Prepared for:

Miles Sand & Gravel Company

Prepared by:

Ramboll US Corporation
Lynnwood, Washington

Kristen Wallace

Date

October 7, 2019

# GRIP ROAD MINE

## UPDATED NOISE AND VIBRATION STUDY

RAMBOLL

# CONTENTS



## TABLES



## FIGURES



## APPENDICES

# 1. INTRODUCTION

Miles Sand & Gravel Company (Miles) is proposing to mine gravel from a 68-acre parcel located in unincorporated Skagit County near Sedro Woolley, Washington. The mine is completely surrounded by Natural Resource designated land (NRL) and is situated near the north end of 726 acres of contiguously owned property. The site is currently forested, but some of the site is proposed to be logged. All material from the mine would be sold as pit run or transported to other facilities for processing.

The following report reviews noise terminology, regulatory criteria applicable to the project, and the methods and findings of the analysis.

# 2. TERMINOLOGY AND BACKGROUND

## 2.1 Noise Level Terminology and Human Hearing

The human ear responds to a very wide range of sound intensities. The decibel scale (dB) used to describe sound is a logarithmic rating system which accounts for the large differences in audible sound intensities. This scale accounts for the human perception of a doubling of loudness as an increase of 10 dB. Therefore, a 70-dB sound level will sound about twice as loud as a 60-dB sound level. People generally cannot detect differences of 1 dB; in ideal laboratory situations, differences of 2 or 3 dB can be detected by people, but such a change probably would not be detectable in an average outdoor environment. A 5-dB change would probably be perceived under normal listening conditions.

When addressing the effects of noise on people, it is useful to consider the frequency response of the human ear. Sound-measuring instruments are therefore often programmed to weight measured sounds based on the way people hear. The frequency-weighting most often used is A-weighting because it approximates the frequency response of human hearing and is highly correlated to the effects of noise on people. Measurements from instruments using this system are reported in "A-weighted decibels" or dBA. All sound levels in this evaluation are reported in A-weighted decibels.

Distance from the source, the frequency of the sound, the absorbency of the intervening ground, obstructions, and duration of the noise-producing event all affect the transmission and perception of noise. The degree of this effect also depends on who is listening and on existing sound levels.

## 2.2 Vibration Terminology

Vibration is an oscillatory motion that can be measured and characterized by the frequency and amplitude of waves of motion. Because it takes time for the human body to perceive and respond to vibration signals, vibration amplitude (i.e., the size of the wave of motion) is usually characterized using a "smoothed" amplitude based on the root mean square (rms). Some methodologies used for assessing potential impacts from vibration consider vibration amplitude reported as rms velocity, converted to vibration decibel levels or VdB.

The typical background level in residential areas is about 50 VdB. Most people generally cannot detect levels below about 65 VdB and do not consider levels below 70 VdB to be of significance. People are rarely annoyed by groundborne vibration when they are outside. Exterior sources of groundborne vibration perceived inside buildings are typically caused by construction, steel wheels on rails, or heavy vehicles (i.e., buses or trucks) traveling on rough roads. Rubber-tired vehicles traveling on smooth roads rarely result in perceptible levels of groundborne vibration.[1]

In addition to the vibration level, the duration of a vibration event has an effect on human response. Generally, as the duration of a vibration event increases, the potential for adverse human response increases. Additionally, the rate of recurrence of events can also affect human response.

# 3. AFFECTED ENVIRONMENT

## 3.1 Skagit County Noise Regulations

The project site and surrounding properties are located in unincorporated Skagit County. Chapter 9.50 of the Skagit County Code (SCC 9.50) adopts regulations established in Chapter 173-60 of the Washington Administrative Code (WAC).

Chapter 173-60 of the WAC limits the levels and durations of noise crossing property boundaries (**Table 1**). Allowable "maximum permissible" sound levels depend on the Environmental Designation of Noise Abatement (EDNA) of the source of the noise and the EDNA of the receiving property. WAC 173-60-030 stipulates that EDNA land classification shall conform to land *uses* unless a local jurisdiction has adopted a program in which EDNA classifications are based on zoning. Generally, lands of residential use are considered Class A EDNAs, commercial properties are considered Class B EDNAs, and industrial areas are considered Class C EDNAs.

[1] [1] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, May 2006. FTA-VA-90-1003-06.

**Table 1. WAC Maximum Permissible Sound Levels (dBA)**

| EDNA of Sound Source | EDNA of Receiving Property | | |
|---|---|---|---|
| | Class A Day / Night | EDNA B | EDNA C |
| EDNA A | 55 / 45 | 57 | 60 |
| EDNA B | 57 / 47 | 60 | 65 |
| EDNA C | 60 / 50 | 65 | 70 |

The limitations for noise received in a Class A EDNA are reduced by 10 dBA during nighttime hours, defined as between 10 PM and 7 AM.

*Source: WAC 173-60-040*

The "maximum permissible" environmental noise levels in Table 1 may be exceeded for short periods as defined in WAC 173-60-040. The allowed short-term increases are as follows: 5 dBA for no more than 15 minutes in any hour, or 10 dBA for no more than 5 minutes of any hour, or 15 dBA for no more than 1.5 minutes of any hour. These allowed short-term increases can be described in terms of noise "metrics" that represent the percentage of time certain levels are exceeded. For example, the hourly $L_{25}$ metric represents the sound level that is exceeded 25 percent of the time, or 15 minutes in an hour. Similarly, the $L_{8.3}$ and $L_{2.5}$ are the sound levels exceeded 5 and 1.5 minutes in an hour, respectively. The maximum permissible levels are not to be exceeded by more than 15 dBA at any time, and this limit is represented by the $L_{max}$ noise metric.

The Washington Administrative Code (173-60-050) identifies a number of noise sources or activities that are exempt from the maximum permissible sound levels. The following sources are among those exempt:

- Sounds created by motor vehicles on public roads when individual vehicles are subject to performance standards regulated by WAC 173-62 (motor vehicle fleet performance standards)
- Sounds caused by motor vehicles, licensed or unlicensed, when operated off public highways, except when such sounds are received in Class A EDNAs; and
- Sounds created by warning devices not operating continuously for more than five minutes (such as back-up alarms on vehicles).

### 3.2 FTA Vibration Impact Criteria

There are currently no applicable vibration limits or regulations established by Skagit County. Therefore, we are applying Federal Transit Administration (FTA) vibration impact criteria in this assessment to gauge the potential for vibration impacts from the proposed mining and material transport activities.

FTA vibration impact criteria vary depending on the type of receiver and the frequency of occurrence of vibration events. FTA categorizes receiving properties as Category 1 (e.g., most sensitive, such as research facilities with vibration sensitive equipment), Category 2 (e.g., residences), and Category 3 (e.g., institutional uses such as schools, churches, etc.). For this project, groundborne vibration would have the potential to primarily affect residences (Category 2 receiving properties), and these types of properties are the focus of this assessment. The FTA vibration impact criteria for Category 2 receivers are shown in Table 2. [2]

### Table 2. FTA Vibration Impact Criteria

| Land Use Category | Frequent Events | Occasional Events | Infrequent Events |
|---|---|---|---|
| Category 2 - Residential | 72 VdB | 75 VdB | 80 VdB |
| "***Frequent Events***" is defined as more than 70 vibration events of the same source per day.<br>"***Occasional Events***" is defined as between 30 and 70 vibration events of the same source per day.<br>"***Infrequent Events***" is defined as fewer than 30 vibration events of the same kind per day.<br>FTA, 2006. | | | |

### 3.3 Land Uses and Zoning

The proposed mining area and surrounding properties are zoned RRv and RRc-NRL (Rural Reserve and Rural Resource, respectively). Skagit County does not specifically assign an EDNA based on zoning designations, so the EDNA classification of the site and surrounding properties are based on the uses of the properties. Mining uses are typically classified as Class C EDNA noise sources and residential uses are classified as Class A EDNAs.

The applicable noise limits for a Class C EDNA noise source affecting a Class A receiver are 60 dBA during daytime hours (7 AM to 10 PM) and 50 dBA during nighttime hours (10 PM to 7 AM). Allowable short-term increases to the above levels are as described previously. Operation of the mine is generally expected to occur between 7 AM and 5 PM, Monday through Friday, but the mine could potentially operate during weekends or at night, on occasion. The applicable noise limits at the nearby receivers from mining activities would be 60 dBA during standard daytime operation and 50 dBA during potential nighttime operation.

### 3.4 Existing Sound Levels

In January 2018, Ramboll measured day-long sound levels at three locations representative of residences nearest the proposed mining area and access drive. The measurements were taken using Larson Davis Class 1 sound level meters (Model LxT). The meters had been

[2] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, May 2006. FTA-VA-90-1003-06.

factory certified within the previous 12 months and were field calibrated immediately prior to the measurements. The microphones of the meters were fitted with wind screens and set approximately 5 feet above the ground (at a typical listening height).

The sound level measurements were taken at the following locations:

- **SLM1** –onsite near northern property boundary
- **SLM2** – near the southern property boundary at the entrance of the mine site, approximately 50 feet from Grip Road
- **SLM3** –approximately 0.3 miles northwest of the site along Wildlife Acres Lane

The measured sound levels are summarized in Table 3, and the sound level measurement locations are depicted in Figure 1. Details of hourly sound level measurements can be found in Appendix A.

## Table 3. Measured Existing Sound Levels (dBA)

| Location | Time of Day [(a)] | Range of Hourly Sound Levels (dBA) [(b)] | | | | |
|---|---|---|---|---|---|---|
| | | Leq | L25 | L8.3 | L2.5 | Lmax |
| SLM1 | Day | 32-46 | 32-47 | 33-50 | 33-55 | 40-73 |
| | Night | 33-41 | 32-41 | 35-44 | 37-47 | 47-63 |
| | 7 AM - 5 PM | 32-46 | 32-47 | 33-50 | 33-55 | 40-73 |
| SLM2 | Day | 46-56 | 32-52 | 37-61 | 52-66 | 71-79 [(c)] |
| | Night | 43-55 | 31-49 | 33-58 | 41-65 | 70-78 [(c)] |
| | 7 AM - 5 PM | 52-56 | 36-52 | 52-59 | 59-66 | 72-79 [(c)] |
| SLM3 | Day | 32-55 | 32-55 | 34-59 | 37-61 | 45-86 [(d)] |
| | Night | 31-47 | 31-40 | 33-44 | 35-52 | 42-77 [(d)] |
| | 7 AM - 5 PM | 32-55 | 32-55 | 34-59 | 37-61 | 49-86 [(d)] |

(a) "Day" refers to the hours between 7 AM and 10 PM and "Night" to the hours between 10 PM and 7 AM. 7 AM to 5 PM is the standard hours of operation.

(b) The Leq is the "energy-averaged" sound level. The Lmax is the-highest measured sound level. The L2.5, L8.3, and L25 levels are defined previously in this report in the discussion of the regulatory noise limits.

(c) Although the meter was not staffed during the entire measurement event, elevated Lmax levels are likely due to truck passbys on Grip Road or wildlife (e.g., birdcalls) very near the microphone.

(d) Although the meter was not staffed during the entire measurement event, elevated Lmax levels are likely due to nearby human activity, although wildlife activity (e.g., birdcalls) very near the microphone could also result in elevated levels.

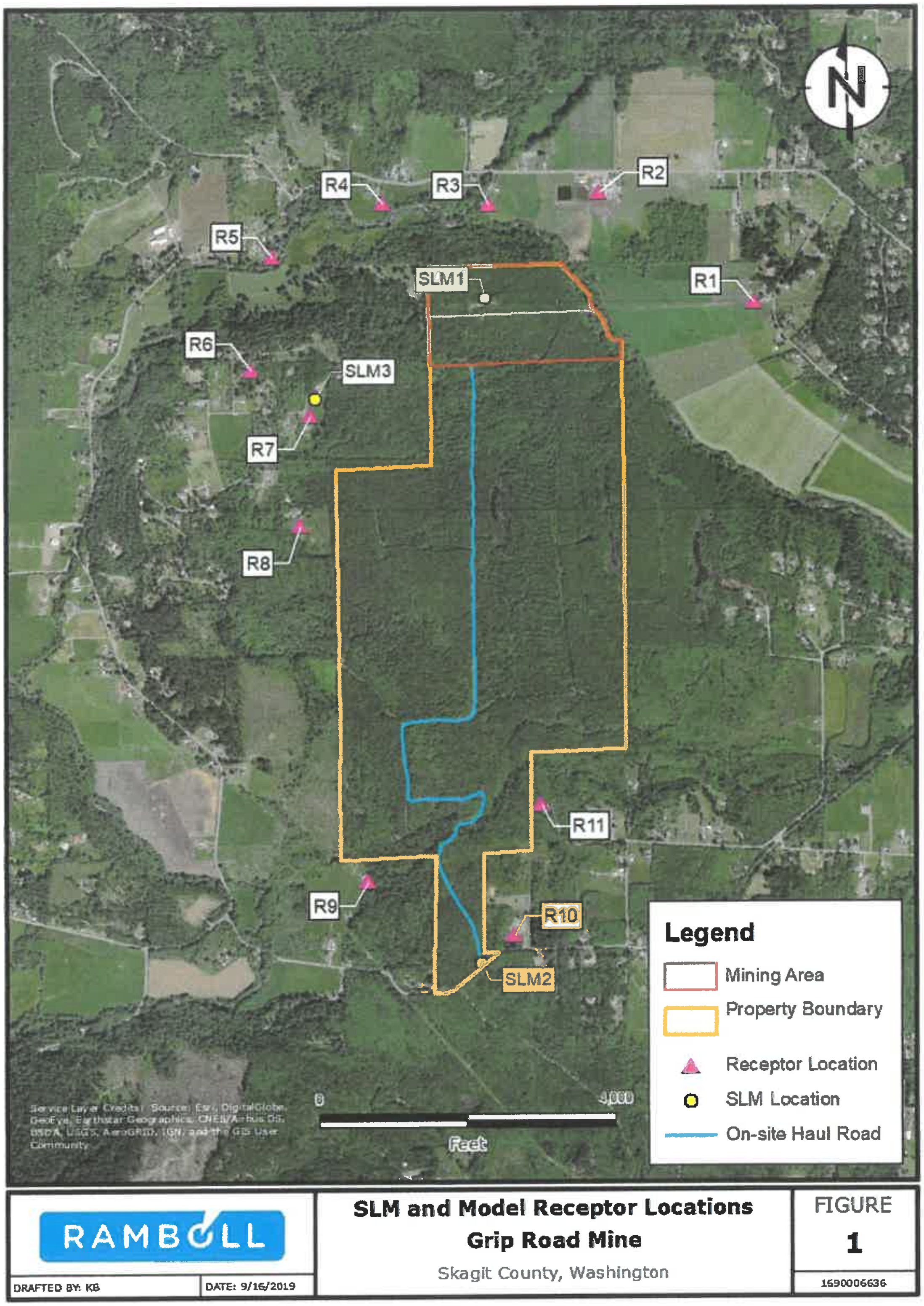


**Figure 1. Sound Level Measurement and Model Receptor Locations**

# 4. OPERATIONAL NOISE IMPACT

## 4.1 Noise Sources

The primary noise sources introduced by the proposal would be a front-end loader, a dozer, and/or an excavator used to excavate material from the floor of the pit in the expansion area and haul/dump trucks used to export the pit run. No crushing or processing is proposed on the site. Trucks would travel on an on-site road south to Grip Road to exit the site.

## 4.2 Noise Model Used

Noise modeling of on-site sources was completed using the CadnaA noise model. CadnaA is a computer tool that calculates sound levels after considering the noise reductions or enhancements caused by distance, topography, varying ground surfaces, atmospheric absorption, and meteorological conditions. For the loader and truck in the mine, the model uses algorithms that comply with the international standards in ISO-9613-2:1996.

The modeling process includes the following steps: (1) characterizing the noise sources, (2) creating 3-dimensional maps of the site and vicinity to enable the model to evaluate effects of distance and topography on noise attenuation, and (3) assigning equipment and activity sound levels to appropriate locations on the site. CadnaA then constructs topographic cross sections to calculate sound levels in the vicinity of a project site.

## 4.3 Modeling Assumptions

The following assumptions were used in our assessment:

- A front-end loader, dozer, and excavator were assumed to operate concurrently in the mine, with haul/dump trucks. Long-term, concurrent operation of the loader, dozer, and excavator may occur occasionally and is representative of a conservative scenario.
- Mining would begin in the northeast quadrant of the site and proceed in a counter-clockwise direction. (See page C5 of the Reclamation Plan and Mine Sequence Plan Set.)
- When excavating the northern and southern halves of the site, the equipment was assumed to be operating at just below the existing elevation. This is likely to occur only at the beginning of mining, after logging and stripping of overburden, after which the equipment would be expected to work at a lower elevation, with the slopes of the mine acting somewhat as a noise barrier. Therefore, this is a conservative assumption.
- All equipment was assumed to work continuously in the same general area for a one-hour period, with equipment locations assumed to be in the northeast, northwest, southwest, and southeast quadrants of the mine. The worst-case southern location

and worst-case northern location for each receptor location were used to assess compliance and potential noise impacts.

- A truck would arrive in proximity to the loader and wait to be loaded. A waiting truck was assumed to be present continuously over the hour.
- The sound levels of the loader, excavator, and dozer were assumed to be 75, 75, and 76 dBA, respectively, at a distance of 100 feet. The sound level of the waiting truck was assumed to be 60 dBA at 100 feet.
- In addition to the waiting trucks, we considered noise from 12 trucks per hour traveling on the on-site access road to and from the mine. This estimated number of hourly trucks was based on the estimated average number of 8 trucks, with an additional 50% increase to ensure a conservative noise estimate. Trucks traveling on the onsite road were modeled using the TNM module of CadnaA.[3]
- The proposed mine site and contiguous property surrounding the mine had been logged. Although there are plans to log some of the site, there are currently no plans to log the entire site, so this is a conservative assumption.
- The model-calculated sound levels represent hourly $L_{eq}$s. For most mining operations, the $L_{eq}$s are very similar to the $L_{25}$s. Therefore, the modeled hourly $L_{eq}$s are used to assess compliance with the State's $L_{25}$ noise limit.

## 4.4 Noise Modeling Results

### 4.4.1 Compliance Assessment

As part of the noise assessment, Ramboll first considered the potential for onsite noise to comply with the applicable WAC noise limits. For this assessment, Ramboll considered the potential sound levels from two working scenarios; 1) equipment operating just below existing grade in the northen half of the site, and 2) equipment operating just below existing grade in the southern half of the site. The resulting model-calculated sound levels for each scenario were compared to the applicable noise limits to assess potential compliance with the WAC noise limits.

The resulting model-calculated sound levels are displayed in **Table 4**. As can be seen by the values in **Table 4**, sound levels from the Grip Road Mine are expected to easily comply with the State's daytime noise limit during excavation. In addition, if mining activities were to occur at night, they would be expected to easily comply with the stricter nighttime limit.

In **Table 4**, the model-calculated sound levels do not always seem to correspond to the distances of the southern or northern halves of the mine to the nearest receivers. For some source and receptor combinations, intervening topography may result in lower levels than might otherwise be expected.

---

[3] The CadnaA noise model includes a module that applies the FHWA's Traffic Noise Model (TNM) traffic noise emission levels and noise attenuation algorithms.

**Table 4. Model-Calculated Sound Levels (Leq/L25, dBA)**

| Model Receptor | Southern Scenario | Northern Scenario | Daytime/Nighttime Noise Limit[a] |
|---|---|---|---|
| R1 | 42 | 42 | 60/50 |
| R2 | 45 | 46 | 60/50 |
| R3 | 40 | 46 | 60/50 |
| R4 | 38 | 40 | 60/50 |
| R5 | 39 | 43 | 60/50 |
| R6 | 39 | 42 | 60/50 |
| R7 | 34 | 37 | 60/50 |
| R8 | 31 | 36 | 60/50 |
| R9 | 32 | 33 | 60/50 |
| R10 | 40 | 40 | 60/50 |
| R11 | 41 | 41 | 60/50 |

[a] Daytime refers to the hours between 7 AM and 10 PM. Nighttime refers to the hours between 10 PM and 7 AM.

*Source: Ramboll*

### 4.4.2 Increases Over Existing Noise Levels From Project Sources

In addition to evaluating the potential compliance of onsite sources, Ramboll considered potential noise impacts caused by project-related increases over existing background sound levels. For the existing background sound level, we used the period $L_{eq}$ (energy-average sound level) between 7 AM and 5 PM to represent the existing baseline sound levels, since this represents the typical hours of operation.

**Table 5. Calculated Increases over Existing Levels (Leq, dBA)**

| Receptor | Existing[a] | Southern Scenario | | | Northern Scenario | | |
|---|---|---|---|---|---|---|---|
| | | Project | Cumulative[b] | Increase | Project | Cumulative[b] | Increase |
| R1 | 43 | 42 | 46 | 3 | 42 | 46 | 2 |
| R2 | 43 | 45 | 47 | 4 | 46 | 48 | 4 |
| R3 | 43 | 40 | 45 | 2 | 46 | 48 | 4 |
| R4 | 43 | 38 | 44 | 1 | 40 | 45 | 2 |
| R5 | 43 | 39 | 45 | 1 | 43 | 46 | 3 |
| R6 | 49 | 39 | 49 | 0 | 42 | 50 | 1 |
| R7 | 49 | 34 | 49 | 0 | 37 | 49 | 0 |
| R8 | 49 | 31 | 49 | 0 | 36 | 49 | 0 |
| R9 | 54 | 32 | 54 | 0 | 33 | 54 | 0 |
| R10 | 54 | 40 | 54 | 0 | 40 | 54 | 0 |
| R11 | 54 | 40 | 54 | 0 | 41 | 54 | 0 |

Notes:

The values depicted in the table have been rounded to the nearest whole number. Apparent errors in calculations are remnants of the rounding process, not a calculation error.

(a) The existing sound level shown is the period Leq between 7 AM and 5 PM. When identifying existing sound levels, the sound levels measured at SLM1 were assumed to represent receptors R1-R5, the levels at SLM3 represent R6-R8, and the levels at SLM2 represent R9-R11.

(b) Cumulative levels represent the existing measured sound levels + the modeled project-related sound levels.

*Source: Ramboll*

As can be seen in Table 5, the model-calculated sound levels of all equipment operating in the northern and southern halves of the mine site increase by 0 to 4 dBA at the nearest residential receivers to the site. Increases of 0-2 dBA would generally be not perceptible or barely perceptible. Increases of 3 to 4 dBA may be readily perceptible but would not be characterized as a substantial increase. It should be noted that these levels were modeled using conservative assumptions that all equipment would be operating concurrently for at least an hour and would be operating near the existing grade. For the vast majority of the mine life, the equipment would be working well below the existing grade in a pit, and the walls of the mine would act as a noise barrier to residences north of the site. This would reduce potential increases over existing sound levels.

# 5. OPERATIONAL VIBRATION IMPACT

Although most gravel mining operations do not typically result in perceptible vibrations at offsite locations (unless blasting is required), vibration was mentioned as a source of concern by residents in the project vicinity. Therefore, Ramboll evaluated the potential for vibration impacts from the project. The proposed onsite mining operations and haul road would be located more than 500 feet (and generally much farther) from the nearest residential structures, and there is no potential for impacts from groundborne vibration due to these onsite activities. Therefore, this assessment focused on the potential for vibration impacts from trucks traveling between the site and Old Highway 99 via Grip Road and Prairie Road. For this assessment, we used FTA vibration assessment methods in conjunction with the FTA vibration impact criteria identified earlier in this report.

## 1.1 FTA Vibration Screening Procedure

FTA guidance includes a screening procedure to identify locations where there is little possibility of vibration impacts related to facility operations. Based on specific screening distances for various types of sources, the screening review applies the principle that if no sensitive receivers are identified within the screening distance, no vibration impacts would be expected, and no further assessment is necessary. Ramboll employed this screening procedure as the first step in the review of ground-borne vibration related to the Project. As per FTA guidance, the screening distance for rubber-tired vehicles affecting residences is 50 feet. Therefore, any residential structures farther than 50 feet from Grip Road or Prairie Road are not expected to be affected by vibration from trucks traveling to and from the site.

On roads more distant from the mine than Grip Road or Prairie Road, the same screening distances and calculated vibration levels would apply as described in this report. However, the percentage of traffic related to the Grip Road Mine on these more distant roadways would eventually be subsumed by background traffic.

Ramboll identified all residential structures located within 50 feet of the nearest and farthest lanes of Grip Road and Prairie Road, west of the mine entrance. The following two residences (see figure in Appendix B) were identified for additional consideration:

- A residential property to the west of the mine entrance along Grip Road, approximately 48 feet from the westbound lanes of the road
- A residential property along Prairie Road, approximately 41 feet from the westbound lanes of the road

## 1.2 FTA General Vibration Assessment

Based on the findings of the FTA vibration impact screening procedure it was necessary to conduct a more detailed "general vibration assessment" for the two residential properties identified. Ramboll conducted a general vibration assessment as described below.

The FTA guidance manual includes a chart (Figure 10-1 in the manual) used to estimate potential vibration levels (VdB) based on a reference travel speed, a general transit vehicle type (e.g., rubber-tired vehicles), and distance from the lane of travel. Using these reference vibration levels, adjustments can be made to account for variations in speed and other adjustments, as identified in Table 10-1 of the FTA guidance manual. Most of the adjustments identified in Table 10-1 pertain to transit vehicles with steel wheels traveling on tracks. One adjustment, other than speed, relevant to rubber-tired vehicles is an adjustment for uneven road surfaces (e.g., potholes). For purposes of this assessment, we have assumed the roadway surfaces are smooth. Using the reference levels and adjustments, Ramboll estimated the future vibration levels at each of the two locations, as detailed below.

**Residential Property Along Grip Road** – There is a single residential structure that is approximately 48 feet from the westbound travel lane of Grip Road. (The eastbound lane is more than 50 feet from the residence, is beyond the screening distance, and is not considered further.) The reference vibration level for a rubber-tired vehicle traveling 30 mph at a distance of 48 feet is 64 VdB, and this reference vibration level was adjusted by +2.5 VdB (as shown in Table 10-1 of the FTA guidance manual) to account for the higher posted speed limit of 40 mph on this section of Grip Road. With the speed adjustment, the estimated vibration level at the residential structure along Grip Road is approximately 67 VdB, which would be barely perceptible. For comparison, vibration from trucks traveling 40 mph would generally be imperceptible (i.e., at or below 65 VdB) at a distance of 55 feet from the lane of travel. The FTA impact criterion for frequent events (i.e., more than 70 events per day) affecting residential structures is 72 Vdb, and the calculated vibration level is lower than this. It should also be noted that the number of trucks per day traveling in the westbound lane is expected to be less than 70.

**Residential Property Along Prairie Road** – There is a single residential structure that is approximately 41 feet from the westbound travel lane of Prairie Road. (The eastbound lane is more than 50 feet from the residence, is beyond the screening distance, and is not considered further.) The reference vibration level for a rubber-tired vehicle traveling 30 mph at a distance of 41 feet is 65 VdB, and this reference vibration level was adjusted by +4.4 VdB to account for the higher posted speed limit of 50 mph on this section of Prairie Road. With the speed adjustment, the estimated vibration level at the residential structure along Prairie Road is approximately 69 VdB. Vibration from trucks traveling 50 mph would generally be imperceptible (i.e., at or below 65 VdB) at a distance of 65 feet from the lane of travel. The FTA impact criterion for frequent events (i.e., more than 70 events per day) affecting residential structures is 72 Vdb, and the calculated vibration level is below this. Again, as noted above, the number of trucks per day traveling in the westbound lane is expected to be less than 70.

# 6. CONCLUSION

Model-calculated sound levels from onsite mining equipment and haul trucks are well below both the daytime noise limit of 60 dBA (applicable between 7 AM and 10 PM) and the nighttime limit of 50 dBA (applicable between 10 PM and 7 AM. Therefore, the mine is expected to easily comply with the applicable noise limits. Furthermore, estimated increases over existing levels range from 0 to 4 dBA and would be less than 3 dBA during the vast majority of mining activities. Therefore, noise impacts from onsite mining operations would be slight.

In addition to noise impacts, the potential for vibration impacts from haul trucks traveling along Grip Road and Prairie Road were considered. Using FTA vibration assessment methods and criteria, we found that vibration levels affecting residences from trucks traveling to and from the site on these roads would be barely perceptible and lower than the impact criteria levels established by FTA (**Table 2**)

# APPENDIX A: SOUND LEVEL MEASUREMENT DATA

## Table A- 1. Measured Sound Levels at SLM1 (dBA)

| Date | Time | Leq | Lmax | L2.5 | L8.3 | L25 | L90 |
|---|---|---|---|---|---|---|---|
| 22/01/2018 | 13:00:00 | 32.9 | 48.6 | 37.0 | 34.3 | 32.7 | 31.4 |
| 22/01/2018 | 14:00:00 | 31.8 | 40.1 | 33.0 | 32.5 | 32.0 | 31.3 |
| 22/01/2018 | 15:00:00 | 32.6 | 52.9 | 34.3 | 33.4 | 32.6 | 31.4 |
| 22/01/2018 | 16:00:00 | 42.2 | 71.4 | 48.7 | 38.8 | 34.5 | 32.0 |
| 22/01/2018 | 17:00:00 | 35.6 | 45.3 | 39.0 | 37.8 | 36.3 | 33.2 |
| 22/01/2018 | 18:00:00 | 36.3 | 47.7 | 40.8 | 39.1 | 36.9 | 33.2 |
| 22/01/2018 | 19:00:00 | 35.5 | 49.2 | 41.4 | 38.4 | 35.6 | 32.0 |
| 22/01/2018 | 20:00:00 | 34.6 | 47.5 | 40.3 | 37.3 | 34.7 | 31.7 |
| 22/01/2018 | 21:00:00 | 33.8 | 50.2 | 38.5 | 36.0 | 33.8 | 31.6 |
| 22/01/2018 | 22:00:00 | 33.2 | 46.8 | 37.3 | 34.8 | 33.3 | 31.4 |
| 22/01/2018 | 23:00:00 | 33.0 | 48.4 | 37.2 | 34.7 | 32.9 | 31.4 |
| 23/01/2018 | 00:00:00 | 33.4 | 51.1 | 38.7 | 35.5 | 33.1 | 31.2 |
| 23/01/2018 | 01:00:00 | 34.1 | 51.0 | 41.0 | 36.0 | 32.4 | 31.2 |
| 23/01/2018 | 02:00:00 | 34.5 | 48.1 | 40.2 | 37.3 | 34.3 | 31.6 |
| 23/01/2018 | 03:00:00 | 37.0 | 55.8 | 44.0 | 42.3 | 35.7 | 31.7 |
| 23/01/2018 | 04:00:00 | 35.0 | 50.4 | 39.8 | 37.7 | 35.5 | 32.4 |
| 23/01/2018 | 05:00:00 | 37.5 | 58.0 | 43.4 | 40.2 | 36.9 | 33.2 |
| 23/01/2018 | 06:00:00 | 41.2 | 63.3 | 47.1 | 43.6 | 40.9 | 36.6 |
| 23/01/2018 | 07:00:00 | 46.2 | 67.9 | 54.5 | 50.3 | 44.6 | 36.7 |
| 23/01/2018 | 08:00:00 | 45.8 | 63.7 | 51.4 | 49.2 | 46.5 | 38.9 |
| 23/01/2018 | 09:00:00 | 45.8 | 64.6 | 52.2 | 48.6 | 45.4 | 40.7 |
| 23/01/2018 | 10:00:00 | 44.9 | 69.9 | 52.3 | 47.5 | 43.1 | 37.8 |
| 23/01/2018 | 11:00:00 | 43.0 | 72.9 | 48.0 | 45.0 | 42.9 | 38.4 |
| 23/01/2018 | 12:00:00 | 42.4 | 64.4 | 48.0 | 44.8 | 42.0 | 37.4 |

## Table A- 2. Measured Sound Levels at SLM2 (dBA)

| Date | Time | Leq | Lmax | $L_{2.5}$ | $L_{8.3}$ | $L_{25}$ | $L_{90}$ |
|---|---|---|---|---|---|---|---|
| 22/01/2018 | 13:00:00 | 52.8 | 72.5 | 63.6 | 54.6 | 39.5 | 30.6 |
| 22/01/2018 | 14:00:00 | 51.8 | 74.4 | 62.1 | 52.3 | 35.7 | 30.7 |
| 22/01/2018 | 15:00:00 | 53.0 | 71.5 | 64.0 | 56.2 | 40.8 | 30.5 |
| 22/01/2018 | 16:00:00 | 55.5 | 73.7 | 66.2 | 59.3 | 46.8 | 31.2 |
| 22/01/2018 | 17:00:00 | 55.9 | 74.2 | 66.4 | 60.8 | 47.9 | 31.0 |
| 22/01/2018 | 18:00:00 | 54.2 | 77.1 | 64.7 | 56.8 | 39.6 | 30.2 |
| 22/01/2018 | 19:00:00 | 51.5 | 73.4 | 61.7 | 51.0 | 33.0 | 29.9 |
| 22/01/2018 | 20:00:00 | 51.2 | 74.0 | 60.5 | 47.1 | 33.2 | 30.1 |
| 22/01/2018 | 21:00:00 | 45.9 | 71.0 | 52.0 | 37.3 | 32.0 | 29.8 |
| 22/01/2018 | 22:00:00 | 45.8 | 70.4 | 52.5 | 37.3 | 32.2 | 29.8 |
| 22/01/2018 | 23:00:00 | 45.3 | 73.8 | 46.5 | 34.7 | 31.4 | 29.7 |
| 23/01/2018 | 00:00:00 | 44.7 | 72.0 | 45.6 | 34.4 | 31.1 | 29.4 |
| 23/01/2018 | 01:00:00 | 46.9 | 76.8 | 40.6 | 32.6 | 32.0 | 29.9 |
| 23/01/2018 | 02:00:00 | 43.5 | 70.3 | 41.3 | 34.8 | 32.5 | 30.3 |
| 23/01/2018 | 03:00:00 | 43.1 | 71.5 | 46.7 | 44.1 | 38.0 | 32.2 |
| 23/01/2018 | 04:00:00 | 47.4 | 71.9 | 54.1 | 43.2 | 39.9 | 34.5 |
| 23/01/2018 | 05:00:00 | 53.7 | 78.1 | 62.8 | 53.9 | 45.7 | 37.8 |
| 23/01/2018 | 06:00:00 | 55.0 | 74.4 | 65.2 | 58.3 | 49.4 | 40.8 |
| 23/01/2018 | 07:00:00 | 54.4 | 76.7 | 64.6 | 57.0 | 49.0 | 39.9 |
| 23/01/2018 | 08:00:00 | 56.0 | 79.2 | 65.4 | 58.6 | 52.0 | 43.1 |
| 23/01/2018 | 09:00:00 | 54.7 | 74.4 | 63.4 | 56.9 | 51.6 | 44.3 |
| 23/01/2018 | 10:00:00 | 51.9 | 72.5 | 59.4 | 53.8 | 50.0 | 42.1 |
| 23/01/2018 | 11:00:00 | 52.1 | 72.0 | 60.7 | 53.2 | 48.8 | 41.5 |
| 23/01/2018 | 12:00:00 | 53.1 | 74.9 | 62.4 | 54.0 | 46.7 | 41.0 |

## Table A- 3. Measured Sound Levels at SLM3 (dBA)

| Date | Time | Leq | Lmax | L2.5 | L8.3 | L25 | L90 |
|---|---|---|---|---|---|---|---|
| 22/01/2018 | 13:00:00 | 34.3 | 55.0 | 40.5 | 37.3 | 33.8 | 30.2 |
| 22/01/2018 | 14:00:00 | 32.5 | 48.8 | 37.0 | 33.8 | 32.3 | 30.3 |
| 22/01/2018 | 15:00:00 | 38.3 | 52.7 | 47.2 | 43.9 | 34.6 | 30.5 |
| 22/01/2018 | 16:00:00 | 43.6 | 69.9 | 49.7 | 46.8 | 42.6 | 31.2 |
| 22/01/2018 | 17:00:00 | 33.6 | 47.9 | 37.5 | 35.1 | 33.6 | 31.7 |
| 22/01/2018 | 18:00:00 | 33.1 | 46.6 | 36.8 | 34.6 | 33.2 | 31.3 |
| 22/01/2018 | 19:00:00 | 33.4 | 44.5 | 36.8 | 35.2 | 33.8 | 31.5 |
| 22/01/2018 | 20:00:00 | 33.6 | 49.9 | 38.0 | 35.9 | 33.9 | 31.4 |
| 22/01/2018 | 21:00:00 | 33.3 | 48.6 | 37.9 | 35.0 | 33.3 | 31.1 |
| 22/01/2018 | 22:00:00 | 32.4 | 46.7 | 36.4 | 34.3 | 32.4 | 30.5 |
| 22/01/2018 | 23:00:00 | 32.3 | 46.9 | 36.9 | 33.9 | 32.3 | 30.3 |
| 23/01/2018 | 00:00:00 | 32.3 | 46.5 | 36.4 | 34.7 | 32.7 | 30.0 |
| 23/01/2018 | 01:00:00 | 31.0 | 42.1 | 34.8 | 32.7 | 30.8 | 29.8 |
| 23/01/2018 | 02:00:00 | 31.8 | 47.1 | 35.3 | 33.4 | 31.8 | 29.9 |
| 23/01/2018 | 03:00:00 | 36.4 | 63.8 | 43.1 | 40.5 | 32.7 | 30.3 |
| 23/01/2018 | 04:00:00 | 35.0 | 66.7 | 38.5 | 35.6 | 33.7 | 31.3 |
| 23/01/2018 | 05:00:00 | 36.5 | 63.0 | 40.8 | 38.0 | 36.1 | 32.2 |
| 23/01/2018 | 06:00:00 | 47.4 | 77.4 | 51.9 | 44.0 | 40.4 | 35.9 |
| 23/01/2018 | 07:00:00 | 48.4 | 77.9 | 51.5 | 47.2 | 43.4 | 36.5 |
| 23/01/2018 | 08:00:00 | 54.5 | 83.1 | 61.4 | 58.6 | 54.6 | 42.6 |
| 23/01/2018 | 09:00:00 | 48.7 | 76.2 | 54.3 | 49.8 | 46.0 | 40.3 |
| 23/01/2018 | 10:00:00 | 46.4 | 72.7 | 52.1 | 47.2 | 42.9 | 38.0 |
| 23/01/2018 | 11:00:00 | 52.7 | 86.2 | 53.9 | 50.5 | 47.1 | 38.8 |
| 23/01/2018 | 12:00:00 | 46.6 | 65.4 | 54.2 | 51.5 | 46.9 | 37.5 |

# APPENDIX B: VIBRATION ASSESSMENT LOCATIONS


Grip Road Mine
Vibration Assessment Locations - Mine Entrance to Old Highway 99
Legend
Vibration Assessment Location
Prairie Road Residence
Grip Road Residence
Prairie Rd
Grip Rd
F and S Grade Rd
Google Earth
© 2018 Google
N
600 m

RAMBOLL

ENVIRONMENT
& HEALTH

# KRISTEN WALLACE

**Senior Managing Consultant**

**Summary of Experience/Expertise**
Kristen Wallace has more than 24 years of experience managing and conducting environmental noise studies. These studies have included compliance determinations, impact assessments, and investigations of mitigation measures for a variety of proposed developments and actions for private developers and government agencies. Projects have included evaluation of noise from power highway and transit sources, power generation facilities, mines, ports, industrial facilities, and urban centers. The results of these analyses have been included in documentation ranging from simple compliance assessment reports to monitoring and management plans, and various state (e.g., SEPA, CEQA) and National Environmental Policy Act (NEPA) environmental impact statements/reports.

## EDUCATION

**MS, Aerospace Engineering**
University of Cincinnati, Cincinnati, Ohio, United States

**BA, Mathematics and History**
College of Idaho, Caldwell, Idaho, United States

## EXPERIENCE

**North Bend Gravel Operation EIS Review and Supplemental Analysis, Washington, USA**
Asked by King County and URS to provide a third-party review of the noise analysis included in the DEIS and FEIS for the proposed North Bend Gravel Operation near North Bend, Washington. Subsequently conducted a supplemental noise analysis, which included additional sound level measurements, updated noise modeling of on-site noise sources, updated modeling of off-site truck traffic, and completion of a new noise section for an addendum to the EIS. Subsequent to the publishing of the EIS Addendum, provided assistance to King County's prosecuting attorney in responding to a challenge to the County's approval of a grading permit for the operation.

**Maury Island Gravel Mine, Washington, USA**
Conducted a noise analysis for the expansion of an existing sand and gravel pit on Maury Island, Washington. As part of the analysis, modeled future sound levels and suggested noise mitigation measures. The noise technical report was attached to an expanded SEPA checklist. Subsequently assisted in responding to public comments on the Maury Island Gravel Mine EIS, assessed the noise impacts of extending the length of the loading pier for a supplemental EIS, and provided testimony to the Shoreline Hearings Board regarding environmental noise issues.

## CONTACT INFORMATION

**Kristen Wallace**

kwallace@ramboll.com
+1 (425) 4121807

Ramboll
19020 33rd Avenue West
Suite 310
Lynnwood, 98036
United States of America

**Snoqualmie Hard Rock, Washington, USA**
Conducted the environmental noise analysis and oversaw the air quality analysis for the expansion of existing operations at the Glacier Northwest Snoqualmie Sand and Gravel Pit to include hard rock mining. The proposed action would add drilling, blasting, and rock screening to the existing crushing, screening, batch processing, and hauling. The results of both the air quality and noise studies were included in an expanded SEPA checklist. Provided testimony on noise issues at the permit hearing. Subsequently developed and implemented a noise monitoring plan in response to a condition imposed on the permit.

**Gold Mine Expansion, Guerrero, Mexico**
Conducted the noise and vibration analyses for a proposed expansion of an existing gold mine located in the state of Guerrero in Mexico. For the noise impact assessment, used baseline sound level data captured for the initial project to characterize the affected environment. Modeled the sound levels of the excavation activities and transport of materials at the nearest villages to the mine. The noise assessment was completed to assess compliance with the International Finance Corporation's performance standards for noise. The analysis included an assessment of potential ground-borne vibration impacts from blasting. Results of the analyses were included in a technical report provided to the client for use in ESIA documentation.

**Gateway Pacific Terminal, Washington, USA**
Conducted the environmental noise impact and mitigation analyses for the Gateway Pacific Terminal, a proposed multi-commodity export/import facility in northwest Washington. Modeled sound levels used the CadnaA model to consider future project-related sound levels to identify potential impacts and mitigation measures. The evaluation extensively considered rail and locomotive noise, including the use of wayside warning horns in lieu of locomotive-mounted warning horns.

**Tacoma-to-Lakewood Commuter Rail Project (D to M Street), Washington, USA**
Conducted the noise and vibration impact assessments for a new section of the Sound Transit Commuter Rail line between Tacoma and Lakewood. The noise impact assessment included 24-hour sound level measurements, CadnaA noise modeling for each alternative commuter rail route and for wayside horn noise at rail/road crossings, TNM noise modeling for realigned roadways in the project vicinity, and the assessment of noise impacts using Federal Transit Administration noise impact criteria. The ground-borne vibration assessment included a screening review of the project corridor and calculations using Federal Transit Administration "general assessment" procedures to consider ground-borne vibration from both construction and operational sources. Results of these analyses were reported in a series of technical memoranda that were summarized in the SEPA/NEPA documentation for the project.

**Lake Oswego to Portland Streetcar Extension, TriMet, Portland, OR.**
Performed the noise and vibration analyses for an extension of the Portland streetcar system from the south downtown area to Lake Oswego. For the impact assessment, initially conducted a screening review followed by modeling assessments of the environmental noise and ground-borne vibration implications of the proposal. The reviews included visual surveys of the entire project alignment, numerous multiday measurements of existing ambient sound levels near potentially affected sensitive receivers, review of noise source specifications, CadnaA noise modeling of the project alignment, evaluation of noise and vibration mitigation measures, detailed calculations regarding construction and operational vibration sources, and technical documentation for the project NEPA EIS.

**Vancouver Energy Distribution Terminal, Washington, USA**
Completed the noise section for the Washington Energy Facility Site Evaluation Council (EFSEC) application and conducted an environmental noise impact assessment to be used to inform the noise section for the SEPA EIS. Conducted extensive noise modeling using CadnaA of both on-site sources and on and off-site train activities to evaluate compliance with regulatory limits and the potential for noise impacts.

## PROFESSIONAL AFFILIATIONS AND ACTIVITIES

Institute for Noise Control Engineering, Member