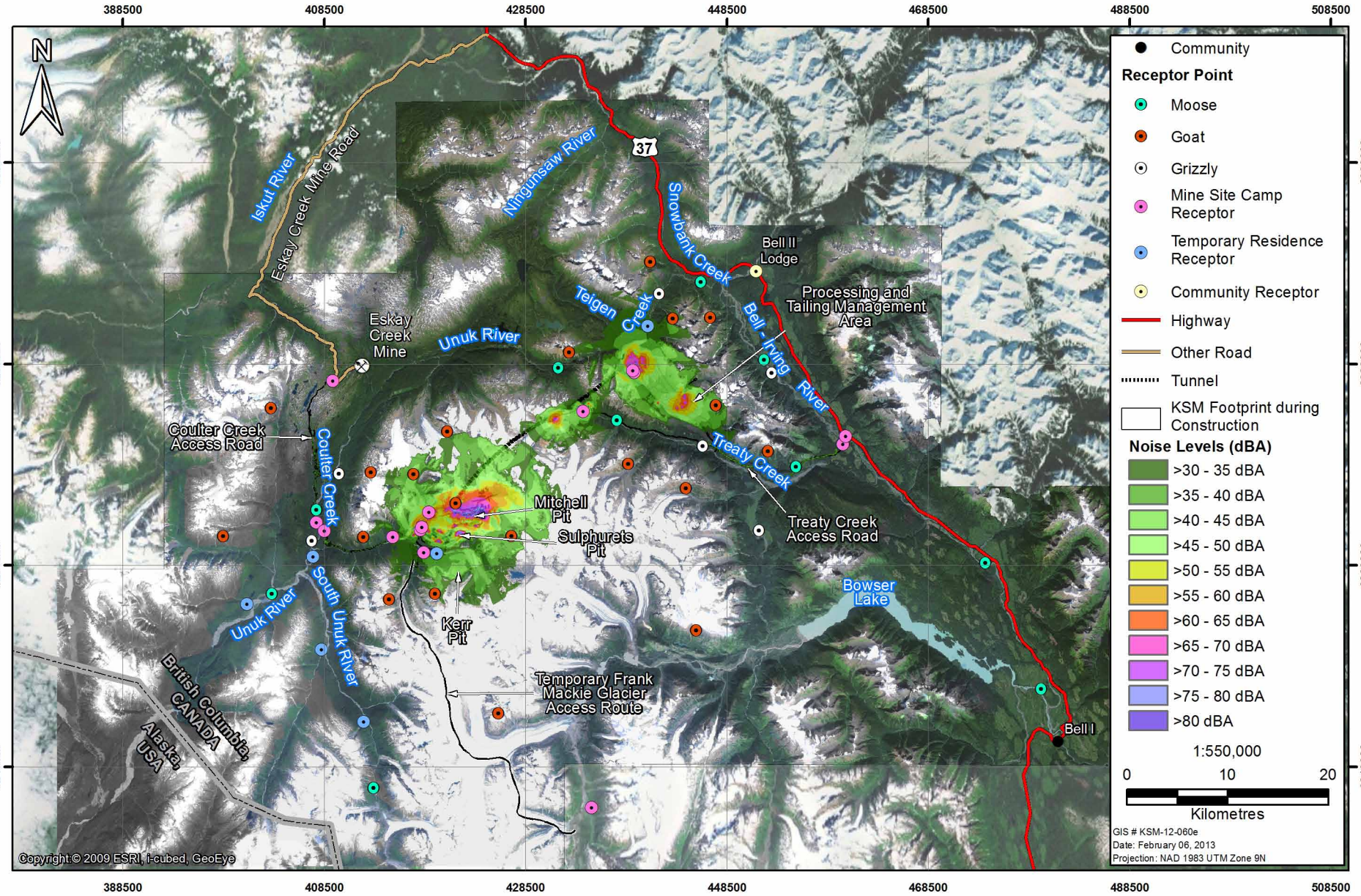


Figure 19.8-5

SEABRIDGE GOLD
KSM PROJECT

Predicted L_{dn} during Year -1 (Construction)

Figure 19.8-5

Rescan
Engineers & Scientists

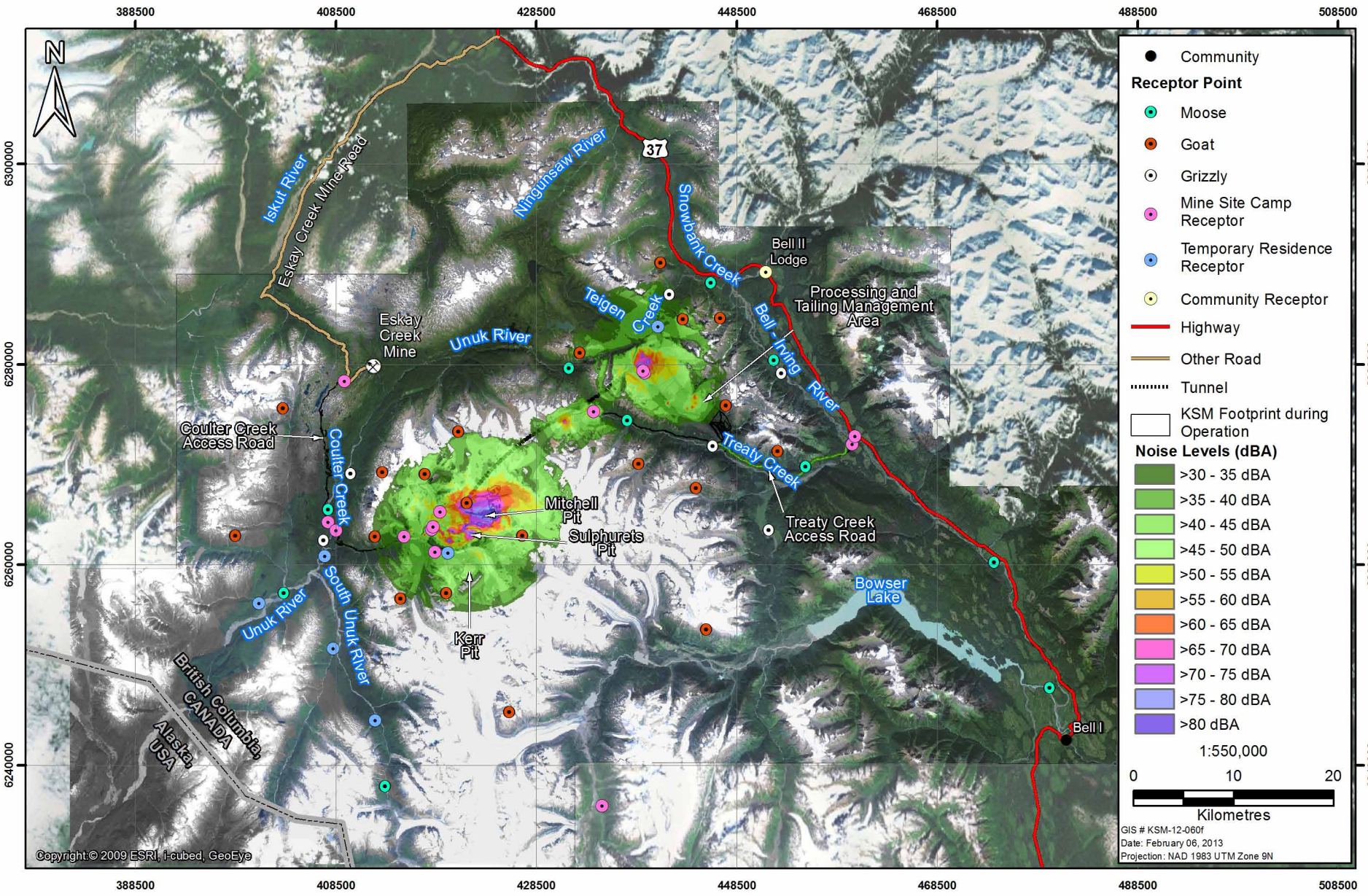


Figure 19.8-6

SEABRIDGE GOLD
KSM PROJECT

Predicted L_{dn} during Year 4 (Operations)

Figure 19.8-6

Rescan
Engineers & Scientists

19.8.2.5 Residual Effects Assessment for High Annoyance

The %HA levels predicted in the noise model account for total continuous Project noise, helicopter and blasting contributions, as well as baseline noise levels. The Health Canada guideline (2011) does not include on-site camps as part of the affected receivers in the %HA calculation. None of the off-site receivers in this study exceeded this limit. The average off-site human receptors %HA increase was predicted to be less than 1%. This is due to the large distance between these receivers and the Mine Site.

Figure 19.8-7 and Figure 19.8-8 show the adjusted day-night noise levels for the construction and operation phases.

19.8.2.6 Residual Effects Assessment for Noise-induced Rattling

The L_{LF} levels used in the noise model account for total continuous Project noise and exclude helicopter and blasting contributions. None of the receivers are predicted to be exposed to low-frequency noise above the "rattle criterion" of 70 dB. In addition, of those receivers that show a 10 dB or more difference between their A-weighted and C-weighted values, none have low-frequency components above 65 dB.

19.8.2.7 Residual Effects Assessment for Loss of Wildlife Habitat

The L_d and L_n levels predicted account for total continuous Project noise and exclude helicopter and blasting contributions. The only affected wildlife receiver that is above L_d 55 dBA and L_n = 45 dBA is a goat receptor located in close proximity to the Mine Site by the Mitchell-Treaty Twinned Tunnels entrance on the mine side showing predicted noise levels of 60-63 dBA during construction and operation (Table 19.8-4; coordinates X = 421,533.7, Y = 6,266,157). Levels received at this location are variable and highly dependent on which equipment is operating nearby. The significance of residual effect of noise on wildlife will be determined based on this mountain goat receptor with the highest increase of noise levels.

Table 19.8-4. Affected Wildlife Receiver (Goat)

Acoustic Parameter	Noise Level (dBA)	Phase
L_d	62	Construction
	62	Operation
L_n	60	Construction
	63	Operation

The L_{peak} levels presented in Table 19.8-5 and Figures 19.8-9 to 19.8-10 account for instantaneous sound pressure levels from blasting activities. The single wildlife receiver that is predicted to be above L_{peak} 108 dB is located in close proximity to the Mine Site. During neither construction nor operation does the L_{peak} value exceed the 120 dB threshold that could potentially result in habitat loss.

The L_{AE} levels presented herein account for event noise exposure levels for helicopter overflights. As per wildlife assessment, only mountain goats are regarded as sensitive to helicopter disturbance. As shown in Figure 19.8-11, no mountain goat receivers modelled were above the threshold.

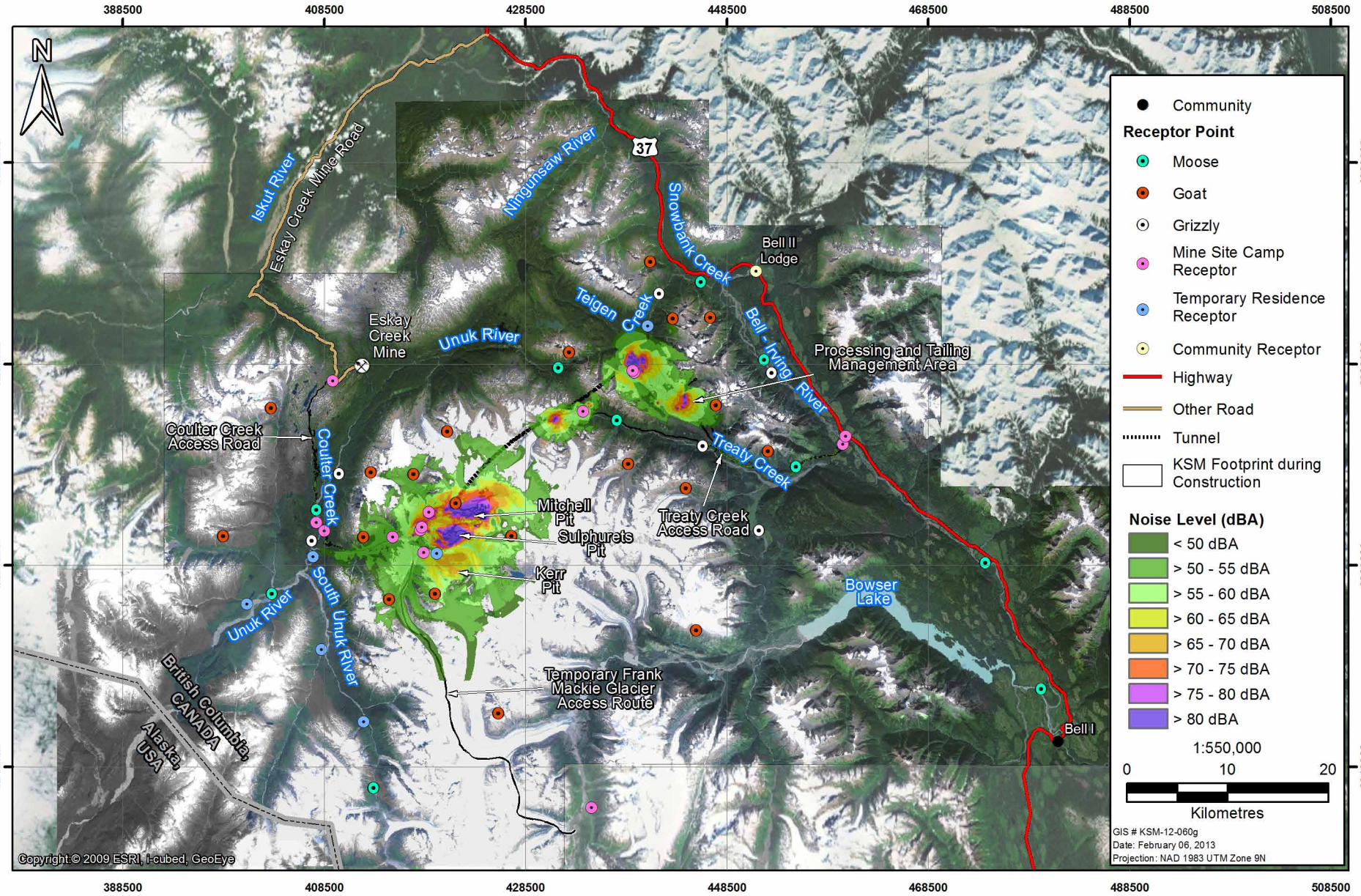


Figure 19.8-7

SEABRIDGE GOLD
KSM PROJECT

Predicted Adjusted L_{dn} during Year -1 (Construction)

Figure 19.8-7

Rescan Engineers & Scientists

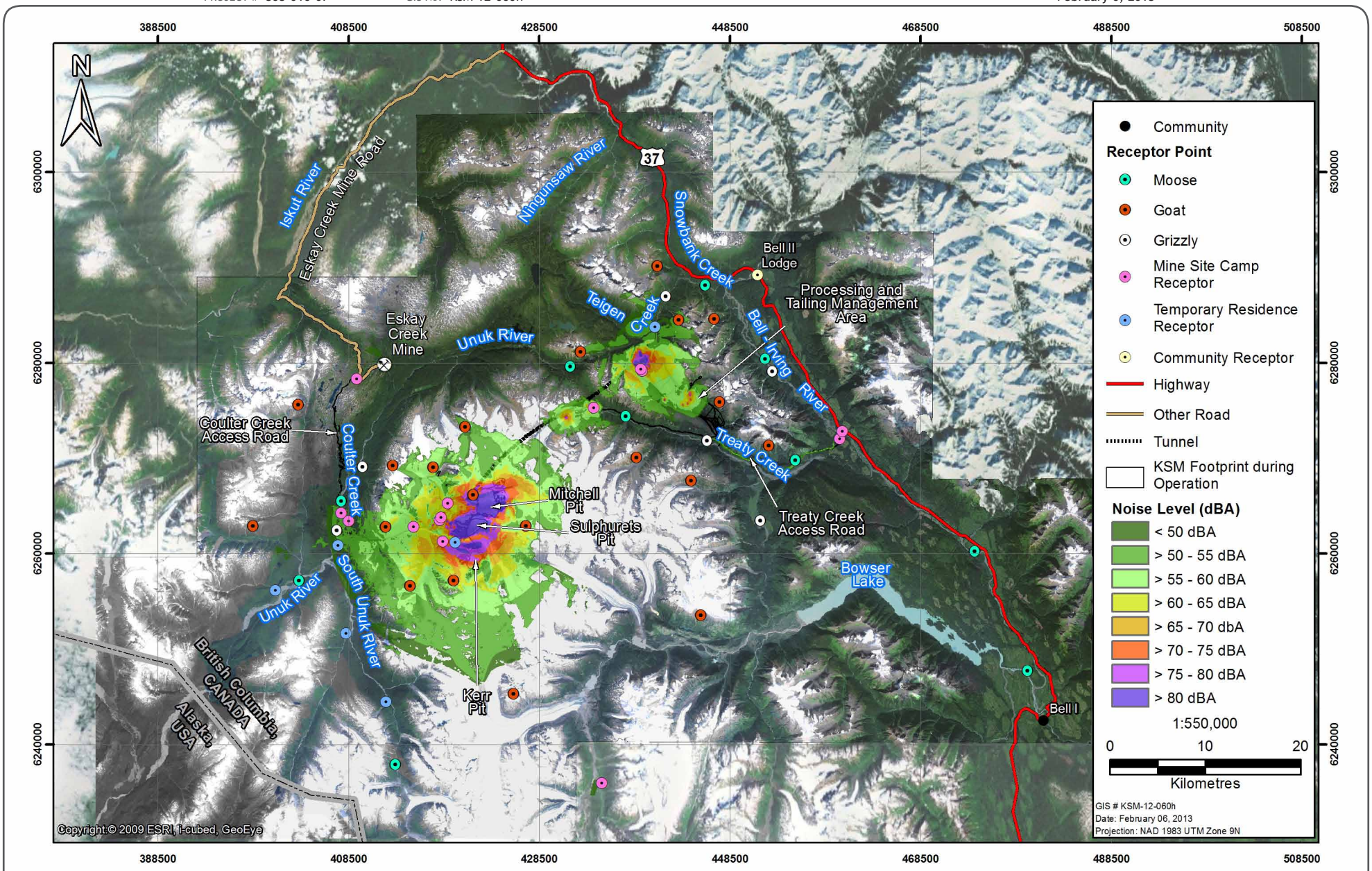


Figure 19.8-8

SEABRIDGE GOLD
KSM PROJECT

Predicted Adjusted L_{dn} during Year 4 (Operations)

Figure 19.8-8

Rescan
Engineers & Scientists

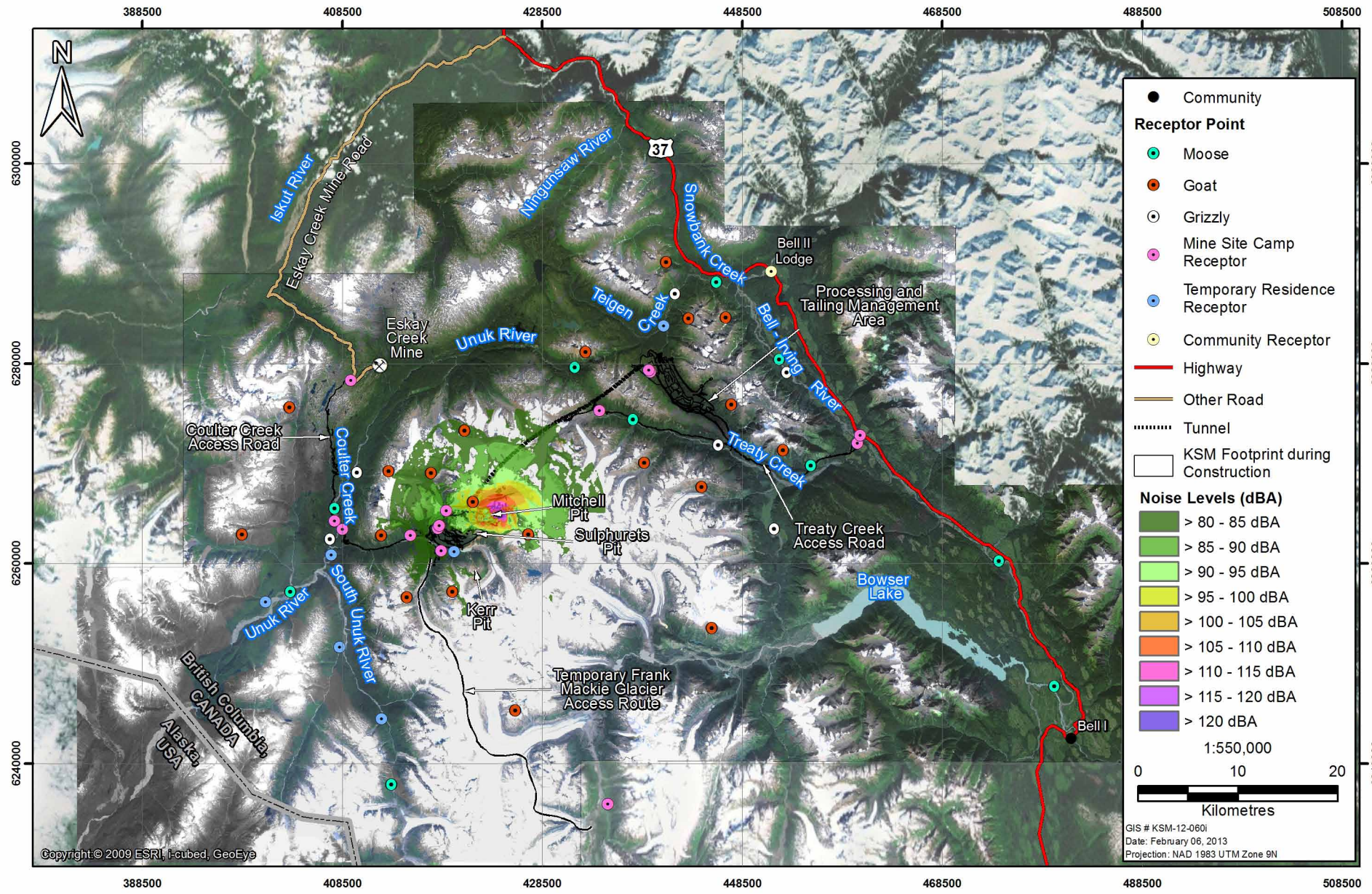


Figure 19.8-9

SEABRIDGE GOLD
KSM PROJECT

Predicted Blasting L_{peak} during Year -1 (Construction)

Figure 19.8-9

Rescan Engineers & Scientists

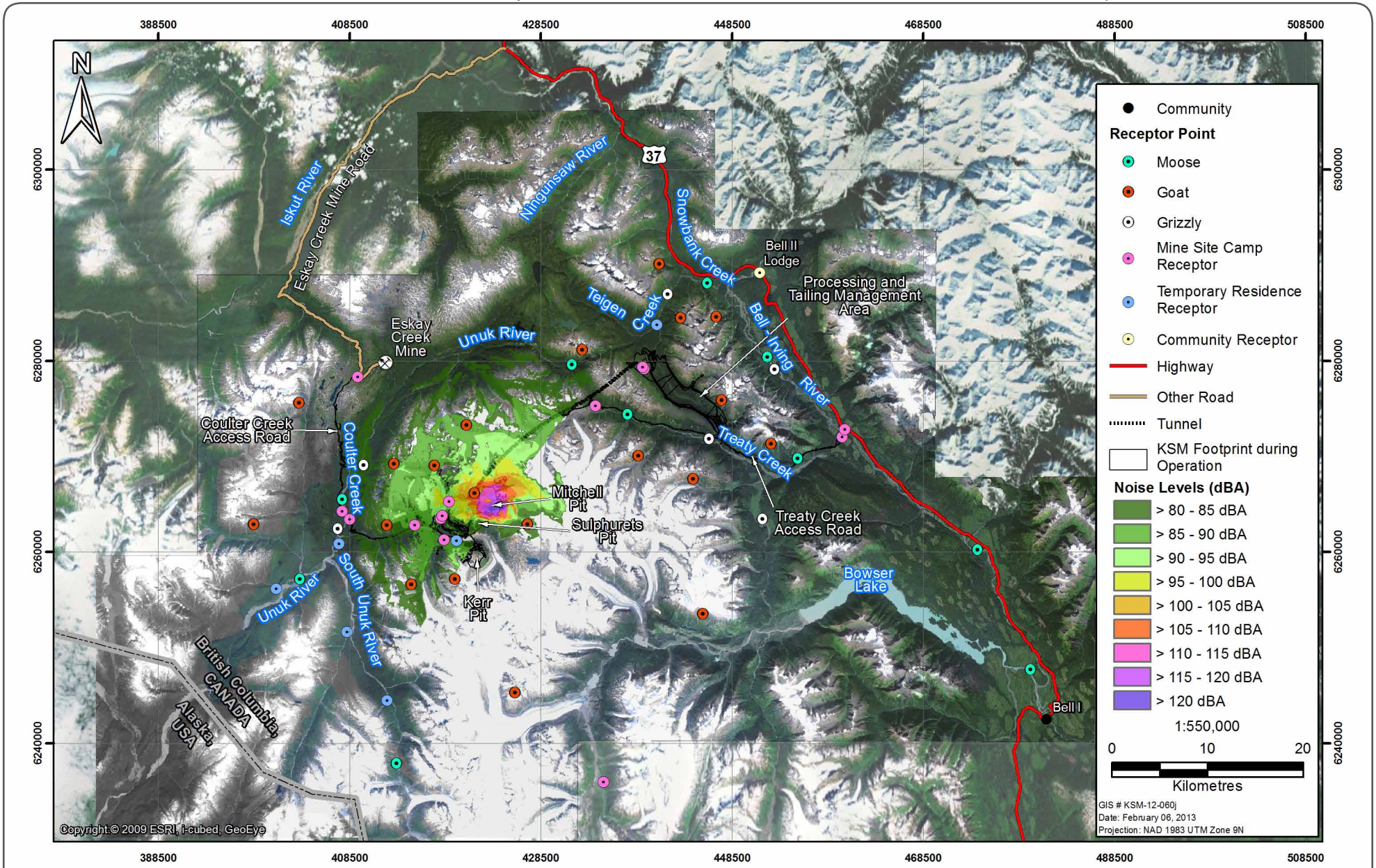


Figure 19.8-10

SEABRIDGE GOLD
KSM PROJECT

Predicted Blasting L_{peak} during Year 4 (Operations)

Figure 19.8-10

Rescan Engineers & Scientists

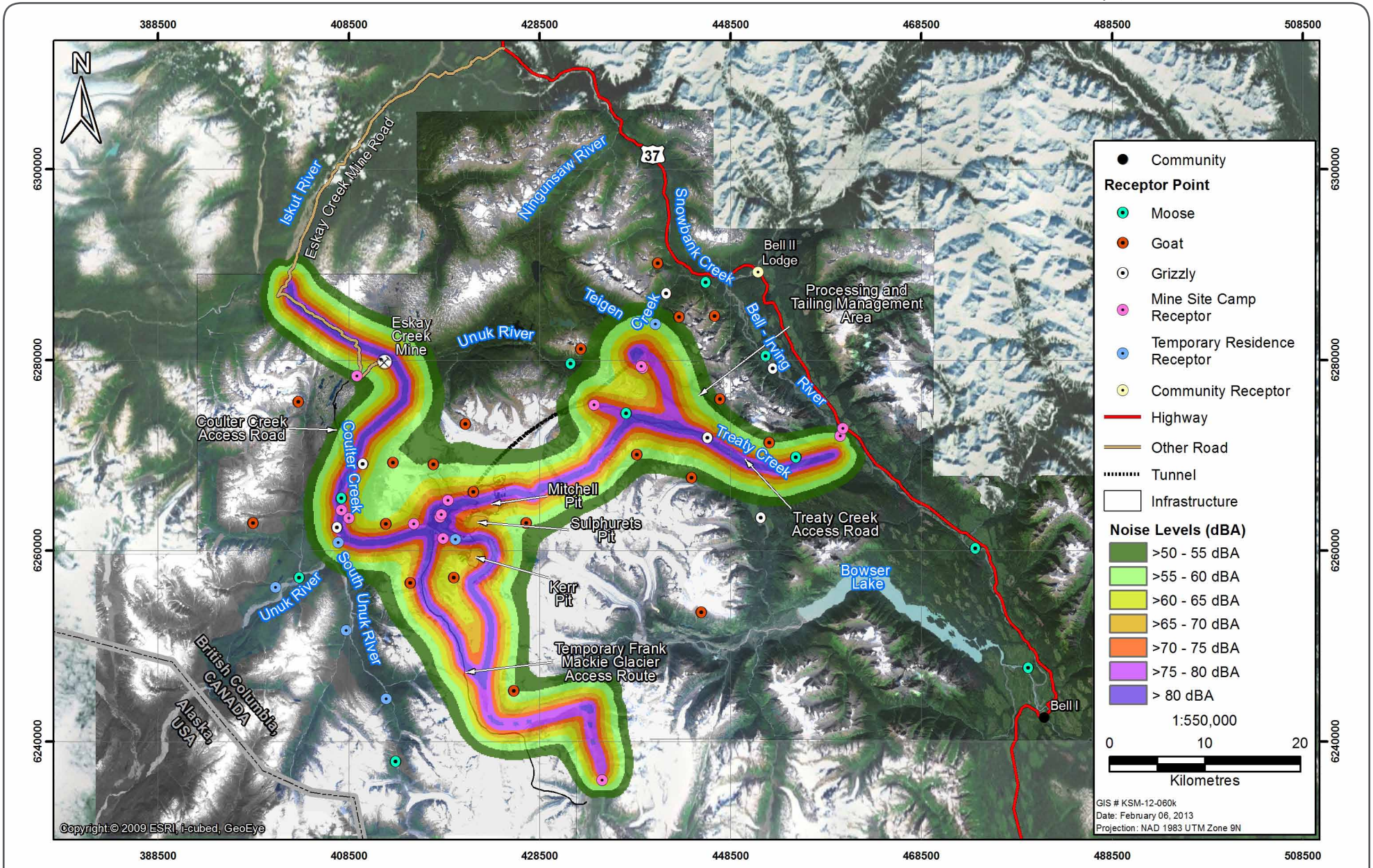


Figure 19.8-11

SEABRIDGE GOLD
KSM PROJECT

Predicted Helicopter L_{AE}

Figure 19.8-11

Rescan Engineers & Scientists

Table 19.8-5. Wildlife Receivers with L_{peak}> 108 dB

Receiver	L_{peak} (dB)	Phase
Goat Receptor 9	117	Construction
Goat Receptor 9	119	Operation

19.8.2.8 Overall Effect on Noise

A shown in Table 19.8-6 below, sleep disturbance is the only potential residual effect that may occur at worker camps on the Mine Site. Short-term construction noise effects are unavoidable during major construction projects, but should be minimized to the extent possible by adhering to best management practices. During construction, the predicted noise levels remain below guideline levels at all applicable receiver locations with the exception of potential sleep disturbance at on-site worker camps. The magnitude of noise effects is considered high during construction (as defined in Section 19.8.1), but would be low with additional mitigation. The spatial extent is local, as noise levels will change in the immediate vicinity of the Project. Given the timeframe for construction and the 24-hour work schedule, the duration of noise effects is considered medium, and the frequency will be related to Project scheduling. Noise is a reversible effect in the short-term. The frequency of the effect is considered regular, as many noise sources are mobile and will be transient at a given location. Given the wide variability in people's tolerance for noise, the resilience is considered neutral. The likelihood of this resilient effect occurring is medium during construction, and the confidence level is rated as intermediate since there are a number of external variables such as location of equipment and construction of camp buildings that are unknown. Based on these criteria, the residual effect is considered not significant, with follow-up monitoring not required.

Similarly, for operation, the noise modelling results predict no significant effect with the exception of potential sleep disturbance at on-site worker camps. The magnitude of this effect is considered low if mitigation measures are taken. The spatial extent is local, as noise levels will change in the immediate vicinity of the Project. Given the timeframe for operation and the 24-hour work schedule, the duration of noise effects is considered long-term and the frequency will be related to Project scheduling. It is expected that the frequency will be approximately regular. Noise is a reversible effect in the short-term. Given the wide variability in people's tolerance for noise, the resilience is considered neutral. The likelihood of this resilient effect occurring is low, and the confidence level is rated as intermediate since there are a number of external variables such as location of equipment and construction of camp buildings that are unknown. Based on these criteria, with mitigation the effect is considered not significant (moderate)), with follow-up monitoring not required.

Mainly due to the effects of noise from blasting, but also considering effects from helicopter travel and the continuous noise expected to occur during mine operations, loss of wildlife habitat is also considered a not significant (moderate) residual effect. This effect is discussed in greater detail in Chapter 18, Wildlife and Wildlife Habitat.

Table 19.8-6. Summary of Residual Effects on Noise

Description of Residual Effect	Project Component (s)	Timing of Effect	Magnitude	Extent	Duration	Frequency	Reversibility	Context	Likelihood of Effects		Significance Determination	Follow-up Monitoring
									Probability	Confidence Level		
Sleep Disturbance	Mining Camp	Construction	High	Local	Medium	Regular	Reversible short-term	Neutral	Medium	Medium	Not Significant (Minor)	Not Required
		Operations	High	Local	Long	Regular	Reversible short-term	Neutral	Low	Medium	Not Significant (Moderate)	Not Required
Interference With Speech Communication	Offsite Receivers	Construction	Negligible	Local	Medium	Regular	Reversible short-term	Neutral	Low	Medium	Not Significant (Minor)	Not Required
	Offsite Receivers	Operations	Negligible	Local	Long	Regular	Reversible short-term	Neutral	Low	Medium	Not Significant (Minor)	Not Required
Complaints	Offsite Receivers	Construction	Negligible	Local	Medium	Regular	Reversible short-term	Neutral	Low	Medium	Not Significant (Minor)	Not Required
	Offsite Receivers	Operations	Negligible	Local	Long	Regular	Reversible short-term	Neutral	Low	Medium	Not Significant (Minor)	Not Required
High Annoyance	Offsite Receivers	Construction	Negligible	Local	Medium	Regular	Reversible short-term	Neutral	Low	Medium	Not Significant (Minor)	Not Required
	Offsite Receivers	Operations	Negligible	Local	Long	Regular	Reversible short-term	Neutral	Low	Medium	Not Significant (Minor)	Not Required
Noise Induced Rattling	Offsite Receivers	Construction	Negligible	Local	Medium	Regular	Reversible short-term	Neutral	Low	Medium	Not Significant (Minor)	Not Required
	Offsite Receivers	Operations	Negligible	Local	Long	Regular	Reversible short-term	Neutral	Low	Medium	Not Significant (Minor)	Not Required
Loss of Wildlife Habitat	Local Wildlife Habitat	Construction	High	Local	Medium	Sporadic	Reversible short-term	Neutral	Low	Medium	Not Significant (Minor)	Refer to Chapter 18, Wildlife
		Operations	High	Local	Long	Sporadic	Reversible short-term	Neutral	High	Medium	Not Significant (Moderate)	Refer to Chapter 18, Wildlife
Overall Residual Effect	All		High	Local	Long	Regular	Reversible short-term	Neutral	High	Medium	Not Significant (Moderate)	Not Required

19.9 Potentially Cumulative Effects for Noise

19.9.1 Scoping of Cumulative Effects

19.9.1.1 Spatial Linkages with Other Projects and Human Actions

Noise effects generally diminish with distance from a source. Since most human generated noise has been found to be undetectable within 5 km for a large industrial source, a 10 km range from project activities is expected to conservatively encompass all potential acoustic effects of the proposed Project. Other noise-generating projects and activities within this boundary have the potential to act cumulatively with noise generated from the KSM Project (Figure 19.9-1). These projects and activities are considered to potentially have a spatial linkage, and include:

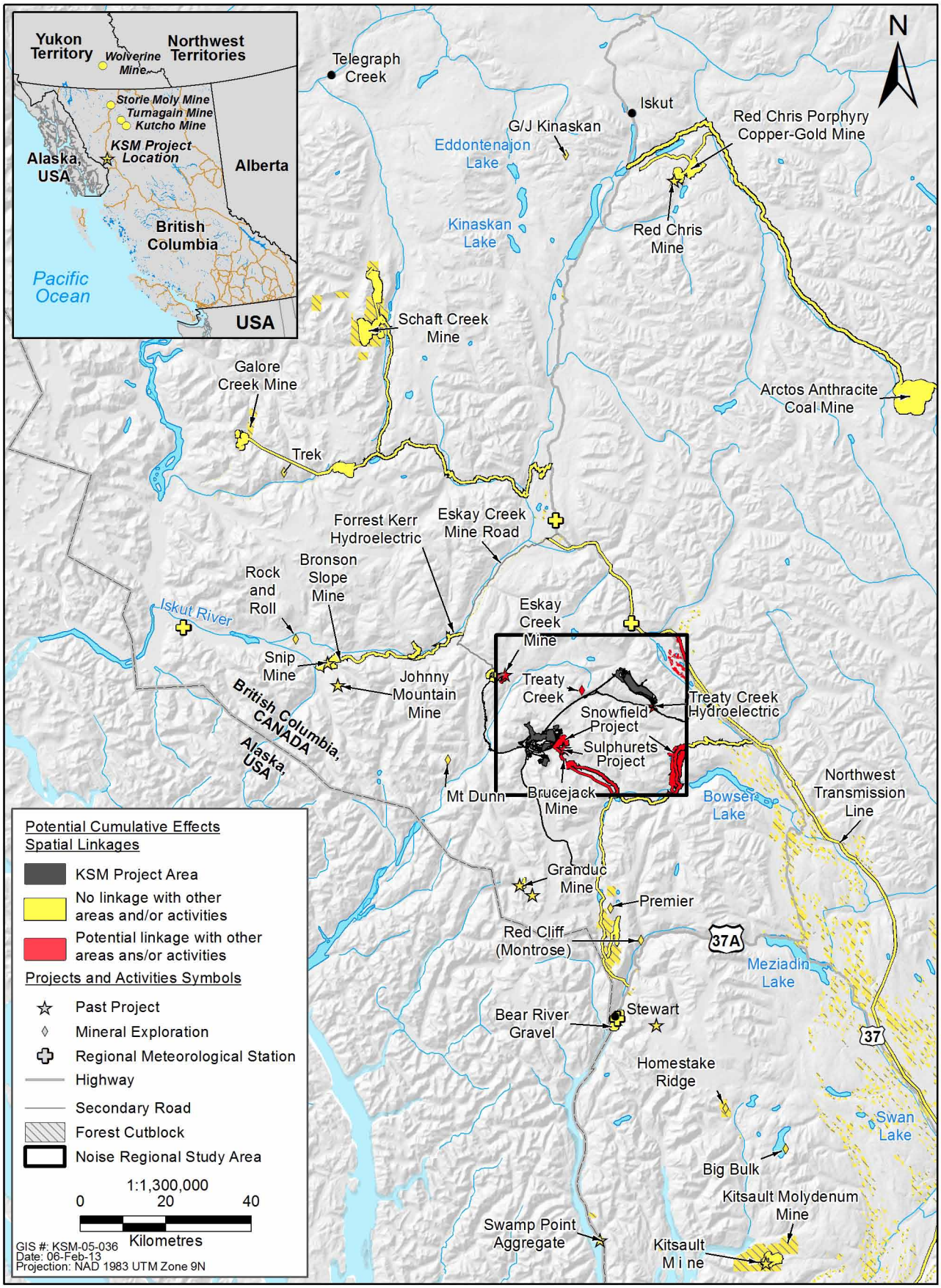
- past-producing Eskay Creek Mine;
- Snowfield Gold-Copper Project
- Brucejack Gold Mine;
- Northwest Transmission Line;
- Forest Kerr Hydroelectric;
- Treaty Creek Hydroelectric; and
- Road access and traffic.

As shown in Figures 19.8-1 to 19.8-11, the spatial area over which the KSM Project has a measurable effect on noise levels varies for each residual effect due to differing modelling methods and applicable guidelines or standards. An analysis of which of the above six projects, if any, would have a spatial linkage for each residual effect is completed below. In order to be conservative, it is assumed that each of the above projects will have a measurable effect on noise levels 5 km away (the furthest distance noise could be expected to travel at an appreciable level from an industrial source) regardless of the fact that they are all much smaller in scope than the KSM Project.

Sleep Disturbance – The only receptors typically considered in the assessment of sleep disturbance are residential areas and mining camps. With the exception of the Snowfield Project, none of the above projects are within 5 km of a receptor affected by the KSM Project.

Interference with Speech Communication, Complaints, High Annoyance, Noise Induced Rattling – For each of these residual effects, only residential areas are considered to be receptors. There are currently no permanent residences that are with 5 km of both the KSM Project and any of the above listed projects.

Loss of Wildlife Habitat – Two potential sources of loss of wildlife habitat were analyzed: helicopters and blasting. Because information on helicopter use and flight paths for the above projects is not readily available, and the noise from helicopters decays quickly with distance, it is not anticipated that any of the identified wildlife receptors will be subject to noise from multiple helicopters from different projects. With regard to blasting, only the Snowfield Project is expected to blast within close enough proximity to the KSM Project to have a potentially overlapping area of effect.



SEABRIDGE GOLD
KSM PROJECT

KSM Project Cumulative Effects Issue Scoping: Potential Spatial Linkages for Noise

Figure 19.9-1

Rescan Engineers & Scientists

With regard to noise from traffic, volumes due to the above projects are unknown, but if similar volumes to the KSM Project along Highway 37 are expected (a conservative assumption given the relative size of the projects) the effect would be a less than a 1 dB increase at the camps where sleep disturbance has been identified as an issue, even if the camps are within 50 m of the roadway. At this less than 1 dB level, no interaction is considered to have occurred for the purposes of this assessment. It should be noted that even this small increase in noise is a very conservative estimate given that the distance from the major roadways will likely be greater than 50 m, and this does not account for any mitigation methods that may be employed. As there are no residences within the study area within 50 m of a roadway that would be used by the KSM Project or by any of the other projects, cumulative effects need not be considered for any of the other residual effects.

19.9.1.2 Temporal Linkages with Other Projects and Human Actions

All projects and activities listed above are considered to have a potential temporal overlap with noise from the Project. Table 19.9-1 summarizes potential linkages between noise from other human actions and noise from the Project.

Table 19.9-1. Summary of Potential Linkages between the KSM Project and Other Human Actions with regard to Noise

Action/Project		Past	Present	Future
Past Projects	Eskay Creek Mine	X; acclimation	NL	NL
	Granduc Mine	NL	NL	NL
	Johnny Mountain Mine	NL	NL	NL
	Kitsault Mine (Closed)	NL	NL	NL
	Snip Mine	NL	NL	NL
	Sulphurets Project	NL	NL	NL
	Swamp Point Aggregate Mine	NL	NL	NL
Present Projects	Forrest Kerr Hydroelectric	NL	X; construction phase may overlap with the beginning of KSM construction	NL
	Long Lake Hydroelectric	NL	NL	NL
	Northwest Transmission Line	NL	NL	X; overlap of construction
	Red Chris Mine	NL	NL	NL
	Wolverine Mine	NL	NL	NL
Reasonably Foreseeable Future Projects	Arctos Anthracite Coal Mine	NL	NL	NL
	Bear River Gravel	NL	NL	NL
	Bronson Slope Mine	NL	NL	NL
	Brucejack Mine	NL	NL	X; overlap of construction and operation
	Galore Creek Mine	NL	NL	NL
	Granduc Copper Mine	NL	NL	NL
	Kitsault Mine	NL	NL	NL
	Kutcho Mine	NL	NL	NL
	McLymont Creek Hydroelectric	NL	NL	NL
	Schaft Creek Mine	NL	NL	NL

(continued)

Table 19.9-1. Summary of Potential Linkages between the KSM Project and Other Human Actions with regard to Noise (completed)

Action/Project		Past	Present	Future
Reasonably Foreseeable Future Projects *(cont'd)*	Snowfield Project	NL	NL	X; overlap of construction and operation during KSM operation
	Storie Moly Mine	NL	NL	NL
	Turnagain Mine	NL	NL	NL
	Treaty Creek Hydroelectric	NL	NL	X; overlap of construction and operation
Land Use Activities	Agricultural Resources	NL	NL	NL
	Fishing	NL	NL	NL
	Guide Outfitting	NL	NL	NL
	Resident and Aboriginal Harvesting	NL	NL	NL
	Mineral and Energy Resource Exploration	NL	NL	NL
	Recreation and Tourism	NL	NL	NL
	Timber Harvesting	NL	NL	NL
	Traffic and Roads	X; acclimation	X	X; noise from all traffic including estimated traffic from other projects that maybe passing within 20km of Project.

NL = No Linkage (no spatial and temporal overlap, or potential effects do not act in combination)
X = Potential spatial and temporal linkage with project or action

19.9.2 Cumulative Effects Assessment for Noise

Table 19.9-2 below lists the potential interactions between each of the projects and activities identified in the previous section as potentially having a cumulative effect with the KSM Project and each of the previously described residual effects that project noise levels will have.

19.9.2.1 Project-Specific Residual Effects on Noise that Are Not Likely to Result in Cumulative Effects

With the exception of a possible interaction between the KSM Project and the Snowfield Project with regard to wildlife habitat loss and sleep disturbance, none of the other projects or activities are anticipated to have any measureable interaction with the KSM Project. This is mainly because noise effects are very localized and reduce with distance from the source. According to the model results presented in Appendix 19-A, all sources of noise, with the exception of blasting, reach background levels at greater distances away from other potential sources of noise. Additionally, each of these sources of noise are, or will be, substantially smaller than those from the KSM Project. The potential of cumulative effects relating to noise are limited to those receivers within approximately 1 km of the area where the KSM Project and Snowfield Project are immediately adjacent to each other, as are sections of Highway 37, where project-related traffic is likely to overlap. Due to distance from the KSM Project, the Treaty Creek Hydroelectric, the Northwest Transmission Line, and the Forrest Kerr projects are not expected to have any appreciable cumulative effect on noise levels.

Table 19.9-2. Summary of Projects and Activities with Potential to Interact Cumulatively with Expected Project-specific Residual Effects on Noise

Description of KSM Residual Effect	Potential for Cumulative Effect: Relevant Projects and Activities						
	Snowfield Project	**Brucejack Mine**	**Treaty Creek Hydroelectric**	**Eskay Creek Mine**	**Northwest Transmission Line Construction**	**Forest Kerr Construction**	**Road Traffic on Highway 37**
Sleep Disturbance - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Sleep Disturbance - operation	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Interference With Speech Communication - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Interference With Speech Communication - operation	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Complaints - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Complaints - operation	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
High Annoyance - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
High Annoyance - operation	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Noise Induced Rattling - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Noise Induced Rattling - operation	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Loss of Wildlife Habitat - construction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Loss of Wildlife Habitat - operation	Possible Interaction	Possible Interaction	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction

19.9.2.2 Cumulative Effect of Loss of Wildlife Habitat

Loss of wildlife habitat is listed as having a possible interaction between the KSM Project, the Snowfield Project, and Brucejack Mine. At this time, there is insufficient information to determine whether such an interaction will occur. However, it should be noted that although an interaction may be possible, it is very unlikely. Given that the blasting that is potentially causing loss of wildlife habitat only occurs for a few seconds, once per day, the odds of multiple mines blasting simultaneously is almost negligible.

19.9.2.2.1 Project-specific Cumulative Effects Mitigations for Loss of Wildlife Habitat

There are two specific steps that can be taken to reduce the effect that noise from blasting has on local wildlife:

- avoid blasting configurations that could result in more than seven holes detonating simultaneously; and
- ensure blast holes are stemmed to at least 6 m.

19.9.2.2.2 Other Project/Activity Mitigations to Address Loss of Wildlife Habitat

There are no specific mitigation or management measures explicitly identified from other projects or activities to address the effect of loss of wildlife habitat. However, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project.

19.9.2.2.3 Determination of Potential Residual Cumulative Effect and Significance

As was discussed previously, although an interaction potentially causing loss of wildlife habitat may be possible, it is very unlikely given that the odds of blasting simultaneously is almost negligible due to the fact that the blasting only occurs for a few seconds, once per day. For this reason, the cumulative effect on wildlife habitat loss is expected to be no different than the project-specific habitat loss as shown in Table 19.9-3. For both operation and construction, including an adjustment for cumulative effects or not, the significance determination is **Not Significant (moderate)**.

19.9.2.3 Cumulative Effect of Sleep Disturbance

Sleep disturbance is listed as having a possible interaction between the KSM Project, Snowfield Project, and Brucejack Mine. Assuming the Snowfield Project produced an equivalent amount of noise to the KSM Project (which is a very conservative assumption given the relative size of the two planned projects), receivers in this vicinity will experience a maximum 3 dB cumulative effect. Currently, the closest receiver in this area is Exploration Camp 1 (Coordinates X = 419,683.3, Y = 6,261,176) which has an L_{dn} rating level of 39 dBA. Increasing this by 3 dB to allow for potential cumulative effects will still keep it below the limit. As such, there is no significant cumulative effect anticipated for the Snowfield Project. Since Brucejack Mine is farther from the KSM Project than the Snowfield Project, no significant cumulative effect is anticipated for the Brucejack Mine.

Table 19.9-3. Summary of Residual Cumulative Effects on Noise

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Ajusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
Loss of Wildlife Habitat	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	High	High	Local	Regional	Medium	Medium	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Minor)	Not Significant (Moderate)	Refer to Chapter 18, Wildlife	
Loss of Wildlife Habitat	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	High	High	Local	Regional	Long	Long	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	Refer to Chapter 18, Wildlife	
Sleep Disturbance	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	High	High	Local	Local	Medium	Medium	Regular	Regular	Reversible short-term	Reversible short-term	Neutral	Neutral	Medium	Medium	Medium	Medium	Not Significant (Minor)	Not Significant (Minor)	N/A	N/A
Sleep Disturbance	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	High	High	Local	Local	Medium	Medium	Regular	Regular	Reversible short-term	Reversible short-term	Neutral	Neutral	Low	Medium	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	N/A	N/A
Interference With Speech Communication	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	Negligible	Negligible	Local	N/A	Medium	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Interference With Speech Communication	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	Negligible	Negligible	Local	N/A	Long	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Complaints	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	Negligible	Negligible	Local	N/A	Medium	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Complaints	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	Negligible	Negligible	Local	N/A	Long	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A

(continued)

Table 19.9-3. Summary of Residual Cumulative Effects on Noise (completed)

Description of Residual Effect	Other Project(s)/ Activity(ies)	Timing of Effect	Magnitude	Magnitude Ajusted for CE	Extent	Extent Adjusted for CE	Duration	Duration Adjusted for CE	Frequency	Frequency Adjusted for CE	Reversibility	Reversibility Adjusted for CE	Context	Context Adjusted for CE	Likelihood of Effects				Significance Determination	Significance Determination Adjusted for CE	Follow-up Monitoring	Follow-up Monitoring Adjusted for CE
															Probability	Probability Adjusted for CE	Confidence Level	Conf. Level Adjusted for CE				
High Annoyance	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	Negligible	Negligible	Local	N/A	Medium	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
High Annoyance	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	Negligible	Negligible	Local	N/A	Long	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Noise Induced Rattling	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Construction	Negligible	Negligible	Local	N/A	Medium	N/A	Regular	N/A	Reversible short-term	N/A	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Noise Induced Rattling	Snowfield Project, Brucejack Project, Forrest Kerr Hydroelectric, Northwest Transmission Line, Treaty Creek Hydroelectric, Traffic and Roads	Operations	Negligible	Negligible	Local	N/A	Long	N/A	Regular	N/A	Reversible short-term	Reversible short-term	Neutral	N/A	Low	N/A	Medium	N/A	Not Significant (Minor)	N/A	N/A	N/A
Overall Effect	All	Construction	High	High	Local	Regional	Medium	Medium	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	N/A	N/A
Overall Effect	All	Operations	High	High	Local	Regional	Medium	Medium	Sporadic	Sporadic	Reversible short-term	Reversible short-term	Neutral	Neutral	High	High	Medium	Medium	Not Significant (Moderate)	Not Significant (Moderate)	N/A	N/A

Note: CE = Cumulative Effect.

19.9.2.3.1 Project-specific Cumulative Effect Mitigations for Sleep Disturbance

In order to mitigate the potential effect of sleep disturbance, the following key mitigation measures should be considered during the detailed design phase:

- maximize distances from major noise sources to sleeping quarters to minimize noise; and
- calculate the noise dampening efficiency of building facade insulation and improve it so that predicted indoor L_{eq} are 30 dBA or less.

In addition, Health Canada (2011) advises the following mitigation measures to minimize nighttime noise:

- avoid the use of equipment that generates impulsive noise;
- minimize the need for reversing alarms;
- avoid dropping materials from a height;
- avoid metal-to-metal contact on equipment;
- if possible, schedule truck movements to avoid roads near mining camps; and
- avoid mobile plant clustering near residences and other sensitive receptors.

19.9.2.3.2 Other Project/Activity Mitigations to Address Sleep Disturbance

There are no specific mitigation or management measures explicitly identified from other projects or activities to address effects on sleep disturbance. However, it is expected that other large resource development projects would adopt mitigation and management measures similar to those of the KSM Project.

19.9.2.3.3 Determination of Potential Residual Cumulative Effect and Significance

As was discussed previously, although a small interaction could occur between the KSM Project and Snowfield Project with regards to sleep disturbance, even making the very conservative assumption that the Snowfield Project produces as much noise as the KSM Project, the effect at the nearest receptor (Exploration Camp 1) would be a maximum of 3 dB. This small increase would not significantly affect workers in the area as the combined noise levels would still be 15 dB below the Health Canada guidelines. For both operation and construction, including an adjustment for cumulative effects or not, the overall significance determination is **Not Significant (moderate)**.

19.9.2.4 Overall Cumulative Effect on Noise

Noise effects have a very localized impact. The distance to other projects that could be potential sources of noise in the area is great enough for there to be no significant cumulative residual effect with the exception of noise from blasting. Given how infrequent of an activity blasting is, it can be said that there are no significant cumulative impacts with regards to noise.

19.10 Summary of Assessment of Potential Environmental Effects on Noise

The majority of the residual effects identified with regard to noise levels due to the KSM Project were found to be not significant. The only effects caused by noise that were found to be of moderate

(yet still not significant) significance were the potential for sleep disturbance and loss of wildlife habitat during the operation phase. The findings of significance are summarized in Table 19.10-1.

19.11 Noise Conclusions

The assessment of the change in noise levels required:

- an understanding of the current baseline conditions;
- identification of the noise emission sources;
- selection of the worst-case year for construction and operation phases;
- quantification of the noise emission inventory for the worst-case years for construction and operation phases;
- modelling of the sources;
- comparison of the model results to the relevant guidelines and standards; and
- determination of the significance of the effect.

The construction and operation phases were assessed based on the worst-case year with the highest level of mining activities. By determining the effect from these two worst-case years, we can be certain that the effects of all other years during the two phases will be lower than those presented.

Predictions using detailed noise modelling showed that the total continuous Project noise (noise associated with continuous, impulsive, intermittent, or tonal sources on the Project site) was contained largely within the Project boundary, with the only potentially affected human receivers being worker camps on site. Health Canada exempts these receptors from noise level criteria stipulated to prevent human health effects, with the exception of sleep disturbance. Mitigation measures for these camps should be implemented as described previously as sleep disturbance of workers during the operation phase was one of only two residual effects to be considered not significant (moderate) .

Only wildlife receptors in close proximity (less than 2 km) from the centre of mining activities are predicted to receive levels in excess of those suggested by Environment Canada. Blasting completed during the operation phase was the second residual effect to be considered not significant (moderate).

Event noise levels associated with blasting and helicopter flybys were not shown to significantly increase the noise levels when combined with the total continuous Project noise to the extent that off-site human receptors are likely to become annoyed or complain.

Overall, the Project will have no significant impacts due to noise primarily because of the distance from the Project to any permanent residences. With the exception of wildlife habitat loss due to blasting and potential sleep disturbance of workers on site which were deemed to be not significant (moderate) effects, all of the potential residual impacts were found to be not significant (minor). Additionally, with proper mitigation and camp design it is possible to reduce the effect of sleep disturbance of mine workers to a level that causes the residual effect to be considered not significant.

Table 19.10-1. Summary of Assessment of Potential Environmental Effects: Noise

Valued Component	Phase of Project	Potential Effect	Key Mitigation Measures	Significance Analysis of Project Residual Effects	Significance Analysis of Cumulative Residual Effects
Noise	Construction	Sleep Disturbance	Maximize distances from major noise sources to sleeping quarters to minimize noise; calculate building façade insulation and improve so that predicted indoor Leq are 30 dBA or less; avoid the use of equipment that generates impulsive noise; Minimize the need for reversing alarms; Avoid dropping materials from a height; Avoid metal-to-metal contact on equipment; If possible, schedule truck movements to avoid roads near mining camps; avoid mobile plant clustering near residences and other sensitive receptors.	Not Significant (minor)	Not Significant (minor)
	Operation			Not Significant (Moderate)	Not Significant (Moderate)
	Construction	Interference With Speech Communication	Avoid the use of equipment that generates impulsive noise; minimize the need for reversing alarms; avoid dropping materials from a height; avoid metal-to-metal contact on equipment; if possible, schedule truck movements to avoid roads near mining camps; avoid mobile plant clustering near residences and other sensitive receptors.	Not Significant (minor)	Not Significant (minor)
	Operation			Not Significant (minor)	Not Significant (minor)
	Construction	Complaints	Avoid the use of equipment that generates impulsive noise; minimize the need for reversing alarms; avoid dropping materials from a height; avoid metal-to-metal contact on equipment; if possible, schedule truck movements to avoid roads near mining camps; avoid mobile plant clustering near residences and other sensitive receptors.	Not Significant (minor)	Not Significant (minor)
	Operation			Not Significant (minor)	Not Significant (minor)
	Construction	High Annoyance	Avoid the use of equipment that generates impulsive noise; minimize the need for reversing alarms; avoid dropping materials from a height; avoid metal-to-metal contact on equipment; if possible, schedule truck movements to avoid roads near mining camps; avoid mobile plant clustering near residences and other sensitive receptors.	Not Significant (minor)	Not Significant (minor)
	Operation			Not Significant (minor)	Not Significant (minor)
	Construction	Noise Induced Rattling	Avoid the use of equipment that generates impulsive noise; minimize the need for reversing alarms; avoid dropping materials from a height; avoid metal-to-metal contact on equipment; if possible, schedule truck movements to avoid roads near mining camps; avoid mobile plant clustering near residences and other sensitive receptors.	Not Significant (minor)	Not Significant (minor)
	Operation			Not Significant (minor)	Not Significant (minor)
	Construction	Loss of Wildlife Habitat	Use blast mats to reduce noise levels; properly stagger delays for blast pattern to minimize the number of charges simultaneously being ignited; avoid the use of equipment that generates impulsive noise; minimize the need for reversing alarms; avoid dropping materials from a height; avoid metal-to-metal contact on equipment; If possible, schedule truck movements to avoid roads near mining camps; avoid mobile plant clustering near residences and other sensitive receptors.	Not Significant (minor)	Not Significant (minor)
	Operation			Not Significant (Moderate)	Not Significant (Moderate)

References

ANSI. 1996. *Impulse Sound Propagation for Environmental Noise Assessment*. S12.17-1996. Prepared by the American National Standards Institute: New York, NY.

ANSI. 2005. *American National Standard Quantities and Procedures for Decription and Measurement of Environmental Sound*. S12.9. Prepared by the American National Standards Institute: New York, NY.

BC ILMB. 2012. *Nass South Sustainable Resource Management Plan*. Prepared by the Ministry of Forests, Lands and Natural Resource Operations: Smithers, BC.

BC MOE. 2000. *Cassiar Iskut - Stikine Land and Resource Management Plan (LRMP)*. Prepared by the British Columbia Ministry of Environment: Victoria, BC.

BC MOE. 2010. *Management Plan for the Mountain Goat (Oreamnos americanus) in British Columbia*. Prepared by the Mountain Goat Management Team, British Columbia Ministry of Environment: Victoria, BC.

Bears, H., G. Mak, M. Bliss, and R. Spicker. 2012. *Determination of Potential Impacts of Noise from Hydraulic Rock Breaking Activities on Mountain Goats*. Prepared for Innergex (Kwoiek Hydroelectric Project) by Zoetica Wildlife Research Services: Vancouver, BC.

BKL Consultants Ltd. 2012. *Memorandum to Rescan: Highway 37 traffic noise predictions for KSM project at nearby residences*. North Vancouver, BC.

British Standards Institution. 2009. *Code of practice for noise and vibration control on construction and open sites*. BS 5228 1:2009.

Canada Mortgage and Housing Corporation. 1986. *Road and Rail Noise: Effects on Housing*. Ottawa, ON: National Research Council of Canada.

Côté, S. D. 1996. Mountain Goat Responses to Helicopter Disturbance. *Wildlife Society Bulletin*, 24 (Winter): 681-85.

Efroymson, R. and G. W. Sutter. 2001. *Ecological Risk Assessment Framework for Low-altitude Aircraft Overflights: II. Estimating Effects on Wildlife*. Risk Anal, 21 (2): 263-274. US Department of Defence, Strategic Environmental Research and Development Program: Oakridge, TN.

Environment Canada. 2010. *Environmental Code of Practice for Metal Mines: Recommended Environmental Management Practices*. Prepared by Environment Canada: Ottawa, ON.

Environment Canada. 2012. *Environmental Code of Practice for Metal Mines*. http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=CBE3CD59-1&offset=1&toc=show (accessed June 2013).

Health Canada. 2011. *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise*. Health Canada: Ottawa, ON.

Health Insider. 2002. *Noise proprietary questions for Health Canada*. PWC Consulting: n.p.

ISO. 1996. *Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation* 9613-2:1996.

ISO. 2003. *Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures*. ISO 1996-1:2003. Geneva, Switzerland.

Knight, R. and K. Gutzwiller. 1995. *Wildlife and Recreationists: Coexistence Through Management and Research*. Washington, DC: Island Press.

Luz, G. A. and J. B. Smith. 1976. Reactions of Pronghorn Antelope to Helicopter Overflight. *Journal of the Acoustical Society of America*, 59: 6.

Manci, K. M., D. N. Gladwin, R. Villella, and M. G. Cavendish. 1988. *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: a Literature Synthesis*. US Fish and Wildlife Service, National Ecology Research Center: Fort Collins, CO.

Ontario Ministry of Environment. 1977. *Model Municipal Noise Control Bylaw*. Publication NPC-119 Noise from Blasting: Ottawa, ON.

Reimers, E. and J. E. Colman. 2006. Reindeer and Caribou (Rangifer tarandus) Response Toward Human Activities. *Rangifer*, 26 (2): 55-71.

Rescan. 2010. *KSM Project: Nisga'a Nation Desk-based Research Report: Draft Report*. Prepared for Seabridge Gold Inc. by Rescan Environmental Services Ltd.: Vancouver, BC.

Rescan. 2012a. *KSM Project: Gitanyow First Nation Traditional Knowledge and Use Desk-based Research Report*. Prepared for Seabridge Gold Inc. by Rescan Environmental Services Ltd.: Vancouver, BC.

Rescan. 2012b. *KSM Project: Gitxsan Nation Traditional Knowledge and Use Desk-based Research Report*. Prepared for Seabridge Gold Inc. by Rescan Environmental Services Ltd.: Vancouver, BC.

Rescan. 2012c. *KSM Project: Tahltan Nation Traditional Knowledge and Use Desk-based Research Report*. Prepared for Seabridge Gold Inc. by Rescan Environmental Services Ltd.: Vancouver, BC.

Rescan. 2013. *KSM Project: Skii km Lax Ha Traditional Knowledge and Use Research Report*. Prepared for Seabridge Gold Inc. by Rescan Environmental Services Ltd.: Vancouver, BC.

SETRA. 2009a. Methodological guide, Road noise prediction, volume 2: NMPB 2008 - Noise propagation computation including meteorological effects. LRS 2008-76-069.

SETRA. 2009b. NMPB-Routes-2008: Guide méthodologique, Prévision du bruit routier, Volume 1: Calcul des émissions sonores dues au trafic routier. 0924-1.

Weisenberger, M. E., P. R. Krausman, M. C. Wallace, D. W. D. Young, and O. E. Maughan. 1996. Effects of simulated jet aircraft noise on heart rate and behavior of desert ungulates. *Journal of Wildlife Management*, 60: 52-61.

WHO. 1999. *Guidelines for Community Noise*. A68672. World Health Organization: n.p.