

**OPERATING PERMIT APPLICATION
MONTANA LIMESTONE RESOURCES**

**APPENDIX E
OPERATIONAL NOISE ASSESSMENT**

Prepared for:

Montana Limestone Resources, LLC
P.O. Box 16630
Missoula, MT 59808-6630

Compiled by:

WESTECH Environmental Services, Inc.
P.O. Box 6045
Helena, MT 59604

Revised September 2017

APPENDIX E

OPERATIONAL NOISE ASSESSMENT MONTANA LIMESTONE RESOURCES PROJECT GRANITE COUNTY, MONTANA

Prepared for:

Montana Limestone Resources, LLC
P.O. Box 16630
Missoula, Montana 59808-6630

Prepared by:

Sean Connolly
Big Sky Acoustics, LLC
PO Box 27
Helena, Montana 59624

October 2014
Revised September 2017

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION.....	1
2.0 NOISE TERMINOLOGY	1
3.0 NOISE GUIDELINES	2
4.0 NOISE LEVEL MEASUREMENTS	3
5.0 OPERATIONAL NOISE	3
5.1 PLANT SITE.....	4
5.2 BLASTING NOISE	5
5.3 BACK-UP ALARMS	5
5.4 OFF-SITE HAUL TRUCKS	5
6.0 REFERENCES CITED.....	7

TABLES

Table 1	Change in Noise Levels vs. Apparent Change in Loudness	3
Table 2	Plant Site Reference Noise Levels.....	4
Table 3	Plant Site Predicted Noise Levels.....	4
Table 4	Predicted Traffic Noise Levels.....	7

FIGURE

Figure 1	Predicted Operational L_{dn} Noise Contours.....	9
----------	--	---

1.0 INTRODUCTION

Montana Limestone Resources (MLR) is proposing a limestone quarry and plant approximately 2.5 miles west of Drummond, Montana. The Baseline Noise Analysis quantified the existing 2014 ambient noise environment in the vicinity of the project site (Appendix A-11). Big Sky Acoustics, LLC (BSA) predicted the equipment and operational noise levels generated by the project, and compared the levels to the existing noise levels. This report summarizes the Operational Noise Assessment.

2.0 NOISE TERMINOLOGY

Noise is generally defined as unwanted sound, and can be intermittent or continuous, steady or impulsive, stationary or transient. Noise levels heard by humans and animals are dependent on several variables, including distance and ground cover between the source and receiver and atmospheric conditions. Perception of noise is affected by intensity, frequency, pitch and duration, and a person's attitude toward the noise source.

Noise levels are quantified using units of decibels (dB). Humans typically have reduced hearing sensitivity at low frequencies compared with their response at high frequencies. The "A-weighting" of noise levels, or A-weighted decibels (dBA), closely correlates to the frequency response of normal human hearing (250 to 4,000 hertz [Hz]). Decibels are logarithmic values, and therefore, the combined noise level of two 50 dBA noise sources is 53 dBA, not 100 dBA.

Noise levels typically decrease by approximately 6 dBA every time the distance between the source and receptor is doubled, depending on the characteristics of the source and the conditions over the path the noise travels. The reduction in noise levels can be increased if a solid barrier or natural topography is located between the source and receptor.

For environmental noise studies, noise levels are typically described using A-weighted equivalent noise levels, L_{eq} , during a certain time period. The L_{eq} metric uses a single number, similar to an average, to describe the constantly fluctuating instantaneous ambient noise levels at a receptor location during a period of time, and accounts for all noises and quiet periods that occur during that time period.

The 1st percentile-exceeded noise level, L_1 , is a metric that indicates the single noise level that is exceeded during 1 percent of a measurement period. For example, over a 60-second measurement period, a fluctuating noise that occurs for at least 0.6 seconds during that time will determine the L_1 . The L_1 is often near the high end of the instantaneous noise levels during a measurement period, and is typically used to measure impulsive noises of brief durations, such as gunshots, backup alarms, impact noise (such as rocks dumped into an empty truck bed), *etc.* The L_{max} metric denotes the maximum instantaneous noise level recorded during a measurement period.

The day-night average noise level, L_{dn} , is a single number descriptor that represents the constantly varying sound level during a continuous 24-hour period. The L_{dn} can be determined using 24 consecutive one-hour L_{eq} noise levels, $L_{eq}(h)$, or estimated using measured L_{eq} noise levels during shorter time periods (FTA 2006). The L_{dn} includes a 10-decibel penalty that is added to noises that occur during the nighttime hours between 10:00 p.m. and 7:00 a.m., to account for people's higher sensitivity to noise at night when the background noise level is typically low. Because it represents a weighted average noise level during a 24-hour period, the L_{dn} is not effective for describing individual or intermittent noise events, such as a single blast.

Large amplitude impulsive sounds, such as blasting, are commonly defined using the unweighted instantaneous peak noise level, L_{pk} . L_{pk} represents the highest instantaneous noise level during a certain time period, and the units of L_{pk} are unweighted peak decibels (dBP). L_{pk} is used to assess blast noise because A-weighting underestimates the human annoyance caused by these low frequency impulsive sounds (USACHPPM 2005).

3.0 NOISE GUIDELINES

Granite County and the State of Montana do not have noise ordinances or regulations to limit the noise levels of the quarry or processing operations. However, excessive noise can be considered a public nuisance according to Montana Code, if the noise "endangers safety or health, is offensive to the senses, or obstructs the free use of property so as to interfere with comfortable enjoyment of life or property by an entire community or neighborhood or by any considerable number of persons" (MCA 2011).

As a result of the Noise Control Act of 1972, the EPA developed acceptable noise levels under various conditions that would protect public health and welfare with an adequate margin of safety. The EPA identified outdoor L_{dn} noise levels less than or equal to 55 dBA as sufficient to protect public health and welfare in residential areas and other places where quiet is a basis for use (EPA 1979). Although the EPA guideline is not an enforceable regulation, it is a commonly accepted target noise level for environmental noise studies.

No regulations limit the blasting noise produced by the project, but the U.S. Army has determined an approximate noise level associated with human annoyance to blast noise. In general, L_{pk} 115 dBP at a listener location represents the threshold of annoyance for people, and below this level there is a low risk of noise complaints (USACHPPM 2005).

The Montana Department of Transportation (MDT) determines traffic noise impacts based on noise levels generated by peak-hour traffic. Traffic noise impacts occur if predicted one-hour L_{eq} traffic noise levels, $L_{eq}(h)$, are 66 dBA or higher at a residential property during the peak traffic hour, or if the projected traffic noise levels exceed the $L_{eq}(h)$ by 13 dBA or more (MDT 2011).

In addition to the absolute impact limits defined by EPA, MDT and the U.S. Army, changes in noise levels are used to determine noise impacts and gauge community response (Egan 1998). Since a person's response to noise is subjective, the perception of noise can vary from person to person. Table 1 indicates the relationship between a change in noise levels and a person's typical perception of the change.

Table 1	
Change in Noise Levels vs. Apparent Change in Loudness	
Change in Noise Level (dBA)	Apparent Change in Loudness to a Person
±1	Imperceptible
±3	Barely audible (<i>i.e.</i> , barely noticeable reduction or increase)
±5	Clearly audible (<i>i.e.</i> , clearly noticeable reduction or increase)
±10	Half as loud or twice as loud as the original noise (significant change)
±20	One quarter as loud or four times as loud as the original (very significant change)

4.0 NOISE LEVEL MEASUREMENTS

On April 1 and 2, 2014, BSA completed ambient noise level measurements for the project. The results of the Baseline Noise Analysis are included in Appendix A-11.

5.0 OPERATIONAL NOISE

The project will generate noise resulting from the quarry and kiln operations, equipment and blasting, and haul trucks traveling to and from the site. The project noise was evaluated by comparing predicted operational and equipment noise levels to the existing ambient noise environment (Appendix A-11). The equipment noise levels were primarily based on published noise levels for typical noise sources (FTA 2006, Fidel 1983, BSA 2005, BSA 2008).

Noise level predictions at receptor locations generated by equipment and operations (excluding blasting and haul truck traffic) were estimated according to the calculations of the International Organization for Standardization (ISO) Standard 9613-2, *Attenuation of Sound during Propagation Outdoors, Part 2: General Method of Calculation* (ISO 1996). These calculations conservatively assume that atmospheric conditions are favorable for noise propagation, but atmospheric conditions can vary dramatically at large distances between a noise source and a receptor. Therefore, the predicted noise levels in this report should be assumed to be average noise levels, and temporary significant positive and negative deviations from the averages can occur (Harris 1998).

Blasting noise levels were calculated according to the weight of explosive for each delay (Fidel 1983). Haul truck noise level predictions were made using the Federal Highway Administration (FHWA) approved Traffic Noise Model (TNM), Version 2.5 software program.

5.1 Plant Site

The lime plant site will include a quarry with mobile diesel-powered equipment, such as loaders and haul trucks, a crushing circuit with jaw and cone crushers, vibrating screens and conveyor systems, and a lime kiln. The kiln will have an induced-draft (ID) fan that will operate 24-hours per day, and a 150-foot-tall exhaust stack. At the quarry, a rock drill will be used to create holes that will be packed with explosives for blasting. The crushing and quarry operations and their associated mobile diesel-powered equipment will operate 12 hours per day during the daytime hours four days per week (Phoenix 2014a). Table 2 indicates the reference noise levels used for the plant site noise analysis predictions.

Table 2
Plant Site Equipment Reference Noise Levels

Noise Source	Noise Level at Distance from Source	Duration and Frequency	Reference
Crusher circuit (vibrating screens, jaw and cone crushers, and conveyor systems)	L_{eq} 66 dBA at 1,050 ft	12 hrs/day 4 days/wk	BSA 2008
Mobile diesel-powered equipment	L_1 85 dBA at 50 ft		FTA 2006
Haul truck (40-ton) or tandem trailer (60-ton)	L_1 88 dBA at 50 ft	24 hrs/day 7 days/wk	FTA 2006
Rock drill	L_1 98 dBA at 50 ft	8 hrs/day 1-2 days/wk	FTA 2006
Kiln ID fan	L_1 115 dBA at fan	24 hrs/day 7 days/wk	Phoenix 2014a

Table 3 indicates the predicted noise levels at the 2014 noise level measurement locations (Figure 1) due to the equipment and operations of the plant site. The predicted L_{dn} noise contours in the area around the plant site are shown on Figure 1 (page 9). As shown in Table 3, the predicted operational noise levels are L_{dn} 31 to 41 dBA, which are less than the EPA guideline L_{dn} 55 dBA (EPA 1979). As shown on Figure 1, the plant L_{dn} 55 dBA noise contour is predicted to be predominantly on MLR property.

Table 3
Plant Site Predicted Noise Levels

Measurement Location (Figure 1)	Existing L_{dn} (dBA)	Predicted Plant Noise L_{dn} (dBA)	Difference (dBA)	Perception (Table 1)
1	52	31	-21	Imperceptible
2	34	39	+5	Clearly audible increase
3	46	36	-10	Imperceptible
4	58	33	-15	Imperceptible
5	56	41	-15	Imperceptible
6	62	31	-31	Imperceptible

As shown in the table, the predicted plant noise levels are expected to be less than the existing noise levels at each noise measurement location except Location 2 along Mullan Road (Figure 1). Location 2 is far removed from the main roads and railroad, with very low existing noise levels. Although the +5 dBA increase due to the plant noise at Location 2 is predicted to be clearly audible, it typically will not be

perceived as a significant change in the noise environment (Table 1). Even though the predicted plant noise levels are less than the EPA guideline and less than the existing noise levels, except in the vicinity of Location 2, the plant may still be audible at times due to changing atmospheric conditions or operations at the site.

5.2 Blasting Noise

MLR will use blasting to develop the quarry. For the exploration activities, the maximum charge per delay is expected to be approximately 310 pounds (Montana Resources 2014). At the closest residence located approximately 4,600 feet northeast of the quarry (Figure 1), the blast noise is predicted to be approximately L_{pk} 111 dBP. Although blasting will be clearly audible in the area, the predicted blast noise level at the nearest residence is less than the U.S. Army L_{pk} 115 dBP threshold for annoyance (USACHPPM 2005).

5.3 Back-Up Alarms

Federal regulations indicate that backup alarms shall be audible above the surrounding background noise level near the equipment, but does not specify a particular noise level (MSHA 2011). Because of their intermittent, high-pitched, impulsive sound, back-up alarms can cause high levels of annoyance and numerous complaints, even at noise levels equal to or less than the ambient noise levels at a listener location. However, back-up alarm noise has little influence on the L_{eq} or L_{dn} values.

Manufacturer-published back-up alarm sound levels vary between maximum noise levels of 90 and 110 dBA at 4 feet away, depending on the volume setting, model, working environment, *etc.* Back-up alarm noise levels will vary widely in the area around the plant site as mobile equipment move around, and may be clearly audible at times yet inaudible at others. To reduce the possibility of annoyance due to back-up alarms, traditional “beep-beep-beep” alarms on all mobile equipment should be replaced with manually adjustable, self-adjusting, or broadband sound alarms.

5.4 Off-Site Haul Trucks

Tractor-trailer trucks will haul lime off the site. Lime loaded into tractor-trailer trucks will be shipped off-site at an average rate of 8 trucks during a 24-hour period (usually 9 to 10 truck loads per day) 6 days per week, 12 hours per day. If used, a contractor would supply solid fuel to the plant site; as such, these calculations have not been considered in this analysis.

Although a specific route for the haul trucks has not been finalized, possible truck travel routes include State Highway 1 (between the intersection of Main Street/Old Highway 10A and I-90), Front Street through Drummond, and along Main Street/Old Highway 10A (between State Highway 1 and Front Street) (Figure 1) (Phoenix 2014b). The posted speed limits are 55 mph on State Highway 1, 30 mph on Front Street, and 25 and 35 mph on Main Street/Old Highway 10A.

Traffic noise is evaluated using one-hour equivalent noise levels, $L_{eq}(h)$ (MDT 2011). Traffic data for State Highway 1, Front Street and Main Street/Old Highway 10A were obtained from MDT (MDT 2012 and MDT 2014). Traffic noise levels were predicted using the Federal Highway Administration's (FHWA) Traffic Noise Model, Version 2.5. Since the MDT traffic data are provided in terms of average annual daily traffic (AADT) and TNM uses traffic volumes during a one-hour period, BSA assumed that the one-hour traffic volumes were approximately 10 percent of the AADT.

Table 4 summarizes the predicted ranges of traffic noise levels at residences along the possible truck routes. The predicted traffic noise levels associated with the lime haul trucks are not expected to exceed the MDT traffic noise impact criterion of $L_{eq}(h)$ 66 dBA. Along all routes, the increase in traffic noise levels due to trucks hauling lime is predicted to be 0 to +5 dBA, which would be perceived as barely to clearly audible (Table 1) because of the low number of additional trucks per hour.

**Table 4
Predicted Traffic Noise Levels**

Haul Route Option:	State Highway 1	Front Street	Main Street/Old Highway 10A (25 mph)	Main Street/Old Highway 10A (35 mph)
Distance Between Residences and Road Centerline (Figure 3.17-1):	85 to 180 feet	40 to 75 feet	90 to 210 feet	40 to 185 feet
Existing Traffic Noise $L_{eq}(h)$ WITHOUT Haul Trucks:	55 to 60 dBA	55 to 58 dBA	39 to 44 dBA	44 to 52 dBA
Lime Hauling				
Traffic Noise $L_{eq}(h)$ WITH Lime Haul trucks:	56 to 60 dBA	56 to 59 dBA	44 to 49 dBA	47 to 55 dBA
Difference vs. Existing Traffic Noise:	0 to +1 dBA	+1 dBA	+5 dBA	+3 dBA
Perception (Table 3.17-1):	Imperceptible	Imperceptible	Clearly audible	Barely audible

6.0 REFERENCES CITED

- American National Standards Institute (ANSI). 1994.
S12.18-1994, Procedures for Outdoor Measurement of Sound Pressure Level.
- Big Sky Acoustics, LLC (BSA). 2008.
Helena Sand & Gravel Lake Helena Drive Gravel Pit Environmental Noise Study. Prepared for Helena Sand & Gravel. February 29.
- Big Sky Acoustics, LLC (BSA). 2005.
Montana Tunnels EIS Project. Memo to Tetra Tech EMI: Noise Level Measurements Conducted on April 4, 2005. April 27.
- Egan, M. 1988.
Architectural Acoustics. McGraw-Hill, Inc., New York, New York.
- Federal Transit Administration (FTA). 2006.
Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06. May.
- Fidel, S. et al. 1983.
Community Response to Blasting. Journal of the Acoustical Society of America 74(3), September.

Harris, C., ed. 1998.

Handbook of Acoustical Measurements and Noise Control, 3rd edition. Acoustical Society of America, Woodbury, New York.

International Organization for Standardization (ISO). 1996.

Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation. Designation: 9613-2.

Montana Code Annotated (MCA). 2011.

Title 45, Chapter 8, Part 1, Section 11, Public Nuisance.

Montana Department of Transportation (MDT). 2014.

Statewide Traffic Count Site Map. http://www.mdt.mt.gov/publications/datastats/traffic_maps.shtml. Viewed on September 24.

Montana Department of Transportation (MDT). 2012.

Traffic by Sections Report.

Montana Department of Transportation (MDT). 2011.

Traffic Noise Analysis and Abatement Policy. July 1.

Montana Resources. 2014.

Email from Steve Czehura with expected MLR blasting data. September 24.

Phoenix Process Engineering (Phoenix). 2014a.

Email from John Macfadyen with attached ID fan sound power levels and lime plant equipment and operation data. September 9.

Phoenix Process Engineering (Phoenix). 2014b.

Telephone discussion with John Macfadyen about off-site truck traffic. September 25.

U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM). 2005.

Operational Noise Manual, An Orientation for Department of Defense Facilities. November.

U.S. Environmental Protection Agency (EPA). 1979.

Protective Noise Levels. Condensed Version of EPA Levels Document. EPA 550/9-79-100 (N-96-01 II-A-86).

U.S. Mine Safety and Health Administration (MSHA). 2011.

Horns, Back-up Alarms, and Automatic Warning Devices.
<http://www.msha.gov/stats/top20viols/tips/14132.htm>.

