APPENDIX L.
ALTON COAL TRACT LBA EIS NOISE MODELING REPORT

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Prepared for

Bureau of Land Management, Kanab Field Office

Prepared by

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NOISE MODELING REPORT

Prepared for

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1. INTRODUCTION

Alton Coal Development, LLC has proposed to mine coal deposits primarily on federal land near the town of Alton, Utah (*Alton Coal Tract Lease by Application Draft Environmental Impact Statement* [DEIS]). The DEIS addresses existing soundscapes and the impacts to those soundscapes from the Proposed Action and action alternatives (Bureau of Land Management [BLM] 2011). Several comments were received regarding the need to provide additional analysis on potential noise impacts from the Proposed Action and action alternatives on existing soundscapes. Therefore, a computerized noise modeling study of potential noise impacts from the Proposed Action and action alternatives (hereinafter jointly referred to as *the project*) was conducted to address noise-related comments to the DEIS. This noise modeling study was done in accordance with the May 2013 *Alton Coal Tract LBA EIS Noise Modeling Protocol* (Appendix A), with the exceptions noted in Section 2.

Noise levels were modeled and analyzed from several sources of mining activity. Noise levels from mobile and stationary mining equipment, increased mining-related traffic levels on local roadways, and mining blasting events were analyzed and/or modeled to determine if noise impacts result above regulatory thresholds and/or existing ambient conditions within potentially affected residential/commercial areas and at specific sensitive receptors.

Increased ambient noise levels would result from intermittent use of project mining equipment and process operations. A variety of mobile-source mining equipment (excavators, front-end loaders, scrapers, graders, etc.) would be used to carry out the main mining function of the extraction and removal of soils and rock layers covering the coal. In addition to the mobile-source mining equipment, stationary processing equipment (crushers, screens, etc.) would be used to size and load the coal. Potential noise emissions from both mobile-source mining equipment and the fixed-position processing equipment were modeled assuming worst-case conditions (i.e., all the proposed equipment operating at the same time).

Increased off-site roadway noise would occur from increased vehicular traffic on public roadways from vehicles associated with the project. Both worker-commute trips to and from the mine site and coal haul truck trips were accounted for and computer modeled. Roadway noise and noise from mining activities were both accounted for in the same modeled output to account for any noise overlap between the two, where appropriate (i.e., noise sensitive receptors in Bryce Canyon National Park and in and around the town of Alton).

Additionally, mine blasting can result in substantial noise and vibration, particularly in the very low frequency range. However, because mine blasting is both highly transient and occurs at a low frequency range, noise from mine blasting is generally assessed using empirical equations rather than a computer model. Therefore, equations to calculate noise and vibration from blasting were used to estimate noise and vibration levels at specific points of interest.

Mining activities (i.e., mining equipment, increased traffic, and blasting) were analyzed to determine potential noise impacts to the town of Alton, sensitive receptors within Bryce Canyon National Park (i.e., Yovimpa point, Riggs Spring, and Farview Point), and to sensitive receptors in and around the tract. Additionally, the towns of Hatch and Panguitch, despite their distance from the tract, were evaluated to determine whether increased traffic levels on roadways through these towns could impact noise levels in these two towns.

2. CHANGES FROM DRAFT PROTOCOL TO FINAL MODELING REPORT

The following substantive changes were made from the modeling approach outlined in the draft protocol to the final modeling:

- Because US-89 does not run through or near the town of Alton, Alton Road and other local roadways (1st East Street, East 200 South Street, County Road 10) were added to the model as applicable. Baseline vehicle traffic data were gathered from the Utah Department of Transportation (UDOT). Modeling of roadways is discussed in further detail in Section 4.2.

- A drill rig was added to the mobile equipment roster (adding this piece of equipment increased the aggregated sound power level of the equipment by 0.1 dBA; therefore, when rounded to the nearest whole number, the 134 dBA remained valid and was still used in the model). Section 4.1 discusses the sound power levels of equipment in further detail.

- More representative equations were used from the protocol to derive blasting noise and vibration at fixed locations. The blasting equations proposed in the protocol were for a gold mine in Australia, whereas the blasting equations used in this report were derived from United States-based coal mine blasting data, and thus were identified as being more representative of project blasting. The equations used in this report, although of a different form than the ones identified in the protocol, give comparable results to the proposed equations from the protocol. Section 4.4 discusses the equations used to conservatively estimate blasting noise and vibration.

- Additional single-point receptors were added for both the modeling and the evaluation of blasting noise and vibration. These receptors were added to better portray noise and vibration impacts. Modeling receptor locations are discussed in further detail in Section 5.1. Blasting noise and vibration receptor locations are discussed in further detail in Section 5.2.

- The thresholds for assessing blasting noise and vibration impacts were changed to better reflect impact levels identified in the scientific literature, as discussed is Section 5.2. The protocol relied on threshold values determined solely from regulation, whereas an analysis of the state of the science of blasting noise and vibration conducted for this report was able to identify human awareness threshold values as well.

Other minor changes from the protocol are not explicitly addressed herein. Comments to the draft protocol were received from the BLM, Alton Coal Development, and the National Park Service (NPS). Suggested changes were made to the modeling and analysis, as appropriate.

3. NOISE FUNDAMENTALS

Airborne sound is the rapid fluctuation of air pressure caused by mechanical vibrations. Simply defined, noise is “unwanted sound” that interferes with normal activities or in some way reduces the quality of the environment. Response to noise varies according to its type, perceived importance, appropriateness in the setting, time of day, and the sensitivity of the individual receptor. This section provides definitions of common acoustical terms and an explanation of the noise assessment components used throughout this assessment.

3.1. Definition of Acoustical Terms

The following describes the acoustical terms used throughout this analysis:

- *Ambient sound level* is defined as the composite of noise from all sources near and far, the normal or existing level of environmental noise at a given location.
- A *decibel* (dB) is the dimensionless unit commonly used to measure sound levels. The dB scale is logarithmic; therefore, individual dB values for different sources cannot simply be added together to calculate the sound level for the two sources. For example, two 50-dB sources, added logarithmically, produce a collective noise level of 53 dB, not 100 db.
- Sound measurement is further refined by using a decibel *A-weighted* sound level (dBA) scale that more closely measures how a person perceives sound. There is a strong correlation between A-weighted sound levels and the way the human ear perceives sound.
- *Percentile sound level* (L_n) is the decibel value exceeded during n% of a measurement period. For example, L_{10} is a relatively loud noise exceeded only 10% of the measured time, whereas L_{90} is a relatively quiet sound exceeded 90% of the measured time.
- *Equivalent noise level* (L_{eq}) is the energy-averaged A-weighted noise level during a measurement period.
- *Intruding noise* is noise that intrudes over and above the existing ambient sound level at a given location. The relative intrusiveness of a sound depends on its amplitude, duration, frequency, time of occurrence, and tonal informational content, as well as the prevailing ambient sound level.
- *Natural ambient* sound level (L_{nat}) is derived by subtracting out all human-caused, mechanical, or electrical sounds from collected sound level data. This is done by calculating the percentage of extrinsic sounds either by listening to sound recordings collected contemporaneously with the data and/or by analyzing daily spectrograms and then using a mathematical formula to subtract calculated extrinsic sounds from the data.
- *Sound pressure level* (SPL) is the sound force per unit area, usually expressed in microPascals (µPa) or pounds per square inch (psi). The sound pressure level is expressed in decibels as 20 times the base 10 logarithm of the ratio between the pressures exerted by the sound to a reference sound pressure (usually 20 µPa or 2.9×10^{-9} psi, which are equivalent and which are both used as the reference sound pressure in this report).
- *Sound power level* (SWL) is the sound power emitted by a sound source, usually expressed in picoWatts (pW). The sound power level is expressed in decibels as 10 times the base 10 logarithm of the ratio between the pressures exerted by the sound to a reference sound power (usually 1 pW, which is used as the reference sound power in this report).
- *Peak particle velocity* (PPV) is the maximum velocity of ground particles (vibration) in any dimension (i.e., vertical, radial, or transverse). The peak particle velocity can be expressed as either an acceleration (usually in millimeters per square second [mm/s^2] or inches per square second [in/s^2]) or as a velocity (usually in millimeters per second [mm/s] or inches per second [in/s]).
- *Airblast overpressure* refers to the pressure caused by a shockwave (i.e., an abrupt, discontinuous change in a medium) from an explosion over and above normal atmospheric pressure. Airblast overpressure is expressed herein in linear (i.e., non-weighted) decibels.

3.2. Noise Assessment Components

A noise assessment is based on the following components: a sound-generating source, a medium through which the source transmits and the pathways taken by these sounds, and an evaluation of the proximity to receptors (i.e., noise sensitive areas [NSAs]). Soundscapes are affected by the following factors:

- Source: The sources of sound and vibration are any generators of small back-and-forth motions (i.e., motions that transfer their motional energy to the transmission path where it is propagated). The acoustic characteristics of the sources are very important. Sources must generate sound or vibration of sufficient strength, approximate pitch, and duration so that the sound or vibration may be perceived and is capable of causing adverse effects, compared with the natural ambient sounds.

  There are several potential sources of noise and/or vibration emissions from the project. Mobile mining equipment, coal processing equipment, increased traffic levels from mining activities on local roadways, and blasting events are analyzed and/or modeled to determine noise and/or vibration emissions from these sources. Each of these sources is discussed in further detail in Section 4.

- Proximity to receptors or NSAs: An NSA is defined as a location where a state of quietness is a basis for use or where excessive noise interferes with the normal use of the location. Typical NSAs include residential areas, parks, and wilderness areas, but also include passive parks and monuments, schools, hospitals, churches, and libraries.

  The NSAs analyzed to determine impacts from mining and mining-related noise and/or vibration sources include the Greater Sage-grouse habitats and lek in and around the mining tract; residential/commercial areas in and around the towns of Alton, Hatch, and Panguitch; and specific points of interest within Bryce Canyon National Park. The baseline conditions for these NSAs against which the proposed mining noise sources are evaluated are discussed in further detail in Section 5.

- Transmission path or medium: The *transmission path* or medium for sound or noise is most often the atmosphere (i.e., air), whereas for vibration, the medium is the earth or a human-made structure. For the noise/vibration to be transmitted, the transmission path must support the free propagation of the small vibratory motions that make up the sound and vibration energy. Atmospheric conditions (e.g., wind speed and direction, temperature, humidity, precipitation, etc.) influence the attenuation of sound. Barriers and/or discontinuities (existing structures, topography, foliage, ground cover, etc.) that attenuate the flow of sound or vibration energy may compromise the path. For example, sound will travel very well across reflective surfaces such as water and pavement, but can be attenuated when ground cover is field grass, lawns, or even loose soil.

  The attenuation of sound and vibration from the source to the receiver is empirically calculated through either equations or computer modeling. The specific equations or models used to calculate and determine noise and/or vibration impacts to NSAs from mining sources are discussed in further detail in Section 6.

4. SOURCE CHARACTERIZATION

There are several potential sources of noise emissions from the project. The noise sources that are analyzed in the following sections include noise from mining equipment and processes located on the mining tract; increased noise levels on public roadways from mine worker and coal haul truck trips to and from the mine; and intermittent noise and vibration from mine blasting events.

4.1. Noise from On-Tract Mining Activity

Sound generated by mining equipment and processes was modeled to determine noise levels at NSAs. For the purposes of modeling noise levels, project on-tract mining activity is divided into noise sources that are mobile in nature and can thus range over a wide area (i.e., wheeled, internal combustion engine-driven vehicles), and those that are generally fixed to a single location (i.e., processing equipment). Noise from mobile equipment is primarily produced from the internal combustion engines used to power the equipment. Noise from processing equipment is from a combination of the internal combustion engines used to power the equipment and the mechanical actions of processing the mined material. To model noise emissions from the project mobile and fixed sources, then, the sound power level of the equipment for input into the model first had to be quantified.

The project equipment and process sound power levels for input into the model were derived from measured sound power levels from representative mining equipment from other mining environmental assessments. The individual equipment or process, the estimated quantity, and the sound power level and data source for the equipment used in the model are provided in Table 1. Additionally, the aggregated sound power level of all the individual mobile sound sources is presented in Table 1.

Table 1. Plant and Equipment Fleet for Mining Activities

Source	Quantity	dBA per Equipment	Information Source
Mobile			
Haul truck	5	124	Cowal Gold Mine EIS (Barrick Gold Corporation 2009)
Front-end loader	3	117	Barrick Gold Corporation 2009
Excavator	1	123	Ensham Central Project Environmental Noise Assessment (Ensham Resources 2006)
Dozer	6	118	Barrick Gold Corporation 2009
Track hoe	2	121	Barrick Gold Corporation 2009
Skytrack*	1	123	Barrick Gold Corporation 2009
Grader	2	110	Ensham Resources 2006
Water truck	2	118	Ensham Resources 2006
Scraper	4	116	Barrick Gold Corporation 2009
Diesel generator	3	100	Ensham Resources 2006
Drill	1	118	Barrick Gold Corporation 2009
Total Mobile Equipment	**30**	**134**	**–**
Fixed			
Central processing area (e.g., coal crushing, conveying, stacking, and loading)	–	124	Barrick Gold Corporation 2009

Notes: Sources are intended to be reasonably representative of equipment that would be used during mining operations, but may vary depending on the availability of exact equipment at the time mining operations would occur.

* Sound power level was assumed to be equivalent to those of an excavator.

Modeling mobile equipment is difficult because the equipment can theoretically range over the entire proposed mining tract. To overcome this difficulty and still conservatively model equipment positions relative to areas with sensitive receptors, all mobile equipment is modeled together as a single 40-acre area source. The entire area source is assumed to emit at the highest emission level (134 dBA), as if all the equipment was simultaneously operating at full capacity and was “stacked” together in a manner that maximizes the additive effects of noise levels from each piece of equipment. The highest decibel level from all the equipment summed together is calculated by the additive equation for incoherent sound sources:

$$L_{\Sigma} = 10 \times Log_{10}\left(10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}} + \ldots + 10^{\frac{L_n}{10}}\right) dB$$

Where:

L_{Σ} = Total sound power level

L_n = Sound power level of the separate source

Noise emissions from the coal processing operations (crushing, conveying, stacking, sorting, etc.) would take place at processing facilities located in the approximate center of the mining tract. Coal processing operations were modeled in the same manner as the mobile equipment: as a 35-acre area source where sound is conservatively assumed to be uniformly generated over the entire area. Measured sound power levels from mining process equipment (as provided in Table 1) from an analogous mine (Cowal Gold Mine located in New South Wales, Australia) were assumed representative of sound power levels for project coal processing equipment (Barrick Gold Corporation 2009).

Coal mining is proposed over a mining tract that has been divided into several different blocks. Mining operations would only take place on a single block at any given time. Therefore, each modeled 40-acre mobile area source is placed within each mining block closest to the noise sensitive receptor of greatest concern to mining in that block. Potential mining blocks and the locations of noise emitting area sources within these blocks are depicted on Figure 1.

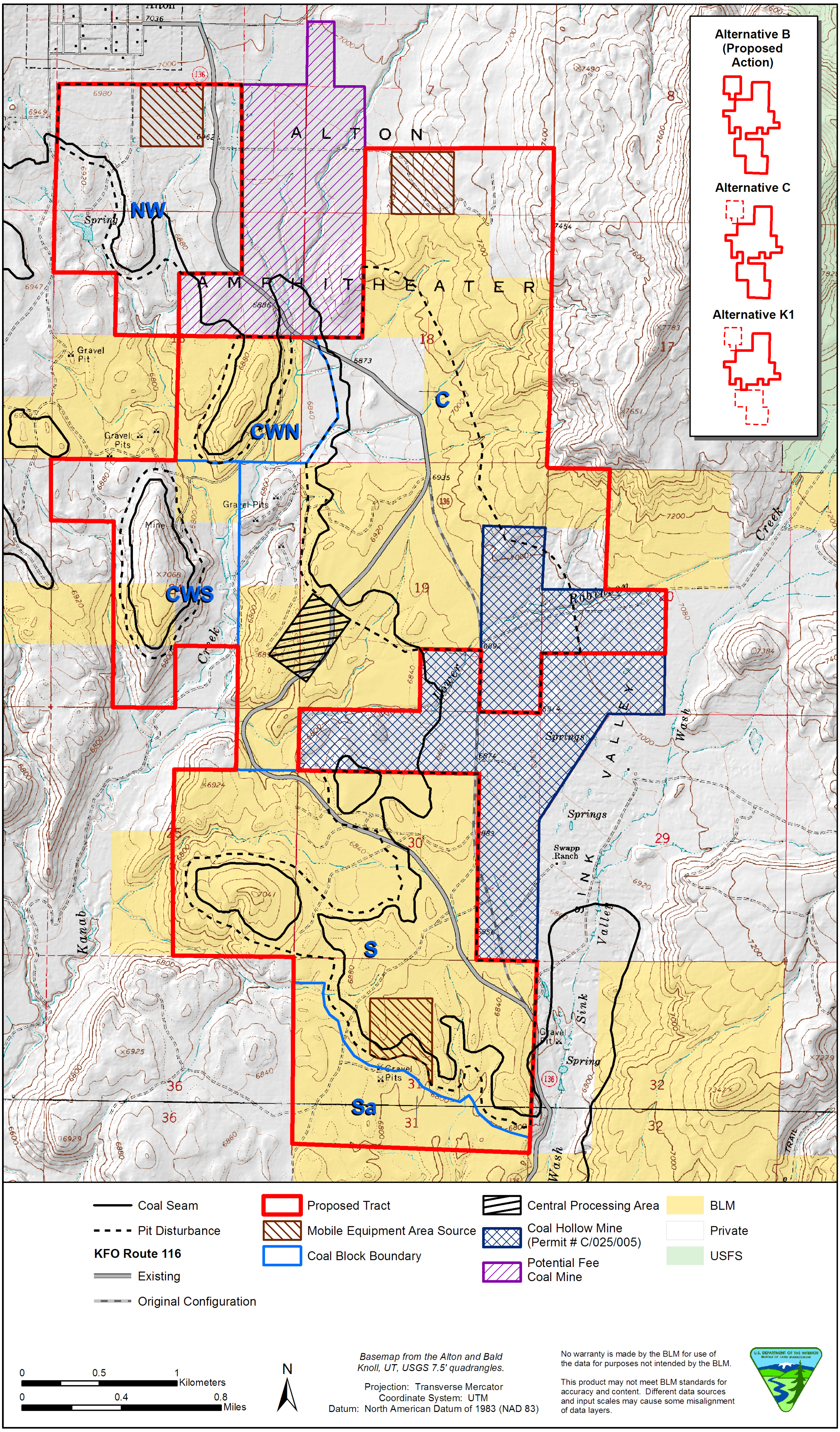

Figure 1. Mining blocks and source map.

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Of the mining blocks depicted on Figure 1, three are of particular concern due to their proximity to sensitive noise receptors. Block NW is the closest mining block to the town of Alton, Block C is closest to Bryce Canyon National Park, and Block S is close to the sage-grouse lek. Noise-emitting equipment and processes are only evaluated within these three blocks because noise levels from mining activities in the other mining blocks (CWN and CWS) would be of equal or less impact than the blocks analyzed due to their increased distance from sensitive receptors. Because mining would only take place on one block at a time, modeling of noise emissions from the mobile equipment was done in three separate iterations for Blocks NW, C, and S, with noise emissions from the central processing area modeled with each.

4.2. Roadway Noise

In addition to noise from mining equipment, transportation noise levels were modeled from increases to baseline traffic from both project coal haul trucks and commuter traffic from project workers. Project-related haul truck noise was only modeled on roadways that were off the mine tract, as noise from haul trucks located on the mine tract are accounted for in the modeling of project mobile equipment (as shown in Table 1). Additionally, baseline traffic conditions (i.e., the traffic level assuming the project did not exist) were not modeled separately from proposed project impacts to roadways; instead, roadway noise levels from total traffic (baseline plus project) were conservatively modeled and compared to the baseline noise levels at the NSAs (which would presumably already account for baseline traffic conditions).

Haul truck and commuter traffic would likely use existing roadways, in particular U.S. Route 89 (US-89). A traffic study by Fehr and Peers (2008) estimates average daily traffic (ADT) volumes for US-89 under four scenarios: currently existing conditions, currently existing conditions plus the addition of project coal haul truck traffic, estimated 2020 background conditions, and estimated 2020 background conditions plus project coal haul truck traffic. Fehr and Peers (2008) estimate ADT values of between 4,400 and 5,850 vehicles per day on US-89 for the year 2020 without the addition of project-related traffic. The DEIS estimates an increase of 2% in baseline traffic from mining commuter traffic from the project. Estimates from haul truck trips from the proposed project are approximately 153 truck round-trips per day (Fehr and Peers 2008). Therefore, for modeling purposes, ADT volumes on US-89 were assumed at 6,120 (5,850 + 2% increase from commuting trips + 153 round-trip haul truck trips), which represent the worst-case anticipated vehicle traffic on US-89 in the year 2020 with the inclusion of project haul truck trips and worker commuting trips.

The percentage of heavy trucks to light vehicle traffic along US-89 was only estimated in the Fehr and Peers (2008) report for existing traffic plus the addition of project haul truck trips. Therefore, the highest projected estimate in the Fehr and Peers (2008) report of 31% of heavy vehicles to light vehicles was used for modeling purposes. This conservatively represents the portion of heavy vehicles to light vehicles, because the increases in traffic projected in the 2020 scenario are likely to be proportionate to that of the currently existing baseline, whereas the mine haul truck trips are anticipated to be the same.

Roadway noise from US-89 was modeled for impacts to the towns of Alton, Hatch, and Panguitch. Roadway noise was modeled simultaneously with noise emissions from mining equipment and processes, where appropriate (i.e., in and around the town of Alton). The three modeling scenarios for mining impacts to the town of Alton from mining equipment and processes (one modeled run on each of Blocks NW, C, and S) each took into account approximately 6.0 kilometers (km) of US-89, stretching northward from the intersection of Alton Road and US-89. Based on posted speed limits, vehicle speeds of 65 mph (105 kilometers per hour [kph]) were assumed for light vehicles and 55 mph (90 kph) for heavy vehicles throughout the modeled portions of US-89.

In addition to the modeling of noise impacts from traffic on US-89, traffic from Alton Road and other local roadways within the town of Alton, including 1st East Street, East 200 South Street, and County Road 10, was modeled for noise impacts to Alton. Alton Road was modeled from where the road exits to the north of the town of Alton to where the road intersects with US-89, approximately 6.0 km of roadway. For Alton Road, UDOT data of 150 ADT was used as the baseline value. For modeling purposes, the conservative estimate was used that all the additional traffic from commuting trips from US-89 (2% of 5,850 vehicles per day) and all the coal haul truck round-trips per day will take place on Alton Road. For Alton Road, then, the total estimated ADT value used in the model was 420 (150 + [2% of 5,850] increase from commuting trips + 153 round-trip haul truck trips). Vehicle speeds of between 30 and 35 mph (55 kph) for both light and heavy vehicles were assumed on Alton Road.

Local roadways in and around the town of Alton leading from the mining tract boundary to Alton Road were also modeled. For these roadways, the UDOT data of 115 vehicles per day were used as the baseline value. For modeling purposes, the conservative estimate was used that all the additional traffic from commuting trips from US-89 (2% of 5,850 vehicles per day) and all the coal haul truck round-trips per day will take place on these local roadways in the town of Alton. For these other roadways, then, the total estimated ADT value used in the model was 384 (115 + [2% of 5,850] increase from commuting trips + 153 round-trip haul truck trips). Vehicle speeds of between 30 and 35 mph (55 kph) for both light and heavy vehicles were assumed on the modeled local roadways.

Modeling for the town of Hatch took into account approximately 6.2 km of US-89. A portion of the modeled US-89 runs through the town of Hatch and has a posted speed limit of 40 mph. Therefore, modeling of the approximately 1.2 km of US-89 that runs through the town used a speed on all vehicles of 40 mph (65 kph). Vehicle speeds of 65 mph (105 kph) were assumed for light vehicles and 55 mph (90 kph) for heavy vehicles were used throughout the rest of the modeling for traffic on US-89. Due to the distance of the project from the town of Hatch (approximately 15 miles to the nearest project boundary), modeling was not included for project mining equipment and process noise impacts to the town.

Modeling for the town of Panguitch took into account approximately 7.4 km of US-89. A portion of the modeled US-89 runs through the town of Panguitch and has a posted speed limit of 35 mph. Therefore, the approximately 3.4 km of US-89 that runs through the town uses a speed limit on all vehicles of 35 mph (60 kph). Vehicle speeds of 65 mph (105 kph) were assumed for light vehicles, and 55 mph (90 kph) for heavy vehicles throughout the remaining modeled portions of US-89. The town of Panguitch is located an even further distance than Hatch from the project boundaries, and therefore modeling of noise impacts from project mining equipment and processes was also not included for the town.

4.3. Modeling Mining and Roadway Noises

Three separate modeling runs of each of the mobile equipment area sources were evaluated in each of the mining blocks of concern. Each of these modeling runs also included modeling of the process area source and the roadways (i.e., US-89, Alton Road, and local roadways) around the town of Alton. Based on their distance from mining activities, two additional modeling runs were done just for the roadway (i.e., US-89) in and around the towns of Hatch and Panguitch. Table 2 outlines what was modeled in each run.

Table 2. Modeled Scenarios

Modeled Scenarios	Modeled Noise Source						
	Block NW Mobile Equipment	**Block C Mobile Equipment**	**Block S Mobile Equipment**	**Central Processing Area**	**SR-89, Alton Road, and Local Roadways (town of Alton)**	**SR-89 (town of Hatch)**	**SR-89 (town of Panguitch)**
1	X			X	X		
2		X		X	X		
3			X	X	X		
4						X	
5							X

Further details regarding the computer noise model parameters and limitations are discussed in Section 6.

4.4. Blasting Noise and Vibration

Blasting releases large amounts of energy to fracture, split apart, and/or displace the rock immediately surrounding the explosive charge. The explosive energy released decreases proportionally with distance to a point where shattering or displacement of the rock no longer occurs and the remaining blasting energy travels through the rock under multiple elastic vibration waveforms (i.e., radial, vertical, and transverse waveforms). Ground vibration at sufficiently high levels can be felt by people or wildlife and potentially damage buildings.

Air vibration (or airblast) emissions also result from the pressure or shockwaves from blasting activities. Pressure waves resulting from blasting increase and decrease the air pressure at a given point from the blast fairly rapidly. The airblast noise from blasting can be of sufficient loudness to be heard over great distances and even potentially damage the hearing of people or wildlife that are too close to the blast.

Multiple equations have been developed to estimate vibration and airblast emissions from blasting activities, depending on the type of blasting occurring (fully or partially confined blast holes, unconfined surfaces, etc.), the type of rock blasted, and additional variables that affect the transmission of sound through the medium (topography, shielding or amplification from barriers, meteorological conditions, whether there is a free-face or not, etc.). The Bureau of Mines for the U.S. Department of the Interior has characterized vibration and airblast noise from blasting at coal mines in several investigative reports. Vibration from blasting can be predicted using the equations presented in Report of Investigation (RI) 8507 – *Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting* (Siskind et al. 1984), whereas the equations to characterize airblast noise are found in RI 8485 *Structure Response and Damage Produced by Airblast from Surface Mining* (Siskind et al. 1980). The relevant equations used herein for calculating vibration and airblast overpressure from blasting are presented and discussed in Table 3.

Table 3. Airblast and Vibration Equations

Equation	Citation	Notes
$PPV = 119 \times \left(\frac{D}{W^{1/2}}\right)^{-1.52}$	RI 8507	Vibration equation representing the mean line from measured blasting data from coal mines. This equation represents the expected vibration from blasting.
$PPV = 438 \times \left(\frac{D}{W^{1/2}}\right)^{-1.52}$	RI 8507	Vibration equation representing two standard deviations above the mean line of measured coal mine blasting data. This equation thus conservatively represents the maximum expected vibration from blasting.
$AB = 0.162 \times \left(\frac{D}{W^{1/3}}\right)^{-0.794}$ $SPL = 20 \times \log_{10}\left(\frac{AB}{P_0}\right)$	RI 8485	Low-frequency cut-off equation (high-pass frequencies of greater than 0.1 hertz (Hz)) for airblast noise from highwall coal mine blasting. Blasts of this type tend to have a high degree of charge confinement and are representative of a typical coal mine blast.
$AB = 169 \times \left(\frac{D}{W^{1/3}}\right)^{-1.623}$	RI 8485	Low-frequency cut-off equation (high-pass frequencies of greater than 0.1 Hz) for airblast noise from parting coal mine blasting. Parting blasting takes place between coal seams and tends to have a lower degree of charge confinement than highwall blasting. As such, parting blasting has higher airblast overpressures than comparable highwall blasts over most distances and thus provides a more conservative representation of expected airblast noise than highwall blasting. However, due to a greater cube-root scaled distance slope, the equations for parting blasting can result in lower sound pressure levels than that of highwall blasting over great distances.

PPV = Peak particle vibration velocity (in/s).

AB = Peak airblast overpressure (psi).

SPL = Peak airblast noise level (dB Linear).

D = Distance between charge and receiver (feet]).

W = Charge mass per delay or maximum instantaneous charge (pounds).

P_0 = The reference sound pressure of 2.9×10^{-9} psi.

The vibration equations used in Table 3 conservatively represent the total vibration by combining both the horizontal and vertical components of vibration at a given location. Project blasting is characterized herein using both the mean and maximum blasting vibration equations presented in Table 3.

Additionally, airblast noise levels in this report are conservatively calculated by using the low-frequency cut-off equations that include the infrasound frequencies (below 20 Hz; the threshold of human hearing) that can be generated from blasting. These lower thresholds take into account those frequencies that can be "felt" at high enough pressures, but are generally not heard by humans or animal species. Both equations for calculating airblast noise levels (highwall and parting blasting) are used to comprehensively categorize project blasting impacts, as presented in Table 3.

Based on actual blasting design parameters provided by Alton Coal, the charge mass per delay is estimated as being between 17.3 and 266 pounds (lb). As such, 266 lb is conservatively used as the charge mass per delay for blasting modeling purposes. PPV (in in/s) and SPL (in dB Linear) values are calculated and reported for given points of concern. The distances used to estimate PPV and SPL vary based on distance to the nearest point on the mining tract to the specific location of concern, as discussed in Section 5.

5. BASELINE CONDITIONS CHARACTERIZATION

Modeled and calculated noise and vibration levels are compared against regulatory thresholds and/or ambient background conditions at several NSAs to analyze the potential effects of noise levels associated with mining and mine-related activities at these areas. The analyzed NSAs are the towns of Alton, Panguitch, and Hatch; three individual noise receptors within Bryce Canyon National Park (identified as Yovimpa F, Farview F, and Riggs Spring B ("F" represents "Front-country" and "B" represents "Back-country"); and the Greater Sage-grouse habitat and lek in and adjacent to the proposed tract. Figure 2 shows an overview map of the locations of the coal mining tract and off-site roadways in relation to the NSAs, as well as individually modeled points within NSAs and the general noise modeling contour limit boundaries for the mining equipment and roadway noise.

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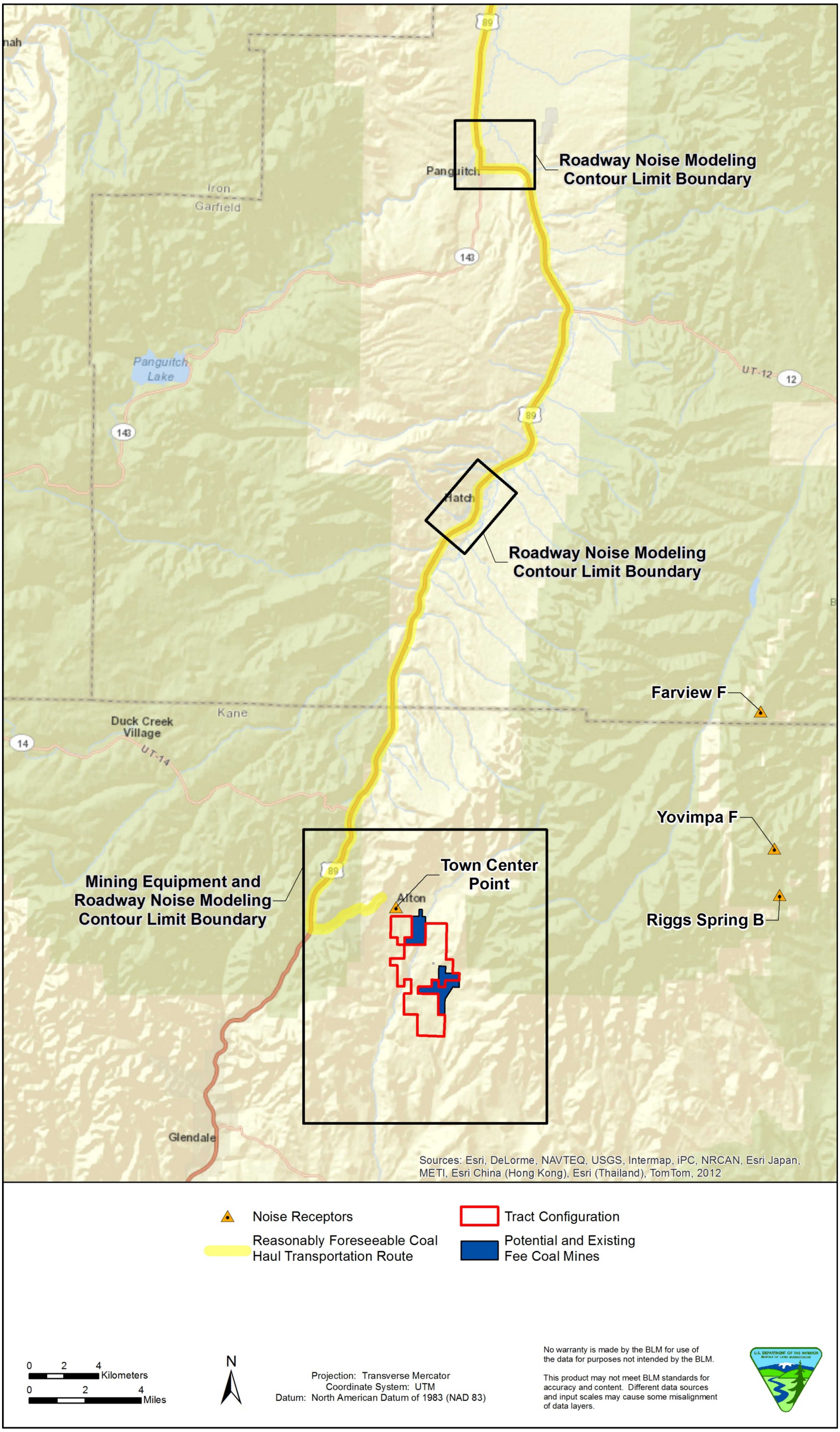

Figure 2. Overview map.

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5.1. Ambient Sound Levels

As outlined in the DEIS, ambient noise level surveys were conducted in the towns of Alton, Hatch, and Panguitch. Ambient noise level surveys for the town of Alton indicated average daytime noise levels ranging from 41 dBA L_{eq} to 55 dBA L_{eq}. In the town of Panguitch, ambient average daytime noise levels were recorded ranging from 64 dBA L_{eq} to 67 dBA L_{eq}. In the town of Hatch, average daytime noise levels were recorded at a single location of 64 dBA L_{eq}. The lowest ambient L_{eq} noise levels recorded in each of the towns were used as representative of the background sound levels for these towns in this analysis.

The background noise levels for Bryce Canyon National Park were determined from data collected by NPS personnel at several representative locations. NPS personnel used Larson Davis 831 sound level meters to take digital sound recordings and to collect and analyze sound pressure level data in both a range of dBA values and in one-third octave band frequencies ranging from 12.5 hertz (Hz) to 20,000 Hz. Noise data gathered by the NPS from 2009 to 2012 are presented in L_{eq}, L_n, and L_{nat} dBA values in Table 4 for the three areas within the park to be evaluated (Farview F, Yovimpa F, and Riggs Spring B).

Table 4. Bryce Canyon National Park Noise Level Survey Results

Receptor Location (year)	Sound Level Data (dBA re 20* µPa)				
	L_{90}	L_{nat}	L_{50}	L_{10}	L_{eq}
Farview F (2009)	30.0	31.8	37.8	45.8	53.0
Farview F (2010)	35.8	37.5	42.1	48.0	55.0
Yovimpa F (2009)	24.7	27.1	30.6	37.7	42.0
Yovimpa F (2010)	27.0	28.6	33.0	40.2	47.0
Riggs Spring B (2012)	24.5	24.5†	31.2	38.6	40.0

Source: BRCA Acoustical Data for Alton gathered by BLM from 2009 to 2012.

* *re 20 uPa* signifies the reference pressure used (i.e., 20 UPa).

† Estimated L_{nat} from L_{90}

Modeled project noise is compared in this analysis to the most conservative L_{nat} sound values recorded from the three areas in Bryce Canyon National Park (i.e., Farview F, Yovimpa F, and Riggs Spring B). The background values for these three park points is therefore 31.8 dBA for Farview F, 27.1 dBA for Yovimpa F, and 24.5 dBA for Riggs Spring B.

No ambient sound level data have been gathered at the sage-grouse habitat and lek in and around the project mining tract. Therefore, for conservatism, baseline conditions at the lek were assumed to be those of the lowest recorded L_{eq} value for Bryce Canyon National Park, or 40.0 dBA (recorded at Riggs Spring B).

Table 5 summarizes the source receptors and locations, ambient noise conditions, and the data source and/or methodology used for the evaluation of modeling impacts.

Table 5. Noise-sensitive Receptor Table

Receptor Location (description)	Ambient Noise Condition (dBA)	Data Sources and/or Methodology	Additional Supporting Information as Applicable
Yovimpa F (Bryce Canyon National Park)	27.1	BRCA acoustical data* gathered by BLM from 2009 to 2012	Lowest measured L_{nat} value used as representative of ambient conditions.
Riggs Spring B (Bryce Canyon National Park)	24.5	BRCA acoustical data* gathered by BLM from 2009 to 2012.	Lowest measured L_{nat} value used as representative of ambient conditions.
Farview F (Bryce Canyon National Park)	31.8	BRCA acoustical data* gathered by BLM from 2009 to 2012.	Lowest measured L_{nat} value used as representative of ambient conditions.
Town of Alton (single point and area receptor)	41.0	Morro Group, Inc. environmental noise data gathered from points in the town in 2008.	Lowest measured L_{eq} value used as representative of ambient conditions.
Town of Hatch (area receptor)	64.0	Morro Group, Inc. environmental noise data gathered from point in the town in 2008.	Measured L_{eq} value used as representative of ambient conditions.
Town of Panguitch (area receptor)	64.0	Morro Group, Inc. environmental noise data gathered from point in the town in 2008.	Measured L_{eq} value used as representative of ambient conditions.
Sage-grouse Lek (area receptor)	40.0	BRCA acoustical data* gathered by BLM for BRCA from 2009 to 2012 used as proxy.	Lowest measured L_{eq} value from the Bryce Canyon National Park data taken as representative of ambient conditions.

*Data were collected by the NPS.

The three Bryce Canyon National Park points analyzed (i.e., Farview F, Yovimpa F, and Riggs Spring B) are located closest to Block C on the mining tract, at distances from the east edge of this block of approximately 12.3 miles (19.8 km) for both Yovimpa F and Riggs Spring B and approximately 14.0 miles (22.6 km) from Farview F. Due to the distance of these park points from the project, single point calculations were made in the computer noise model for project impacts at each of these points, as presented in Section 7. Otherwise, project noise impacts were modeled out to a distance of approximately 5 km from the mine tract, as discussed further in Section 6.2. For impacts to the towns for which only roadway noise was modeled (i.e., Hatch and Panguitch), noise impacts were modeled out to a distance of approximately 1 km from the town boundaries in all directions.

5.2. Baseline Conditions for Blasting Noise and Vibration

Federal regulations governing the use of explosives for mines specify maximum limits for blasting noise and vibration at "any dwelling, public building, school, church, or community or institutional building" according to the levels presented in Tables 6 and 7 (30 Code of Federal Regulations (CFR) 816.67(b)(i)).

Table 6. Federal Airblast Noise Limits

Lower Frequency Limit of Measuring System (Hz; + / - 3 dB)	Maximum Level (dB Linear)
0.1 Hz or lower, flat response	134 peak
2 Hz or lower, flat response	133 peak
6 Hz or lower, flat response	129 peak
C-weighted, slow response	105 peak dBC

Source: adapted from table in 30 CFR 816.67(b).

Table 7. Federal Blasting Vibration Limits

Distance from the Blasting Site (feet)	Maximum Allowable Peak Particle Velocity for Ground Vibration (in/s)
0 to 300	1.25
301 to 5,000	1.00
5,001 and beyond	0.75

Source: Adapted from table in 30 CFR 816.67(d)(2).

The federal limits for airblast noise from blasting outlined in Table 6 were derived from studies to determine the “probability of the most superficial type of damage in residential-type structures” (Siskind 1980). These limits also generally correspond to the threshold for human annoyance identified in the literature, which range from 132 to 137 dB linear (as summarized in Siskind 1980). Because the equations used to calculate airblast noise assume a high-pass frequency of 0.1 Hz (Table 3, Section 4.4), the threshold of 134 dB linear from Table 6 for 0.1 Hz lower frequency limit is used as the threshold for both impacts to buildings and people. The noise threshold for human annoyance, however, is not the same as the level at which humans become aware of an intrusive noise; therefore, an additional threshold of human awareness of airblast overpressure needs to be identified.

The lowest identified level for human awareness of airblast overpressure has been cited as 100 dB linear in the literature (see Richards 2009 and *Acoustic Investigation, Virginia Development Plan Amendment* [AECOM 2011]; also see Richards 1997). This value has been cited as a value below which “airblast overpressure is barely noticed” (AECOM 2011) by communities. Higher thresholds than this have also been identified in the literature, such as by the U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, which notes that airblasts at or below 120 dB linear should be expected to offer “minimal” annoyance (Rosenthal 1987). Therefore, peak airblast noise levels (SPL) calculated using the equations outlined in Table 3, Section 4.4, are compared against the threshold for impact to buildings and human annoyance of 134 db linear, as well as the lowest identified threshold for human awareness of 100 dB linear.

The federal blasting vibration limits as outlined in Table 7 are the limits for measuring blasting vibration impacts to buildings. More stringent criteria have been identified in blasting studies by Chae (1978), which classifies the maximum tolerable vibration response to buildings by the age and condition of the building, as summarized in Table 8.

Table 8. Chae Building Vibration Criteria

Class	PPV (single blast) (in/s)	PPV (repeated blast) (in/s)
Structures of substantial construction	4	2
Relatively new residential structures in sound condition	2	1
Relatively old residential structures in poor condition	1	0.5
Relatively old residential structures in very poor condition	0.5	–

Source: Chae (1978).

Siskind (1980) has also identified from blasting studies building damage thresholds and has quantified the percentage of blasting events that would be expected to cause damage at that threshold. The lowest threshold to building damage (e.g., loosening of paint, plaster cracking at joints) at the lowest percentile of probabilistic damage expected per blasting event (5%) identified by Siskind (1980) was also 0.5 in/s PPV. Project vibration from blasting calculated by the equations outlined in Table 3, Section 4.4 are therefore compared against the most stringent criteria identified in the literature for impact to buildings of 0.5 in/s PPV.

As with awareness to airblast overpressure, human awareness to vibration extends below the lowest vibration threshold identified for building damage. Reiher and Meister performed the classic study in 1931 measuring subjective human tolerance to vibration and identified the lowest threshold of awareness in humans to steady-state vibrations of 0.012 in/s PPV (as identified in Jones & Stokes 2004). However, blasting vibrations are transient events and therefore likely have a different level of perceptibility than steady-state vibrations. A study by Wiss (1974) identified the “barely perceptible” threshold for human awareness from transient vibrations of 0.035 in/s PPV. Therefore, project vibration blasting calculations are compared against the 0.035 in/s PPV value identified as the threshold for human awareness. However, neither of these studies took into account the differences in human awareness of vibration when inside buildings, which has a lower threshold due to human perception of non-damaging vibratory phenomena (rattling windows, movement of objects, etc.). The California Department of Transportation (Caltrans) has developed guidance for blasting associated with transportation and construction projects. Using the International Standards of Organization (ISO) *Guide to the Evaluation of Human Exposure to Vibration and Shock in Buildings (1 Hz to 80 Hz)* (ISO 2631), Caltrans has identified the lowest threshold of human awareness in the most sensitive of building environments (e.g., hospital operating room) of 0.004 in/s PPV (Jones & Stokes 2004). This is below the threshold at which humans perceive vibration outside of buildings; therefore, for conservatism, the 0.004 in/s PPV threshold is used as the lowest threshold of human awareness to vibration from project blasting within buildings.

Table 9 summarizes the baseline threshold values against which the calculated project blasting SPL values are compared. The baseline threshold values include both the thresholds for building damage and for human awareness and annoyance of blasting noise. Also summarized in Table 9 are the thresholds for vibration damage and human awareness against which blasting vibration PPV values are compared.

Table 9. Airblast and Vibration Blasting Threshold Values

Airblast Threshold	SPL (dB linear)	Source
Lowest threshold for building damage and human disturbance	134	30 CFR 816.67(b)
Barely noticeable threshold for humans	100	Richards (2009); AECOM (2011)
Vibration Threshold	**PPV (in/s)**	**Source**
Lowest threshold for building damage	0.5	Chae (1978); Siskind (1980)
Lowest threshold for human awareness (outdoors)	0.035	Wiss (1974)
Lowest threshold for human awareness (indoors)	0.004	Jones & Stokes (2004)

Blasting noise and vibration are estimated at each of the site boundaries out to a distance of 50 feet from the blast, because this is the minimum safe distance from a mine blast, regardless of the amount of charge used, as prescribed by mine blasting regulations (30 CFR 56.2). Blasting noise and vibration were also estimated from the nearest site boundary to the three locations in the Bryce Canyon National Park, as well as the nearest identified building to the mining boundaries (approximately 500 feet north of the northernmost boundary of Block C). Additionally, the equations for calculating blasting noise and vibration are inversed to determine the maximum distance over which impacts could exist above a given threshold. Calculation results from blasting are presented in Section 7.2

6. SOUNDSCAPE MODELING APPROACH

The following sections provide a summary of the technical parameters that were used in the model to evaluate noise impacts at receptor locations.

6.1. Description of Model: SoundPLAN

SoundPLAN Essential, Version 2.0, was used to evaluate the noise emissions of the project. Based on the sound power levels input for each source, SoundPLAN estimates noise contours of the overall facility in accordance with a variety of standards, primarily ISO 9613-2 standards for noise propagation calculations. All sound propagation losses, such as geometric spreading, air absorption, ground absorption, and barrier shielding, are calculated automatically in accordance with these recognized standards. The model uses industry-accepted propagation algorithms and accepts sound power levels (in decibels) provided by the equipment manufacturer or other sources.

6.2. Technical Capabilities and Limitations

As discussed in Section 5.1, single point calculations were made in the computer noise model for project impacts at the three Bryce Canyon National Park points (i.e., Farview F, Yovimpa F, and Riggs Spring B). Additionally, project noise impacts were modeled using noise contour lines and grid noise maps out to a distance of approximately 5 km from the mining tract boundaries. Therefore, project impacts were also modeled for any park points that lie within approximately 5 km from the project boundaries, as shown in the contour line and grid noise map figures included in Section 7.

Due to the multiple dispersed residential and commercial receptors located within each of the towns for which project impacts were modeled (i.e., Alton, Hatch, and Panguitch), modeling analysis of individual receptors was not generally conducted in the towns (the exception being a single, centrally located point within the town of Alton for which noise modeling was conducted to show a representative, single numeric value for project noise impact to the town). Mining and/or vehicle traffic impacts to the towns were modeled and analyzed using noise contour lines and grid noise maps depicting project impacts over an area. Due to the dispersed and transient nature of the sage-grouse, impacts to the lek and birds were analyzed using the noise contour line and grid noise maps. For all receptors, a receiver height of 2 m was used in the model.

As discussed in Section 4.1, equipment sound power levels from mobile equipment were summed together to produce a single emitting 40-acre area source in several of the potential mining blocks to generate a representative noise level from mining operations in each block. As mobile noise sources were summed, a single dBA sound power level was input into the model for each area calculation from the mobile equipment. A single representative sound power level was also input into the model for the 35-acre area source representing the central processing facility. Sound power was entered in A-weighted values at a mean representative frequency of 500 Hz for both the mobile equipment and central processing facility area sources (model default if frequency spectrum data are unavailable). Noise sources from mobile and fixed mining equipment and processes were assumed to have a uniform height of 3 m off the ground for modeling purposes. Noise emissions from mobile and stationary sources on the blocks were modeled per ISO 9613-2:1996 (ISO 1996).

Roadways were modeled using the SoundPLAN 2.0 roadway option. Roadway noise emissions were modeled per Federal Highway Administration (FHWA) Traffic Noise Model standards (FHWA 1998). Traffic data entered into the model are discussed in Section 4.2. Both roadway and mine tract emissions were modeled simultaneously, where appropriate (i.e., in and around the town of Alton).

No noise barriers were modeled from buildings, foliage, or mining high walls, even though these barriers to noise levels from mining activities will likely be present to some degree. Therefore, the model conservatively estimated peak noise levels in the absence of any attenuation due to barriers between the noise source and the receptor of interest.

6.3. Technical Options Used in Modeling

Single receiver, noise limit contour lines, and grid noise maps were calculated for the noise emission sources associated with mining activities and roadways using the SoundPLAN model. Noise limit contour lines were based on a grid noise calculation with grid spacing of 100 m. Grid noise maps show all noise contours and fill in the areas between contour lines. Noise emissions from mobile and stationary sources were modeled out to a distance of approximately 5 km from the proposed mining tract. The roadway noise emissions were modeled out to a distance of approximately 1 km from the existing roadways. Table 10 outlines the technical parameters that were used in the modeling.

Table 10. Technical Parameters to Be Used in Modeling

Technical Parameter	Standard	Input Parameters/Notes
Geometric attributes	ISO 9613-2:1996 (ISO 1996)	Automatically calculated by SoundPLAN.
Meteorological conditions	ISO 1996	Air absorption was determined using “standard day” conditions derived from the nearest representative meteorological station. Daily data were analyzed for calendar year 2012. The annual mean was used in the model for temperature, humidity, and air pressure levels. The modeled meteorological data are discussed further below.
Ground absorption	ISO 1996	The model default of “soft ground” (i.e., fields, forests, or grass) was assumed. Roadways were regarded as “hard ground” (i.e., dense-graded asphaltic concrete) for the roadway effects portion of the calculations.
Topographic features	–	U.S. Geologic Survey (USGS) topographic data for the project site and surrounding area were digitized and input into the model to account for how topographic conditions affect the geometric divergence of the sound pressure levels. Ten-meter spacing was used between topographic lines for modeling project roadway impacts to the towns of Hatch and Panguitch. However, due to the larger area modeled in and around the town of Alton, 100-meter spacing between topographic lines was employed for modeling of mining and roadway impacts to NSAs in and around the mining tract.

6.3.1. Meteorological Conditions

The relationship between temperature, humidity, and air pressure levels to that of sound attenuation is complicated and nonlinear. Although there are general trends in the relationship of each of these variables to the atmospheric attenuation of sound (e.g., when temperature decreases, sound attenuation tends to decrease), the interrelationship of all of these elements together is not so simple (e.g., sound attenuation due to temperature fluctuations peaks at different temperatures depending on the humidity). To further complicate matters, different frequencies of sound attenuate differently for each of these meteorological variables. As such, increases or decreases in one variable (temperature, humidity, air pressure) do not directly lead to increases or decreases in sound attenuation, but are interrelated with one another. Therefore, because a “maximum case” between all three variables cannot be easily established, representative mean variables were used in the modeling.

The nearest identified meteorological monitor that records all three of these variables is located at the Cedar City Regional Airport in Cedar City, Utah (latitude and longitude of 37.70097N, -113.09884W, respectively), approximately 30 miles northwest of the project. The average temperature, humidity, and atmospheric pressure for the year 2012 were used from recorded data from this airport in the model of 11^{o}C, 48% humidity, and 1,016 millibars pressure, respectively (the daily meteorological data are included in Appendix B) (Cedar City Regional Airport data from http://www.wunderground.com/). For consistency, these values were used in all of the model runs, including for the towns of Hatch and Panguitch.

7. NOISE AND VIBRATION IMPACTS

The following section evaluates the potential impacts from noise and vibration from the project.

7.1. Operational Noise Modeling

Noise modeling was conducted for the various scenarios as discussed below.

7.1.1. Mining on Block C

Figure 3 depicts the point receptor and source map for mining activities conducted on Block C. This figure depicts the roadways and area sources (both aggregated mobile equipment and the central processing facility) that were modeled, the overall mining tract boundary, individual point receptors (receivers) for which impacts were modeled and the expected impact in dBA from the modeled mining and roadway activities, and the general topography of the area.

As discussed, calculations were done using the SoundPLAN model at several individual point receptors in Bryce Canyon National Park and one in the town of Alton. Table 11 presents the results of these modeled calculations. The receiver numbers on Figure 3 correspond to the following receivers discussed in Table 11. The background level that is presented in the table is the assumed background sound level for that individual receptor, as discussed in Section 5.1. The calculated impact value presented in both Figure 3 and Table 11 is the impact from modeled activities at the particular point receptor (i.e., all modeled roadways, the block mobile equipment, and the central processing facility). If the calculated impact level is greater than the background level, then noise impacts from mining activities are anticipated for the receiver. If calculated impact levels are below background level, then no impacts from mining activities would be anticipated at the receiver.

Table 11. Calculated Sound Levels at Individual Point Receptors from Mining on Block C.

Receiver	Receiver Description	Background Level (dBA)	Calculated Impact Level (dBA)
1	Farview F (Bryce Canyon National Park)	31.8	0
2	Riggs Spring B (Bryce Canyon National Park)	24.5	0
3	Town of Alton (southwest corner of Center Street and 1st East Street)	41.0	**50.2**
4	Yovimpa F (Bryce Canyon National Park)	27.1	0

Note: Calculated values in excess of background are bolded.

As shown in Table 11, calculated noise impact levels from mining equipment and roadway noise at each of the national park receptors would be 0 dBA. Calculated noise levels at a central point in the town of Alton would exceed expected background by approximately 9 dBA. Noise level contributions from the different sources to each receptor are presented in Appendix C. As shown in Appendix C, noise level contributions from mining activities on Block C account for the greatest source of modeled noise to the receptor analyzed in Alton, accounting for 49.2 dBA of the 50.2-dBA impact.

Figure 3 only depicts impacts to specific receivers. To obtain a more generalized picture of the dispersion of noise levels from the mining impacts and roadways, a contour line and grid noise map was generated from the model. Figure 4 depicts the contour line and grid noise map for modeled mining activities on Block C and roadways.

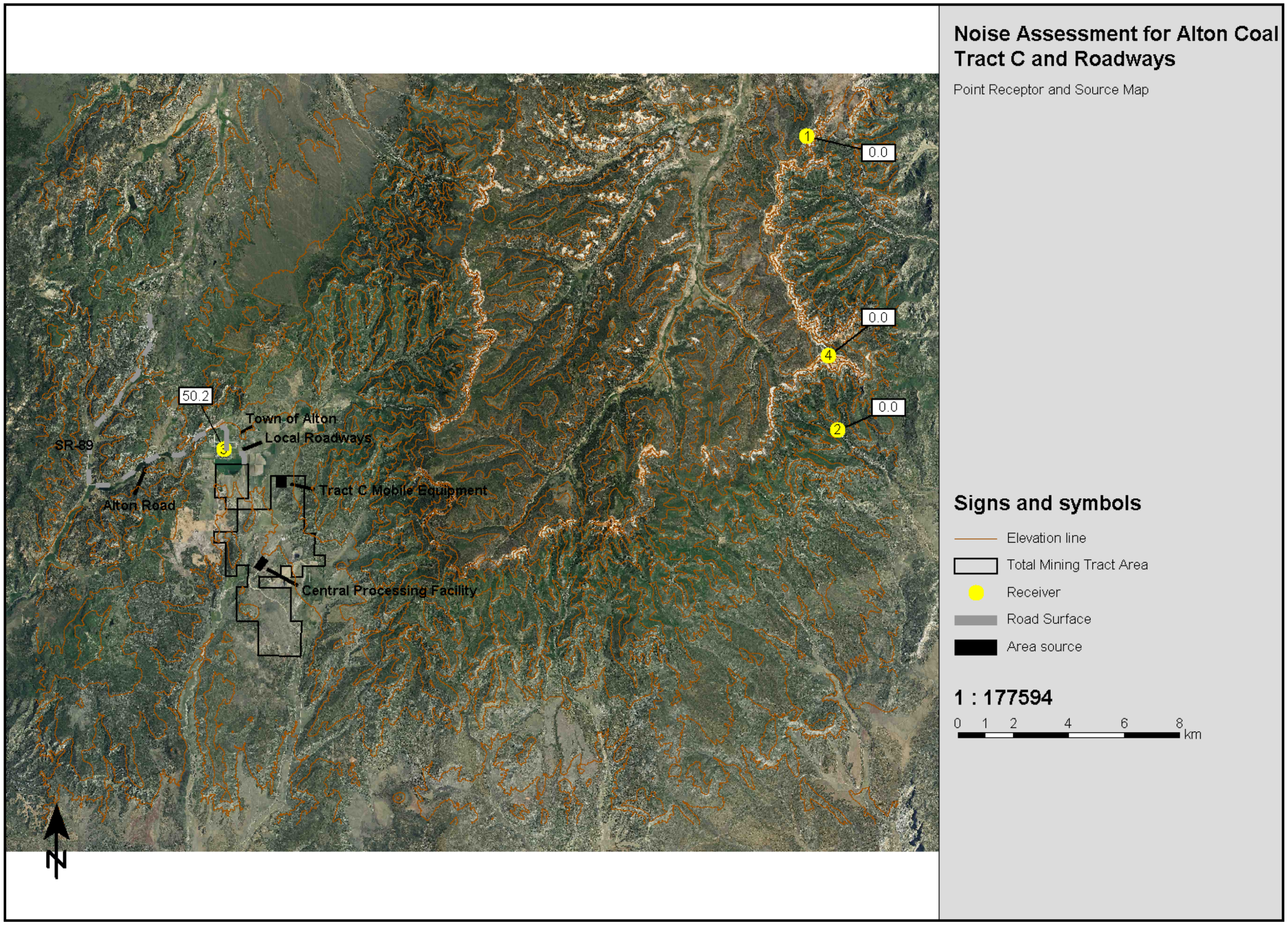

Figure 3. Point receptor and source map for mining on Block C.

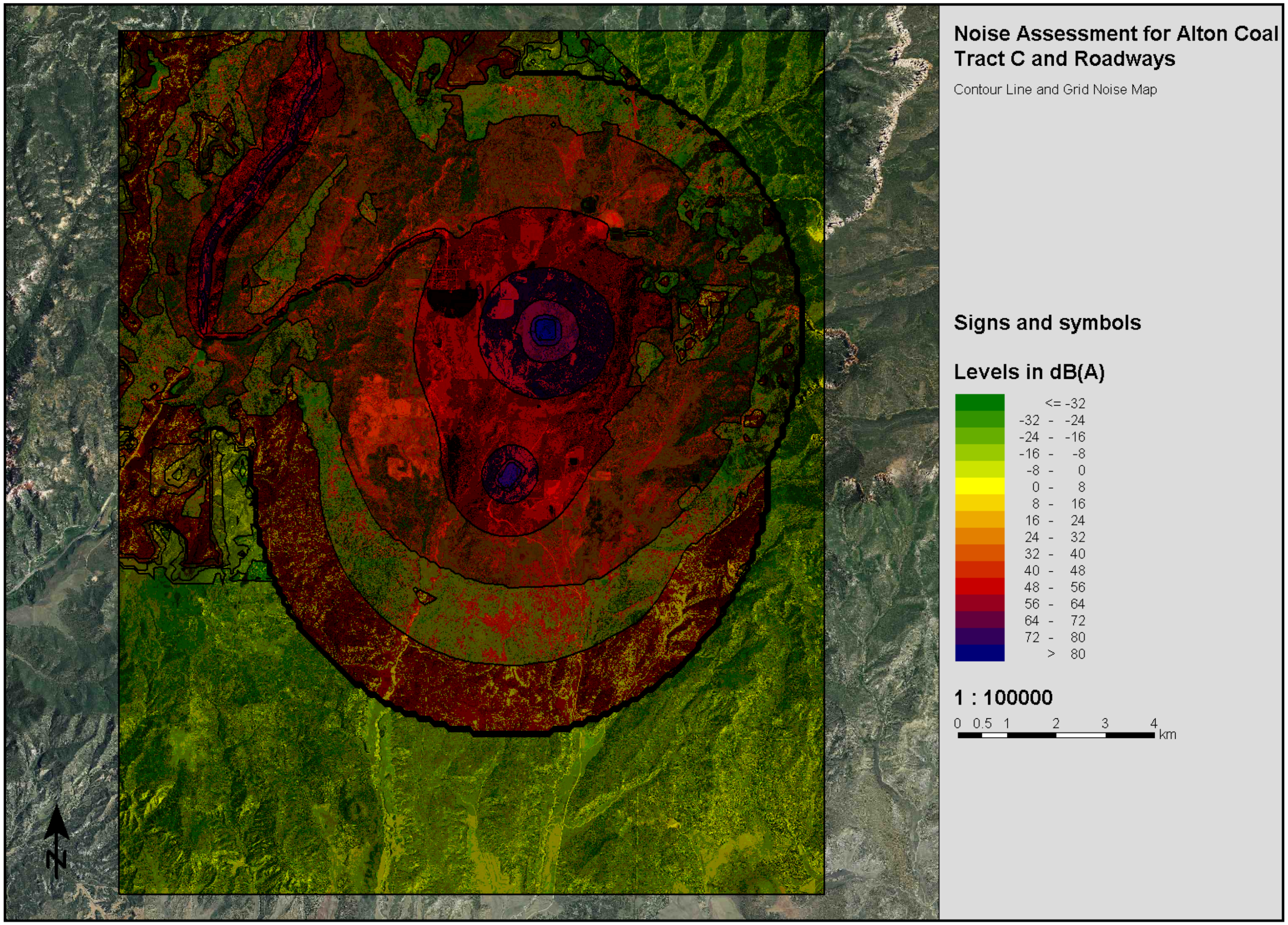

Figure 4. Contour line and grid noise map for mining on Block C.

The receiver point chosen as representative for the town of Alton is not the closest potential receiver to mining activities (this receiver was modeled because it was centrally located, and thus representative of impacts to the town from both roadway and mining noise emissions). However, as Figure 4 indicates, other receivers in the town could expect to have noise levels comparably impacted from the combination of mining and roadway activities.

The sage-grouse lek NSA is located within and around the tract. Noise levels cannot be precisely modeled for the lek for two reasons: 1) the lek is not fixed to an exact location, and 2) the species is highly mobile and has been documented using all available habitat on the tract. As can be observed from Figure 4, however, noise levels could range from as low as 48 dBA to over 80 dBA within approximately 1 km of the modeled equipment and processes. Potential project impacts occur at levels as high as 56 dBA from 1 to 5 km out from the range of the modeled equipment and processes, with intermittent locations of no project impacts (0 dBA or less) occurring at increasing frequency the further away from the equipment and processes one moves. Potential project impacts to ambient noise levels cease out to distances greater than 5 km from modeled equipment and processes. Therefore, sage-grouse located within a 5-km radius from Block C or the central processing equipment on the mining tract could be impacted at levels greater than the 40-dBA baseline sound levels expected at the lek.

7.1.2. Mining on Block NW

Figure 5 depicts the point receptor and source map for mining activities conducted on Block NW. This figure depicts the roadways and area sources (both aggregated mobile equipment and the central processing facility) that were modeled, the overall mining tract boundary, individual point receptors (receivers) for which impacts were modeled and the expected impact in dBA from the modeled mining and roadway activities, and the general topography of the area.

As discussed, calculations were done using the SoundPLAN model at several individual point receptors in Bryce Canyon National Park and one centralized location within the town of Alton. Table 12 presents the results of these modeled calculations. The receiver numbers on Figure 5 correspond to the following receivers discussed in Table 12. The background level that is presented in the table is the measured background sound level as discussed in Section 4. The calculated impact value presented in both Figure 5 and Table 12 is the impact from modeled activities at the particular point receptor (i.e., all modeled roadways, the mobile equipment, and the central processing facility). If the calculated impact level is greater than the background level, then noise impacts from mining activities are anticipated for the receiver. If calculated impact levels are below background level, then no impacts from mining activities would be anticipated at the receiver.

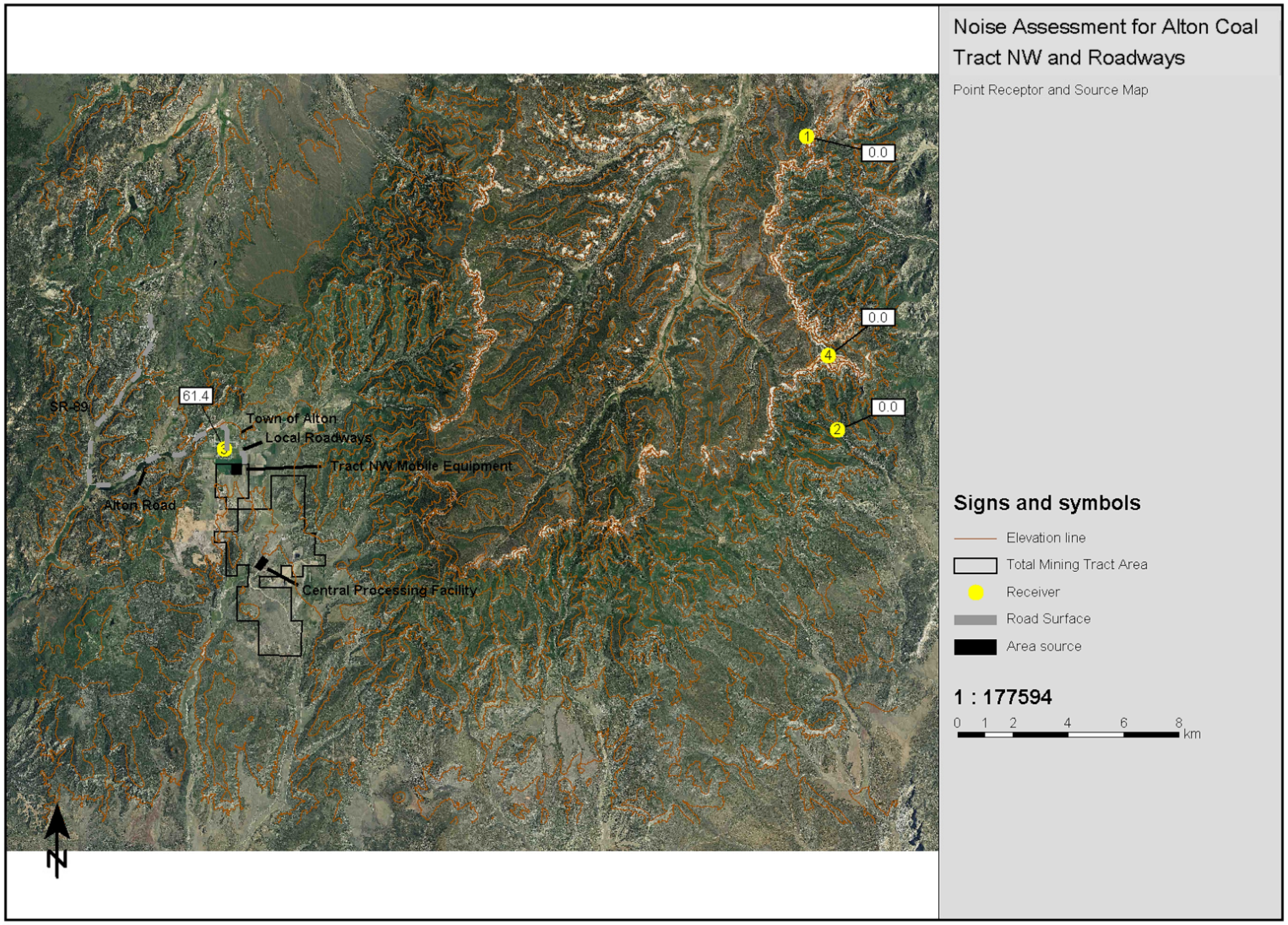

Figure 5. Point receptor and source map for mining on Block NW.

Table 12. Calculated Sound Levels at Individual Point Receptors from Mining on Block NW

Receiver	Receiver Description	Background Level (dBA)	Calculated Impact Level (dBA)
1	Farview Point (Bryce Canyon National Park)	31.8	0
2	Riggs Spring (Bryce Canyon National Park)	24.5	0
3	Town of Alton (southwest corner of Center Street and 1st East Street)	41.0	**61.4**
4	Yovimpa Point (Bryce Canyon National Park)	27.1	0

Note: Calculated values in excess of background are bolded.

As shown in Table 12, calculated noise impact levels from mining equipment and roadway noise at each of the national park receptors would be 0 dBA. Calculated noise levels at a central point in the town of Alton would exceed expected background by approximately 20 dBA. Noise level contributions from the different sources to each receptor are presented in Appendix C. As shown in Appendix C, noise level contributions from mining activities on Block NW account for the greatest source of modeled noise to the receptor analyzed in the town, accounting for 61.3 dBA of the 61.4-dBA impact.

Figure 5 only depicts impacts to specific receivers. To obtain a more generalized picture of the dispersion of noise levels from the mining impacts and roadways, a contour line and grid noise map was created. Figure 6 depicts the contour line and grid noise map for modeled mining activities on Block NW and roadways.

The receiver point chosen as representative for the town of Alton is not the closest potential receiver to mining activities (this receiver was modeled because it was centrally located, and thus representative of impacts to the town from both roadway and mining noise emissions). However, as Figure 6 indicates, other receivers in the town could expect to have noise levels comparably impacted from the combination of mining and roadway activities.

The sage-grouse lek NSA is located within and around the tract. Noise levels cannot be precisely modeled for the lek for two reasons: 1) the lek is not fixed to an exact location, and 2) the species is highly mobile and has been documented using all available habitat on the tract. As can be observed from Figure 6, noise levels could range from as low as 48 dBA to over 80 dBA within approximately 1 km of the modeled equipment and processes. Potential project impacts occur at levels as high as 56 dBA from 1 to 5 km out from the range of the modeled equipment and processes, with intermittent locations of no project impacts (0 dBA or less) occurring at increasing frequency the further away from the equipment and processes one moves. Potential project impacts to ambient noise levels cease out to distances greater than 5 km from modeled equipment and processes. Therefore, sage-grouse located within a 5-km radius from Block NW or the central processing equipment on the mining tract could be impacted at levels greater than the 40 dBA baseline sound levels expected at the lek.

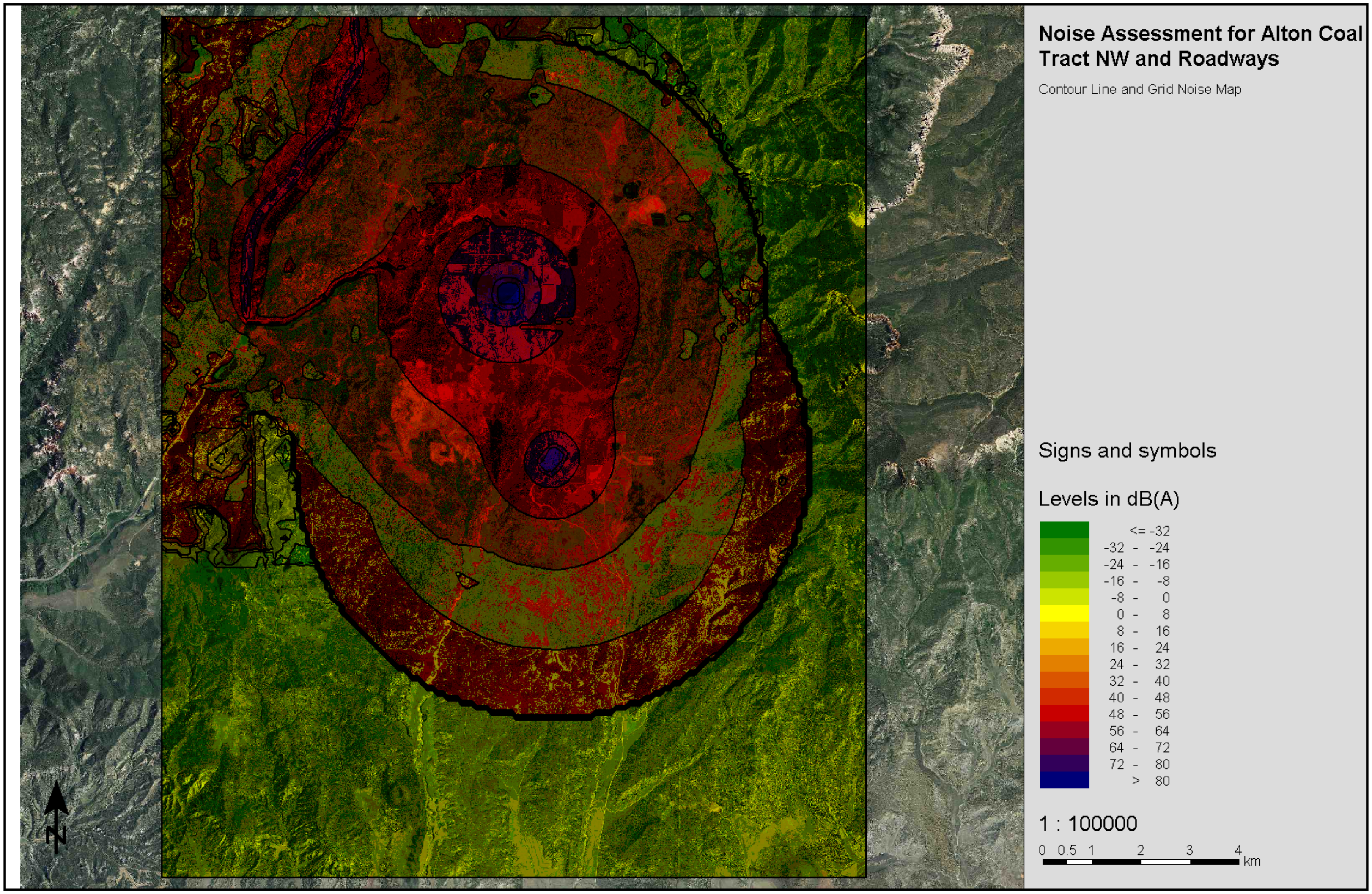

Figure 6. Contour line and grid noise map for mining on Block NW.

7.1.3. Mining on Block S

Figure 7 depicts the point receptor and source map for mining activities conducted on Block S. This figure depicts the roadways and area sources (both aggregated mobile equipment and the central processing facility) that were modeled, the overall mining tract boundary, individual point receptors (receivers) for which impacts were modeled and the expected impact in dBA from the modeled mining and roadway activities, and the general topography of the area.

As discussed, calculations were done using the SoundPLAN model at several individual point receptors in Bryce Canyon National Park and one in the town of Alton. Table 13 presents the results of these modeled calculations. The receiver numbers on Figure 7 correspond to the following receivers discussed in Table 13. The background level that is presented in the table is the assumed background sound level as discussed in Section 4. The calculated impact value presented in both Figure 7 and Table 13 is the impact from modeled activities at the particular point receptor (i.e., all modeled roadways, the block mobile equipment, and the central processing facility). If the calculated impact level is greater than the background level, then noise impacts from mining activities are anticipated for the receiver. If calculated impact levels are below background level, then no noise impacts from mining activities would be anticipated at the receiver.

Table 13. Calculated Sound Levels at Individual Point Receptors from Mining on Block S

Receiver	Receiver Description	Background Level (dBA)	Calculated Impact Level (dBA)
1	Farview F (Bryce Canyon National Park)	31.8	0
2	Riggs Spring B (Bryce Canyon National Park)	24.5	0
3	Town of Alton (SW corner of Center Street and 1st East Street)	41.0	**43.3**
4	Yovimpa F (Bryce Canyon National Park)	27.1	0

Note: Calculated values in excess of background are bolded.

As shown in Table 13, calculated noise impact levels from mining equipment and roadway noise at each of the national park receptors would be 0 dBA. Calculated noise levels at a central point in the town of Alton would exceed expected background by approximately 2 dBA. Noise level contributions from the different sources to each receptor are presented in Appendix C. As shown in Appendix C, noise level contributions from the local roadways running from the mine site through the town of Alton are the greatest source of modeled noise to the receptor analyzed in the town, accounting for 43.1 dBA of the 43.3-dBA impact.

Figure 7 only depicts impacts to specific receivers. To obtain a more generalized picture of the dispersion of noise levels from the mining impacts and roadways, a contour line and grid noise map was created. Figure 8 depicts the contour line and grid noise map for modeled mining activities on Block S and roadways.

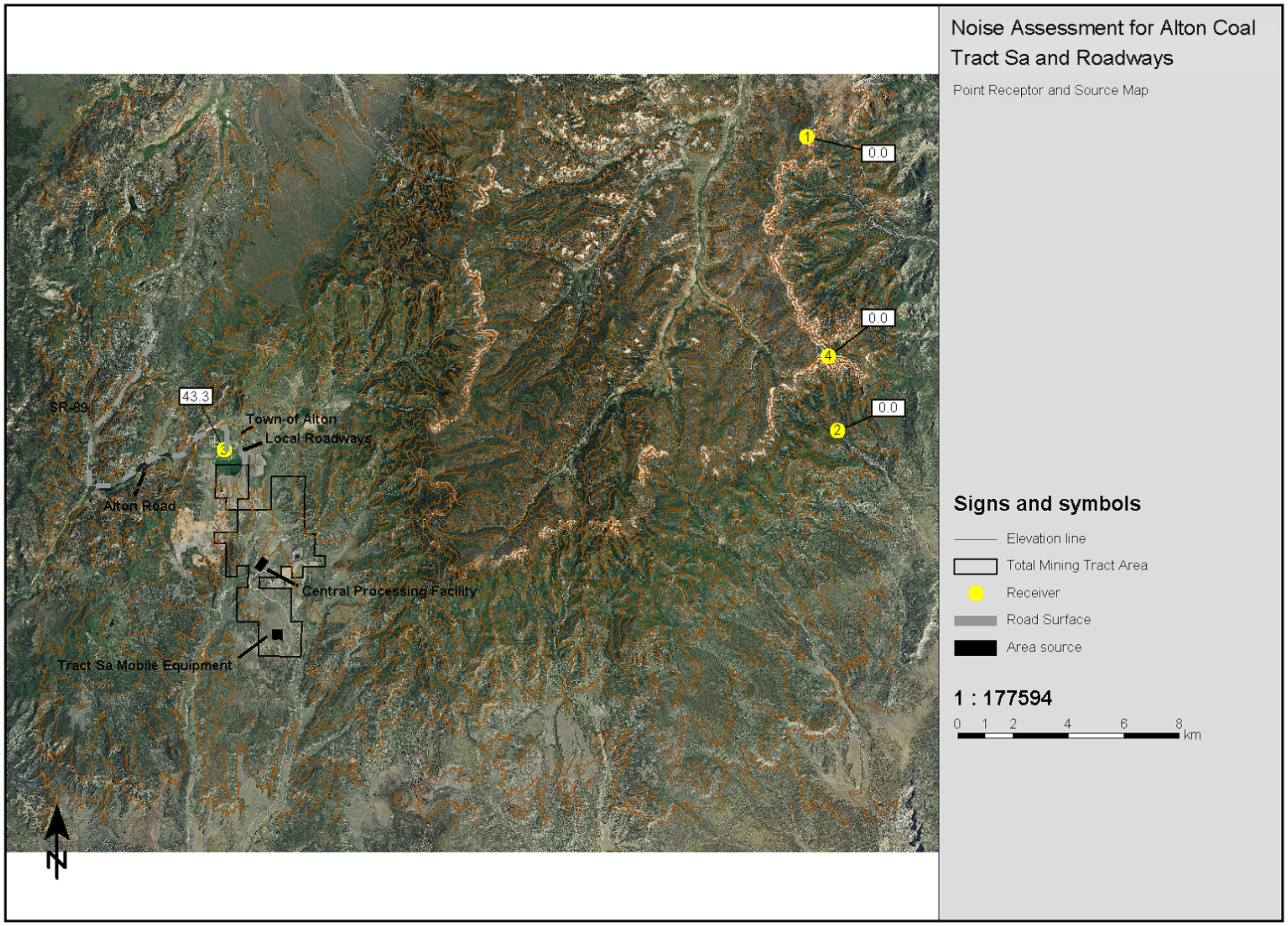

Figure 7. Point receptor and source map for mining on Block S.

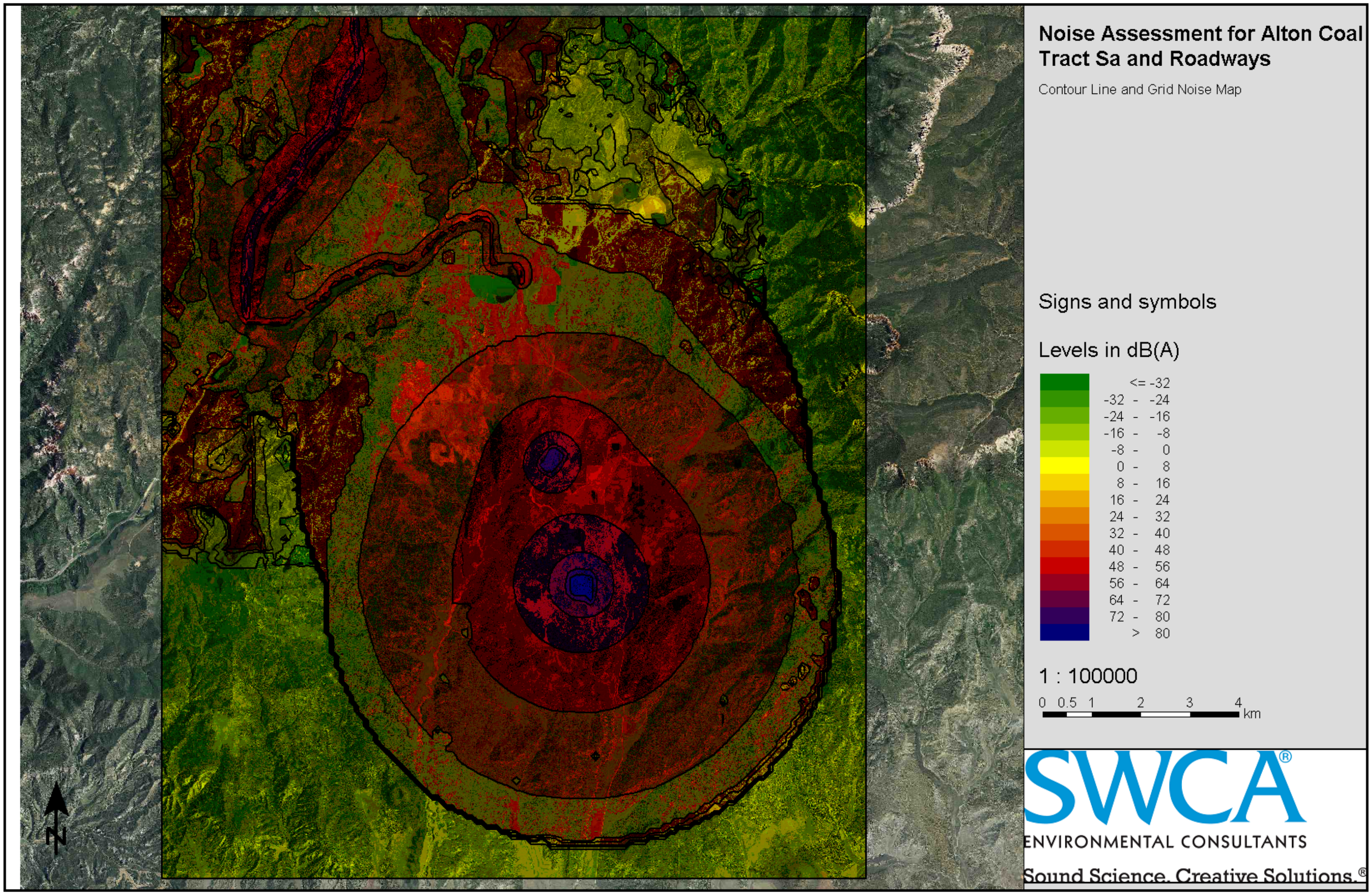

Figure 8. Contour line and grid noise map for mining on Block S.

The receiver point chosen as representative for the town of Alton is not the closest potential receiver to mining activities (this receiver was modeled because it was centrally located, and thus representative of impacts to the town from both roadway and mining noise emissions). However, as Figure 8 indicates, other receivers in the town could expect to have noise levels comparably impacted from the combination of mining and roadway activities.

The sage-grouse lek NSA is located within and around the mine tract. Noise levels cannot be precisely modeled for the lek for two reasons: 1) the lek is not fixed to an exact location, and 2) the species is highly mobile and has been documented using all available habitat on the tract. As can be observed from Figure 8, noise levels could range from as low as 48 dBA to over 80 dBA within approximately 1 km of the modeled equipment and processes. Potential project impacts occur at levels as high as 56 dBA from 1 to 5 km out from the range of the modeled equipment and processes, with intermittent locations of no project impacts (0 dBA or less) occurring at increasing frequency the further away from the equipment and processes one moves. Potential project impacts to ambient noise levels cease out to distances greater than 5 km from modeled equipment and processes. Therefore, sage-grouse located within a 5-km radius from Block S or the central processing equipment on the mining tract could potentially be impacted at levels greater than the 40 dBA baseline sound levels expected at the lek.

7.1.4. Roadway Impacts to the Town of Hatch

Figure 9 depicts the contour line and grid noise map for modeled roadway impacts to the town of Hatch.

As can be seen from Figure 9, impacts from SR-89 to residences and commercial enterprises adjacent to or near the roadway could result in audible noise levels ranging as high as 60 to 68 dBA. This is within the range of the currently measured baseline value of 64 dBA, as presented in Section 4. The modeled noise results when compared to baseline noise conditions for the town of Hatch therefore do not indicate a measurable increase in noise from the proposed project.

7.1.5. Roadway Impacts to the Town of Panguitch

Figure 10 depicts the contour line and grid noise map for modeled roadway impacts to the town of Panguitch.

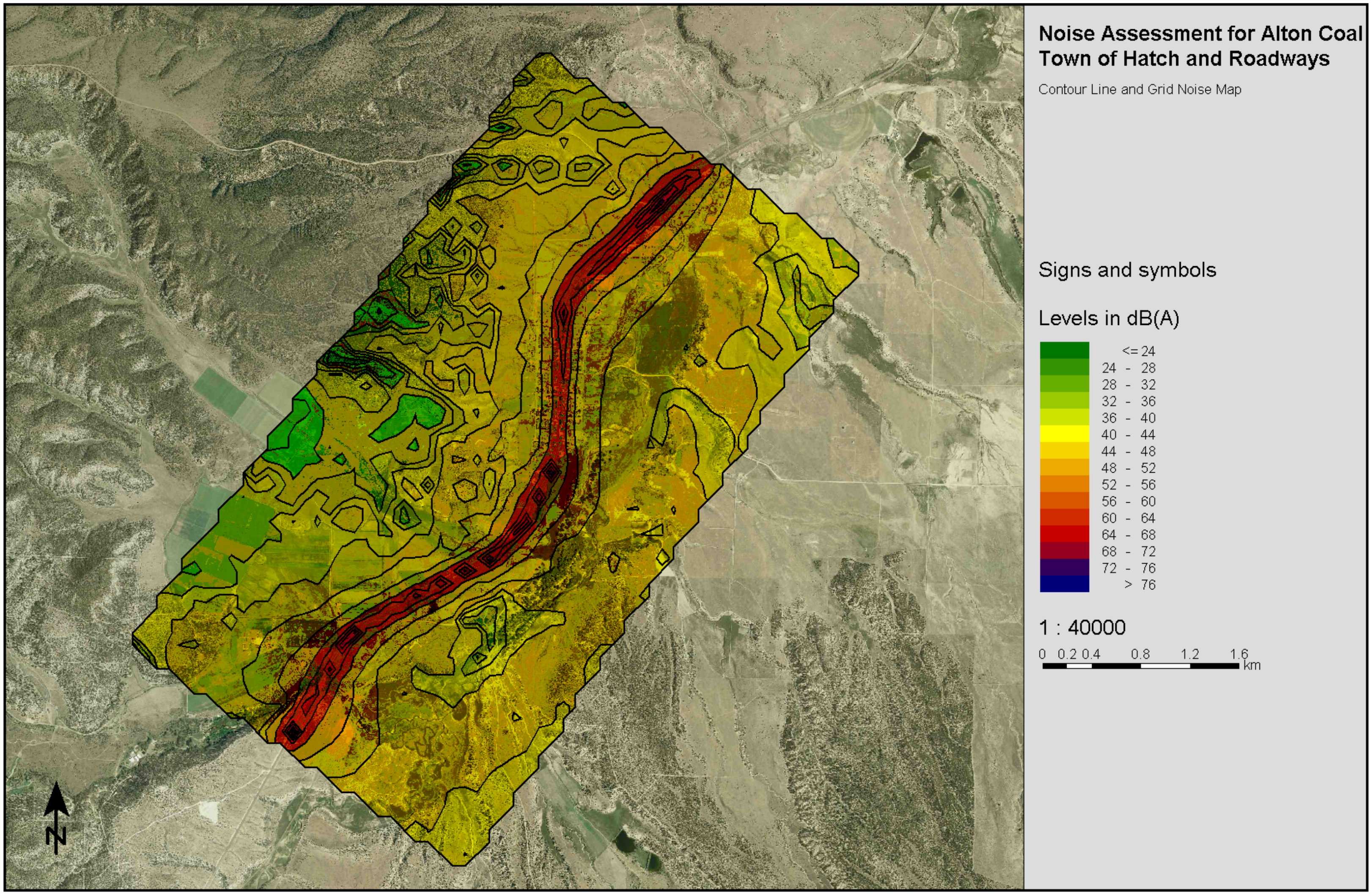

Figure 9. Contour line and grid noise map for town of Hatch.

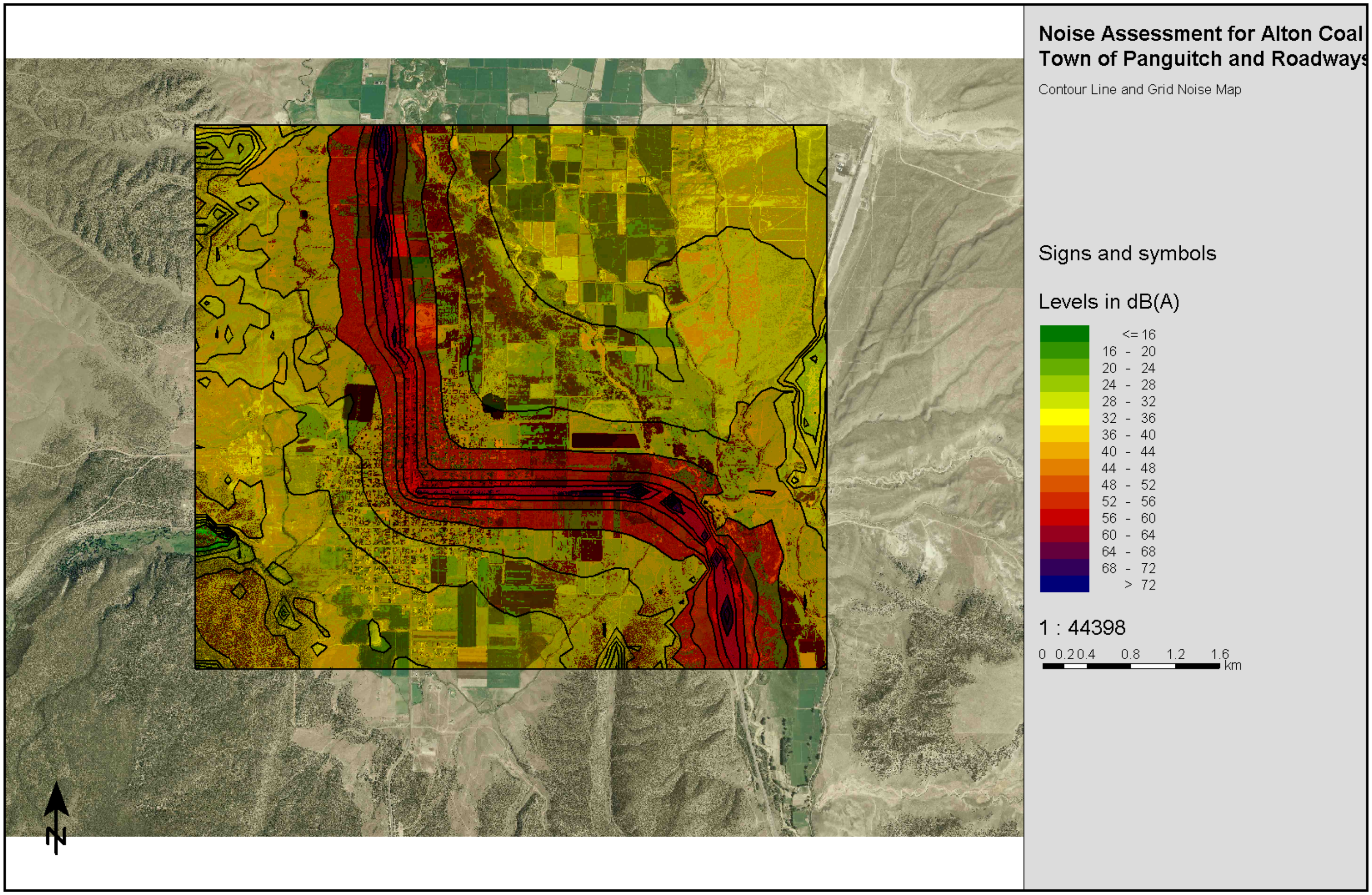

Figure 10. Contour line and grid noise map for town of Panguitch.

As can be seen from Figure 10, impacts from SR-89 to residences and commercial enterprises adjacent to or near the roadway could result in audible noise levels ranging as high as 56 to 64 dBA. This is within the range of the currently measured baseline value of 64 dBA, as presented in Section 4. The modeled noise results when compared to baseline noise conditions for the town of Panguitch therefore do not indicate a measurable increase in noise from the proposed project.

7.2. Blasting Calculation Results

Table 14 outlines the highest calculated PVS and SPL values from blasting operations conducted from the closest edge of the analyzed mining block (Blocks C, NW, and S) to the point of interest or NSA. The maximum impacts from vibration and blasting were analyzed at 50 feet from the blast (the minimum safe distance from blasting as prescribed by regulation) for illustrative purposes of the maximum possible impact from blasting, even though no critical receptors (e.g., humans, buildings, animals) are expected to be that close to a blast. The calculations for blasting noise and vibration impacts at these receptors are presented in greater detail in Appendix D.

As Table 14 indicates, blasting noise at the three Bryce Canyon National Park receiver points were below the 100-dB linear threshold of human annoyance as identified in Section 5.2. Vibration impacts to Bryce Canyon National Park receiver points analyzed would be well below the threshold of human perception.

Both noise and vibration impacts from blasting conducted at the closest point within the mining tract (Block NW) to an identified building within the town of Alton would be well in excess of both vibration and noise regulatory thresholds. Damage to the building may occur, and any persons within may experience noise levels in excess of regulatory thresholds and human comfort levels from blasting. However, blasting was calculated assuming the maximum charge mass per delay at the closest point of blasting from this building to the mining tract; actual impacts from noise and vibration to this building would therefore likely be lower.

Blasting noise and vibration calculated from the closest point on other mining blocks (Blocks C and S) to this same building in the town of Alton indicated vibration levels well below those that could damage buildings. However, vibration levels did exceed the lowest identified level for human perception within a building from blasting on both mining blocks. Additionally, calculated noise levels from blasting on these mining blocks could exceed the threshold for human perception and annoyance, but not the threshold for building damage.

In addition to blasting noise and vibration calculations at individual points, the maximum distance out to which blasting noise and vibration could be expected to exceed threshold values (as identified in Section 5.2) was calculated using the equations for blasting noise and vibration (as identified in Section 4.4). Tables 15 and 16 present the maximum calculated threshold distances out to which these impacts could be expected based on the blasting parameters discussed in Section 4.4 (i.e., 266 lb charge mass per delay).

Table 14. Blasting Calculation Results

Receptor	Closest Mine Block	Distance from Blast (feet)	Threshold Value: PPV (building damage) (in/s)	Threshold Value: PPV (human awareness) (in/s)	Threshold Value: SPL (building damage) (dB linear)	Threshold Value: SPL (human annoyance/ awareness) (dB linear)	Highest Calculated Value: PPV (in/s)	Highest Calculated Value: SPL (dB linear)
50 feet from blast	Block C, NW, or S	50	0.5	0.035	134	100	**79.8**	**186**
Yovimpa F	Block C	65,000	0.5	0.035	134	100	0.0015	91
Riggs Spring B	Block C	65,000	0.5	0.035	134	100	0.0015	91
Farview F	Block C	74,000	0.5	0.035	134	100	0.0012	90
Town of Alton (nearest building)	Block NW	500	0.5	0.004	134	100	**2.4**	**154**
Town of Alton (nearest building)	Block C	5,400	0.5	0.004	134	100	**0.065**	**120**
Town of Alton (nearest building)	Block S	20,000	0.5	0.004	134	100	**0.0088**	**102**

Note: Calculated values in excess of threshold are bolded.

Table 15. Maximum Airblast Impact Distances

Airblast Threshold Value (db linear)	Airblast Threshold Value: Interpretation	Airblast Overpressure (psi)	Blasting Impact Distance Limit: Highwall (feet)	Highwall (mile)	Parting (feet)	Parting (mile)
134	Lowest threshold at which building damage and human annoyance could be expected	1.45E-02	134	0.03	2,057	0.39
100	Barely noticeable threshold for human awareness/lowest reported threshold of human annoyance	2.90E-04	18,541	3.5	22,943	4.3

Table 16. Maximum Vibration Impact Distances

Vibration Threshold Value		Blasting Impact Distance Limit			
		Mean		Maximum	
(in/s)	Interpretation	(feet)	(mile)	(feet)	(mile)
0.5	Lowest threshold at which building damage could be expected	597	0.11	1,407	0.27
0.035	Minimum noticeable threshold for human awareness (outdoors)	3,434	0.7	8,093	1.5
0.004	Minimum noticeable threshold for human awareness (indoors)	14,306	2.7	33,717	6.4

8. LITERATURE CITED

AECOM. 2011. *Acoustic Investigation, Virginia Development Plan Amendment*. Available at: http://dpti.sa.gov.au/__data/assets/pdf_file/0006/99150/Acoustic_Investigation__Virginia_Development_Plan_Amendment,_May_2011_AECOM.pdf. Accessed on July 19, 2013.

Barrick Gold Corporation. 2009. *Cowal Gold Mine E42 Modification – Modified Request.* October 2009. Project No. HAL-09-34. Document No. 00309646.doc. Available at: http://barrick.com/files/cowal/Cowal-E42-Modification-Modified-Request.pdf. Accessed May 15, 2013.

BLM. 2011. *Alton Coal Tract Lease by Application Draft Environmental Impact Statement.* Available at: http://www.blm.gov/ut/st/en/prog/energy/coal/alton_coal_project/alton_coal_eis.html. Accessed May 15, 2013.

Chae, Y. S. 1978. Design of excavation blasts to prevent damage. *Civil Engineering—American Society of Civil Engineers* 48(4):77–79.

Ensham Resources. 2006. *Ensham Central Project Environmental Noise Assessment*. Available at: http://www.ensham.com.au/updated/eis/pdf/Volume-2_Appendices/APPENDIX%20G%20-%20NOISE.pdf. Accessed May 15, 2013.

Fehr & Peers Transportation Consultants. 2008. *Coal Hollow Development Alton Coal EIS – Traffic Technical Report.* Submitted to SWCA Environmental Consultants. July 2008. UT06-721.

FHWA. 1998. *FHWA Traffic Noise Model Technical Manual*. FHWA-PD-96-010, DOT-VNTSC-FHWA-98-2. Final Report. February 2008.

ISO. 1996. ISO 9613-2:1996. Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation.

———. 1997. ISO 2631-1:1997. Mechanical Vibration and Shock – Evaluation of Human Exposure to Whole-Body Vibration – Part 1: General Requirements.

———. 2003. ISO 2631-2:2003. Mechanical Vibration and Shock – Evaluation of Human Exposure to Whole-Body Vibration – Part 2: Vibration in Buildings (1 Hz to 80 Hz).

Jones & Stokes. 2004. *Transportation- and Construction-Induced Vibration Guidance Manual*. Sacramento, California. Prepared for California Department of Transportation, Noise, Vibration, and Hazardous Waste Management Office, Sacramento, California. Available at: http://www.dot.ca.gov/hq/env/noise/pub/vibrationmanFINAL.pdf. Accessed on July 18, 2013.

Richards, A. B., and A. J. Moore. 1997. *Blasting in an Urban Environment, in Resourcing the 21st Century*. Paper read at the AusIMM 1997 Annual Conference, at Ballarat, Victoria, Australia.

Richards, A. B. and A. J. Moore. 2009. Blast Vibration Course: Measurement – Assessment – Control. Available at: http://miningandblasting.files.wordpress.com/2009/09/blast-vibration-course_measurement_assessment_control.pdf. Accessed on July 19, 2013.

Rosenthal, M. F., and G. L. Morlock. 1987. *Blasting Guidance Manual*. United States Department of the Interior, Office of Surface Mining Reclamation and Enforcement.

Siskind, D. E., M. S. Stagg, J. W. Kopp, and C. H. Dowding. 1984. *Structure response and damage produced by ground vibration from surface mine blasting.* (Report of Investigations 8507.) Washington, D.C.: U.S. Bureau of Mines.

Siskind, D. E., V. J. Stachura, M. S. Stagg, and J. W. Kopp. 1980. *Structure response and damage produced by airblast from surface mining*. (Report of Investigations 8485.) Washington, D.C.: U.S. Bureau of Mines.

U.S. Department of Transportation. 2005. *Highway Performance Monitoring System Field Manual, Appendix N: Procedures for Estimating Highway Capacity*. Available at: http://www.fhwa.dot.gov/ohim/hpmsmanl/appn3.cfm. Accessed June 5, 2013.

Wiss, J. F., and H. R. Nichols. 1974. *A study of damage to a residential structure from blast vibrations*. New York: American Society of Civil Engineers.

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Appendix A

Alton Coal Tract LBA EIS Noise Modeling Protocol

Alton Coal Tract LBA EIS
Final Noise Modeling Protocol

Prepared for

Bureau of Land Management,
Kanab Field Office

Prepared by

SWCA Environmental Consultants

May 2013

ALTON COAL TRACT LBA EIS
FINAL NOISE MODELING PROTOCOL

Prepared for

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May 2013

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1. CHANGES FROM DRAFT TO FINAL PROTOCOL

The following substantive changes were made from the draft to the final protocol:

- Because U.S. Route 89 (US-89) does not run through or near the Town of Alton, Alton Road was added for modeling purposes to the model for that town. Vehicle traffic data were gathered from the Utah Department of Transportation (UDOT).
- A drill was added to the equipment roster. Adding this piece of equipment increased the aggregated sound power level of the equipment by 0.1 A-weighted decibels (dBA); therefore, the 134-dBA value discussed in the text will still be used in the model.

Comments to the draft protocol were received from the Bureau of Land Management (BLM), Alton Coal Development, and the National Park Service (NPS). Suggested changes were made to the modeling protocol, as appropriate. These comments are addressed in a separate comment matrix attached to this document (Attachment 1).

2. INTRODUCTION

Alton Coal Development, LLC has proposed to mine coal deposits primarily on federal land near the town of Alton, Utah (*Alton Coal Tract Lease by Application Draft Environmental Impact Statement* [DEIS]). The DEIS addresses existing soundscapes and the impacts to those soundscapes from the Proposed Action and action alternatives (BLM 2011). Several comments were received regarding the need to more quantitatively address noise impacts from the Proposed Action and action alternatives on existing soundscapes. Therefore, a computerized noise modeling study of potential noise impacts from the Proposed Action and action alternatives (hereinafter jointly referred to as *the project*) is being proposed to address noise-related comments to the DEIS.

Increased ambient noise levels would result from intermittent mining equipment and process operations. A variety of mobile-source mining equipment (excavators, front-end loaders, scrapers, graders, etc.) would be used to carry out the main mining function of the extraction and removal of soils and rock layers covering the coal. In addition to the mobile-source mining equipment, stationary processing equipment (crushers, screens, etc.) would be used to size and load the coal. Potential noise emissions from both mobile-source mining equipment and the fixed-position processing equipment will be modeled assuming worst-case conditions (i.e., all the proposed equipment operating at the same time).

Increased off-site roadway noise would occur from increased vehicular traffic on public roadways from vehicles associated with the project. Both worker-commute trips to and from the mine site and coal haul truck trips will be accounted for and computer modeled. Roadway noise and noise from mining activities will both be accounted for in the same model to account for any noise overlap between the two, where appropriate (i.e., in and around the Town of Alton).

Additionally, mine blasting can result in substantial noise and vibration, particularly in the very low frequency range. However, because mine blasting noise emissions are both highly transient and occur at a low frequency range, noise from mine blasting emissions is generally assessed using empirical equations rather than a computer model. Therefore, equations to calculate noise and vibration from blasting emissions are proposed to estimate noise and vibration levels at specific points of interest.

Noise levels will be modeled and analyzed from several sources of mining activity. Noise levels from mobile and stationary mining equipment, increased traffic levels on local roadways, and blasting events will all be analyzed and/or modeled to determine if noise impacts result above existing ambient conditions at several designated sensitive receptors, as discussed in the following sections.

3. BASELINE CONDITIONS CHARACTERIZATION

Modeled and calculated noise levels will be compared against ambient background locations at several areas of concern to analyze the potential effects of noise levels associated with mining and mine-related activities at these areas. The analyzed areas of concern are the towns of Alton, Panguitch, and Hatch; Bryce Canyon National Park; and the Greater Sage-Grouse habitat and lek in and adjacent to the proposed mining blocks. Figure 1 shows an overview map of the locations of the coal mining blocks and off-site roadways in relation to the sensitive noise receptors, as well as the proposed noise modeling contour boundaries for both the mining equipment and roadway noise.

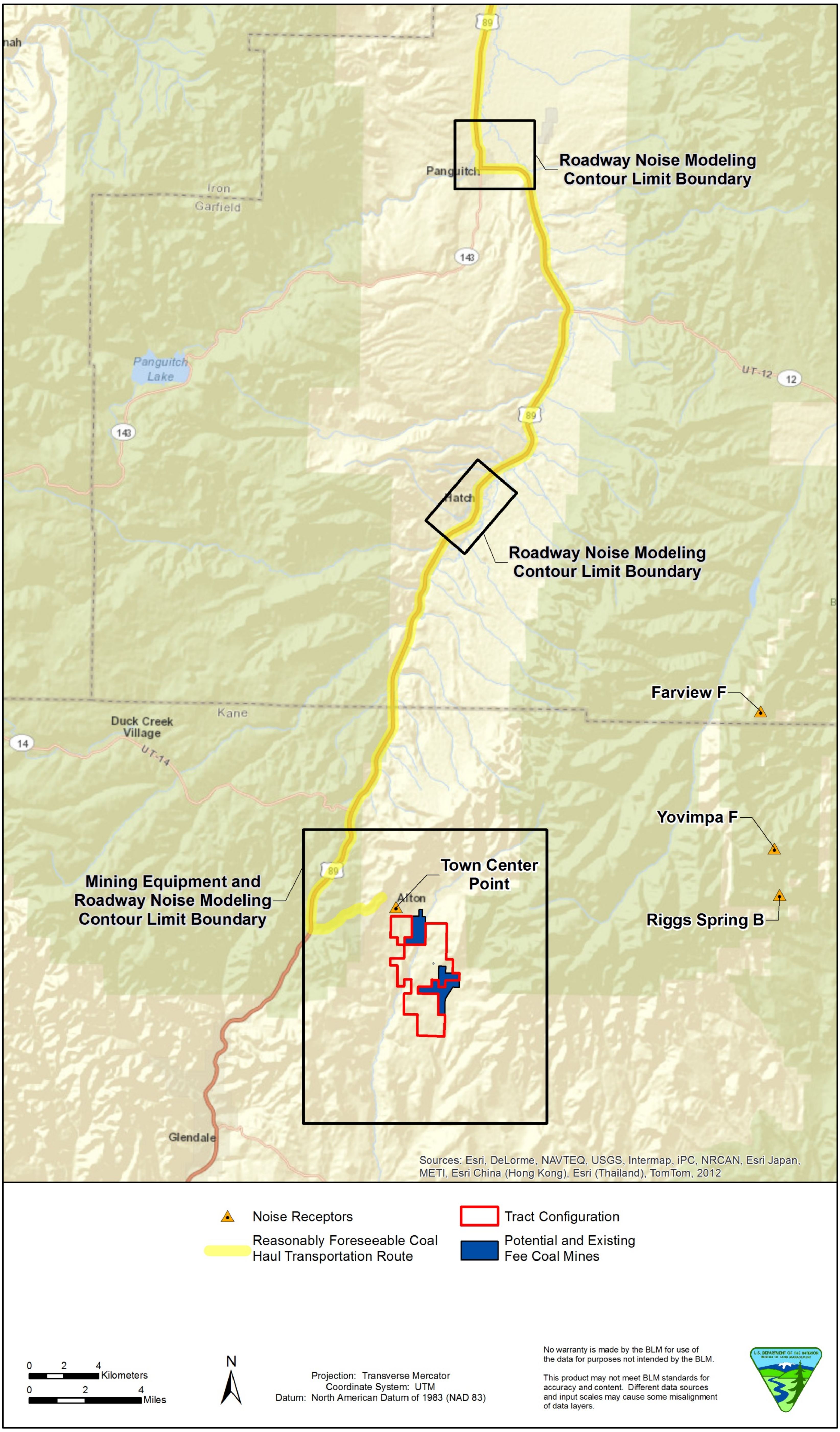

Figure 1. Overview map.

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Baseline traffic conditions will not be modeled separately from proposed project impacts to roadways; instead, roadway noise levels from total traffic (both baseline plus project) will be conservatively evaluated and compared to baseline conditions at the sensitive receptors.

As discussed in the DEIS, the Environmental Protection Agency (EPA) has offered general recommendations regarding noise thresholds. EPA has identified 55 A-weighted decibels (dBA) as the outdoor noise level above which humans can be expected to experience annoyance (EPA 1974). As outlined in the DEIS, ambient noise level surveys were conducted in the towns of Alton, Hatch, and Panguitch. Ambient noise level surveys for the town of Alton indicated average daytime noise levels ranging from 41 dBA equivalent continuous noise level (L_{eq}) to 55 dBA L_{eq}. In the towns of Hatch and Panguitch, ambient noise levels were each recorded at single locations of 64 dBA L_{eq} and 67 dBA L_{eq}, respectively. The ambient noise levels recorded in the towns will be used for this analysis.

The background levels for Bryce Canyon National Park were determined by data collected by NPS personnel at several representative locations. NPS personnel used Larson Davis 831 sound level meters to record digital recordings and to collect and analyze sound pressure levels in dBA and in one-third octave band data ranging from 12.5 hertz (Hz) to 20,000 Hz. Noise data gathered by the NPS are presented in both percentage exceedance levels (L_x) and "natural ambient" sound levels (L_{nat}). This natural ambient sound level is derived from the collected sound level data by subtracting out all human-caused, mechanical, or electrical sounds. This is done by calculating the percentage of extrinsic sounds either by listening to the sound recording collected contemporaneously with the data collected or by analyzing daily spectrograms and then using a mathematical formula to subtract these sounds from the data.

Table 1 presents noise data from Bryce Canyon National Park noise level surveys gathered by the NPS personnel from 2009 to 2012 for the three areas within the park to be evaluated in both various L_x values and L_{nat} values.

Table 1. Bryce Canyon National Park Noise Level Survey Results

Receptor Location (Year)	Sound Level Data				
	L_{90}	L_{nat}	L_{50}	L_{10}	L_{eq}
Farview F (2009)	30.0	31.8	37.8	45.8	53.0
Farview F (2010)	35.8	37.5	42.1	48.0	55.0
Yovimpa F (2009)	24.7	27.1	30.6	37.7	42.0
Yovimpa F (2010)	27.0	28.6	33.0	40.2	47.0
Riggs Spring B (2012)	24.5	24.5*	31.2	38.6	40.0

Source: BRCA Acoustical Data for Alton gathered by BLM from 2009 to 2012.

* Estimated L_{nat} from L_{90}

Based on the results, modeled project noise will be compared to the most conservative L_{nat} sound values from the three areas analyzed in Bryce Canyon National Park (i.e., Farview F, Yovimpa F, and Riggs Spring B). The background values to be used from the park for these points will be 31.8 dBA for Farview F, 27.1 dBA for Yovimpa F, and 24.5 dBA for Riggs Spring B.

Sound level data were gathered by the park service in several locations for each general area analyzed (Farview, Yovimpa, and Riggs Spring). To calculate project noise level impacts at these areas, noise levels will be modeled at a fixed point within each area as follows: Farview F (12 U 0389788 4155879), Yovimpa F (12 U 0390580 4147992), and Riggs Spring B (12 U 0390888 4145310). Additionally, noise contour lines and grid noise maps will reveal sound pressure levels for any area of the park located within 5 kilometers of the modeled sound source, as discussed in Section 4.3. The individual town and lek area receptors will be analyzed using noise contour lines and grid noise maps. Individual receptor locations will not be analyzed for these locations.

No data have been gathered for ambient sound levels at the sage-grouse lek. Therefore, for conservatism, baseline conditions at the lek will be assumed to be those of the lowest recorded L_{eq} value for Bryce Canyon National Park, or 40.0 dBA (Riggs Spring B).

Table 2 summarizes the source receptors, ambient noise conditions, and the data source and/or methodology used for the evaluation of modeling impacts.

Table 2. Noise Sensitive Receptor Table

Receptor Location (individual point UTMs; NAD 83)	Ambient Noise Condition (dBA)	Data Sources and/or Methodology	Additional Supporting Information as Applicable
Yovimpa Point (12 U 0390580 4147992)	30.6	BRCA acoustical data gathered by BLM from 2009 to 2012.	L_{nat} value used as representative of ambient conditions.
Riggs Spring (12 U 0390888 4145310)	24.5	BRCA acoustical data gathered by BLM from 2009 to 2012.	L_{nat} value used as representative of ambient conditions.
Farview Point (12 U 0389788 4155879)	31.8	BRCA acoustical data gathered by BLM from 2009 to 2012.	L_{nat} value used as representative of ambient conditions.
Town of Alton (area receptor)	41.0	Morro Group, Inc. environmental noise data gathered from points in the town in 2008.	Lowest L_{eq} value used as representative of ambient conditions.
Town of Hatch (area receptor)	64.0	Morro Group, Inc. environmental noise data gathered from point in the town in 2008.	L_{eq} value used as representative of ambient conditions.
Town of Panguitch (area receptor)	67.0	Morro Group, Inc. environmental noise data gathered from point in the town in 2008.	L_{eq} value used as representative of ambient conditions.
Sage-grouse Lek (area receptor)	40.0	BRCA acoustical data gathered by BLM for BRCA from 2009 to 2012 used as proxy.	Lowest L_{eq} value from the Bryce Canyon National Park data taken as representative of ambient conditions.

4. SOURCE CHARACTERIZATION

There are several potential sources of noise emissions from mining activities for the project. The noise sources that are analyzed in the following sections include noise levels from mining equipment and processes located on the mining blocks, increased noise levels on public roadways from mine worker and vendor commuter trips and coal haul truck trips to and from the mine, and mine blasting events.

4.1. On-Tract Activity Noise

Mining activities would occur on several potential blocks. Potential mining blocks and the locations of noise emitting area sources within these blocks are depicted on Figure 2.

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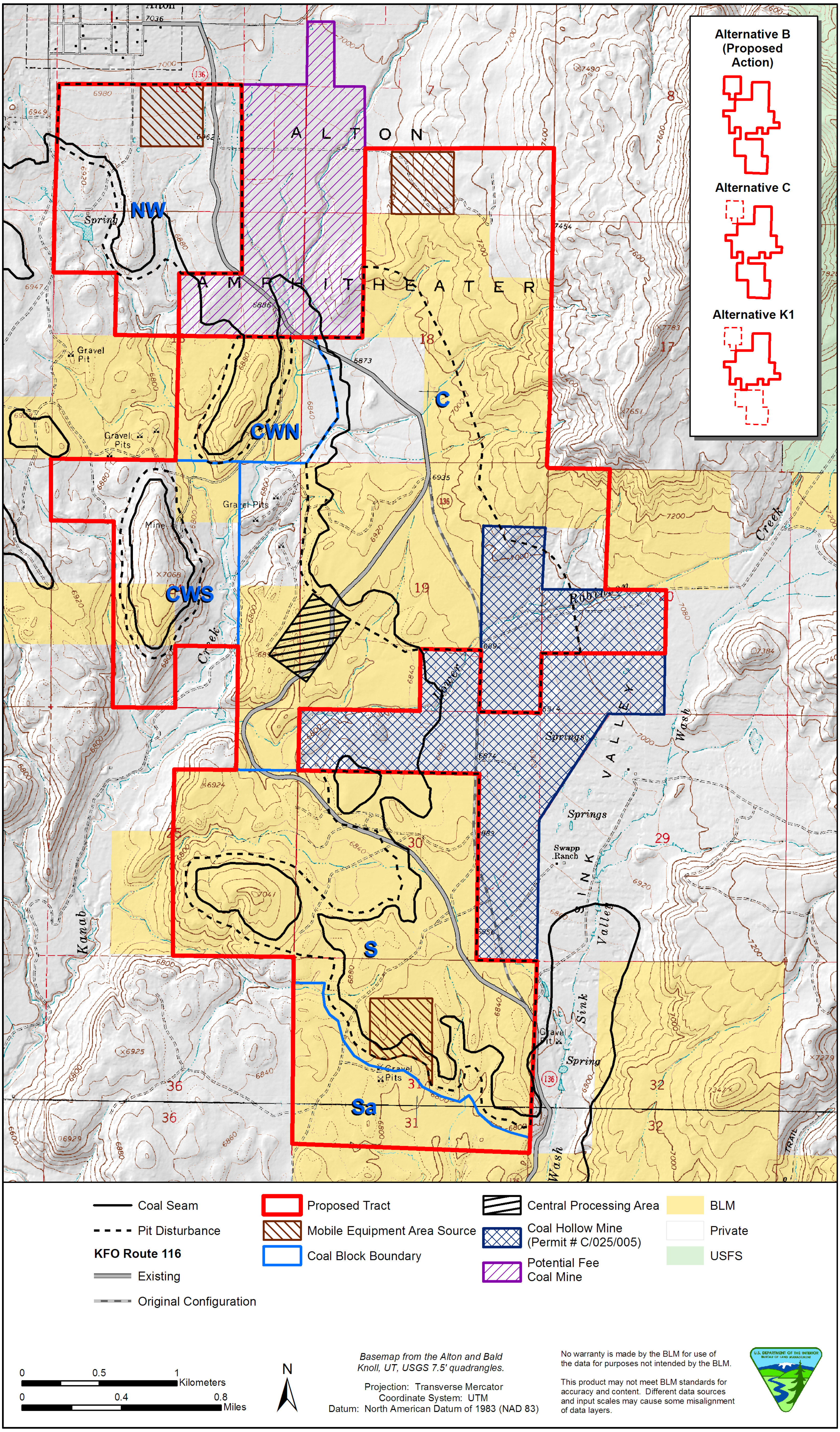

Figure 2. Mining blocks and source map.

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Of the mine blocks depicted on Figure 2, three are of particular concern due to their proximity to sensitive noise receptors. Block NW is the closest mining block to the town of Alton, Block C is closest to Bryce Canyon National Park, and Block S is close to a sage-grouse lek. Noise-emitting equipment and processes will only be evaluated within these three blocks because noise levels from mining activities in the other mining blocks (CWN and CWS) would be of equal or less impact than the blocks analyzed due to increased distance from sensitive receptors.

4.1.1. Mobile Sources

The project plant and equipment noise levels are calculated from representative measured sound power levels for other mining environmental assessments. The individual equipment or process, the estimated quantity, and the sound power level and data source are provided in Table 3.

Table 3. Plant and Equipment Fleet for Mining Activities

Source	Quantity	dBA per equipment	Information Source
Mobile			
Haul truck	5	124	Cowal Gold Mine EIS (Barrick Gold Corporation 2009)
Front-end loader	3	117	Barrick Gold Corporation 2009
Excavator	1	123	Ensham Central Project Environmental Noise Assessment (Ensham Resources 2006)
Dozer	6	118	Barrick Gold Corporation 2009
Track hoe	2	121	Barrick Gold Corporation 2009
Skytrack*	1	123	Barrick Gold Corporation 2009
Grader	2	110	Ensham Resources 2006
Water truck	2	118	Ensham Resources 2006
Scraper	4	116	Barrick Gold Corporation 2009
Diesel generator	3	100	Ensham Resources 2006
Drill	1	118	Barrick Gold Corporation 2009
Total Mobile Equipment	**30**	**134**	**–**
Fixed			
Central processing area (e.g., coal crushing, conveying, stacking, and loading)	–	124	Barrick Gold Corporation 2009

Notes: Sources are intended to be reasonably representative of equipment that would be used during mining operations but may vary depending on the availability of exact equipment at the time mining operations would occur.

* Sound power levels were assumed to be equivalent to those of an excavator.

Modeling mobile equipment is difficult because the equipment can theoretically range over the entire proposed mining tract. To overcome this difficulty and still conservatively model equipment positions relative to areas with sensitive receptors, all mobile equipment is modeled together as a single 40-acre area source. The entire area source is assumed to emit at the highest emission level (134 dBA), as if all the equipment were simultaneously operating at full capacity and were “stacked” together in a manner that maximizes the additive effects of noise levels from each piece of equipment. The highest decibel level from all the equipment summed together is calculated via the additive equation for incoherent sound sources (Sengpielaudio 2013):

$$L_{\Sigma} = 10Log_{10}\left(10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}} + \ldots. + 10^{\frac{L_n}{10}}\right) dB$$

Where:

L_{Σ} = Total sound power level

L_n = Sound power level of the separate source

Equipment of the same category (5 haul trucks, 6 dozer, etc.) was summed using the simplified equation below for the summation of equal sound power sources (The Engineering Toolbox 2013):

$$L_{\Sigma} = L_s + 10Log_{10}(n)$$

Where:

L_s = sound power level from each single source

n = number of sources

Furthermore, each modeled 40-acre mobile area source will be placed within each mining block closest to the noise sensitive receptor of greatest concern to mining in that block (the town of Alton for Block C, Bryce Canyon National Park for Block C, the sage-grouse lek for Block S), as depicted on Figure 2.

4.1.2. Central Processing Operations

Noise emissions from the coal processing operations (crushing, conveying, stacking, sorting, etc.) would take place at the central processing facilities as shown on Figure 2, which will be modeled in the same manner as the mobile equipment: as a 35-acre area source where noise is conservatively assumed to be equally distributed over the entire area. Measured sound power levels from mining process equipment (provided in Table 2) located at a gold mine (Cowal Gold Mine located in New South Wales, Australia) were assumed representative of project sound power levels of coal processing equipment (Barrick Gold Corporation 2009).

4.2. Roadway Noise

Transportation noise levels from mine-related haul road traffic will be accounted for in the model. Haul truck traffic would likely use existing roadways, in particular US-89 and Alton Road. Alton Road will be modeled from where the road exits to the north of the town of Alton to where the road intersects with US-89; this is approximately 5.6 kilometers of roadway. Portions of US-89 stretching from the town of Alton to approximately 1 kilometer north of the town of Panguitch (see Figure 1) will be modeled to determine noise level impacts from increased haul truck traffic along this roadway. The potential impact of increased vehicular activity from mining operations to other roadways (e.g., SR-20, Interstate 15, local roadways with the exception of Alton Road) will not be analyzed in the modeling due to the distance from the mine source and the lack of receptors of interest.

A traffic study by Fehr and Peers (2008) estimates average daily traffic (ADT) volumes for US-89 under four scenarios: currently existing conditions, currently existing conditions plus the addition of project coal haul truck traffic, estimated 2020 background conditions, and estimated 2020 background conditions plus project coal haul truck traffic. The estimated 2020 background conditions plus project coal haul truck traffic will be modeled as the most conservative estimation of impacts from the project to roadway noise.

Fehr and Peers (2008) estimate ADT values of between 4,400 and 5,850 vehicles per day on US-89 for the year 2020 without the addition of project-related traffic. The DEIS estimates an increase of 2% in baseline traffic from mining commuter traffic from the project. Estimates from haul truck trips from the proposed project are approximately 153 truck round-trips per day (Fehr and Peers 2008). Therefore, for modeling purposes, ADT volumes on US-89 will be assumed at 6,120 (5,850 + 2% increase from commuting trips + 153 round-trip haul truck trips), which represent the worst-case anticipated vehicle traffic on US-89 in the year 2020 with the inclusion of project haul truck trips and worker commuting trips.

The percentage of heavy trucks to light vehicle traffic along US-89 was only estimated in the Fehr and Peers (2008) report for existing traffic plus the addition of project haul truck trips. Therefore, the highest projected estimate in the Fehr and Peers (2008) report of 31% of heavy vehicles to light vehicles (with current vehicle trips used as the baseline) will be used for modeling purposes. This is likely to conservatively represent the portion of heavy vehicles to light vehicles, because the increases in traffic projected in the 2020 scenario are likely to be proportionate to that of the currently existing baseline, whereas the mine haul truck trips are anticipated to be the same.

For Alton Road, UDOT data of 150 vehicles per day will be used as the baseline value. For modeling purposes, the conservative estimate that will be used is as follows: all the additional traffic from commuting trips from US-89 (2% of 5,850 vehicles per day) and all the coal haul truck round-trips per day will take place on Alton Road. For Alton Road, then, the total estimated ADT value that will be used in the model will be 420 (150 + [2% of 5,850] increase from commuting trips + 153 round-trip haul truck trips).

The level of service (LOS) describes traffic operating conditions on roadways through several qualitative "grades" ranging from "A" (free flow of traffic) to "F" (unpredictable traffic flow with excessive delays). The Fehr and Peers (2008) report indicates that LOS on the US-89 roadway would range from A to C in 2020, without project impacts. Because the project is only expected to marginally increase traffic levels, the traffic LOS will be assumed to remain the same for modeling purposes. Although the traffic impact to Alton Road from mine-related activities will be greater than that to US-89 because of the lower baseline for Alton Road, the roadway capacity will still allow for a favorable traffic LOS (the increase in traffic from mine-related activities will result in a less than a 1-mile-per-hour reduction in average travel speed using the Highway Performance Monitoring System Field Manual Equation 20-5, estimating average travel speed for rural two-lane capacity roadway). As discussed in Section 4.2, traffic flow will be modeled assuming "steady" flow conditions based on the LOS.

4.3. Blasting Noise

Air vibration (or airblast) emissions result from the pressure or shock waves from blasting activities. Pressure waves resulting from blasting increase and decrease the air pressure at a given point from the blast fairly rapidly. Multiple equations in the literature have been developed to estimate vibration and airblast emissions from blasting activities, depending on the type of blasting occurring (fully or partially confined blast holes, unconfined surfaces, etc.), the type of rock blasted, and additional variables that affect the transmission of sound through the air (topography, shielding or amplification from barriers, meteorological conditions, whether there is a free-face or not, etc.).

4.3.1. Description of Blasting Calculations

The vibration and airblast emissions can be predicted using the relevant vibration and airblast formula presented in AS 2187.2-2006 (Standards Australia 2006).

The relevant formulae are as follows:

$$PVS = 3{,}272\ (R/Q^{1/2})^{-1.60}$$

$$SPL = 173.4 - 24(\log_{10} R - \log_{10} Q)$$

Where,

PVS = Peak Vector Sum vibration velocity (millimeters per second [mm/s])

SPL = Peak airblast noise level (dB Linear)

R = Distance between charge and receiver (meters [m])

Q = Charge mass per delay or maximum instantaneous charge (kilograms [kg])

Based on actual blasting design parameters provided by the mine, the charge mass per delay was estimated as being between 8 and 120 kg. As such, 120 kg will conservatively be used as the charge mass per delay for blasting modeling purposes. PVS (in mm/s) and SPL (in dB Linear) values will be calculated and reported for given points of concern. PVS values will be compared against the threshold for the most stringent structural damage of 6.4 mm/s (Department of Transportation Federal Transit Administration 2006), whereas SPL values will be compared against the same background noise values at receptor locations as will be used for modeling purposes.

4.3.2. Blasting Receptor Locations

Blasting noise and vibration will be estimated from the nearest site boundary to the three locations in the Bryce Canyon National Park discussed in Section 2, as well as the town of Alton and nearby sage-grouse lek.

5. SOUNDSCAPE MODELING APPROACH

The following sections provide a summary of the technical parameters that will be used in the model to evaluate noise impacts at receptor locations. Noise modeling will be conducted on portions of the SR-89 roadway of the proposed coal haul truck route and the proposed mining equipment and processes located on the mining tracts.

5.1. Description of Model: SoundPLAN

SoundPLAN Essential, Version 2.0, will be used to evaluate the noise emissions of the project. Based on the sound power levels input for each source, SoundPLAN estimates noise contours of the overall facility in accordance with a variety of standards, primarily International Organization for Standardization (ISO) 9613-2 standards for noise propagation calculations. All sound propagation losses, such as geometric spreading, air absorption, ground absorption, and barrier shielding, are calculated automatically in accordance with these recognized standards. Reflection off of adjacent structures and the ground will be accounted for in the modeling. The model uses industry-accepted propagation algorithms and accepts sound power levels (in decibels) provided by the equipment manufacturer and other sources.

5.2. Technical Capabilities and Limitations

Equipment noise sources will be summed together to produce a single emitting area source in several of the potential mining parcel blocks to generate a representative noise level assuming that all the equipment is operating at maximum capacity simultaneously. Process noise sources have already been aggregated, as discussed in Section 3.1.2; therefore, this single aggregated value will be modeled as a continuous area source. Noise from process equipment and mobile operational equipment will therefore be treated by the model as fixed areas of evenly distributed point sources. Three separate modeling runs of each of the equipment area sources will be evaluated in each of the mining blocks of concern. Each of these modeling runs will also include modeling of the process area source and the roadway area source around the town of Alton. Based on their distance from mining activities, two additional modeling runs will be done just for the roadways around the towns of Hatch and Panguitch, respectively. Table 4 outlines what will be modeled in each run.

Table 4. Proposed Modeling Run

Model Run	Modeled Noise Source						
	Block NW Mobile Equipment	Block C Mobile Equipment	Block S Mobile Equipment	Central Processing Area	SR-89 Roadway and Alton Road (town of Alton)	SR-89 Roadway (town of Hatch)	SR-89 Roadway (town of Panguitch)
1	X			X	X		
2		X		X	X		
3			X	X	X		
4						X	
5							X

As noise sources are summed, a single dBA value will be input into the model for each area calculation. Sound power will therefore be entered as a single value A-weighted sum level at a mean representative frequency of 500 Hz for all the equipment and processes (model default if frequency spectrum data are unavailable). Noise sources from mobile and fixed mining equipment and processes will have a uniform assumed height of 3 m off the ground.

Roadways will be modeled using the SoundPLAN 2.0 roadway option. Road surfaces will be modeled assuming smooth asphalt surfaces as per ISO 11819-1:1997 (ISO 1997). Traffic data to be entered into the model are discussed in Section 3.2. Because the LOS is expected to remain generally favorable all the way out to 2020, and project traffic levels are not expected to substantively increase traffic, traffic flow will be assumed to be steady for modeling purposes.

No noise barriers will be modeled from buildings, foliage, or mining high walls, even though these barriers to noise levels from mining activities will likely be present to some degree. Therefore, the model will conservatively estimate peak noise levels in the absence of any attenuation due to barriers between the noise source and the receptor of interest.

5.3. Technical Options Used in Modeling

Single receiver, noise limit contour lines, and grid noise maps will be calculated for the noise emission sources associated with mining activities and roadways, as discussed in Section 3, using the SoundPLAN model. Noise limit contour lines will be based on a grid noise calculation with grid spacing of 100 m. Grid noise maps will show all noise contours and will fill in the areas between contour lines. Noise emissions from mobile and stationary sources will be measured out to a distance of 5 kilometers from the proposed mining blocks. The roadway noise emissions will be measured out to a distance of 1 kilometer from the existing roadways. For the three single receiver emission sources in the Bryce Canyon National Park, a receiver height of 2 m will be used.

Roadway noise emissions will be modeled per Federal Highway Administration (FHWA) traffic noise model standards (FHWA 1998). Noise emissions from mobile and stationary sources on the blocks will be modeled per ISO 9613-2:1996 (ISO 1996). Both roadway and mine tract emissions will be modeled simultaneously, where appropriate (i.e., in and around the Town of Alton).

Table 5 outlines the technical parameters that will be used in the modeling.

Table 5. Technical Parameters to be used in Modeling

Technical Parameter	Standard	Input Parameters/Notes
Geometric attributes	ISO 9613-2:1996 (ISO 1996)	Automatically calculated by SoundPLAN
Meteorological conditions	ISO 1996	Air absorption will be determined using “standard day” conditions derived from the nearest representative meteorological station. Monthly data will be analyzed, and the annual mean will be used in the model for temperature, humidity, and air pressure levels.
Ground absorption	ISO 1996	The model default of “soft ground” (i.e., fields, forests, or grass) will be assumed. Roadways will be regarded as “hard ground” (i.e., asphalt) for the roadway effects portion of the calculations.
Topographic features	–	U.S. Geologic Survey (USGS) Topographic data for the project site and surrounding area will be digitized and input into the model to account for how topographic conditions will affect the geometric divergence of the sound pressure levels.

6. LITERATURE CITED

Barrick Gold Corporation. 2009. *Cowal Gold Mine E42 Modification. Modified Request*. Project No. HAL-09-34. Document No. 00309646.doc. October 2009. Available at: http://barrick.com/files/cowal/Cowal-E42-Modification-Modified-Request.pdf. Accessed May 15, 2013.

BLM. 2011. *Alton Coal Tract Lease by Application Draft Environmental Impact Statement.* Available at: http://www.blm.gov/ut/st/en/prog/energy/coal/alton_coal_project/alton_coal_eis.html. Accessed May 15, 2013.

Department of Transportation Federal Transit Administration. 2006. *Transit Noise and Vibration Impact Assessment.* FTA-VA-90-1003-06. May 2006. Available at: http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf. Accessed May 15, 2013.

Ensham Resources. 2006. *Ensham Central Project Environmental Noise Assessment*. Available at: http://www.ensham.com.au/updated/eis/pdf/Volume-2_Appendices/APPENDIX%20G%20-%20NOISE.pdf. Accessed May 15, 2013.

EPA. 1974. *Noise Levels Affecting Health and Welfare*. EPA Press Release, April 2, 1974. Available at: http://www.epa.gov/history/topics/noise/01.html. Accessed May 15, 2013.

Fehr & Peers Transportation Consultants. 2013. *Coal Hollow Development Alton Coal EIS – Traffic Technical Report*. UT06-721. Salt Lake City, Utah: Fehr & Peers Transportation Consultants.

FHWA. 1998. *FHWA Traffic Noise Model Technical Manual*. FHWA-PD-96-010, DOT-VNTSC-FHWA-98-2. Final Report. February 2008.

ISO. 1996. ISO 9613-2:1996. Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation.

———. 1997. ISO 11819-1:1997. Measurement of the Influence of Road Surfaces on Traffic Noise – Part 1: Statistical Pass-by Method.

Sengpielaudio. 2013. Sound Calculations – Total Level Adding of Non-coherent Sound Sources. Available at: http://www.sengpielaudio.com/calculator-leveladding.htm. Accessed May 13, 2013.

Standards Australia. 2006. AS 2187.2-2006. Explosives – Storage and Use – Use of Explosives.

The Engineering Toolbox. 2013. Adding Decibels. Available at: http://www.engineeringtoolbox.com/adding-decibel-d_63.html. Accessed May 13, 2013.

U.S. Department of Transportation. *Highway Performance Monitoring System Field Manual, Appendix N: Procedures for Estimating Highway Capacity*. Available at: http://www.fhwa.dot.gov/ohim/hpmsmanl/appn3.cfm. Accessed June 5, 2013.

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Attachment A

Comment Matrix

Alton Coal Tract Lease by Application Noise Analysis Protocol DRAFT
May 2013

Please Read: *Enter comments in the table below. The* ***Section #/Title*** *column is important because page and line numbers shift once revisions begin, but section numbers and titles change less often. In the* ***Page #*** *and* ***Line #*** *columns, write ONLY the NUMBER of the page and the line within the page. Also, please put your name on every comment so if we have questions, we can call you. Please avoid putting comments such as "see above." It is better to paste the same comment in another row. Submit your comments to Keith Rigtrup (krigtrup@blm.gov), and Ben Gaddis (bgaddis@swca.com, AltonCoalEIS@swca.com). Based on the current schedule the deadline for comments is May 24, 2013.*

Commenter	Section #/Title	Page #	Line #	Comment	Comment Disposition
JD McKenzie	1	1	9	~~…redress project…~~ address	This change has been made.
JD McKenzie	1	1	11	from *intermittent* mining equipment and process *operations*	This change has been made.
Byard Kershaw – Kane County	1	1	12	In the list of equipment in parentheses, "scrappers" is a misspelling. It should be "scrapers."	This change has been made.
JD McKenzie	1	1	13	~~geologic material from the earth~~ *soils and rock layers covering the coal*	This change has been made.
ACD	1	1	14	Remove "grinders"	This change has been made.
ACD	1	1	15	Change to "would be used to size the coal before shipping."	
JD McKenzie	1	1	15	~~separate the coal from the gangue~~ *to size and load the coal*	This change has been made.
JD McKenzie	1	1	18	Increased *offsite* roadway	This change has been made.
JD McKenzie	1	1	28	traffic levels on ~~offsite~~ local roadways	This change has been made.
JD McKenzie	1	1	37	blocks and *offsite* roadways	This change has been made.
Byard Kershaw – Kane County	2. Baseline Conditions Characterization	6	Line 1 and Table 2.	Include the datum used in the UTM Coordinates.	This change has been made.
JD McKenzie	3.1.1	12	4	"…equal sound power sources…" But these are not equal. Ok to approximate as equal?	Equipment that is within the same category (5 haul trucks, 6 dozers, etc.) is assumed to be of the same sound power level. For this equipment, the simpler summation equation is used. For adding together all the equipment of disparate sound power levels, the incoherent source equation is used.

Commenter	Section #/Title	Page #	Line #	Comment	Comment Disposition
ACD	3.1.1 Mobile Sources	11	10	In "Table 3" where are these noise levels taken. The average noise level that an employee can work around for an 8 hour period is 90 dbA	These are measured noise power levels of the equipment category – sources for each value are provided. The OSHA PEL for noise exposure is for a sound pressure level, which is not equivalent to a sound power level (sound power level is what will be modeled to derive sound pressures at given distances). Furthermore, PPE can be used to mitigate personal exposure, which makes the 90 dBA value irrelevant for sound modeling purposes.
ACD	3.1.1 Mobile Sources	11	10	Should add a DML45 Drill or equivalent for analysis.	This equipment has been added to the sound modeling protocol. Adding this equipment did not change the rounded sound power level that will be used for the purposes of the modeling (adding this equipment increased the total mobile equipment sound power level by 0.1 dBA, so the 134 dBA value proposed is still accurate).
Byard Kershaw – Kane County	3.1.1 Mobile Sources	11	Table 3	Same as first comment. "scrappers" should be "scrapers."	This change has been made.
ACD	3.1.2. Central Processing Operations	12	14	The proposed Facility Area is 35 acres	This change has been made.
Byard Kershaw – Kane County	3.2 Roadway Noise	12	20–31	This paragraph describes vehicle traffic on Highway 89 from the mine to Panguitch and states that past Panguitch, "The potential impact of increased vehicular activity from mining operations to other roadways…will not be analyzed…due to the distance from the mine source and the lack of receptors of interest." The map – Figure 1 on Page 3 suggests that the "Mining Equipment Modeling Boundary" doesn't extend beyond north of the town of Alton. Figure 1 appears to contradict this statement.	Figure 1 was revised to better clarify the modeling boundaries. The modeling boundaries on the figure are for the contour boundaries – noise grid maps and contour lines will only extend to the modeled boundaries depicted on Figure 1. The statement that impacts to roadways from increased vehicular activity from mining operations beyond Panguitch will not be modeled is meant to relate to the potential of increased vehicle traffic outside of the three evaluation areas of the Towns of Alton, Hatch, and Panguitch.

Commenter	Section #/Title	Page #	Line #	Comment	Comment Disposition
Byard Kershaw – Kane County	3.2 Roadway Noise	13	1–4	Are tour busses and large recreational vehicles included in this traffic study? These vehicles are likely to contribute to the noise levels in the "worst-case anticipated vehicle traffic" on Highway 89.	As cited in the protocol, the Fehr and Peers traffic technical report was relied on for vehicle traffic data. The Fehr and Peers report utilized industry standard traffic counting and other methods to establish baseline traffic conditions; therefore, any tour busses and recreational vehicles utilizing roadways should have been counted in the study. Future roadway traffic conditions are based on estimates of percentage increases to existing traffic conditions and, therefore, would also capture any anticipated roadway traffic, including tour busses and recreational vehicles.
JD McKenzie	3.2	13	3	commuting trips + 153 *round-trip* haul truck trips	This change has been made.
JD McKenzie	4.2	15	1	sources ~~were~~ *are* summed	This change has been made.
ACD	4.2. Technical Capabilities and Limitations	15	11–14	Are topographical barriers to noise Modeled?	Existing topographic conditions, including barriers due to topography, will be modeled. Impacts to topography from mining activities, since these are variable and largely unknown, will not be modeled.
JD McKenzie	4.3	16	Table 5	"…and the annual mean will be used …" Also good to run the maximum case?	The relationship between temperature, humidity, and air pressure levels to that of sound attenuation is complicated and non-linear. Increases or decreases in one variable (temperature, humidity, air pressure) do not directly lead to increases or decreases in sound attenuation, but are interrelated with one another. Therefore, since a "maximum case" between all three variables cannot be easily established, representative mean variables will be used.

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Appendix B

Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
1/1/2012	46	31	15	88	61	33	30.64	30.56	30.43
1/2/2012	54	36	17	92	60	28	30.60	30.50	30.39
1/3/2012	59	43	26	75	47	19	30.46	30.38	30.29
1/4/2012	55	39	22	81	50	19	30.58	30.50	30.44
1/5/2012	58	40	21	92	59	25	30.45	30.27	30.05
1/6/2012	54	38	22	81	54	26	30.17	30.06	29.95
1/7/2012	39	32	24	100	74	52	30.25	30.08	29.91
1/8/2012	36	27	18	92	72	52	30.46	30.34	30.25
1/9/2012	40	28	15	88	68	48	30.53	30.43	30.30
1/10/2012	53	35	17	92	62	32	30.33	30.19	30.05
1/11/2012	39	29	18	91	63	35	30.36	30.25	30.09
1/12/2012	39	27	14	84	57	30	30.38	30.32	30.23
1/13/2012	46	27	8	83	51	19	30.52	30.42	30.33
1/14/2012	55	34	13	80	46	12	30.38	30.26	30.09
1/15/2012	51	42	32	29	22	15	30.06	29.93	29.77
1/16/2012	42	26	10	83	62	40	30.22	29.89	29.70
1/17/2012	43	24	4	86	55	24	30.39	30.28	30.16
1/18/2012	50	35	19	73	48	22	30.27	30.20	30.12
1/19/2012	51	38	25	68	46	23	30.13	30.01	29.86
1/20/2012	55	40	24	53	38	22	30.07	29.95	29.83
1/21/2012	48	39	29	100	64	28	29.87	29.65	29.45
1/22/2012	36	23	9	91	74	56	30.16	30.08	29.89
1/23/2012	37	34	30	85	69	52	30.05	29.89	29.77

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
1/24/2012	36	27	18	100	82	64	30.41	30.19	29.96
1/25/2012	48	32	16	84	67	50	30.51	30.40	30.32
1/26/2012	57	40	23	92	66	39	30.31	30.17	30.03
1/27/2012	40	29	18	96	66	35	30.50	30.27	30.08
1/28/2012	44	28	11	88	55	22	30.62	30.54	30.43
1/29/2012	49	33	17	84	52	19	30.53	30.38	30.18
1/30/2012	54	38	22	74	46	18	30.16	30.03	29.93
1/31/2012	52	37	22	75	49	22	30.18	30.09	29.97
2/1/2012	53	39	24	74	49	24	30.19	30.08	29.96
2/2/2012	34	32	29	100	86	72	30.11	30.03	29.96
2/3/2012	37	29	20	88	74	59	30.26	30.16	30.08
2/4/2012	41	28	14	91	68	45	30.33	30.26	30.20
2/5/2012	42	29	16	88	62	36	30.30	30.21	30.10
2/6/2012	43	29	14	88	59	29	30.23	30.17	30.11
2/7/2012	48	31	13	84	58	31	30.23	30.16	30.08
2/8/2012	55	41	26	78	53	28	30.33	30.19	30.11
2/9/2012	52	37	21	88	62	35	30.38	30.31	30.24
2/10/2012	61	41	21	92	57	22	30.29	30.16	30.04
2/11/2012	57	43	29	85	55	24	30.06	29.85	29.74
2/12/2012	41	33	25	100	85	70	29.88	29.80	29.70
2/13/2012	42	31	19	100	88	76	29.87	29.76	29.67
2/14/2012	35	26	16	92	81	69	29.95	29.82	29.67
2/15/2012	36	30	24	92	84	75	30.06	29.91	29.85

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
2/16/2012	41	27	13	92	76	59	30.31	30.18	30.03
2/17/2012	45	33	20	92	65	37	30.29	30.21	30.14
2/18/2012	49	33	17	84	61	38	30.19	30.02	29.80
2/19/2012	40	33	25	100	74	48	30.12	29.86	29.76
2/20/2012	38	19	-1	92	71	49	30.28	30.18	30.03
2/21/2012	47	31	14	80	59	37	30.29	30.23	30.17
2/22/2012	56	40	24	88	63	38	30.25	30.11	29.87
2/23/2012	43	36	29	82	60	38	30.18	30.03	29.84
2/24/2012	51	35	18	84	53	21	30.31	30.24	30.12
2/25/2012	56	43	30	63	40	16	30.10	29.96	29.87
2/26/2012	45	33	20	68	44	20	30.13	30.02	29.86
2/27/2012	51	38	24	55	42	29	29.79	29.68	29.59
2/28/2012	41	35	28	100	85	69	30.13	29.87	29.60
2/29/2012	44	33	22	88	62	36	30.09	29.98	29.83
3/1/2012	44	36	27	78	49	20	29.99	29.88	29.76
3/2/2012	35	23	11	81	58	35	30.43	30.28	30.01
3/3/2012	50	31	12	76	54	31	30.48	30.43	30.40
3/4/2012	60	40	19	88	54	19	30.44	30.31	30.19
3/5/2012	66	43	20	84	48	12	30.19	30.05	29.83
3/6/2012	59	50	40	33	24	14	29.76	29.48	29.24
3/7/2012	29	24	19	92	78	63	30.27	29.83	29.50
3/8/2012	45	29	12	81	61	40	30.58	30.46	30.31
3/9/2012	56	36	16	84	52	19	30.56	30.38	30.17

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
3/10/2012	61	40	18	92	54	16	30.15	30.01	29.87
3/11/2012	60	45	30	53	36	19	29.90	29.84	29.78
3/12/2012	61	48	35	38	27	16	29.94	29.88	29.81
3/13/2012	62	49	35	30	23	16	29.95	29.86	29.79
3/14/2012	63	47	31	47	32	17	30.04	29.97	29.90
3/15/2012	66	47	27	69	44	19	30.13	30.03	29.96
3/16/2012	65	49	33	56	39	22	29.98	29.81	29.63
3/17/2012	56	44	32	96	64	32	29.62	29.49	29.41
3/18/2012	35	31	26	96	80	63	29.65	29.48	29.37
3/19/2012	38	30	22	92	78	64	29.97	29.72	29.63
3/20/2012	47	33	19	96	62	28	30.16	30.08	29.96
3/21/2012	60	42	24	88	55	21	30.18	30.09	30.01
3/22/2012	70	48	26	85	52	19	30.02	29.92	29.83
3/23/2012	66	53	39	59	41	22	29.93	29.87	29.81
3/24/2012	68	51	33	75	47	18	30.07	29.92	29.85
3/25/2012	65	52	39	45	33	20	29.84	29.72	29.59
3/26/2012	52	42	32	82	56	29	30.04	29.83	29.57
3/27/2012	61	42	22	81	51	20	30.07	30.00	29.93
3/28/2012	62	49	36	48	34	19	29.94	29.90	29.86
3/29/2012	64	46	27	78	51	23	30.02	29.96	29.92
3/30/2012	72	52	31	64	43	22	29.99	29.92	29.85
3/31/2012	72	55	38	57	40	22	29.86	29.72	29.53
4/1/2012	57	45	32	100	62	24	30.00	29.81	29.50

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
4/2/2012	45	33	20	92	68	43	30.10	30.05	29.98
4/3/2012	60	39	18	84	55	25	30.13	30.03	29.92
4/4/2012	68	51	34	64	40	16	29.99	29.82	29.67
4/5/2012	64	56	47	36	24	12	29.68	29.60	29.51
4/6/2012	51	39	27	69	40	10	30.22	30.00	29.61
4/7/2012	68	41	14	67	37	7	30.31	30.21	30.12
4/8/2012	73	47	21	55	31	7	30.19	30.11	30.03
4/9/2012	75	52	29	53	31	9	30.07	29.99	29.90
4/10/2012	75	56	36	41	25	8	30.00	29.84	29.70
4/11/2012	60	53	46	77	49	20	29.83	29.69	29.56
4/12/2012	52	42	32	100	69	38	29.94	29.89	29.82
4/13/2012	51	44	36	53	41	29	29.86	29.71	29.55
4/14/2012	39	34	29	100	82	64	29.91	29.68	29.43
4/15/2012	52	39	26	100	71	41	30.11	30.03	29.88
4/16/2012	61	44	26	92	56	20	30.22	30.15	30.11
4/17/2012	67	50	32	70	48	26	30.15	30.07	29.98
4/18/2012	70	54	38	76	48	20	29.99	29.92	29.86
4/19/2012	70	54	37	86	56	25	30.08	29.98	29.91
4/20/2012	75	54	32	82	54	25	30.23	30.10	30.05
4/21/2012	81	58	35	82	48	13	30.11	30.03	29.96
4/22/2012	84	62	39	73	43	12	30.05	29.97	29.91
4/23/2012	86	64	42	65	38	10	30.03	29.90	29.81
4/24/2012	78	61	44	53	31	9	30.05	29.87	29.83

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
4/25/2012	68	59	49	50	39	27	30.15	29.92	29.84
4/26/2012	66	54	41	76	49	22	29.87	29.74	29.67
4/27/2012	62	50	37	93	61	28	30.12	29.99	29.79
4/28/2012	62	47	32	75	49	22	30.04	29.97	29.90
4/29/2012	68	48	27	75	45	14	30.08	29.96	29.91
4/30/2012	75	52	29	69	42	14	29.96	29.88	29.71
5/1/2012	76	65	53	41	30	19	29.89	29.67	29.59
5/2/2012	74	63	51	41	30	19	29.75	29.69	29.61
5/3/2012	74	62	50	48	35	22	29.97	29.78	29.72
5/4/2012	74	60	45	42	28	13	29.84	29.81	29.77
5/5/2012	66	51	36	53	35	16	30.06	29.98	29.82
5/6/2012	66	46	26	46	30	13	30.13	30.08	30.01
5/7/2012	62	43	23	54	37	19	30.09	30.02	29.95
5/8/2012	75	53	31	69	42	15	30.07	30.00	29.92
5/9/2012	79	56	33	56	32	8	30.05	29.92	29.79
5/10/2012	83	60	37	46	28	9	29.95	29.77	29.67
5/11/2012	76	57	37	52	32	12	29.97	29.88	29.80
5/12/2012	79	57	34	59	33	7	30.11	30.04	29.96
5/13/2012	77	56	35	59	33	7	30.15	30.10	30.06
5/14/2012	85	59	32	48	28	8	30.15	30.02	29.85
5/15/2012	86	72	57	17	12	6	29.84	29.78	29.70
5/16/2012	83	62	41	31	20	8	29.83	29.80	29.75
5/17/2012	86	65	44	36	22	8	29.82	29.66	29.44

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
5/18/2012	72	60	47	63	39	15	29.88	29.66	29.44
5/19/2012	74	54	33	92	51	10	30.01	29.96	29.88
5/20/2012	84	61	37	53	32	10	30.04	29.98	29.92
5/21/2012	88	66	44	49	28	7	30.00	29.92	29.82
5/22/2012	88	71	54	26	17	8	29.81	29.72	29.55
5/23/2012	80	64	47	39	26	12	29.81	29.59	29.48
5/24/2012	76	56	36	59	33	6	29.72	29.61	29.39
5/25/2012	77	69	60	42	28	14	29.40	29.31	29.26
5/26/2012	58	51	44	49	32	15	29.91	29.61	29.36
5/27/2012	65	50	35	59	39	18	30.00	29.95	29.88
5/28/2012	75	53	31	64	38	12	30.04	29.97	29.90
5/29/2012	80	58	36	44	26	7	29.96	29.91	29.87
5/30/2012	85	64	42	33	21	9	29.98	29.93	29.88
5/31/2012	86	65	44	42	28	14	30.01	29.94	29.86
6/1/2012	91	70	48	50	31	12	29.95	29.83	29.72
6/2/2012	91	71	51	48	28	7	29.93	29.72	29.67
6/3/2012	92	74	56	30	19	8	30.02	29.78	29.70
6/4/2012	88	71	53	35	22	8	30.03	29.75	29.64
6/5/2012	77	71	65	34	21	8	29.89	29.64	29.50
6/6/2012	72	52	31	56	36	16	30.00	29.92	29.85
6/7/2012	82	58	33	56	32	8	30.00	29.92	29.82
6/8/2012	85	69	53	24	16	8	30.00	29.74	29.60
6/9/2012	84	74	64	28	20	12	29.90	29.63	29.52

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
6/10/2012	73	54	34	35	21	7	30.03	29.98	29.91
6/11/2012	82	56	30	44	25	6	30.21	30.03	29.95
6/12/2012	88	65	41	35	20	5	30.15	29.93	29.82
6/13/2012	89	67	45	29	18	6	30.02	29.75	29.66
6/14/2012	89	68	46	34	21	7	29.79	29.73	29.68
6/15/2012	88	68	48	36	22	8	29.97	29.76	29.70
6/16/2012	89	70	50	41	27	12	30.16	29.93	29.84
6/17/2012	93	71	48	41	23	4	30.19	29.88	29.77
6/18/2012	91	75	58	23	14	5	29.76	29.68	29.59
6/19/2012	91	73	54	24	16	7	29.91	29.69	29.58
6/20/2012	86	67	47	39	24	9	30.14	29.90	29.74
6/21/2012	97	70	42	37	22	6	29.94	29.82	29.70
6/22/2012	91	78	64	24	15	6	29.70	29.65	29.59
6/23/2012	90	72	54	14	10	5	29.91	29.65	29.58
6/24/2012	93	77	61	13	10	7	30.07	29.82	29.73
6/25/2012	90	73	55	42	29	15	29.90	29.83	29.74
6/26/2012	90	77	64	20	13	6	30.02	29.75	29.68
6/27/2012	91	74	57	26	18	9	29.86	29.81	29.76
6/28/2012	92	74	56	43	28	13	30.16	29.92	29.87
6/29/2012	93	79	65	32	21	10	29.94	29.89	29.81
6/30/2012	95	73	50	31	18	5	29.88	29.80	29.73
7/1/2012	90	71	51	28	18	7	30.01	29.78	29.71
7/2/2012	92	72	51	38	24	9	29.84	29.80	29.76

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
7/3/2012	92	72	52	33	23	13	30.00	29.80	29.74
7/4/2012	90	72	53	32	25	18	30.02	29.81	29.77
7/5/2012	84	73	62	72	49	26	29.95	29.89	29.82
7/6/2012	90	70	50	71	46	20	30.23	30.01	29.94
7/7/2012	92	74	55	66	38	10	30.21	29.97	29.89
7/8/2012	95	75	55	51	32	12	30.00	29.95	29.90
7/9/2012	98	76	53	55	33	10	29.99	29.92	29.86
7/10/2012	99	79	58	42	26	10	30.16	29.88	29.81
7/11/2012	98	84	70	27	20	12	30.17	29.89	29.81
7/12/2012	98	81	64	40	26	12	30.24	29.92	29.81
7/13/2012	85	74	62	84	58	32	30.22	29.98	29.89
7/14/2012	81	70	58	100	68	36	30.14	29.97	29.90
7/15/2012	79	69	59	78	58	37	30.18	29.99	29.89
7/16/2012	84	68	52	77	52	26	30.08	29.91	29.84
7/17/2012	85	68	50	89	53	17	30.06	29.90	29.83
7/18/2012	88	71	54	40	24	7	30.18	29.94	29.90
7/19/2012	85	67	48	56	36	16	30.07	30.03	29.96
7/20/2012	91	74	57	80	51	21	30.29	30.06	29.96
7/21/2012	92	76	60	73	49	24	30.25	30.07	29.94
7/22/2012	89	75	60	90	57	23	30.14	29.99	29.88
7/23/2012	88	75	62	78	51	24	30.24	30.02	29.87
7/24/2012	80	69	58	86	67	47	30.22	30.01	29.90
7/25/2012	88	74	60	72	49	25	29.96	29.92	29.85

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
7/26/2012	92	74	55	72	45	17	29.95	29.89	29.84
7/27/2012	90	74	58	67	43	18	30.17	29.92	29.86
7/28/2012	92	76	59	60	41	21	30.21	29.94	29.87
7/29/2012	85	74	63	61	47	33	30.26	30.03	29.91
7/30/2012	80	72	63	81	60	38	30.27	30.07	29.98
7/31/2012	85	71	56	93	65	37	30.25	30.07	29.96
8/1/2012	81	70	59	90	66	42	30.27	30.09	29.99
8/2/2012	91	74	57	67	41	15	30.22	30.00	29.84
8/3/2012	88	74	60	64	44	23	30.16	29.89	29.81
8/4/2012	85	73	61	49	37	25	30.17	29.96	29.83
8/5/2012	88	70	52	83	51	18	30.09	30.04	29.99
8/6/2012	89	76	62	67	45	22	30.36	30.11	30.03
8/7/2012	93	74	55	86	54	21	30.23	30.09	29.95
8/8/2012	93	76	58	65	43	21	30.24	30.03	29.96
8/9/2012	93	76	58	78	49	20	30.23	30.03	29.92
8/10/2012	94	78	62	65	41	16	30.22	29.91	29.82
8/11/2012	93	74	55	77	46	14	30.18	29.94	29.87
8/12/2012	92	75	58	72	46	19	30.17	29.99	29.88
8/13/2012	90	76	62	72	48	24	30.25	30.00	29.86
8/14/2012	87	73	58	90	61	32	30.25	29.97	29.85
8/15/2012	88	73	57	84	54	23	30.14	29.91	29.84
8/16/2012	92	74	55	80	48	16	30.14	29.93	29.86
8/17/2012	91	79	66	63	46	28	30.23	30.01	29.85

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
8/18/2012	88	73	58	84	53	22	30.01	29.92	29.83
8/19/2012	87	74	60	73	54	35	30.27	29.97	29.84
8/20/2012	85	71	56	100	66	32	30.28	29.98	29.88
8/21/2012	86	74	61	78	58	37	30.22	29.99	29.87
8/22/2012	74	66	58	93	73	53	30.15	29.98	29.89
8/23/2012	76	68	59	93	70	46	30.13	29.93	29.87
8/24/2012	84	70	56	80	62	43	30.07	29.92	29.82
8/25/2012	85	70	54	83	54	25	30.09	29.92	29.80
8/26/2012	86	71	55	86	59	31	30.14	29.92	29.85
8/27/2012	87	71	54	80	53	25	30.27	30.00	29.94
8/28/2012	90	72	53	77	51	24	30.25	30.00	29.93
8/29/2012	91	74	57	72	46	19	30.19	29.97	29.83
8/30/2012	88	72	56	72	46	20	30.04	29.87	29.78
8/31/2012	77	69	61	84	64	44	30.19	29.94	29.85
9/1/2012	83	70	56	84	55	26	29.97	29.93	29.87
9/2/2012	85	68	51	83	53	22	30.21	29.97	29.91
9/3/2012	87	69	50	71	45	18	30.05	29.99	29.94
9/4/2012	85	69	53	61	42	23	30.25	30.03	29.96
9/5/2012	88	69	50	83	48	13	30.08	29.98	29.91
9/6/2012	84	70	55	72	51	29	30.13	29.93	29.88
9/7/2012	87	70	52	86	55	23	30.10	30.02	29.96
9/8/2012	86	68	50	63	39	14	30.29	30.09	29.99
9/9/2012	88	67	45	58	37	16	30.26	30.01	29.91

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
9/10/2012	81	68	55	60	43	26	30.16	29.92	29.84
9/11/2012	68	62	55	100	82	63	30.17	29.99	29.90
9/12/2012	76	65	54	100	64	27	30.23	30.10	30.02
9/13/2012	79	60	40	70	42	14	30.34	30.26	30.19
9/14/2012	81	61	41	73	44	15	30.32	30.22	30.14
9/15/2012	84	65	46	66	40	14	30.21	30.13	30.06
9/16/2012	81	63	45	61	38	15	30.13	30.05	29.97
9/17/2012	81	64	46	56	36	15	30.19	30.02	29.95
9/18/2012	81	59	36	59	34	9	30.19	30.11	30.06
9/19/2012	83	60	37	64	37	9	30.20	30.09	30.02
9/20/2012	85	64	42	53	32	11	30.26	30.07	29.99
9/21/2012	85	64	42	57	34	10	30.13	30.03	29.97
9/22/2012	85	64	42	53	34	14	30.23	30.02	29.97
9/23/2012	81	68	55	51	36	21	30.04	29.99	29.94
9/24/2012	76	64	51	50	38	25	30.17	29.98	29.82
9/25/2012	68	58	47	100	68	35	30.10	29.97	29.85
9/26/2012	73	55	36	92	61	29	30.11	30.01	29.95
9/27/2012	76	58	39	92	58	23	30.12	30.05	29.99
9/28/2012	79	60	40	82	48	13	30.09	30.00	29.93
9/29/2012	82	61	39	67	40	13	30.11	30.05	29.99
9/30/2012	83	62	41	62	38	13	30.19	30.13	30.09
10/1/2012	83	61	39	62	38	13	30.22	30.12	30.04
10/2/2012	84	61	37	64	37	10	30.09	29.98	29.88

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
10/3/2012	85	65	45	49	30	11	29.96	29.91	29.85
10/4/2012	79	61	43	42	28	13	30.04	29.97	29.91
10/5/2012	75	59	42	58	38	17	30.07	29.99	29.91
10/6/2012	71	54	36	40	26	12	30.09	30.01	29.93
10/7/2012	70	49	28	51	31	10	30.13	30.05	29.98
10/8/2012	74	54	33	48	32	16	30.05	29.96	29.90
10/9/2012	76	58	39	60	38	15	30.00	29.92	29.87
10/10/2012	73	59	45	60	45	29	30.00	29.92	29.85
10/11/2012	68	55	42	70	49	27	30.02	29.90	29.84
10/12/2012	49	45	40	93	77	60	30.10	29.98	29.81
10/13/2012	64	51	38	100	72	43	30.26	30.16	30.05
10/14/2012	67	51	35	92	63	34	30.33	30.24	30.17
10/15/2012	73	54	34	92	57	22	30.14	30.06	29.99
10/16/2012	75	56	37	85	54	23	30.00	29.90	29.79
10/17/2012	64	50	36	71	44	16	30.16	30.05	29.89
10/18/2012	69	49	28	69	42	14	30.27	30.19	30.13
10/19/2012	74	51	28	75	45	14	30.18	30.04	29.89
10/20/2012	73	55	37	60	37	14	29.89	29.78	29.69
10/21/2012	69	59	48	59	46	32	29.75	29.71	29.68
10/22/2012	65	59	53	66	50	34	29.71	29.68	29.63
10/23/2012	64	57	49	50	33	16	29.75	29.70	29.65
10/24/2012	53	42	30	82	59	36	30.11	29.90	29.73
10/25/2012	53	36	19	96	59	22	30.31	30.18	30.09

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
10/26/2012	52	35	18	84	52	19	30.44	30.31	30.20
10/27/2012	63	42	21	68	42	16	30.22	30.15	30.09
10/28/2012	68	47	25	69	43	16	30.19	30.11	30.03
10/29/2012	71	50	28	69	42	14	30.21	30.13	30.08
10/30/2012	73	53	32	64	41	17	30.19	30.12	30.05
10/31/2012	73	52	30	69	40	11	30.14	30.06	29.98
11/1/2012	66	55	44	37	25	12	29.98	29.95	29.91
11/2/2012	65	46	26	63	40	16	30.10	30.03	29.96
11/3/2012	66	46	26	68	42	16	30.23	30.16	30.07
11/4/2012	68	47	25	69	45	20	30.35	30.29	30.22
11/5/2012	68	49	30	72	48	24	30.40	30.32	30.24
11/6/2012	69	49	28	78	51	23	30.35	30.24	30.16
11/7/2012	71	51	30	78	47	16	30.15	30.04	29.86
11/8/2012	65	51	37	71	46	20	29.89	29.74	29.62
11/9/2012	51	44	37	86	76	66	29.71	29.59	29.49
11/10/2012	36	31	25	92	70	47	30.06	29.78	29.64
11/11/2012	35	25	14	92	64	35	30.50	30.32	30.05
11/12/2012	47	29	11	88	57	25	30.53	30.43	30.34
11/13/2012	52	34	15	84	56	28	30.42	30.33	30.25
11/14/2012	59	39	18	88	54	19	30.31	30.22	30.12
11/15/2012	55	38	20	75	50	24	30.29	30.21	30.13
11/16/2012	58	48	37	70	49	28	30.09	30.05	30.01
11/17/2012	56	45	33	82	67	51	30.10	30.01	29.96

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
11/18/2012	55	46	37	85	62	38	30.15	30.05	29.96
11/19/2012	57	43	28	85	60	35	30.27	30.22	30.15
11/20/2012	61	44	26	85	55	25	30.27	30.16	30.06
11/21/2012	61	44	27	69	45	20	30.11	30.03	29.96
11/22/2012	55	40	25	75	55	35	30.46	30.29	30.07
11/23/2012	54	38	22	92	62	32	30.54	30.43	30.34
11/24/2012	65	44	22	81	48	15	30.36	30.21	30.04
11/25/2012	64	45	26	55	36	16	30.07	29.98	29.89
11/26/2012	55	39	22	77	53	28	30.28	30.18	30.03
11/27/2012	62	40	18	84	51	17	30.35	30.26	30.19
11/28/2012	62	46	29	59	42	25	30.21	30.11	30.02
11/29/2012	56	44	32	64	51	38	30.12	30.07	30.04
11/30/2012	52	46	39	79	65	50	30.02	29.98	29.94
12/1/2012	54	43	32	89	70	50	30.09	30.04	30.00
12/2/2012	54	43	31	85	68	50	30.03	29.92	29.83
12/3/2012	53	42	30	96	73	50	30.27	30.11	29.93
12/4/2012	61	45	29	92	62	32	30.36	30.27	30.21
12/5/2012	62	46	29	72	48	23	30.19	30.07	29.97
12/6/2012	56	47	37	85	64	43	29.98	29.94	29.86
12/7/2012	50	37	24	92	66	39	30.09	30.02	29.92
12/8/2012	54	39	23	81	50	19	30.01	29.94	29.87
12/9/2012	34	23	12	84	61	38	30.40	30.23	30.01
12/10/2012	46	28	9	83	58	33	30.37	30.27	30.17

Table B1. Daily Meteorological Data for the Alton Area (Cedar City Regional Airport)

Date	Max. Temperature (°F)	Mean Temperature (°F)	Min. Temperature (°F)	Max. Humidity (%)	Mean Humidity (%)	Min. Humidity (%)	Max. Sea Level Pressure (in Hg)	Mean Sea Level Pressure (in Hg)	Min. Sea Level Pressure (in Hg)
12/11/2012	49	32	14	81	55	29	30.21	30.07	29.88
12/12/2012	51	42	33	44	34	23	29.84	29.78	29.73
12/13/2012	50	45	39	37	30	22	29.78	29.74	29.68
12/14/2012	39	35	30	100	86	72	29.84	29.66	29.52
12/15/2012	36	32	28	92	85	78	29.92	29.83	29.78
12/16/2012	35	30	25	92	81	69	30.07	29.99	29.89
12/17/2012	41	34	26	89	80	70	30.05	29.97	29.86
12/18/2012	43	36	29	96	85	73	29.85	29.67	29.53
12/19/2012	22	10	-2	91	77	62	30.60	30.17	29.71
12/20/2012	27	9	-10	91	76	61	30.64	30.51	30.37
12/21/2012	39	21	2	80	59	37	30.40	30.24	30.16
12/22/2012	42	28	13	73	54	34	30.16	30.06	29.94
12/23/2012	42	30	18	68	59	49	30.12	30.01	29.90
12/24/2012	39	34	29	92	73	54	30.17	29.87	29.76
12/25/2012	31	17	3	92	74	55	30.34	30.20	29.93
12/26/2012	31	27	23	92	67	42	29.88	29.77	29.72
12/27/2012	32	26	20	88	79	69	30.10	29.89	29.77
12/28/2012	31	19	6	96	72	47	30.29	30.21	30.10
12/29/2012	35	23	10	84	61	38	30.25	30.15	30.01
12/30/2012	25	19	13	91	76	60	30.04	29.93	29.85
12/31/2012	24	12	0	92	79	65	30.40	30.11	29.94
Annual Averages	***67***	***52***	***36***	***70***	***48***	***25***	***30.13***	***29.99***	***29.89***

Source: Weather Underground, Inc. (2013)

Modeled Values	**Value**	**Units**
Mean Temperature	11	^{o}C
Mean Humidity	48	%
Mean Atmospheric Pressure	1,016	mbar

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Appendix C

Noise Level Contributions from Different Sources to each Receptor

Table C1. Noise Emissions of Road Traffic - Hatch

Stationing (km)	ADT Veh./24h	Traffic Values				Control Device	Constr. Speed (km/h)	Affect. Veh. %	Road Surface	Gradient Min./Max.%
		Vehicles Type	Vehicle Name	Veh./h	Speed (km/h)					
SR-89 Traffic direction: In entry direction										
0+000	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	2.1/-0.1
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
3+319	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	1.1
		Automobiles	-	175	65					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	65					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
4+518	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	1.1/0
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
6+240	-					-	-	-	-	-

Table C2. Noise Emissions of Road Traffic - Panguitch

Stationing (km)	ADT Veh./24h	Traffic Values: Vehicles type	Vehicle name	Veh./h	Speed (km/h)	Control Device	Constr. Speed (km/h)	Affect. Veh. %	Road Surface	Gradient Min./Max.%
SR-89 Traffic direction: In entry direction										
0+000	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	-6.8/5.3
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
2+035	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	-1/0.3
		Automobiles	-	175	60					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	60					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
5+421	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	-1.3/0
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
7+436	-					-	-	-	-	-

Table C3. Noise Emissions of Road Traffic - Track C

Stationing (km)	ADT Veh./24h	Traffic Values				Control Device	Constr. Speed (km/h)	Affect. Veh. %	Road Surface	Gradient Min./Max.%
		Vehicles type	Vehicle name	Veh./h	Speed (km/h)					
Alton Road Traffic direction: In entry direction										
0+000	420	Total	-	18	-	none	-	-	DGAC (dense-graded asphaltic concrete)	2.8/0.2
		Automobiles	-	9	55					
		Medium trucks	-	-	-					
		Heavy trucks	-	9	55					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
6+028	-					-	-	-	-	-
SR-89 Traffic direction: In entry direction										
1+907	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	0.0/11.8
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
8+390	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	0.7
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
8+760	-					-	-	-	-	-

Table C3. Noise Emissions of Road Traffic - Track C

Local Roadways Traffic direction: In entry direction										
0+306	384	Total	-	16	-	none	-	-	DGAC (dense-graded asphaltic concrete)	5.1/5.9
		Automobiles	-	8	55					
		Medium trucks	-	-	-					
		Heavy trucks	-	8	55					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
0+695	384	Total	-	16	-	none	-	-	DGAC (dense-graded asphaltic concrete)	0.3/5.6
		Automobiles	-	8	55					
		Medium trucks	-	-	-					
		Heavy trucks	-	8	55					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
1+865	-					-	-	-	-	-

Table C4. Noise Emissions of Road Traffic - Tract NW

Stationing (km)	ADT Veh./24h	Traffic Values: Vehicles Type	Vehicle Name	Veh./h	Speed (km/h)	Control Device	Constr. Speed (km/h)	Affect. Veh. %	Road Surface	Gradient Min./Max.%
Alton Road Traffic direction: In entry direction										
0+000	420	Total	-	18	-	none	-	-	DGAC (dense-graded asphaltic concrete)	2.8/0.2
		Automobiles	-	9	55					
		Medium trucks	-	-	-					
		Heavy trucks	-	9	55					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
6+028	-					-	-	-	-	-
SR-89 Traffic direction: In entry direction										
1+907	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	0.0/11.8
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
8+390	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	0.7
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
8+760	-					-	-	-	-	-

Table C4. Noise Emissions of Road Traffic - Tract NW

Local Roadways Traffic direction: In entry direction										
0+306	384	Total	-	16	-	none	-	-	DGAC (dense-graded asphaltic concrete)	5.1/5.9
		Automobiles	-	8	55					
		Medium trucks	-	-	-					
		Heavy trucks	-	8	55					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
0+695	384	Total	-	16	-	none	-	-	DGAC (dense-graded asphaltic concrete)	0.3/5.6
		Automobiles	-	8	55					
		Medium trucks	-	-	-					
		Heavy trucks	-	8	55					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
1+865	-					-	-	-	-	-

Table C5. Noise Emissions of Road Traffic - Tract S

Stationing (km)	ADT Veh./24h	Traffic Values: Vehicles Type	Vehicle Name	Veh./h	Speed (km/h)	Control Device	Constr. Speed (km/h)	Affect. Veh. %	Road Surface	Gradient Min./Max.%
Alton Road Traffic direction: In entry direction										
0+000	420	Total	-	18	-	none	-	-	DGAC (dense-graded asphaltic concrete)	2.8/0.2
		Automobiles	-	9	55					
		Medium trucks	-	-	-					
		Heavy trucks	-	9	55					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
6+028	-					-	-	-	-	-
SR-89 Traffic direction: In entry direction										
1+907	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	0.0/11.8
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
8+390	6120	Total	-	255	-	none	-	-	DGAC (dense-graded asphaltic concrete)	0.7
		Automobiles	-	175	105					
		Medium trucks	-	-	-					
		Heavy trucks	-	80	90					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
8+760	-					-	-	-	-	-

Table C5. Noise Emissions of Road Traffic - Tract S

Local Roadways Traffic direction: In entry direction										
0+306	384	Total	-	16	-	none	-	-	DGAC (dense-graded asphaltic concrete)	5.1/5.9
		Automobiles	-	8	55					
		Medium trucks	-	-	-					
		Heavy trucks	-	8	55					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
0+695	384	Total	-	16	-	none	-	-	DGAC (dense-graded asphaltic concrete)	0.3/5.6
		Automobiles	-	8	55					
		Medium trucks	-	-	-					
		Heavy trucks	-	8	55					
		Buses	-	-	-					
		Motorcycles	-	-	-					
		Auxiliary Vehicle	-	-	-					
1+865	-					-	-	-	-	-

Appendix D

Calculations for Blasting Noise and Vibration Impacts at each Receptor

Table D1. Blasting Impact Noise Calculations

Receptor	Closest Mine Block	Distance (D) (ft)	Cube root scaled distance $(D/W^3)^1$ (ft/lb^3)	Airblast Overpressure (AB)		Blasting Impact (SPL)	
				Highwall[2] (psi x 10^6)	Parting[3] (psi x 10^6)	Highwall[4] (dB linear)	Parting[4] (dB linear)
Tract (50 ft)	Block C, NW, S	50	8	31,792	6,057,862	141	186
Yovimpa Point	Block C	65,000	10,107	107	54	91	85
Riggs Spring	Block C	65,000	10,107	107	54	91	85
Farview Point	Block C	74,000	11,506	97	43	90	83
Town of Alton (nearest building)	Block NW	500	78	5,109	144,318	125	154
Town of Alton (nearest building)	Block C	5,400	840	772	3,034	109	120
Town of Alton (nearest building)	Block S	20,000	3,110	273	362	99	102

1 The cube-root scaled distance is calculated based on a maximum instantaneous charge of 266 lb per delay.

2 Calculated via the equation for airblast overpressure from highwall coal mine blasting (high-pass frequencies of greater than 0.1 Hz):

$$AB = 0.162 \times \left(\frac{D}{W^{1/3}}\right)^{-0.794}$$

3 Calculated via the equation for airblast overpressure from parting coal mine blasting (high-pass frequencies of greater than 0.1 Hz)

$$AB = 169 \times \left(\frac{D}{W^{1/3}}\right)^{-1.623}$$

4 Calculated via the standard equation for deriving sound pressure levels in decibels:

$$SPL = 20 \times \log_{10}\left(\frac{AB}{P_0}\right)$$

Table D2. Blasting Impact Vibration Calculations

Receptor	Closest Mine Block	Distance (ft)	Square root scaled distance[1] (ft/lb^2)	Vibration Impact	
				Mean[2] (in/s)	Maximum[3] (in/s)
Tract (50 ft)	Block C, NW, S	50	3	21.7	79.8
Yovimpa Point	Block C	65,000	3,985	0.0004	0.0015
Riggs Spring	Block C	65,000	3,985	0.0004	0.0015
Farview Point	Block C	74,000	4,537	0.0003	0.0012
Town of Alton (nearest building)	Block NW	500	31	0.7	2.4
Town of Alton (nearest building)	Block C	5,400	331	0.0176	0.0647
Town of Alton (nearest building)	Block S	20,000	1,226	0.0024	0.0088

[1] The square-root scaled distance is calculated based on a maximum instantaneous charge of 266 lb per delay.

[2] Calculated via the equation for mean expected vibration from blasting:

$$PPV = 119 \times \left(\frac{D}{W^{1/2}}\right)^{-1.52}$$

[3] Calculated via the equation for maximum expected vibration from blasting:

$$PPV = 438 \times \left(\frac{D}{W^{1/2}}\right)^{-1.52}$$