Sound and Vibration Analysis Report

Resolution Copper Mine Project

Pinal County, Arizona

April 2019

Prepared for:

Resolution Copper Mining

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
ANSI	American National Standards Institute
^{o}F	degrees Fahrenheit
µPa	microPascal
dB	decibel
dBA	A-weighted decibel
dBL	linear decibel
EIS	Environmental Impact Statement
EPS	East Plant Site
FTA	Federal Transit Authority
Hz	Hertz
ISO	International Organization for Standardization
kHz	kilohertz
L_{eq}	equivalent sound level
L_{W}	sound power level
L_{P}	sound pressure level
m	meters
MARRCO	Magma Arizona Railroad Company
mi	miles
ML	monitoring location
mph	Miles per hour
NSA	Noise Sensitive Area
PPV	Peak-Particle-Velocity
pW	picowatt
OSHA	Occupational Safety and Health Administration
OSMRE	Office of Surface Mining Reclamation and Enforcement
rms	root mean square
TSF	Tailings Storage Facility
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
USBM	U.S. Bureau of Mines
WPS	West Plant Site

1.0 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) has prepared this noise impact assessment for the proposed Resolution Copper Project to support an environmental impact statement (EIS), which consists of an underground mine, ore processing operation, and associated facilities and infrastructure. Project noise sources will include stationary mechanical equipment located both inside and outside of buildings, conveyors, mobile equipment, a 7-mile section of railway, and vehicle traffic operating on public and site access roadways (see **Figure 1**).

This report provides background information on environmental sound including: descriptions of the sound and vibration metrics used throughout the report; applicable noise standards and regulations; the results of the ambient sound and vibration measurement program; predicted noise levels from equipment operation; and an assessment of the potential noise impacts from development and operation.

The objectives of this report are to:

- Identify noise-sensitive areas;(NSA)
- Describe the applicable regulations and guidelines;
- Document existing ambient sound and vibration levels;
- Identify the principal project noise source levels;
- Assess the project impacts on noise levels through the use of a predictive acoustic modeling for operation analysis; and
- Propose practicable measures to minimize noise impacts. These mitigation measures are presented to show the Resolution Copper Project is capable of meeting the specific noise requirements; however, final design may incorporate different mitigation measures in order to achieve the same objectives.

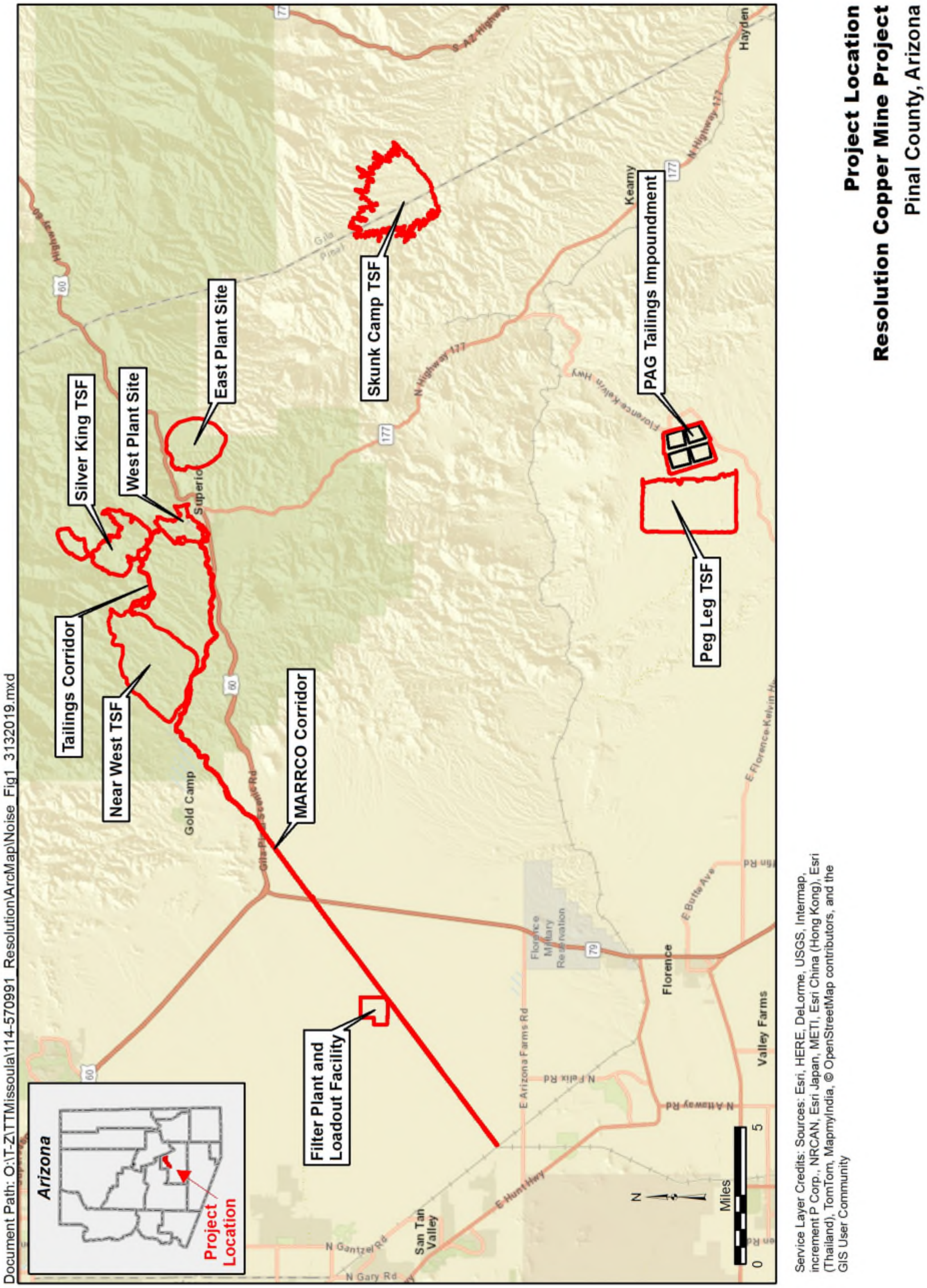
Resolution Copper's administrative headquarters are near Superior, Pinal County, Arizona, at Resolution Copper's West Plant Site (WPS). These administrative offices are immediately north of Superior at 102 Magma Heights, Superior, Arizona. The proposed ore processing facilities (the Concentrator) will be at the WPS.

Facilities and infrastructure components are located in north-central Pinal County (see **Figure 1**). On alternative tailings storage facility (TSF) is partially located in Gila County and Pinal County. The East Plant Site (EPS) encompasses the proposed underground mine, associated shafts, and surface support facilities. The EPS is approximately 6 road miles east of the WPS and is accessed from US 60 by turning south on the Magma Mine Road.

The copper concentrate filtration plant and concentrate loadout facility will be constructed on already disturbed private lands near Magma Junction, adjacent to the existing Magma Arizona Railroad Company (MARRCO) right-of-way. The MARRCO Corridor will be the site of connecting infrastructure, such as water supply pipelines, dewatering pipelines, concentrate pipelines, and power lines, and the existing rail line.

Impacts from operations at the EPS, WPS, filter plant and loadout facility, and four Tailings Storage Facility locations are evaluated within Section 4.0 of this report.

Figure 1: Project Location



1.1 ACOUSTIC METRICS AND TERMINOLOGY

All sounds originate at a source, whether it is a human voice, motor vehicles on a roadway, or a combustion turbine. Energy is required to produce sound and this sound energy is transmitted through the air in the form of sound waves – tiny, quick pressure oscillations just above and just below atmospheric pressure. These oscillations, or sound pressures, enter the ear, creating the sound we hear. A sound source is defined by a sound power level (abbreviated "L_W"), which is independent of any external factors. By definition, sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts.

A source sound power level cannot be measured directly. It is calculated from measurements of sound intensity or sound pressure at a given distance from the source outside the acoustic and geometric near-field. A sound pressure level (abbreviated "L_P") is a measure of the sound wave fluctuation at a given receiver location and can be obtained through the use of a microphone or calculated from information about the source sound power level and the surrounding environment. The sound pressure level in decibels (dB) is the logarithm of the ratio of the sound pressure of the source to the reference sound pressure of 20 microPascals (μPa), multiplied by 20[1]. The range of sound pressures that can be detected by a person with normal hearing is very wide, ranging from about 20 μPa for very faint sounds at the threshold of hearing, to nearly 10 million μPa for extremely loud sounds such as a jet during take-off at a distance of 300 feet.

Broadband sound includes sound energy summed across the entire audible frequency spectrum. In addition to broadband sound pressure levels, analysis of the various frequency components of the sound spectrum can be completed to determine tonal characteristics. The unit of frequency is Hertz (Hz), measuring the cycles per second of the sound pressure waves. Typically, the frequency analysis examines 11 octave bands ranging from 16 Hz (low) to 16,000 Hz (high). Since the human ear does not perceive every frequency with equal loudness, spectrally-varying sounds are often adjusted with a weighting filter. The A-weighted filter is applied to compensate for the frequency response of the human auditory system and is represented in dBA.

An inherent property of the logarithmic dB scale is that the sound pressure levels of two separate sources are not directly additive. For example, if a sound of 50 dBA is added to another sound of 50 dBA, the result is a 3-decibel increase (or 53 dBA), not an arithmetic doubling to 100 dBA. The human ear does not perceive changes in the sound pressure level as equal changes in loudness. Scientific research has demonstrated that the following general relationships hold between sound level and human perception for two sound levels with the same or very similar frequency characteristics:

- 1 dBA is the practically achievable limit of the accuracy of sound measurement systems and corresponds to an approximate 10 percent variation in sound pressure. A 1 dBA increase or decrease is a non-perceptible change in sound;
- 3 dBA increase or decrease is a doubling (or halving) of acoustic energy and corresponds to the threshold of perceptibility of change in a laboratory environment. IThe average person is not able to distinguish a 3 dBA difference in environmental sound outdoors;
- 5 dBA increase or decrease is described as a perceptible change in sound level and is a discernible change in an outdoor environment; and

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[1] The sound pressure level (L_p) in decibels (dB) corresponding to a sound pressure (p) is given by the following equation:

$$Lp = 20 \log10 (p / pref);$$

Where:

p = the sound pressure in μPa; and

pref = the reference sound pressure of 20 μPa.

- 10 dBA increase or decrease is a tenfold increase or decrease in acoustic energy but is perceived as a doubling or halving in sound (i.e., the average person will judge a 10 dBA change in sound level to be twice or half as loud).

Sound can be measured, modeled, and presented in various formats, with the most common metric being the equivalent sound level (L_{eq}). The equivalent sound level has been shown to provide both an effective and uniform method for comparing time-varying sound levels and is widely used in acoustic assessments of noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in **Table 1**. **Table 2** presents additional reference information on terminology used in the report.

Table 1. Sound Pressure Levels (LP) and Relative Loudness of Typical Noise Sources and Acoustic Environments

Noise Source or Activity	Sound Level (dBA)	Subjective Impression
Vacuum cleaner (10 feet)	70	Moderate
Passenger car at 65 miles per hour (25 feet)	65	Moderate
Large store air-conditioning unit (20 feet)	60	Moderate
Light auto traffic (100 feet)	50	Quiet
Quiet rural residential area with no activity	45	Quiet
Bedroom or quiet living room; Bird calls	40	Faint
Typical wilderness area	35	Faint
Quiet library, soft whisper (15 feet)	30	Very quiet
Wilderness with no wind or animal activity	25	Extremely quiet
High-quality recording studio	20	Extremely quiet
Acoustic test chamber	10	Just audible
	0	Threshold of hearing

Adapted from: Kurze and Beranek (1988) and United States Environmental Protection Agency (1971)

Table 2. Acoustic Terms and Definitions

Term	Definition
Noise	Typically defined as unwanted sound. This word adds the subjective response of humans to the physical phenomenon of sound. It is commonly used when negative effects on people are known to occur.
Sound Pressure Level (L_P)	Pressure fluctuations in a medium. Sound pressure is measured in dB referenced to 20 microPascals, the approximate threshold of human perception to sound at 1,000 Hz.
Sound Power Level (L_W)	The total acoustic power of a noise source measured in dB referenced to picowatts (one trillionth of a watt). Noise specifications are provided by equipment manufacturers as sound power as it is independent of the environment in which it is located. A sound level meter does not directly measure sound power.
Day-Night Average Sound Level (L_{dn})	The L_{dn} represents a 24-hour A-weighted sound level average conducted from midnight to midnight, where sound levels during the nighttime hours of 10:00 p.m. to 7:00 a.m. have an added 10 dB weighting, but no added weighting to the evening hours.
Equivalent Sound Level (L_{eq})	The L_{eq} is the continuous equivalent sound level, defined as the single sound pressure level that, if constant over the stated measurement period, would contain the same sound energy as the actual monitored sound that is fluctuating in level over the measurement period.

Term	Definition
A-Weighted Decibel (dBA)	Environmental sound is typically composed of acoustic energy across all frequencies. To compensate for the auditory frequency response of the human ear, an A-weighting filter is commonly used for describing environmental sound levels. Sound levels that are A-weighted are presented as dBA in this report.
Unweighted Decibels (dBL)	Unweighted sound levels are referred to as linear. Linear decibels are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise. Sound levels that are linear are presented as dBL in this report.
Propagation and Attenuation	Propagation is the decrease in amplitude of an acoustic signal due to geometric spreading losses with increased distance from the source. Additional sound attenuation factors include air absorption, terrain effects, sound interaction with the ground, diffraction of sound around objects and topographical features, foliage, and meteorological conditions including wind velocity, temperature, humidity, and atmospheric conditions.
Octave Bands	The audible range of humans spans from 20 to 20,000 Hz and is typically divided into center frequencies ranging from 31 to 8,000 Hz.
Broadband Noise	Noise which covers a wide range of frequencies within the audible spectrum, i.e., 200 to 2,000 Hz.
Frequency (Hz)	The rate of oscillation of a sound, measured in units of Hz or kilohertz (kHz). One hundred Hz is a rate of one hundred times (or cycles) per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate. For comparative purposes, the lowest note on a full range piano is approximately 32 Hz and middle C is 261 Hz.

1.2 VIBRATION METRICS AND TERMINOLOGY

Vibration is an oscillatory motion that is described in terms of the displacement, velocity, or acceleration. Velocity is the most common descriptor used when evaluating human perception or structural damage. Velocity represents the instantaneous speed of movement and more accurately describes the response of humans, buildings, and equipment to vibrations.

Peak-Particle-Velocity (PPV) and root mean square (rms) velocity are typical metrics used to describe vibration levels in units of inches per second in the USA and meters per second in the rest of the world. PPV is defined as the maximum instantaneous positive or negative peak of the vibration signal. PPV is commonly used in evaluating the potential of building damage and is used to measuring blasting events.

However, to evaluate and describe vibration levels from transit operations, the vibration decibel (VdB) notation is commonly used. The decibel notation acts to compress the range of numbers required to describe vibration. In the USA, the accepted velocity reference for converting to decibels is $1x10^{-6}$ inches per second.

In contrast to airborne sound, ground-borne vibration is not an everyday occurrence for humans. The background vibration velocity levels within residential areas are usually 0.0013 PPV in/sec (50 VdB) or lower, which is well below the human perception threshold of approximately 0.007 PPV in/sec (65 VdB). However, human response to vibration is not usually significant unless the vibration exceeds 0.013 PPV in/sec (70 VdB). Outdoor sources that generate perceptible ground-borne vibrations are typically construction equipment, steel-wheeled trains, and traffic on uneven roadways. **Table 3** provides common vibration sources as well as human and structural response to ground borne vibrations.

Table 3. Typical Levels of Ground-Borne Vibration

Human/Structural Response	PPV (In/sec)	Velocity Level (VdB)*	Typical sources 50 feet from source)
Threshold, Minor Cosmetic Damage, Fragile Buildings	0.4	100	Blasting from Construction Projects
	0.15-0.2	92-94	Heavy Tracked Construction Equipment
Difficulty with Tasks Such as Reading a VDT Screen	0.13	90	
	0.07	85	Commuter Rail, Upper Range
Residential Annoyance, Infrequent Events	0.04	80	Rapid Transit, Upper Range
	0.022	75	Commuter Rail, Typical
Residential Annoyance, Frequent Events	0.016	72	Bus or Truck Bump Over
	0.013	70	Rapid Transit, Typical
Approximate Threshold of Human Perception	0.007	65	
	0.005	62	Bus or Truck, Typical
	0.0013	50	Typical Background Vibration Levels

*RMS Vibration Velocity in VdB reference to 10-6 inches/second. Source: FTA Transit Noise and Vibration Impact Assessment Manual, 2006

Vibration from construction and traffic do not typically result in damage to buildings, with the occasional exception of blasting and pile-driving during construction operations. The U.S. Bureau of Mines and the Office of Surface Mining Reclamation and Enforcement have developed blast vibration criteria for the protection of buildings with various structure types and conditions.

The degree of annoyance cannot always be explained by the magnitude of the vibrations alone. Ground-borne noise, rattling, visual effects such as movement of hanging objects, and time of day all influence the response of individuals. The American National Standards Institute (ANSI) and the International Organization for Standardization (ISO) have developed criteria for evaluation of human exposure to vibrations. The recommendations of these standards and other studies evaluating human response to vibrations have been incorporated into the Federal Transit Authority's published "Transit Noise and Vibration Impact Assessment Manual", May 2006. The Criteria within this manual is used to assess noise and vibration impacts from transit operations.

2.0 NOISE LEVEL REQUIREMENTS AND GUIDELINES

Noise levels resulting from operation of the project were evaluated with respect to noise guidelines and policies as established by Pinal County. Pinal County Municipal Ordinance, Section 050306-ENO, provides noise threshold limits for excessive noise levels at specific identified land use areas. The Pinal County Municipal Ordinance applies to unincorporated areas of the County. The Town of Superior is an incorporated area but does not have an established noise regulations so the Pinal County Municipal Ordinance applies to the Town of Superior. Furthermore, there is a alternative located in Gila County, which does not have established noise regulations. Therefore, all receptors located within Gila County will be evaluated based on the noise threshold established by Pinal County. The Pinal County noise regulations are further discussed below.

2.1 PINAL COUNTY EXESSIVE NOISE ORDINANCE

The Pinal County Excessive Noise Ordinance (Section 050306-ENO) prescribes noise limits along property boundaries according to the land use category as shown in **Table 4**.

Table 4. Limiting Sound Levels for Land Use Districts

Zoning District Classifications	L_{eq} Limits, dBA
(Residential) CR-1A, CR-1, CR-2, CR-3, CR-4, CR-5, OS, MH, RV, MHP, PM/RVP, TR	60dBA {7am-8pm} 55dBA {8pm-7am}
(Commercial or Business) CB-1, CB-2	65dBA {7am-10pm} 60dBA {10pm-7am}
(Industrial) CI-B, CI-1, CI-2	70dBA {7am-10pm} 65dBA {10pm-7am}
(Rural) CAR, SR, SR-1, SH, GR, GR-5, GR-10	65dBA {7am-9pm} 60dBA {9pm-7am}

Source: Pinal County 2011.
(a) The Leq limits specified in Table 4 are Leq for a 2-minute time interval. Partial Leq levels may be obtained as necessary to assure an accurate indication of the representative sound environment for the site.
(b) Sound projected from property within one zoning district into property within another zoning district of a lesser sound level limit shall not exceed such lesser sound level limit.

Resolution Copper will follow the Pinal County Excessive Noise Ordinance, which does not limit noise from construction but does limit the allowed operation times for construction to occur to the following:

- Concrete Work – 5:00 a.m. to 7:00 p.m. from April 15th to October 15th and 6:00 a.m. to 7:00 p.m. from October 16th to April 14th.
- Other Types of Construction – 6:00 a.m. to 7:00 p.m. from April 15th to October 15th and 7:00 a.m. to 7:00 p.m. from October 16th to April 14th.
- Construction and repair work in non-residential areas, not within 500 feet of a residential property, shall not limited to 5:00 a.m. to 7:00 p.m.
- Weekends and Holidays Excluded – Construction or repair work shall be limited to 7:00 a.m. to 7:00 p.m. and concrete pouring shall be limited to 6:00 a.m. to 7:00 p.m.

3.0 EXISTING ENVIRONMENT

3.1 EXISTING SOUND LEVELS BASED ON POPULATION

The proposed project is located in Pinal County, Arizona. Pinal County incorporates rural areas and small cities. The Federal Transit Administration (2006) identifies methodology for calculating sound levels for cities based on population density. The U.S. Census Bureau (U.S. Census Bureau 2012) was used to identify population densities in nearby towns. Sound levels for towns near the proposed project range from 34 dBA L_{dn} to 56 dBA L_{dn} based on their respective population density. **Table 5** summaries the Sound levels for city population density including L_{dn}, L_{eq} for the daytime period (7:00 a.m. to 10:00 p.m.), and L_{eq} for the nighttime period (10:00 p.m. to 7:00 a.m.). The town of Superior is the populated area closest to the project.

Table 5. Pinal County, AZ Sound Levels Based on Population Density

Populated Area	Population Density (People per square mile)	Sound Level (dBA)		
		Ldn	Daytime Leq	Nighttime Leq
Apache Junction City	1,017	52	52	42
Florence Town	17	34	34	24
Gold Canyon	454	49	49	39
Kearny	707	50	50	40
Queen Valley	81	41	41	31
San Tan Valley	2,272	56	56	46
Town of Superior	1,462	54	54	44
Top-of-the-World	45	39	39	29

3.2 EXISTING LAND USES AND EXPECTED SOUND LEVEL RANGES

The area surrounding the project incorporates different types of land uses. The land uses within 2 miles of the project area have been categorized based on the Pinal County Comprehensive Plan (Pinal County 2009), and grouped into three categories;

- Residential: Any property, the dominant use of which is non-transient occupancy of residential dwelling units.
- Commercial: Any Property occupied by businesses, store or shop which shall be a retail establishment where all products shall be sold on the premises.
- Recreation/Conservation: Any property where access is allowed to the public for recreational activities or lands protected for cultural or ecological reasons

These land use groupings are focused around the projects four major components, which include the WPS, EPS, Near West TSF, and the Filter Plant/ MARRCO Corridor. For each of these components sensitive receptors were identified within a 2-mile radius and have been identified as having similar acoustical environments. **Figure 2** identifies the project components, land use categories, and sensitive receptor locations. **Table 6** summarizes the expected sound level ranges for each of the sensitive receptors based on land use. These sound level ranges are based on population density, acoustical reference books, and noise studies conducted in similar types of land uses.

Table 6. Sound Sensitive Receptors Expected Sound Level Ranges

Project Component	Sensitive Receptors	Land Use Group from Comprehensive Plan	Sound Level (dBA)		
			L_{dn}	Daytime L_{eq}	Nighttime L_{eq}
WPS	Residences in Superior	Residential and Commercial	48-54	48-54	38-44
EPS	Oak Flat Campground	Recreation/Conservation	41-44	41-45	31-33
	Apache Leap Special Management Area	Residential and Recreation/Conservation	41-54	41-54	31-44
Near West TSF	Hewitt Station	Residential	35-45	35-45	31-33
	Residences in Queen Valley	Residential	36-42	36-42	26-32
	Boyce Thompson Arboretum	Recreation/Conservation	41-44	41-45	31-33
	Arizona Trail	Recreation/Conservation	33-35	32-37	25-30

Project Component	Sensitive Receptors	Land Use Group from Comprehensive Plan	Sound Level (dBA)		
			L_{dn}	Daytime L_{eq}	Nighttime L_{eq}
Filter Plant/MARRCO Corridor	Westernstar Road	Residential	36-45	35-45	28-35
	Lind Road	Residential	36-45	35-45	28-35
	Felix Road	Residential	36-45	35-45	28-35
	Attaway Road	Residential	36-45	35-45	28-35
Silver King TSF	Arizona Trail	Recreation/Conservation	33-35	32-37	25-30
Peg Leg TSF	Arizona Trail	Recreation/Conservation	33-35	32-37	25-30
Skunk Camp	Dripping Springs Road	Residential	33-35	32-37	25-30
	Arizona Trail	Recreation/Conservation	33-35	32-37	25-30

Sources: Federal Transit Administration (2006), Harris (1998), LSA Associates (2003), and Stantec (2012).

3.3 BASELINE SOUND MONITORING

Tetra Tech conducted both summer and winter ambient sound and vibration level measurements to characterize the existing acoustic environment. This section summarizes the methodologies used by Tetra Tech to conduct the sound and vibration survey, describes the measurement locations, and presents the results of the ambient measurements. Although Pinal County noise standards are based on specific property boundary decibel levels, existing ambient levels are provided for context and characterization of the setting.

3.3.1 Field Methodology

Ambient sound and vibration measurements were performed from June 7 through July 2016 to represent the existing environment for the spring and summer periods when there are fewer residents and less outdoor recreation. Additional sound and vibration measurements were conducted from November 14, 2017 through January 18, 2018 to represent the existing environment for the fall and winter conditions, when there are more residents and more outdoor recreation. The summer ambient sound and vibration measurements were performed from June 7 through July 5, 2016 to represent the spring and summer existing environment. The winter ambient sound and vibration measurements were performed from November 14, 2017 through January 18, 2018. Measurements included continuous long-term measurements that collected sound and vibration data in 5-minute intervals.

All of the sound measurements were collected using four Larson Davis Model 831 precision integrating sound-level meters that meet the ANSI Standards for Type 1 precision instrumentation. This model has an operating range of 5 to 140 dB, and an overall frequency range of 8 to 20,000 Hz. During the measurement program, microphones were fitted with windscreens, and set upon a tripod approximately 8 feet above ground and located out of the influence of any vertical reflecting surfaces. The sound analyzer was calibrated at the beginning and end of the measurement period and during data downloads using a Larson Davis Model CAL200 acoustic calibrator according to procedures from the National Institute of Standards and Technology. The sound level meters were programmed to sample and store A-weighted (dBA) and octave band-specific sound level data, including Leq sound levels.

Vibration measurements were conducted using the Instantel Micromate seismographs using a tri-axial geophone sensor. The geophone sensor has a frequency range of 0.025 to 800 Hz and is considered appropriate for ground vibration monitoring. Each of the geophone sensors measured PPV on three mutually perpendicular axes (Vx, Vy, Vz) corresponding to a radial, transverse, and vertical directions. The geophone was deployed using spikes pressed into the ground and was buried at a depth of six inches. **Table 7** lists the measurement equipment employed during the survey. The equipment calibration certificates (by serial number) are provided in Appendix A.

Figure 2: Existing Noise Environmental Schedule

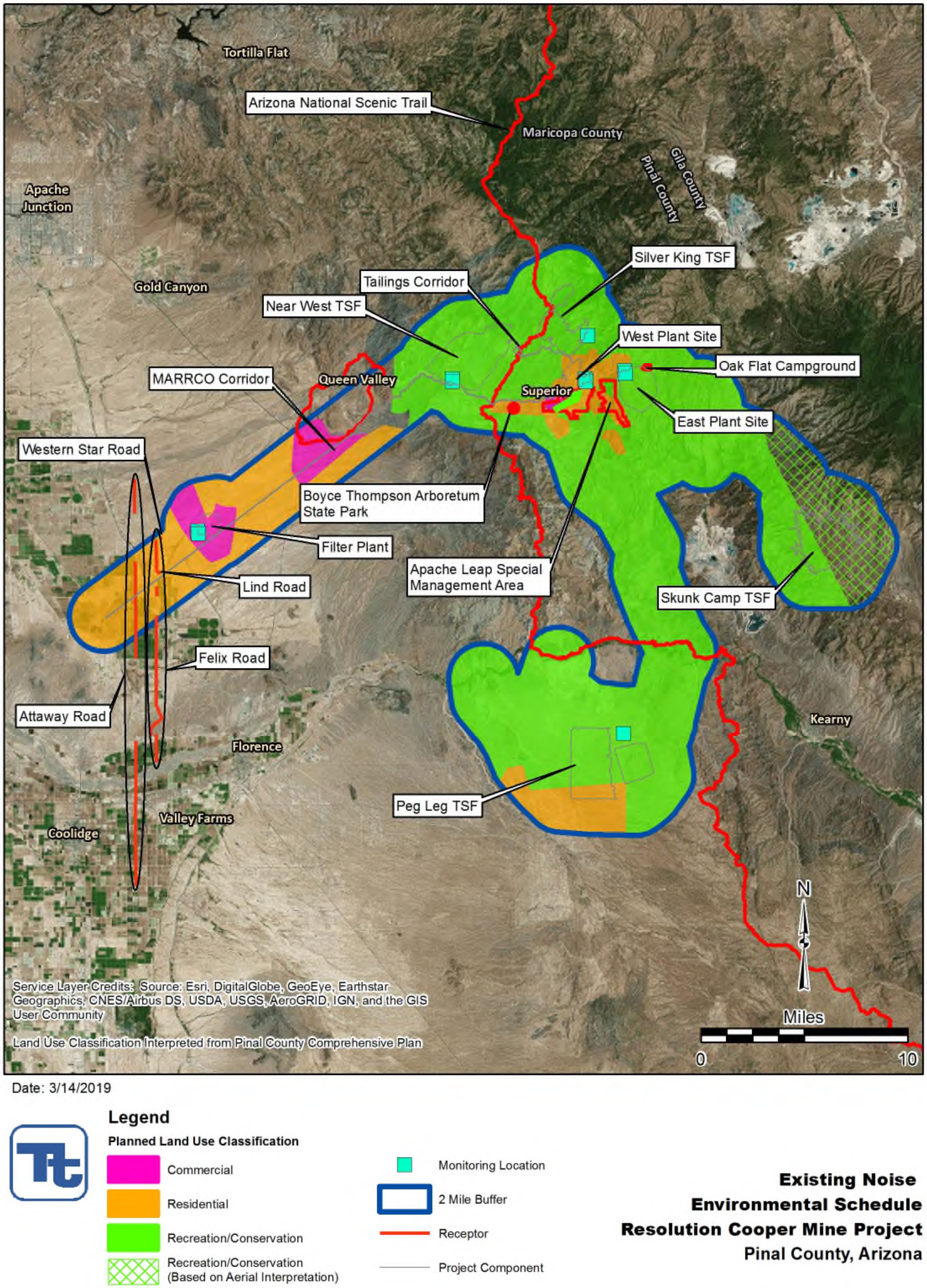


Table 7. Measurement Equipment

Description	Manufacturer	Type	Serial Number
Signal Analyzer	Larson Davis	831	2227
Signal Analyzer	Larson Davis	831	3140
Signal Analyzer	Larson Davis	831	2667
Signal Analyzer	Larson Davis	831	3555
Preamplifier	Larson Davis	PRM831	036754
Preamplifier	Larson Davis	PRM831	010875
Preamplifier	Larson Davis	PRM831	036849
Microphone	PCB	377B02	150728
Microphone	PCB	377B02	109271
Microphone	PCB	377B02	156091
Windscreen	ACO Pacific	7-inch	NA
Calibrator	Larson Davis	CAL200	9540
Vibration Monitor System[1]	Instantel	Micromate System	UM10191
Vibration Monitor System[1]	Instantel	Micromate System	UM10400
Vibration Monitor System[1]	Instantel	Micromate System	UM10397
Vibration Monitor System[1]	Instantel	Micromate System	UM10398

[1]The vibration monitor system included a geophone, cables, a rugged lockable weather proof enclosure, and powered by a solar panel.

3.3.2 Monitoring Locations

Four sound and vibration monitors were deployed during the summer of 2016 and three monitors were deployed during the winter of 2017-2018. The monitors were placed at each of the project components to document the baseline acoustical environments. The monitor locations are described in **Table 8** and Mapped on **Figures 3a through 3e**. A description of each of the monitoring locations are provided below.

Table 8. Sound Level Monitoring Locations

Monitoring Location	Coordinates (Universal Transverse Mercator Zone 12S)	
EPS[1]	493849	3685065
WPS[1]	490775	3684460
Near West TSF[1,2]	480458	3684456
Filter Plant and Loadout Facility[1]	460654	3672647
Silver King[2]	490963	3687862
Peg Leg[2]	493761	3656939

1 Monitor deployed during the summer period.
2 Monitors deployed during the winter period.

3.3.2.1 East Plant Site Monitoring Location

The EPS sound monitor was deployed during the summer period and was located at the edge of the EPS facility approximately 646 feet from the existing Shaft 10. The nearest receptor is the Oak Flat Campground approximately 0.8 miles to the east. For security of the equipment, it was not possible to place this monitor at the Oak Flat Campground. Land use in the vicinity of this monitor location is recreation/conservation (Tetra Tech 2018). This location was selected to document the baseline acoustic environment near the existing EPS. Noise associated with EPS operations was primarily vehicle traffic and backup alarms. Sound generated by the shaft operations and other project related mechanical equipment was not detected in the collected data. The majority of activity at the site occurs underground. This location is about the same distance from Highway 60 as the Oak Flat Campground. Therefore, to be representative of the Oak Flat Campground audio files collected were evaluated and all identified EPS sources were removed from the data set. Sound from wildlife as well as vehicle traffic from Magma Mine Road and Highway 60 were the primary sources left in the data set. Additional anomalies removed from this data set include thunder and rain fall. Sound level measurements at this location were collected from June 7 through June 20, 2016. Sound level data was not collected after June 20, 2016 due to extreme temperatures affecting the equipment. The vibration data was collected from June 7 through July 5, 2016.

3.3.2.2 WPS Monitoring Location

The WPS sound monitor was deployed in the summer at the existing WPS facility near the property line, adjacent to the town of Superior where the nearest residential property line is approximately 260 feet south. Land uses within a 2-mile radius of this monitor includes residential, commercial, and recreation/conservation. However, the land use adjacent to this monitor is residential (Tetra Tech 2018). This location is representative of the town of Superior's baseline acoustic environment. This location is considered a conservative representative location because sensitive receptors closer to Highway 60 would experience greater sound than this monitoring location. Sound from operations at the WPS was from light vehicle traffic and occasional delivery trucks. However, to be representative of the town of Superior, audio files were evaluated and the identified WPS sources were removed from the data set. Sounds generated by wildlife and community sources from the town of Superior were the primary sources left in the data set. Additional anomalies removed from this data set includes thunder, rain fall and fireworks. Sound level measurements were collected from June 7 through 10, 2016 and from June 22 through July 5, 2016. Sound level data for this location was not collected from June 11, 2016 through June 21, 2016 due to temporary equipment failure related to the extreme temperatures. The vibration data was collected from June 7 through July 5, 2016.

3.3.2.3 Near West TSF Monitoring Location

The Near West TSF sound monitor was deployed during both the summer and winter. This monitor was located on the residential property at 32898 Hewitt Station Road in Superior within the Tonto National Forest. For security of the equipment, a location on private land was selected. The monitor was approximately 550 feet from the residence to limit influence from residential activities. The location is approximately 1,000 feet from the edge of the proposed Near West TSF. Land use is residential and recreation/conservation (Tetra Tech 2018). This location was selected to document the existing sound environment at the Hewitt Station residence and the section of the Arizona Trail

Figure 3a: Sound and Vibration Level Monitoring Locations – WPS and EPS

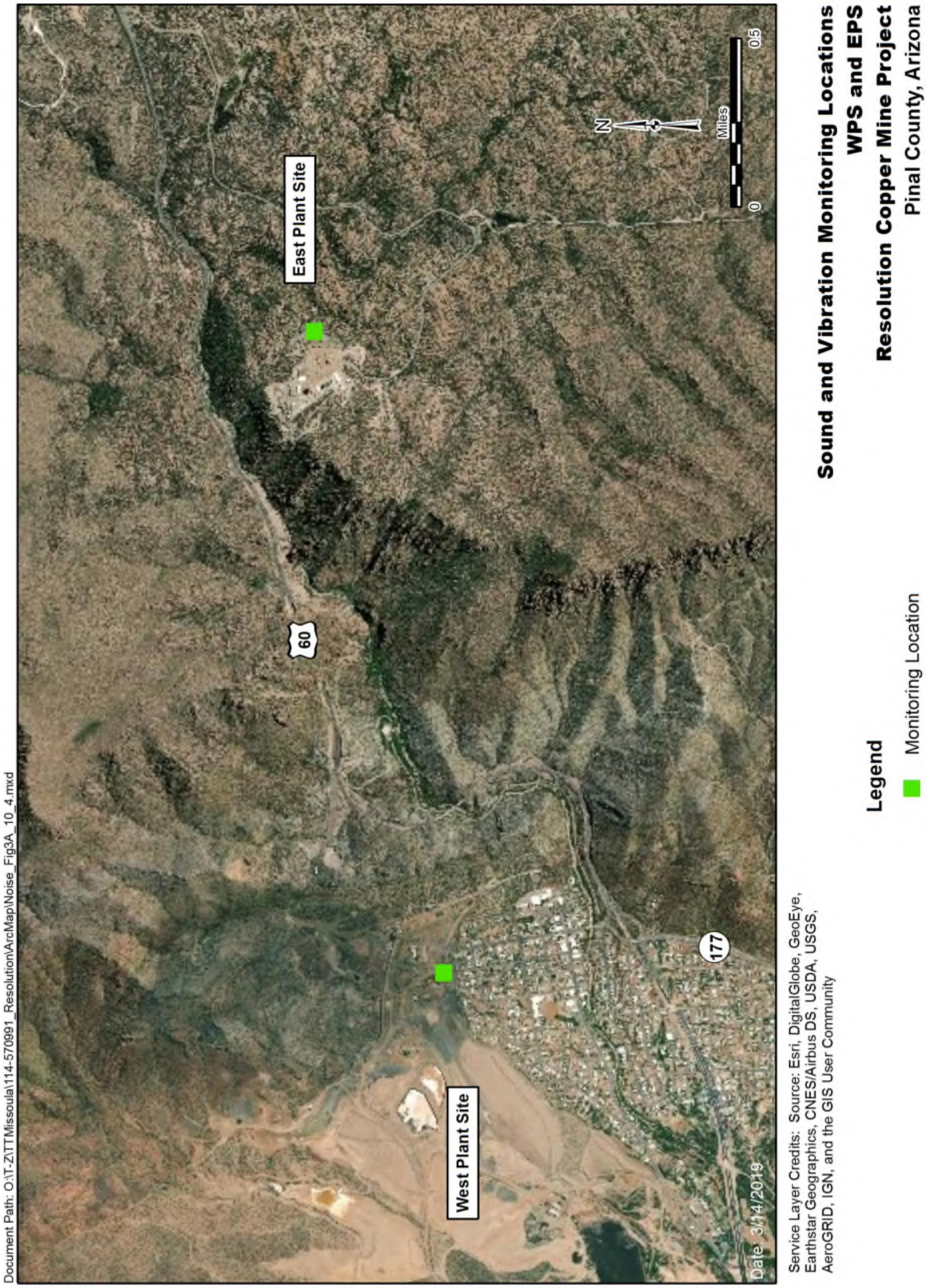


Figure 3b: Sound and Vibration Level Monitoring Locations – Near West TSF

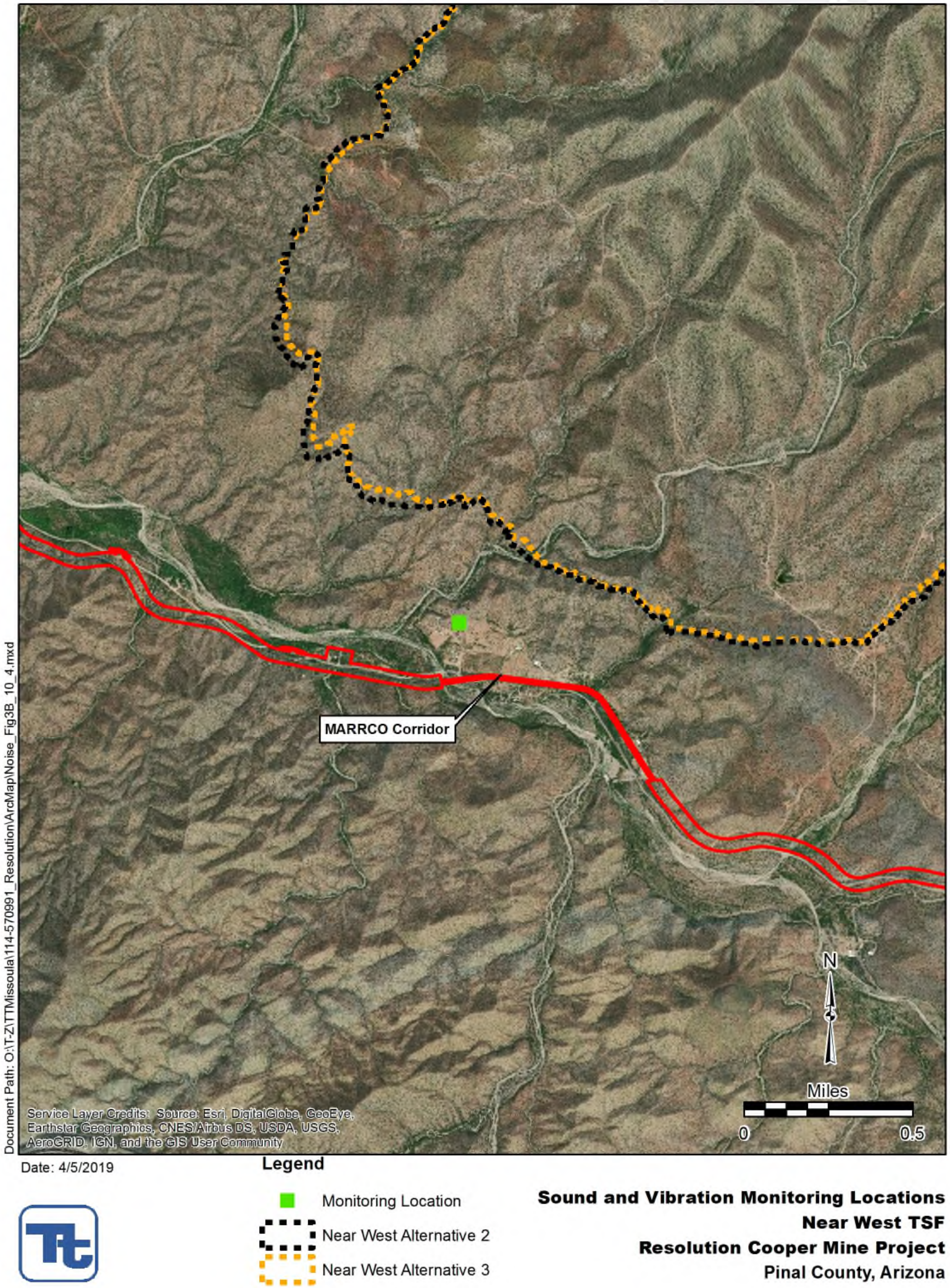


Figure 3c: Sound and Vibration Level Monitoring Locations – Filter Plant and Loadout Facility

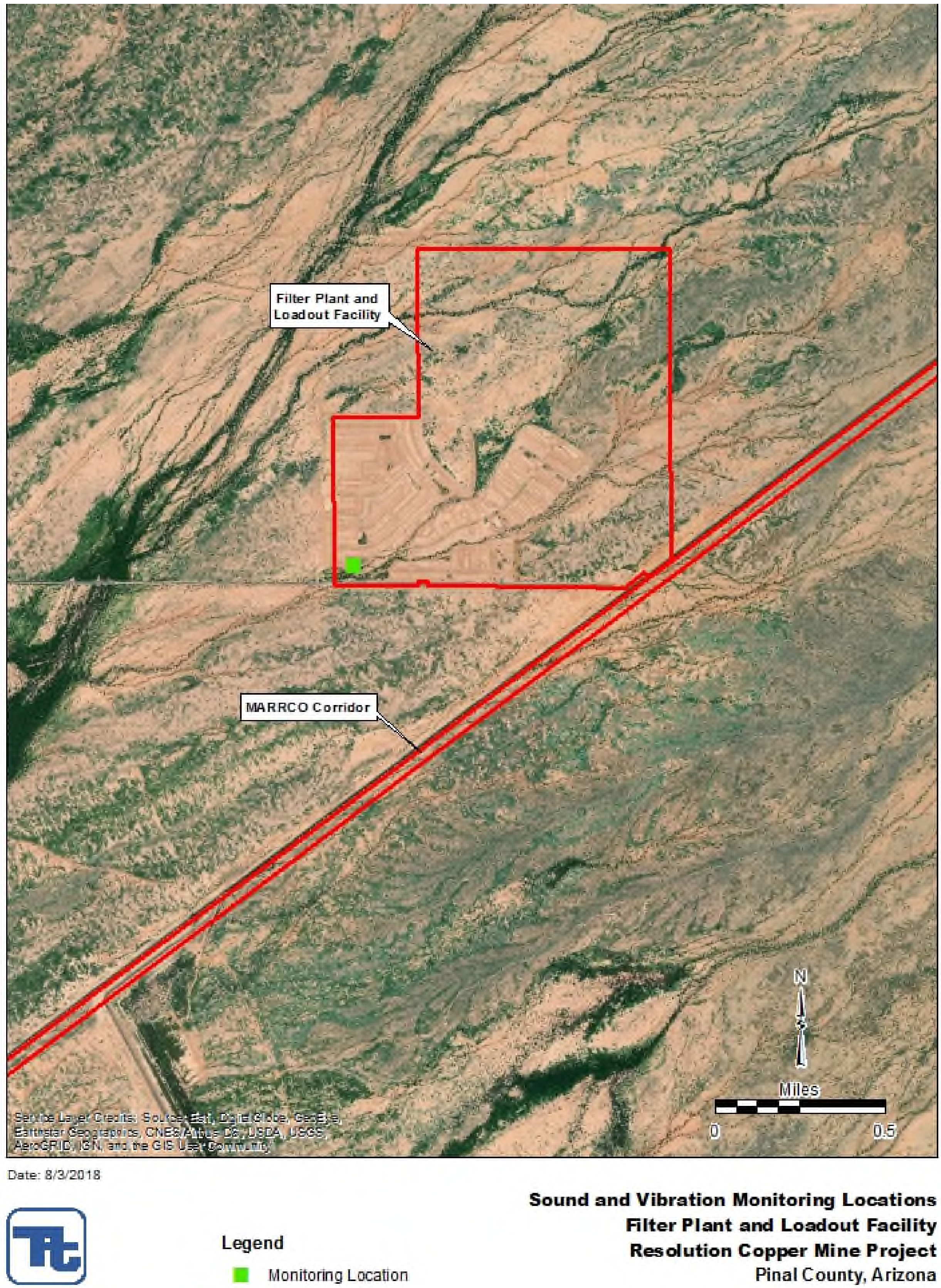


Figure 3d: Sound and Vibration Level Monitoring Locations – Peg Leg Tailings Storage Facility

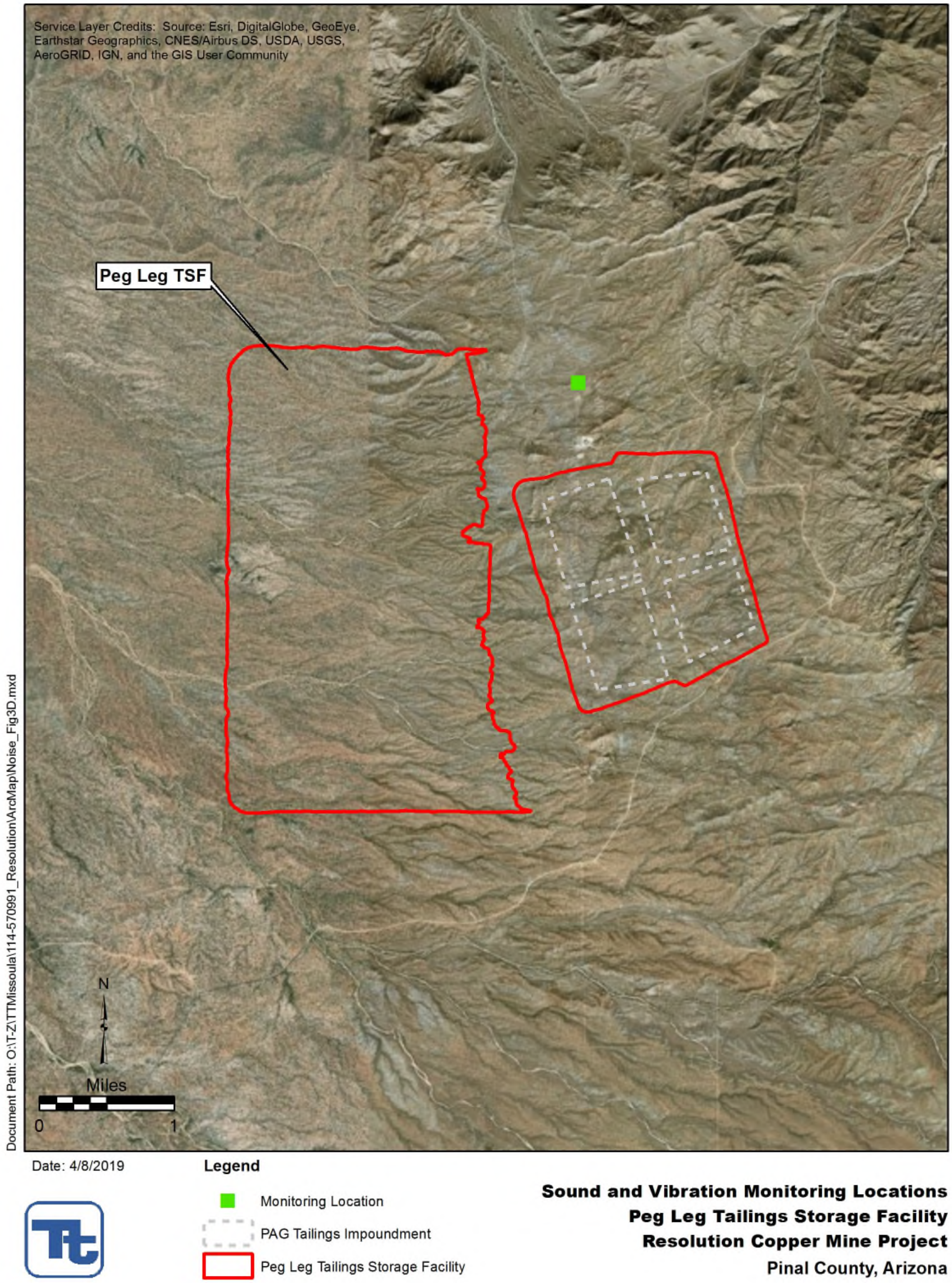
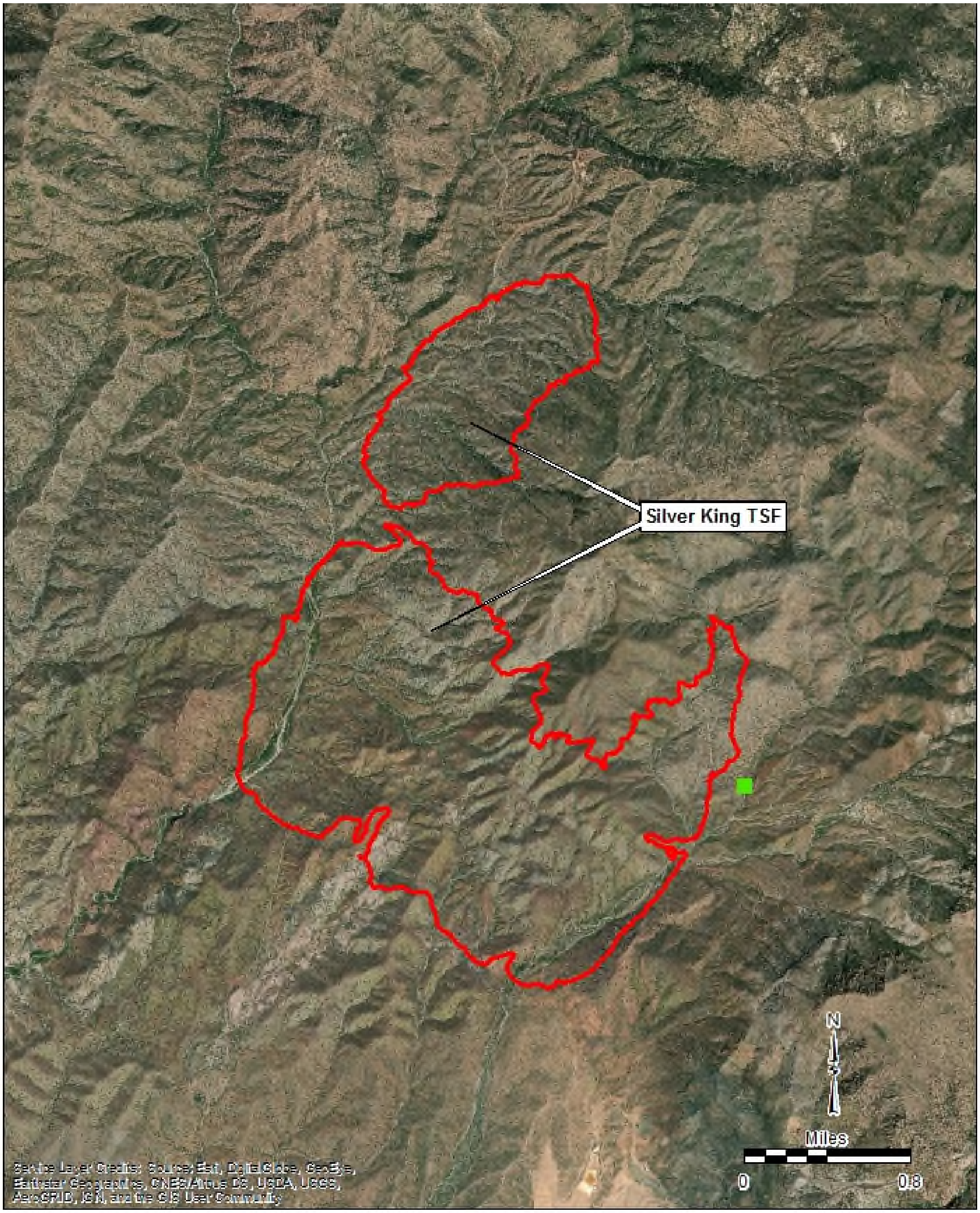


Figure 3e: Sound and Vibration Level Monitoring Locations – Silver King Tailings Storage Facility



Date: 8/3/2018

Legend

Monitoring Location

Sound and Vibration Monitoring Locations
Silver King Tailings Storage Facility
Resolution Copper Mine Project
Pinal County, Arizona

near the Near West TSF. The existing noise sources include operations from nearby ranchers and light vehicle traffic on local roadways. Noise from Highway 60 is approximately 1.9 miles away from the monitoring station was not detected in the data collected.

Summer sound level measurements were collected from June 7 through June 16, 2016 and from June 20 through July 5, 2016. Sound level data was not collected from June 17 through 19, 2016 due to temporary equipment failure related to the extreme temperatures. The vibration data was collected from June 7 through July 5, 2016. Anomalies removed from this summer data set include thunder, rain fall, and all-terrain vehicles (ATVs). The ATV sound was only detected on one night during the summer monitoring; therefore, it was considered an anomaly.

Winter sound level measurements were collected from November 15 through November 23, 2017 and from November 28 through December 6, 2017. Sound level data for this location was not collected Between November 24 and November 27, 2017 and after December 6 due to high winds that resulted in temporary equipment failure or invalid data. A vibration monitor was not deployed during the winter period. Anomalies removed from this winter data set include noise from the ranch, excessive wind, rain fall, and ATVs. The ATV sound was only detected several times during this monitoring period; therefore, it was considered an anomaly.

3.3.2.4 Filter Plant and Loadout Facility Monitoring Locations

The Filter Plant Facility/MARRCO Corridor sound monitor was deployed during the summer at the proposed site of the Filter Plant and Loadout Facility. The nearest sensitive receptors are residence located 1.6 miles to the west along Skyline Drive in the City of San Tan Valley. There are no sensitive receptors to the north, south, and east of the filter plant location. The monitor was placed on a commercial land use surrounded by residential land uses (Tetra Tech 2018). However, there was no commercial activity occurring anywhere near this location. This site is isolated from any significant sources. Highway 79 is approximately 4.3 miles east and local residential roads are approximately 1.6 miles southeast. The MARRCO is directly south of the proposed Filter Plant and Loadout Facility. Aircraft overflights were observed during equipment deployment and readily identifiable in the dataset. Anomalies removed from this data set include thunder and rain fall. Sound level measurements were collected from June 7 through 16, 2016 and from June 20 through July 5, 2016. Sound level data was not collected from June 17 through 19, 2016 due to temporary equipment failure that was once again weather related. The vibration data was collected from June 7 through July 5, 2016.

3.3.2.5 Silver King Tailings Storage Facility Monitoring Locations

The Silver King TSF sound and vibration monitor was deployed during the winter on the proposed site. The nearest sensitive receptors are a residence located 2 miles to the south in the town of Superior and a nearby section of the Arizona Trail located approximately 2 miles to the west. This site is isolated from any significant sources. Highway 60 is approximately 2 miles southeast and WPS is approximated 1.9 miles south. Cattle were observed during the equipment deployment as well as signs of campers. Anomalies removed from this data set include excessive wind and light rain fall. Sound level measurements were collected from November 14 through 18, 2017 and from January 5 through January 15, 2018. Sound level data was not collected from November 19, 2017 through January 4, 2018 due to high winds that resulted in temporary equipment failure or invalid data. The vibration data was collected from November 15 through December 12, 2017.

3.3.2.6 Peg Leg Tailings Storage Facility Monitoring Locations

The Peg Leg TSF sound and vibration monitor was deployed during the winter at the property proposed Peg Leg site. The nearest sensitive receptors are residences located 7 miles to the east in the town of Kearny and the section of the Arizona Trail near the Peg Leg TSF located approximately 2.3 miles to the east. This site is isolated from any significant sources. SR 177 is approximately 8 miles east and SR 79 is approximately 16 miles to the west. There is also a local airport in the town of Kearny approximately 7 miles to the east. Aircraft overflight was observed during the equipment deployment. The site was near a small substation, but the monitor was placed far enough away that noise from the substation was not detected. Anomalies removed from this data set include excessive wind Sound level measurements were collected from November 14 through December 27, 2017. Sound level data was not collected after December 27, 2017 due to high winds that resulted in temporary equipment failure or invalid data. The vibration data was collected from November 15 through December 12, 2017.

3.4 MEASUREMENT RESULTS

Table 9 provides a summary of the adjusted measured sound level ranges measured at each of the monitoring locations. The adjusted sound levels include the removal of the EPS and WPS operations as well as anomalies identified at each site. For each monitoring location, **Table 9** provides the overall L_{dn}, daytime L_{eq}, and nighttime L_{eq}. Appendix B provides the sound measurement dataset and daily plots.

Table 9. Adjusted Sound Measurement Results

Monitor Location	Sound Level (dBA)		
	L_{dn}	Daytime L_{eq}	Nighttime L_{eq}
EPS	52-54	45-50	45-48
WPS	43-53	39-47	33-47
Filter Plant Facility/MARRCO	38-48	38-45	27-41
NWTSF Summer Period	40-46	36-43	32-39
NWSTF Winter Period	34-43	30-40	27-36
Silver King TSF	35-46	31-41	27-39
Peg Leg TSF	34-52	30-51	26-46

Results of the ambient sound survey indicate that sound levels surrounding the proposed Project are relatively low. Sound levels at the WPS were predominantly wildlife and community sources from the town of Superior. The EPS sound levels were primarily influenced by Highway 60 and wildlife. The Near West TSF sound levels included sources from wildlife, operations from nearby ranchers, and light vehicle traffic. The Filter Plant Facility/MARRCO Corridor sound levels were predominantly wildlife and aircracft overflights. The Silver King RSF sound levels included sources from wildlife and lite traffic from campers. The Peg Leg TSF sound levels were predominantly wildlife and aircracft overflights. As expected, the surrounding receptors baseline sound levels did exhibit typical diurnal patterns. Daytime L_{eq} sound levels at the measurement locations ranged from a low of 30 dBA in proximity to the Near West TSF to a high of 50 dBA adjacent to the EPS. Nighttime sound levels ranged from a low of 26 dBA in proximity to the Peg Leg TSF to 48 dBA at the EPS.

Table 10 provides a summary of the measured ambient vibration levels at each of the monitoring locations. For each monitoring location, **Table 10** provides the average PPV and the maximum PPV.

Table 10. Vibration Measurement Results Summary

Measurement Locations	Average PPV (inch/sec)	Maximum PPV (inch/sec)
EPS	0.0031	0.013
WPS	0.0034	0.0723
Filter Plant and Loadout Facility	0.0077	0.0186
Near West TSF	0.0035	0.0164
Silver King TSF	0.0033	0.0048
Peg Leg TSF	0.0057	0.0175

The vibration levels at the measurement locations are low and are at or below the threshold of human perception. At times there were levels that could be perceived by humans but were not found to be of a level that would approach threshold of 0.5 PPV in/sec where there is a potential for damage to existing structures to occur. No strange or unusual vibrations were identified over the course on the vibration monitoring program. Appendix C provides the full vibration measurement dataset.

3.5 SENSITIVE RECEPTORS EXISTING SOUND LEVEL RANGES

The sound levels from the monitoring locations were compared to the sensitive receptors expected sound level ranges (see **Table 6**) to confirm that the monitored levels are representative of the baseline acoustic environment at the sensitive receptor locations. **Table 11** summarizes the expected sound levels (from **Table 6**) compared to the measured sound levels (**Table 11**). The measurement data was applied to sensitive receptors within the vicinity of the monitors.

Table 11. Sensitive Receptors Expected Sound Level Ranges

Project Component	Sensitive Receptors	Land Use	Collection Method	Sound Level (dBA)		
				L_{dn}	Daytime L_{eq}	Nighttime L_{eq}
WSP	Town of Superior	Residential and Commercial	Expected	48-54	48-54	38-44
			Measured	43-53	39-47	33-47
		Residences between US 60 and Main Street	Expected	48-54	48-54	38-44
			Measured	43-53	39-47	33-47
EPS	Oak Flat Campground	Recreation/Conservation	Expected	41-44	41-45	31-33
			Measured	52-54	45-50	45-48
	Apache Leap Special Management Area	Residential and Recreation/Conservation	Expected	41-54	41-54	31-44
			Measured	52-54	45-50	45-48
NWTSF	Hewitt Station	Residential	Expected	35-45	35-45	31-33
			Measured	40-46	36-43	32-39
	Queen Valley	Residential	Expected	36-42	36-42	26-32
			Measured	40-46	36-43	32-39
	Boyce Thompson Arboretum	Recreation/Conservation	Expected	41-44	41-45	31-33
			Measured	40-46	36-43	32-39
	Arizona Trail	Recreation/Conservation	Expected	33-35	32-37	25-30
			Measured	40-46	36-43	32-39
Filter Plant/ MARRCO Corridor	Westernstar Road	Residential	Expected	36-45	35-45	28-35
			Measured	38-48	38-45	27-41
	Lind Road	Residential	Expected	36-45	35-45	28-35
			Measured	38-48	38-45	27-41
	Felix Road	Residential	Expected	36-45	35-45	28-35
			Measured	38-48	38-45	27-41
	Attaway Road	Residential	Expected	36-45	35-45	28-35
			Measured	38-48	38-45	27-41
Silver King TSF	Arizona Trail	Recreation/Conservation	Expected	33-35	32-37	25-30
			Measured	35-46	31-41	27-39
Peg Leg TSF	Arizona Trail	Recreation/Conservation	Expected	33-35	32-37	25-30
			Measured	34-52	30-51	26-46
	Dripping Springs Road	Residential	Expected	33-35	32-37	25-30

Project Component	Sensitive Receptors	Land Use	Collection Method	Sound Level (dBA)		
				L_{dn}	Daytime L_{eq}	Nighttime L_{eq}
Skunk Camp TSF			Measured[1]	34-52	30-51	26-46
	Arizona Trail	Recreation/Conservation	Expected	33-35	32-37	25-30
			Measured[1]	34-52	30-51	26-46

[1]The lower and upper levels for Skunk Camp are based on the Peg Leg TSF sound monitor. Skunk Camp TSF is in an isolated location similar to Peg Leg. Therefore, the measured sound levels for Peg Leg TSF are assumed to be representative of the Skunk Camp TSF area.

The measured sound levels from the WPS, Filter Plant/MARRCO Corridor, Near West TSF, Silver King TSF, and Peg Leg TSF monitors are within the expected sound level ranges for the identified sensitive receptors. Therefore, these adjusted measurements can be used to estimate the existing sound levels at the sensitive receptors where baseline sound levels were not measured.

The adjusted measured sound levels from the EPS monitor is shown to be approximately 5 to 10 dB higher than the expected sound levels for Oak Flat Campground and the Apache Leap Special Management Area. However, the expected sound level ranges were based on campground sites in isolated areas away from highway noise. The Oak Flat Campground and the Apache Leap Special Management Area are within 1,000 feet of Highway 60 where the baseline acoustic environment is influenced by this highway. Therefore, the higher measured data (5 to 10 dB) is reasonable for the location of these sensitive receptors given that the influence from the EPS has been removed from the data set. These adjusted measurements can be used to estimate the baseline sound levels at the sensitive receptors where ambient sound levels were not measured.

3.6 WEST PLANT SITE ADDITIONAL NOISE MONITORING

In 2015, ARCADIS Inc. conducted two noise monitoring studies to document noise levels along the WPS property line adjacent to Superior. The first study collected noise data from May 7 to May 15, 2015 to document the existing noise levels at three locations on the WPS southern property line. The first noise monitor was placed near the existing WPS operations (GAI 12-01), which was similar to the WPS noise monitor location. The second noise monitor was placed near the smelter pond and the third noise monitor was placed near the lower smelter pond. The study found that at two of the locations (GAI 12-01 and the smelter pond) the WPS operations were not detected. At the monitor near the existing WPS operations (GAI 12-01) the noise levels ranged from 39 dBA L_{eq} to 65 dBA L_{eq}. The 65 dBA L_{eq} is an anomaly where the sound levels typically ranged between 40 dBA L_{eq} to 50 dBA L_{eq}. The noise levels at the smelter pond location ranged from 28 dBA L_{eq} to 65 dBA L_{eq}. Again, the 65 dBA L_{eq} is an anomaly where the sound levels typically ranged between 35 dBA L_{eq} to 45 dBA L_{eq}. (ARCADIS September 2015).

The second study collected data from August 18 to September 17, 2015 to gather data and assess noise levels from sludge removal of the smelter pond. The activities occurred Mondays through Saturdays and during the monitoring no work took place on Sundays. The study placed three noise monitors along the WPS southern property line and one monitor was placed within the residential community near the lower smelter pond. When the sludge removal activities occurred the sound levels were as high as 75 dBA L_{eq} to 80 dBA L_{eq} at the monitoring locations. Noise levels during this study when the construction did not occur (Sundays) range from 31 dBA L_{eq} to 50 dBA L_{eq} (ARCADIS December 2015).

The data collected during these studies provide a similar range in noise levels compared to the data collected at the WPS noise monitor in 2016 by Tetra Tech. Therefore, these noise level ranges are representative of residences located adjacent to the WPS. Receptors closer to Highway 60 experience higher noise levels due to consistent traffic on the highway.

4.0 OPERATIONAL NOISE

This section describes the methods and input assumptions used to calculate noise levels due to normal mine operations, a conceptual noise mitigation strategy, and the results of the noise impact analysis.

4.1 NOISE PREDICTION MODEL

The Cadna-A® computer noise model was used to calculate sound pressure levels from equipment operation. An industry standard, Cadna-A® was developed by DataKustik GmbH to provide an estimate of sound levels at distances from sources of known emission. It is used by acousticians and acoustic engineers due to the capability to accurately describe noise emission and propagation from complex facilities consisting of various equipment types and in most cases yields higher results of operational noise levels in the surrounding community because it assumes mechanical equipment operates simultaneously.

The current ISO standard for outdoor sound propagation, ISO 9613 Part 2 – "Attenuation of Sound during Propagation Outdoors," was used within Cadna-A® (ISO 1996). The method calculates sound attenuation under weather conditions that are favorable for sound propagation, such as for downwind propagation or atmospheric inversion, conditions which are typically considered worst-case. The calculation of sound propagation from source to receiver locations consists of full octave band sound frequency algorithms, which incorporate the following physical effects:

- Geometric spreading wave divergence;
- Reflection from surfaces;
- Atmospheric absorption at 10 º Celsius and 70 percent relative humidity;
- Screening by topography and obstacles;
- The effects of terrain features including relative elevations of noise sources;
- Sound power levels from stationary and mobile sources;
- The locations of noise-sensitive land use types;
- Intervening objects including buildings and barrier walls;
- Ground effects due to areas of pavement and unpaved ground;
- Sound power at multiple frequencies;
- Source directivity factors;
- Multiple noise sources and source type (point, area, and/or line); and
- Averaging predicted sound levels over a given time period.

Cadna-A® allows for three basic types of sound sources to be introduced into the model: point, line, and area sources. Each noise-radiating element was modeled based on its noise emission pattern. Point sources were programmed for mobile sources such as dozers and graders. Larger dimensional sources such as the grinding building and conveyor belts were modeled as area sources. Noise walls, equipment enclosures, stationary equipment were modeled as solid structures as diffracted paths around and over structures tend to reduce computed noise levels. The interaction between sound sources and structures was considered with reflection loss. The reflective characteristic of the structure is quantified by its reflection loss, which is typically defined as a smooth façade from which the reflected sound energy is 2 dB less than the incident sound energy. Transformer fire walls and sound barriers were modeled as reflective or absorptive barriers.

Topographical information was imported into the acoustic model to accurately represent terrain in three dimensions. Terrain conditions, vegetation type, ground cover, and the density and height of foliage can also influence the absorption that takes place when sound waves travel over land. The ISO 9613-2 Standard accounts for ground absorption rates by assigning a numerical coefficient of G=0 for acoustically hard, reflective surfaces and G=1 for absorptive surfaces and soft ground. If the ground is hard-packed dirt, typically found in industrial complexes, pavement, bare rock or for sound traveling over water, the absorption coefficient is defined as G=0 to account for reduced sound attenuation and higher reflectivity. In contrast, ground covered in vegetation, including suburban lawns, livestock and agricultural fields (both fallow with bare soil and planted with crops), will be acoustically absorptive and aid in sound attenuation (i.e., G=1.0). For the Project acoustic modeling analysis, a reflective ground factor (G=0) was used for paved areas and a mixed (semi-reflective) ground factor of G=0.5 was used throughout the rest of the Project study area, which is a standardize modeling technique. In addition to geometrical divergence, attenuation factors include topographical features, terrain coverage, and/or other natural or anthropogenic obstacles that can affect sound attenuation and result in acoustical screening. To be conservative, sound attenuation through foliage and diffraction around and over existing anthropogenic structures such as buildings was not included in the model.

Sound attenuation by the atmosphere is not strongly dependent on temperature and humidity; however, the temperature of 10º Celsius (50º Fahrenheit) and 70 percent relative humidity parameters were selected as reasonably representative of conditions favorable to sound propagation. Atmospheric absorption depends on temperature and humidity and is most important at higher frequencies. Over short distances, the effects of atmospheric absorption are minimal. The ISO 9613-2 Standard calculates attenuation for meteorological conditions favorable to propagation, i.e., downwind sound propagation or what might occur typically during a moderate atmospheric ground level inversion. In addition, the acoustic modeling algorithms essentially assume laminar atmospheric conditions, in which neighboring layers of air do not mix. This conservative assumption does not take into consideration turbulent eddies and micrometeorological inhomogeneities that may form when winds change speed or direction, which can interfere with the sound wave propagation path and increase attenuation effects.

The output from Cadna-A® includes tabular sound level results at selected receiver locations and color-coded noise contour maps (isopleths) that show areas of equal and similar noise levels.

4.2 INPUT TO THE NOISE PREDICTION MODEL

The noise model incorporated input data for the EPS, WPS, MARRCO corridor, the Filter Plant and Loadout Facility, Near West TSF, Silver King TSF, Peg Leg TSF, and Skunk Camp TSF. The inputs and noise sources for each of the project elements are further described below. Each project component was modeled assuming maximum number equipment at the site. Reference sound power levels input to Cadna-A® were provided by equipment manufacturers, based on information contained in reference documents, or developed using empirical methods. The reference sound power levels used within this analysis are provided in **Tables 10 through 17** below. The source levels used in the predictive modeling are based on estimated sound power levels that are generally deemed to be conservative. The sound power level (abbreviated “Lw”) is defined as ten times the logarithm (to the base 10) of the ratio of a given sound power to the reference sound power of 1 picowatt. Sound power is defined as the rate per unit time at which sound energy is radiated from a source and is expressed in terms of watts.

4.2.1 EPS Noise Model Input

The EPS general arrangement and equipment list were reviewed and directly imported into the acoustic model so that on-site equipment could be easily identified; buildings and structures could be added; and sound emission data could be assigned to sources as appropriate. **Figure 4** shows the EPS equipment layout based on Figure 3.2-2 of the General Plan of Operations dated January 12, 2016.

The primary noise sources for the EPS include ventilation exhaust fans, transformers, condenser cooling towers, refrigeration plant, bulk air cooler, hoist houses, and batch plants. Additional noise sources include mobile equipment. The mobile equipment was based on the year that has the the maximum equipment, which occurs in Year -1. The EPS was modeled assuming all shafts are in operation. **Table 10** summarizes the equipment sound power level data, equipment quantity, and utilization factors used as inputs to the modeling analysis.

Figure 4: EPS Project Equipment Layout

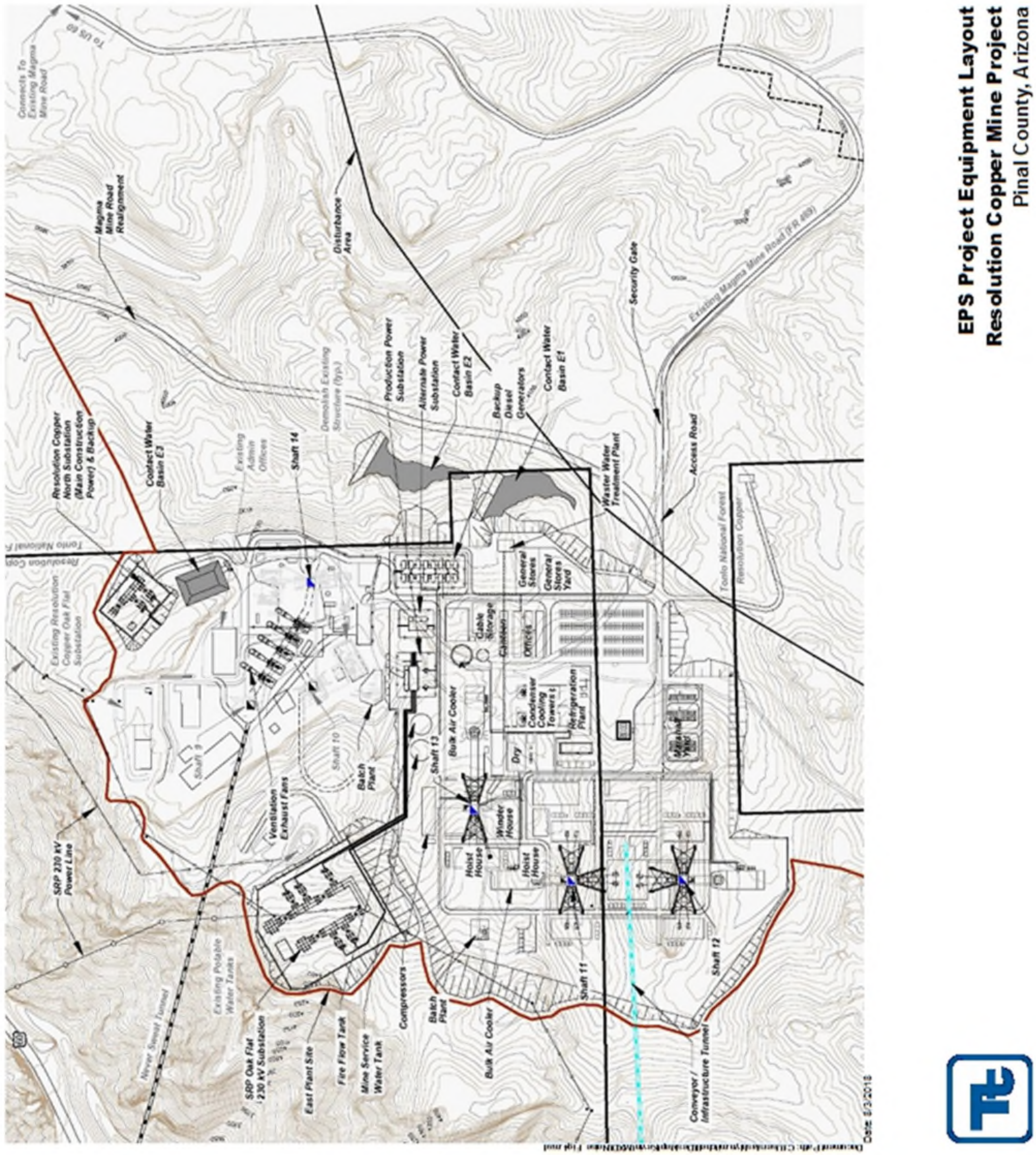


Table 10. Sound Power Level (L_P) for EPS Major Pieces of Project Equipment

Sound Source	Year 1 Quantity	Utilization Factor	Broadband Level
		%	dBA
Ventilation Exhaust Fans	6	100	107
Hoist Houses	10	100	101
Compressor House	3	100	91
Transformers	11	100	91
Substations	2	100	91
Chillers	2	100	101
Batch Plants	2	100	101
Bulk Air Cooler	3	100	106
Condenser Cooling Tower	2	100	85
Refrigeration Plant	1	100	101
Surface Loader	2	60	119
Shotcrete Truck	2	60	118

The EPS incorporates an entrance road that is estimated to have a peak hour of 332 personnel trips and 22 truck shipments (SWTE 2017). The entrance road was inputted as a roadway linear sound source in the Cadna-A® model. However, the current use on US 60 is 8,760 vehicles per day (approximately 508 vehicles per hour with a truck percentage of 30) (SWTE 2017). Noise level calculations shows that current noise levels from US 60 in the vicinity of EPS is approximately 73 dBA L_{eq} at 50 feet from the roadway centerline. The additional 354 peak hour vehicles from the EPS would result in an approximate noise level of 67 dBA L_{eq} along US 60 at 50 feet from the roadway centerline, which would result in an increase of 1 dBA or less to the existing traffic noise levels. The Federal Highway Administration (FHWA) identifies a substantial noise increase from traffic noise as 5 to 15 dBA increase to the existing noise levels (FHWA 2011). Furthermore, a noise level of increase of 3 dB or less is considered barely perceptible in a laboratory environment where, in practice, the average person is not able to distinguish a 3 dB change in environmental sound outdoors. Therefore, because the EPS related traffic noise levels would not result in a substantial noise level increase and would not be a perceivable change in existing noise levels the EPS vehicles were not modeled after they enter onto US 60.

4.2.2 WPS Noise Model Input

The WPS general arrangement and equipment list was reviewed and sound emission data assigned based on manufacturers technical specifications and representative data from engineering technical guidelines. **Figure 5** shows the WPS equipment layout based on Figure 3.3-1a of the General Plan of Operations, dated January 12, 2016.

The primary noise sources associated with the WPS include conveyors, waste water treatment plant, SAG Chillers, Grinding Building, flotation areas, compressor buildings, pebble crusher, molybdenum (Moly) plant and mobile equipment. The mobile equipment was evaluated using the maximum quantity expected when operations at WPS begin. There is no maximum year as one operational, all following years will have the same noise level until operations cease. The WPS was modeled with all expected equipment operating based the assigned utilization factor. **Table 11** summarizes the WPS equipment sound power level data, equipment quantity, and utilization factor used as inputs to the modeling analysis.

Figure 5: WPS Project Equipment Layout

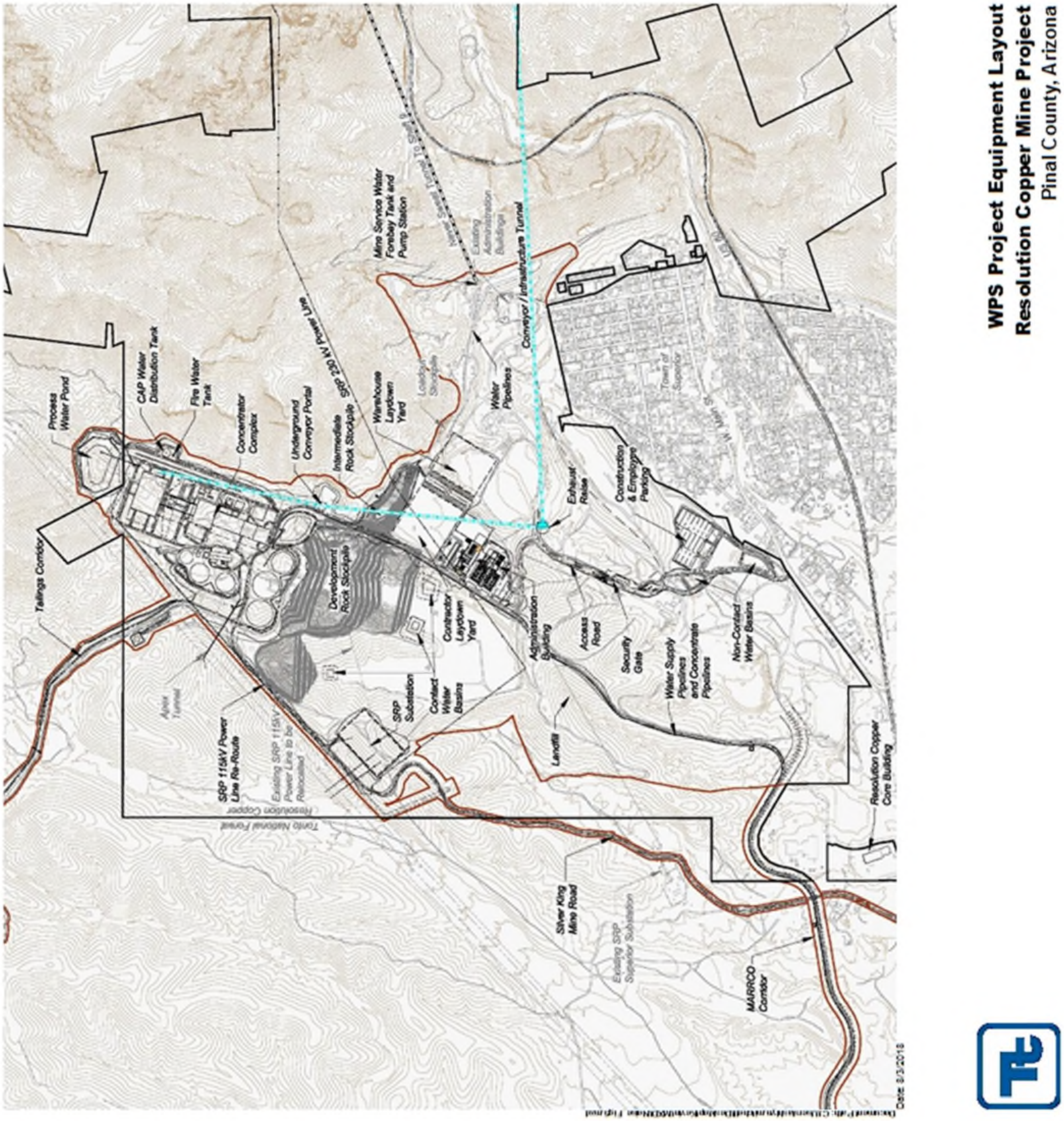


Table 11. Sound Power Level (L_P) for WPS Major Pieces of Project Equipment

Sound Source	Operations Quantity	Utilization Factor	Broadband Level
		%	dBA
SAG Mill Chiller	8	100	101
Grinding Building	1	100	108
Rougher Flotation Area	1	100	91
Cleaner Flotation Area	1	100	91
Compressor Building	1	100	111
Waste Water Plant	1	100	104
Conveyors	9	100	93
Pebble Crusher	1	100	116
Moly Plant	1	100	96
Thickeners	8	100	91
Regrinding Mill	8	100	103
Regrinding Cyclone	2	100	116
Dozer	1	60	120
Boom Truck	2	60	119
Wheel Loader	2	60	115
Fork Lifts	4	60	115
Bobcats	2	60	115
Flatbed Truck	3	90	119
Storm Water Pump	3	90	115
Grader	1	60	120
Backhoe	1	60	115
Water Truck	2	60	119
Fuel Lube Truck	1	90	119
Cranes	2	50	120
Air Compressors	2	90	115
Lights	2	90	117
Fusion Machine	1	90	117
Maintenance Vehicle	1	80	115
Bucket Truck	1	90	119
Vacuum Truck	1	90	119
Boom Lift	2	50	119
Loader	1	60	115
Ventilation Exhaust Fans	1	100	107

The WPS incorporates an entrance road that is estimated to have a peak hour of 336 personnel trips and 22 truck shipments (SWTE 2017). The entrance road to the facility was entered as a linear roadway noise source in the Cadna-A® model. However, the current use on US 60 is 10,740 vehicles per day (approximately 623 vehicles per hour with a truck percentage of 10) (SWTE 2017). Noise level calculations shows that current noise levels from US 60 in the vicinity of WPS is approximately 71 dBA L_{eq} at 50 feet from the roadway centerline. The additional 358 peak hour vehicles from the WPS would result in an approximate noise level of 67 dBA L_{eq} along US 60 at 50 feet from the roadway centerline, which would result in increase of 2 dBA or less to the existing traffic noise levels. Therefore, because the WPS related traffic noise levels would not result in a substantial noise level increase (FHWA 2011) and would not be a perceivable change in the existing noise levels the WPS vehicles were not modeled after they enter onto US 60.

4.2.3 Filter Plant and Loadout Facility Noise Model Input

The Filter Plant and Loadout Facility general arrangement and equipment list was reviewed and directly imported into the acoustic model. Sound emission levels were assigned based on manufacturer specification and engineering technical guidelines. **Figure 6** shows the Filter Plant and Loadout Facility equipment layout based on Figure 3.3-11 of the General Plan of Operations, dated January 12, 2016.

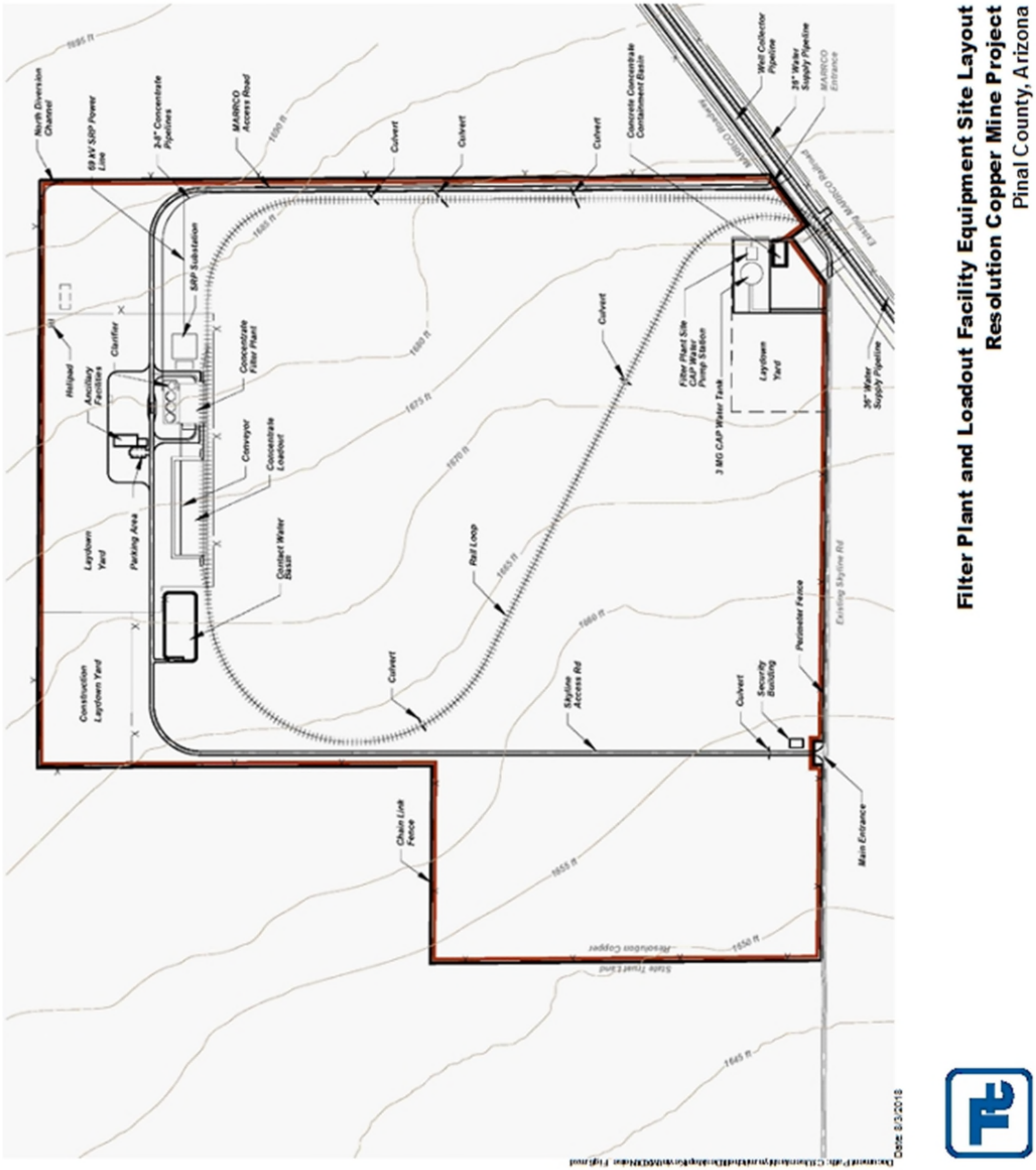
The primary noise sources for the Filter Plant and Loadout Facility include conveyors, concentrator filter plant, substation and mobile equipment. The mobile equipment was evaluated using the maximum quantity expected, which occurs during operations until operations cease. **Table 12** summarizes the Filter Plant and Loadout Facility equipment sound power level data, equipment quantity, and utilization factors used as inputs to the modeling analysis.

Table 12. Sound Power Level (L_P) for Filter Plant and Loadout Facility Major Pieces of Project Equipment

Sound Source	Operations Quantity	Utilization Factor	Broadband Level
		%	dBA
Conveyors	2	100	93
Substation	1	100	91
Concentrate Filter Plant	1	100	110
Thickeners	3	100	91
Compressors	6	100	115
Switch Engine	1	80	120
Wheel Loader	1	60	115
Track Mobile	1	60	120
Sweeper	1	60	119
Loader	3	60	115
Filter Plant Pump Station	1	100	105

The Filter Plant and Loadout Facility incorporates an entrance road that is estimated to have peak hour of 18 personnel trips (SWTE 2017). The entrance road was entered as a roadway source in the Cadna-A® noise model. The Filter Plant and Loadout Facility will be accessed by Skyline Drive, which the current vehicles per day is 1,210 (approximately 70 vehicles per hour with a truck percentage of 3) west of the facility (SWTE 2017). Noise level calculations shows that current noise levels from Skyline Drive west of Filter Plant and Loadout Facility is approximately 54 dBA L_{eq} at 50 feet roadway centerline. The additional 18 peak hour vehicles from the Filter Plant and Loadout Facility would result in an approximate noise level of 46 dBA L_{eq} along Skyline Drive at 50 feet from the roadway centerline, which would result in an increase of less than 1 dBA to the existing traffic noise levels. Skyline Drive west of the Filter Plant and Loadout Facility is primarily undeveloped and existing traffic data was not available. Therefore, the project traffic was modeled east of the facility along Skyline Drive until they entered US 79. US 79 current vehicles per day is 2,940 (approximately 171 vehicles per hour with a truck percentage of 10) (SWTE 2018). Noise level calculations shows that current noise levels from US 79 in the vicinity of Filter Plant and

Figure 6: Filter Plant and Loadout Facility Equipment Site Layout



Loadout Facility is approximately 65 dBA L_{eq} at 50 feet from the roadway centerline. The additional 18 peak hour vehicles from the Filter Plant and Loadout Facility would result in a 52 dBA L_{eq} noise level along US 79 at 50 feet from the roadway centerline, which would result in increased less than 1 dBA to the existing traffic noise levels. Therefore, because the Filter Plant and Loadout Facility related traffic noise levels would not result in a substantial noise level increase (FHWA 2011) and would not be a perceivable change in the existing noise levels the WPS vehicles were not modeled after they enter onto US 79 and west on Skyline Drive.

The Filter Plant and Loadout Facility also incorporates a railway system that will tie into the existing railway located along the MARRCO corridor. The facility will be able load a maximum of two trains per day with 100 cars. This railway was entered as a railway source in the noise model and was evaluated from the Filter Plant to Magma Junction.

4.2.4 MARRCO Corridor Noise Model Input

Figure 7 shows the MARRCO Corridor location based on Figure 3.4-1 of the General Plan of Operations, dated January 12, 2016. The linear infrastructure elements of the Project are primarily located within the MARRCO Corridor. These elements include power lines, copper concentrate pipelines, tailings pipelines, and water supply pipelines. A proposed Clean Valley Booster pump station is the only significant noise source to be located in the MARRCO Corridor, with the exception of the railway operations associated with the Filter Plant and Loadout Facility.

Table 13 summarizes the MARRCO Corridor equipment sound power level data, quantity, utilization factors used as inputs to the modeling analysis. the year that has the the maximum equipment, which occurs during operations.

Table 13. Sound Power Level (LP) for MARRCO Corridor Major Pieces of Project Equipment

Sound Source	Quantity	Utilization Factor	Broadband Level
		%	dBA
Clean Valley Booster Pump Station	1	100	105

The MARRCO corridor could also incorporate 13 to 30 pumping wells. The pumps would be submerged and the assoicated noise levels would be negligible.

4.2.5 Near West TSF Noise Model Input

The NWTSF general arrangement is shown in **Figure 8**.

The primary noise sources for the Near West TSF include pumps and mobile equipment. The Near West TSF was modeled using the maximum expected equipment operations, which is shown to be year 15 (see Appendix E). The operations at Near West TSF incorporate a corrdidor that runs to WPS. Noise from this corridor is from project traffic traveling between Near West TSF and WPS. **Table 14** summarizes the equipment sound power level data, equipment quantity, and utilization factors used as inputs to the modeling analysis.

Figure 7: MARRCO Corridor Site Layout

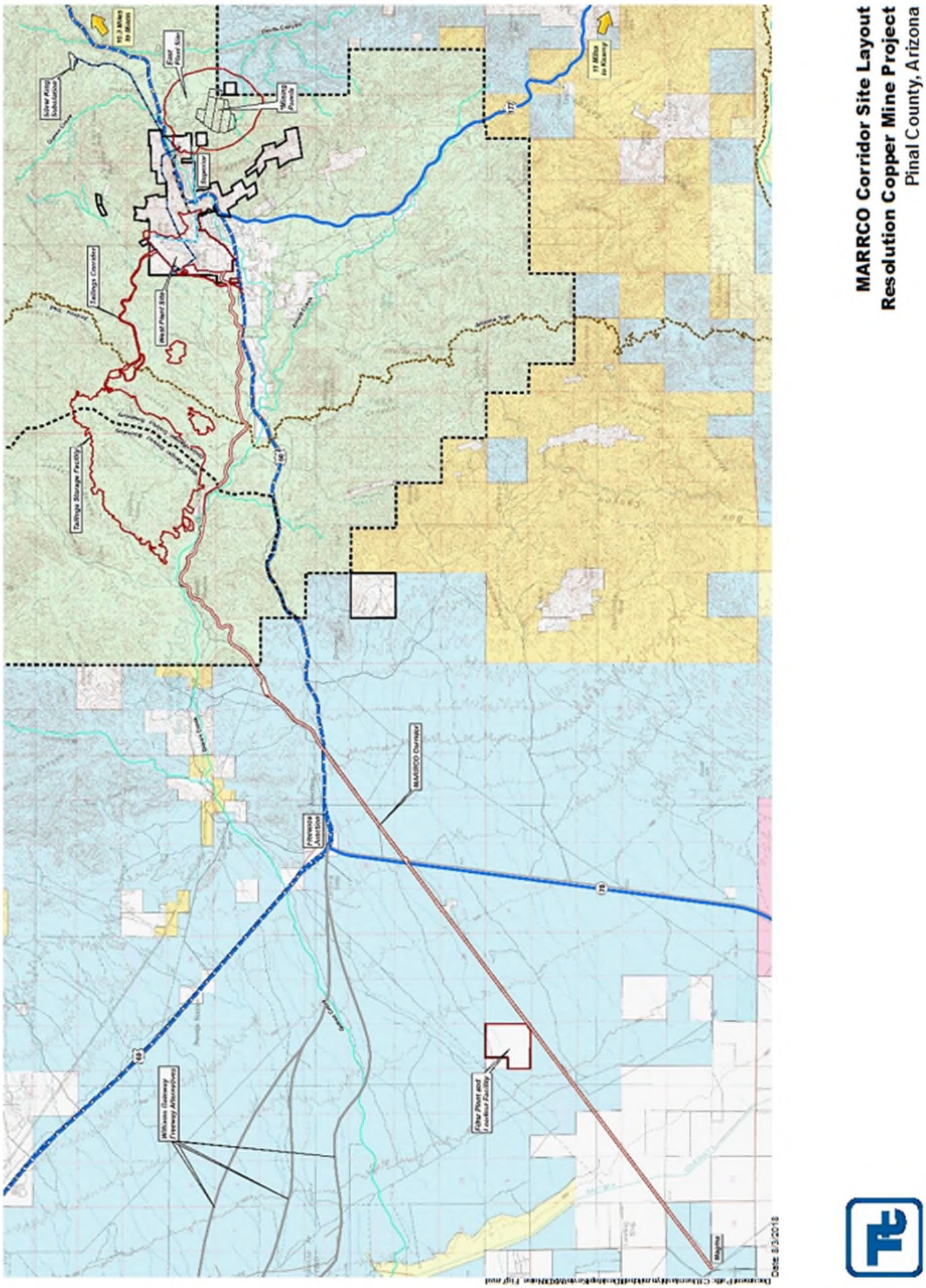


Figure 8: Near West TSF Equipment Site Layout

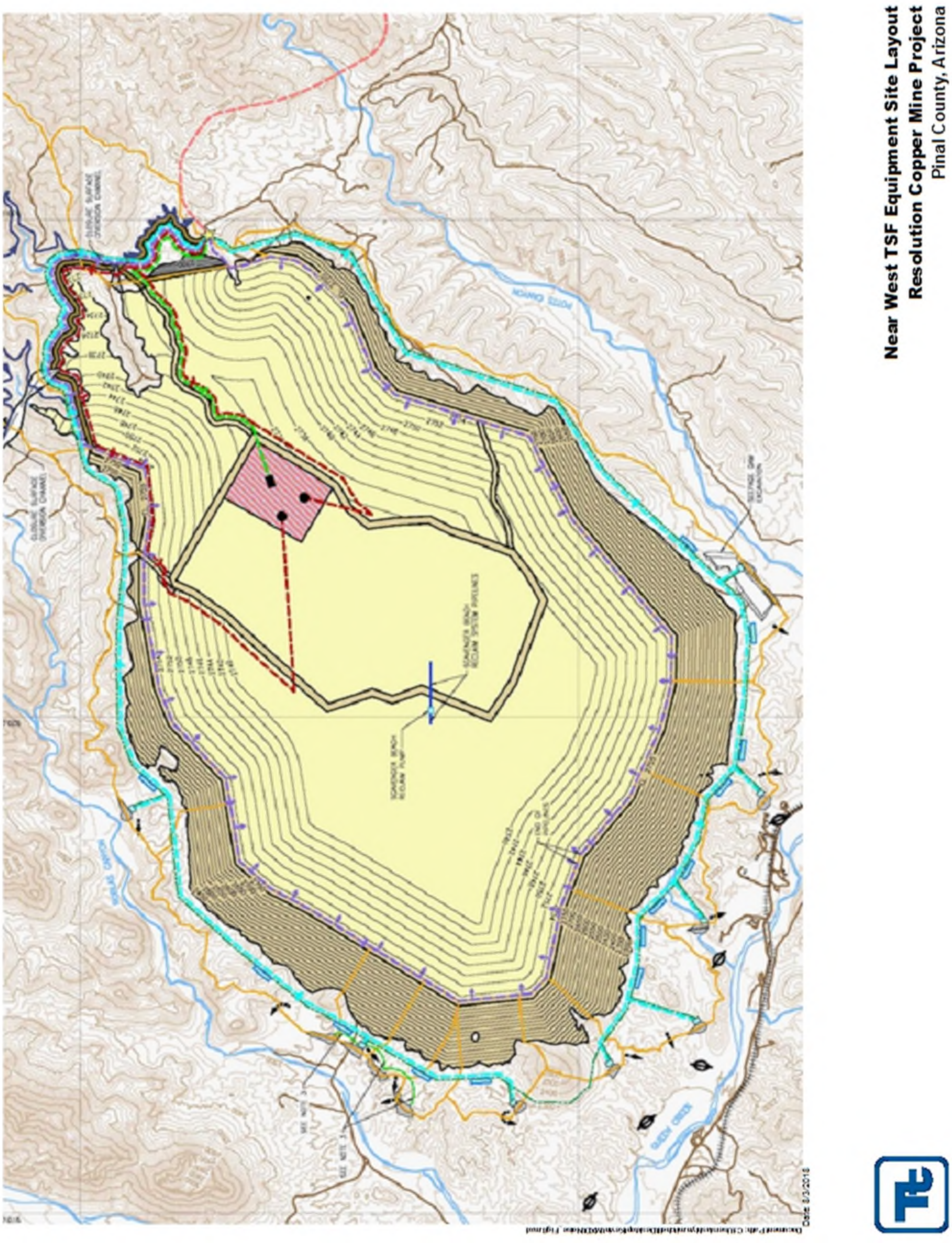


Table 14. Sound Power Level (LP) for Near West TSF Major Pieces of Project Equipment

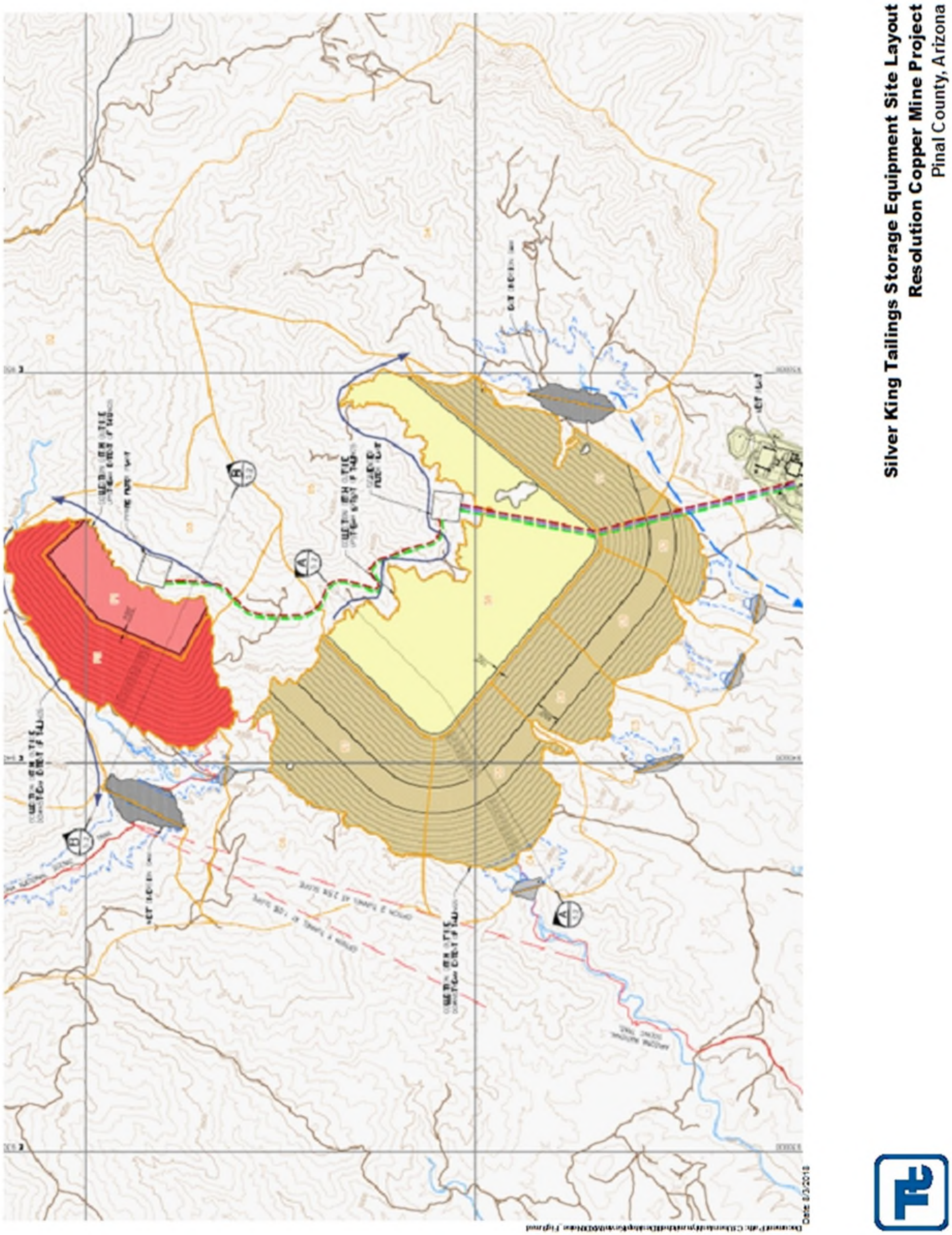
Sound Source	Year 15 Quantity	Utilization Factor	Broadband Level
		%	dBA
Pump Station	1	100	95
Substation	1	100	91
Cyclone Station	1	100	116
Bulldozer	7	60	120
Tractor	6	60	120
Grader	2	60	120
Compactor	3	60	115
Skid Steer	2	60	120
Scraper	2	60	120
Boom Winch Truck	2	60	119
Water Truck	4	60	119
Welder	2	60	108
Forklift	2	60	115
Telehandler	1	60	120
Fuel/lube Truck	1	60	119
Service Truck	8	60	119
Excavator	3	60	120
Air Compressor	1	60	119
Diesel Pumps	2	90	115
Haul Truck	6	60	119
Light Plants	6	60	117
Processing Equipment	1	60	116
Pickup Truck	20	50	90

The NWTSF access is from Highway 60 to Hewitt Station Road. This roadway that is estimated to have a peak hour of 22 truck shipments and 42 personnel vehicles per day (SWTE 2018). The entrance road was entered as a roadway source in the Cadna-A® noise model along Hewitt Station Road. However, the current vehicles per day on US 60 is 12,070 (approximately 700 vehicles per hour with a truck percentage of 10) (SWTE 2018). Noise level calculations show that noise levels from US 60 in the vicinity of the NWTSF is approximately 71 dBA L_{eq} at 50 feet roadway centerline. The additional 64 peak hour vehicles from the NWTSF would result in an approximate noise level of 64 dBA L_{eq} along US 60 at 50 feet from the roadway centerline, which would result in an increase of less than 1 dBA to the existing traffic noise levels. Therefore, because the NWTSF related traffic noise levels would not result in a substantial noise level increase (FHWA 2011) and would not be a perceivable change in the existing noise levels the NWTSF vehicles were not modeled after they enter onto US 60.

4.2.6 Silver King TSF Noise Model Input

The Silver King TSF general arrangement is shown in **Figure 9**.

Figure 9: Silver King Tailings Storage Equipment Site Layout



The primary noise sources for the Silver King TSF include mobile equipment as well as two filter plants, and a conveyor system. This alternative also includes relocating the filter plant near Superior and uses the existing rail line to transport the concentrate to the Union Pacific junction. The Silver King TSF was modeled using the maximum expected equipment operations, which is shown to be year 9 (see Appendix E). **Table 15** summarizes the Silver King TSF equipment sound power level data, equipment quantity, and utilization factors used as inputs to the modeling analysis.

Table 15. Sound Power Level (LP) for Silver King TSF Major Pieces of Project Equipment

Sound Source	Year 9 Quantity	Utilization Factor	Broadband Level
		%	dBA
Conveyors[1]	2	100	93
Concentrate Filter Plant[1]	1	100	110
Thickeners[1]	3	100	91
Compressors[1]	6	100	115
Switch Engine[1]	1	80	120
Wheel Loader[1]	1	60	115
Track Mobile[1]	1	60	120
Sweeper[1]	1	60	119
Loader[1]	3	60	115
Filter Plants[2]	2	100	110
Conveyors[2]	2	100	93
Stackers[2]	15	100	93
Bulldozer[2]	13	60	120
Grader[2]	2	60	120
Compactor[2]	14	60	115
Skid Steer[2]	2	60	120
Scraper[2]	4	60	120
Boom Winch Truck[2]	1	60	119
Welder[2]	2	60	108
Water Truck[2]	4	60	119
Forklift[2]	2	60	115
Telehandler[2]	1	60	120
Service Truck[2]	8	60	119
Fuel/lube Truck[2]	1	60	119
Air Compressor[2]	1	60	120
Light Plant[2]	6	60	115
Pickup Truck[2]	20	50	90

[1]Equipment located at the Filter Plant in Superior.
[2]Equipment located in the Silver King TSF area.

The Silver King TSF access is from Highway 60 to Silver King Mine Road. This roadway that is estimated to have a peak hour of 22 truck shipments and 66 personnel vehicles per day (SWTE 2018). The entrance road was entered as a roadway source in the Cadna-A® noise model along Silver King Mine Road. However, the current vehicles per day on US 60 is 12,110 (approximately 702 vehicles per hour with a truck percentage of 10) (SWTE 2018). Noise level calculations show that noise levels from US 60 in the vicinity of Silver King TSF access road is approximately 71 dBA L_{eq} at 50 feet roadway centerline. The additional 64 peak hour vehicles from the Silver King TSF would result in an approximate noise level of 64 dBA L_{eq} along US 60 at 50 feet from the roadway centerline, which would result in an increase of less than 1 dBA to the existing traffic noise levels. Therefore, because the Silver King TSF related traffic noise levels would not result in a substantial noise level increase (FHWA 2011) and would not be a perceivable change in the existing noise levels the Silver King TSF vehicles were not modeled after they enter onto US 60.

The Silver King TSF also incorporates a railway system that will tie into the existing railway located along the MARRCO corridor from Superior to the Union Pacific junction. The facility will be able load a maximum of two trains per day with 50 cars. This railway was entered as a railway source in the noise model and was evaluated from the Filter Plant in Superior to the Magma Junction.

4.2.7 Peg Leg TSF Noise Model Input

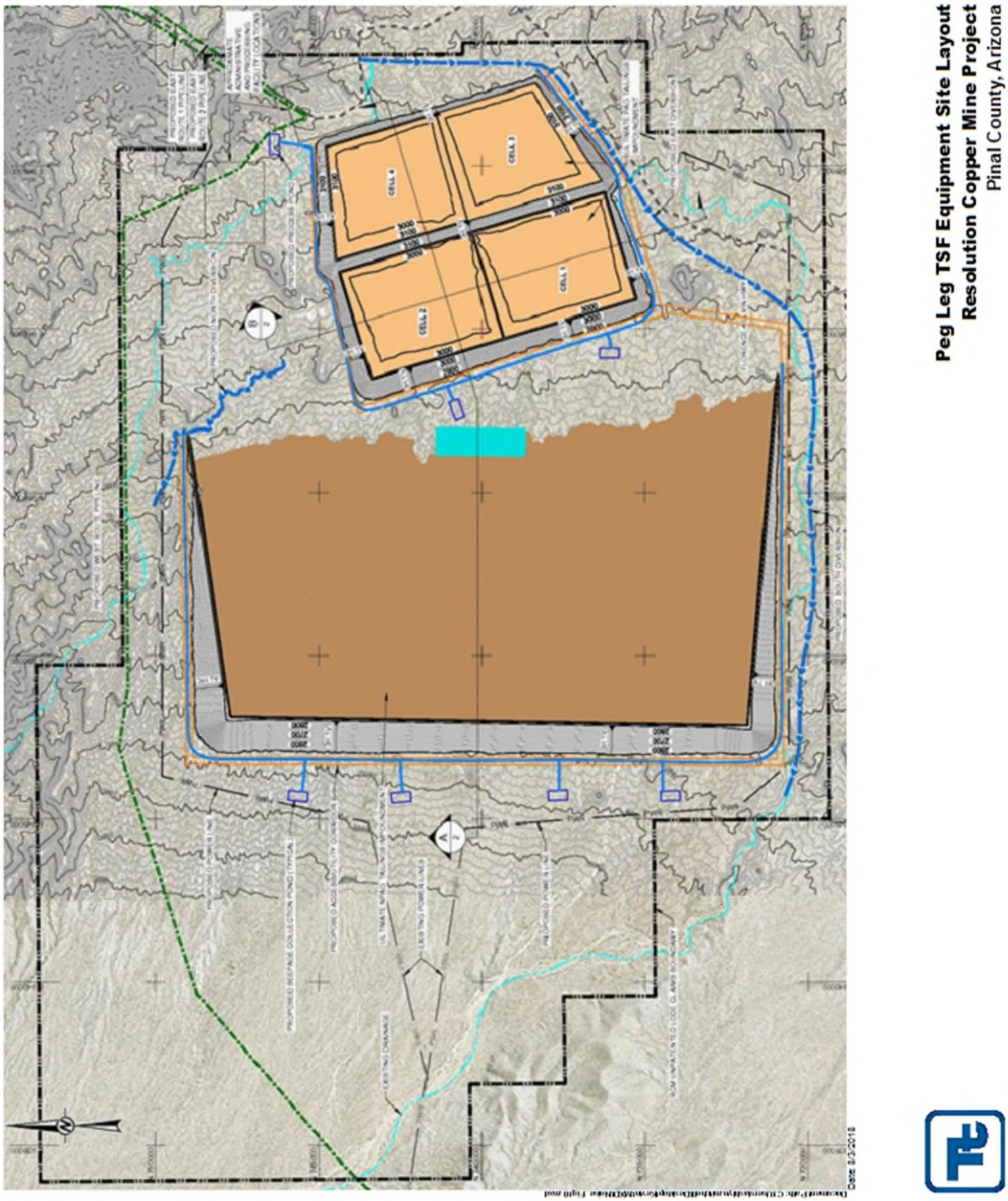
The Peg Leg TSF general arrangement is shown in **Figure 10.** The primary noise sources for the Peg Leg TSF include mobile equipment. The Peg Leg TSF was modeled using the maximum expected equipment operations, which is shown to be year 12 (see Appendix E). **Table 16** summarizes the Peg Leg TSF equipment sound power level data, equipment quantity, and utilization factors used as inputs to the modeling analysis.

Table 16. Sound Power Level (LP) for Peg Leg TSF Major Pieces of Project Equipment

Sound Source	Year 12 Quantity	Utilization Factor	Broadband Level
		%	dBA
Cyclone Station	1	100	116
Bulldozer	7	60	120
Grader	2	60	120
Compactor	2	60	115
Skid Steer	2	60	120
Boom Winch Truck	2	60	119
Welder	2	60	108
Fork Lift	1	60	115
Water Truck	5	60	119
Service Truck	8	60	119
Fuel/lube Truck	5	60	119
Air Compressor	1	60	119
Excavator	10	60	120
Diesel Pumps	2	90	115
Light Plant	6	60	117
Haul Truck	50	60	119
Pickup Truck	49	50	90

The Peg Leg TSF access is from the Florence-Kelvin Highway. This roadway that is estimated to have a peak hour of 22 truck shipments per day and 44 personnel vehicles per day (SWTE 2018). The entrance road was entered as a roadway source in the Cadna-A® noise model along Florence-Kelvin Highway. The Peg Leg TSF will be accessed by both US 79 and US 177. US 79 has a current vehicles per day of 5,200 (approximately 302 vehicles per hour with a truck percentage of 10) and US 177 has a current vehicles per day of 2,050 (approximately 119 vehicles per hour with a truck percentage of 10) (SWTE 2018). Noise level calculations show that noise levels from US 79 is approximately 68 dBA L_{eq} at 50 feet roadway centerline and US 177 is approximately 64 dBA L_{eq} at 50 feet roadway centerline in the vicinity of the Peg Leg TSF. The additional 64 peak hour vehicles from the Peg Leg TSF would result in an approximate noise level of 64 dBA L_{eq} along US 79 and US 177 at 50 feet from the roadway centerline, which would result in an increase of 3 dBA or less to the existing traffic noise levels. Therefore, because the Peg Leg TSF related traffic noise levels would not result in a substantial noise level increase (FHWA 2011) and would not be a perceivable change in the existing noise levels the Peg Leg TSF vehicles were not modeled after they enter onto US 79 and US 177.

Figure 10: Peg Leg TSF Equipment Site Layout



4.2.8 Skunk Camp TSF Noise Model Input

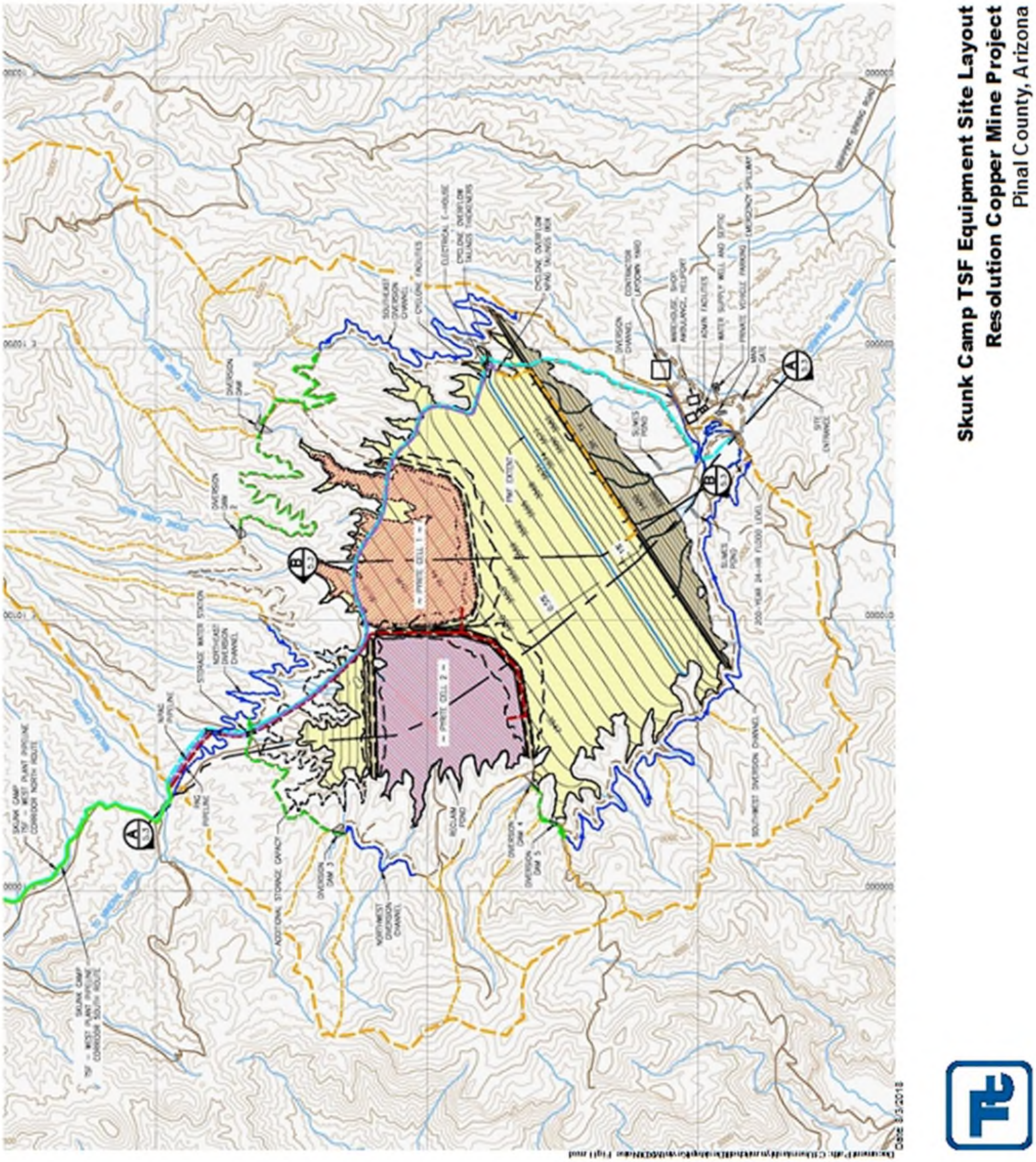
The Skunk TSF general arrangement is shown in **Figure 11**. The primary noise sources for the Skunk Camp TSF is mobile equipment. The Skunk Camp TSF was modeled using the maximum expected equipment operations in year 8 (see Appendix E). **Table 17** summarizes the Skunk Camp TSF equipment sound power level data, equipment quantity, and utilization factors inputs.

Table 17. Sound Power Level (LP) for Skunk Camp TSF Major Pieces of Project Equipment

Sound Source	Year 8 Quantity	Utilization Factor	Broadband Level
		%	dBA
Cyclone Station	1	100	116
Bulldozer	7	60	120
Tractor	6	60	120
Grader	2	60	120
Compactor	2	60	115
Skid Steer	2	60	120
Boom Winch Truck	2	60	119
Welder	2	60	108
Scraper	2	60	120
Water Truck	4	60	119
Forklift	2	60	115
Telehandler	1	60	120
Service Truck	8	60	119
Fuel/lube Truck	1	60	119
Air Compressor	1	60	119
Diesel Pump	2	60	115
Excavator	3	60	120
Light Plant	6	60	115
Haul Truck	7	60	119
Pickup Truck	19	50	90

The Skunk Camp TSF access is from the Drippings Springs Road. This roadway is estimated to have a peak hour use of 22 truck shipments and 42 personnel vehicles added from the project (SWTE 2018). The entrance road was entered as a roadway source in the Cadna-A® noise model along Dripping Springs Road. However, the current vehicles per day on US 77 is 1,375 (SWTE 2018). A screening level analysis shows that noise levels from US 77 near the Skunk Camp TSF access road is approximately 62 dBA L_{eq} at 50 feet roadway centerline. With the additional vehicles from the Skunk Camp TSF noise levels along US 77 would increase by 4 dBA or less. There are scattered NSAs located along US 77 north of the Skunk Camp TSF, which would carry 90 percent of the project traffic. Noise levels at these scattered NSAs north of the Skunk Camp TSF would increase by 4 dBA or less. There are NSAs located approximately 15 miles south along US 77. However, south of the Skunk Camp TSF US 77 could carry 10 percent of the project traffic, which would result in a noise level increase of less than 1 dBA at the southern NSAs. Therefore, due to the insignificant increase in traffic noise levels the project vehicles were not modeled after they enter onto US 77.

Figure 11: Skunk Camp TSF Equipment Site Layout



4.3 NOISE PREDICTION MODEL RESULTS

Broadband (dBA) sound pressure levels were calculated for expected Project operations at all facilities assuming that all components identified previously are operating concurrently based on the applied utilization factor using representative sound source levels. The sound energy was then summed to determine the equivalent continuous A-weighted downwind sound pressure level at a point of reception. Sound contour plots displaying broadband (dBA) sound levels presented as color-coded isopleths are provided in **Figures 12 through 15**. The noise contours are graphical representations of the cumulative noise associated with full operation of the equipment and show how operational noise would be distributed over the surrounding area of the Project Site. The contour lines shown are analogous to elevation contours on a topographic map, i.e., the noise contours are continuous lines of equal noise level around some source, or sources, of noise. Appendix F provides the detailed noise model results.

4.3.1 Near West TSF Noise Model Results

Table 18 shows the projected exterior sound levels resulting from the full, normal operation of the Project at the identified measurement and noise sensitive receptor locations. The noise levels in **Table 18** show that operations will comply with the Pinal County nighttime noise threshold limits.

Table 18. Near West TSF Acoustic Modeling Results Summary

Project Component	Sensitive Receptors	Pinal County Nighttime Noise Threshold Limit (dBA L_{eq})	Project Noise Level (dBA L_{eq})
WPS	WPS Noise Monitor	55	47
	Residences in Superior	55	47
	Residences between US 60 and Main Street	55	53
EPS	EPS Noise Monitor[1]	---	61
	Oak Flat Campground	55	49
	Apache Leap Special Management Area	55	46
NWTSF	NWTSF Noise Monitor	55	43
	Hewitt Station	55	43
	Residences in Queen Valley	55	<10
	Boyce Thompson Arboretum	55	24
	Arizona Trail	55	51
Filter Plant/MARRCO Corridor	Filter Plant/ MARRCO Corridor Noise Monitor	---	47
	Westernstar Road	55	<10
	Lind Road	55	32
	Felix Road	55	26
	Attaway Road	55	21

1 The EPS noise monitor was located within the site boundary. Therefore, this location does not threshold limits applied to it.

Table 19 shows the predicted mean increase in sound energy based on the daytime and nighttime Leq measurement data ranges. The predicted mean sound level range increases from <1 dBA at several of the isolated receptors to 12 dBA at the EPS monitor location.

Table 19. Near West TSF Predicted Sound Level Increase

Project Component	Sensitive Receptors	Measured Sound Level Range (dBA L_{eq})	Project Noise Level (dBA L_{eq})	Average Increase in Sound Level (dBA)
WPS	WPS Noise Monitor	33-47	47	5
	Residences in Superior	33-47	47	5
	Residences between US 60 and Main Street[1]	38-54	53	4
EPS	EPS Noise Monitor	45-50	61	12
	Oak Flat Campground[2]	31-50	43	1
	Apache Leap Special Management Area[2]	31-50	46	2
NWTSF	NWTSF Noise Monitor	32-43	43	4
	Hewitt Station	32-43	44	5
	Residences in Queen Valley[2]	26-43	<10	<1
	Boyce Thompson Arboretum	32-43	24	<1
	Arizona Trail[2]	26-43	51	11
Filter Plant/MARRCO Corridor	Filter Plant/ MARRCO Corridor Noise Monitor	27-45	47	6
	Westernstar Road	27-45	<10	<1
	Lind Road	27-45	32	<1
	Felix Road	27-45	26	<1
	Attaway Road	27-45	13	<1

[1]Lower and upper levels are based on the expected sound levels due to the vicinity of the highway.
[2]The expected lower level was applied to be conservative.

Figure 12: Received Sound Levels: Normal Operation – Near West TSF Location

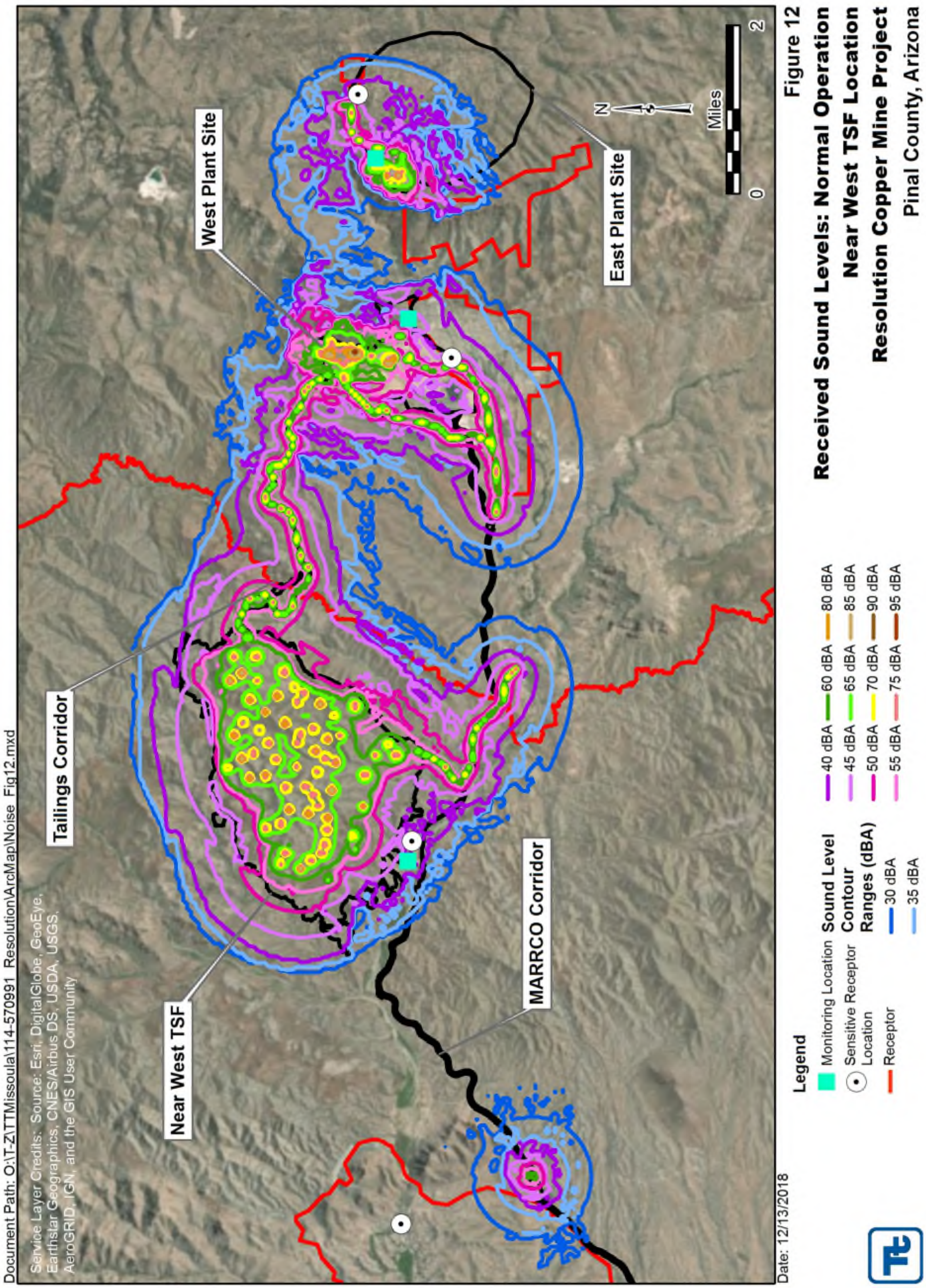
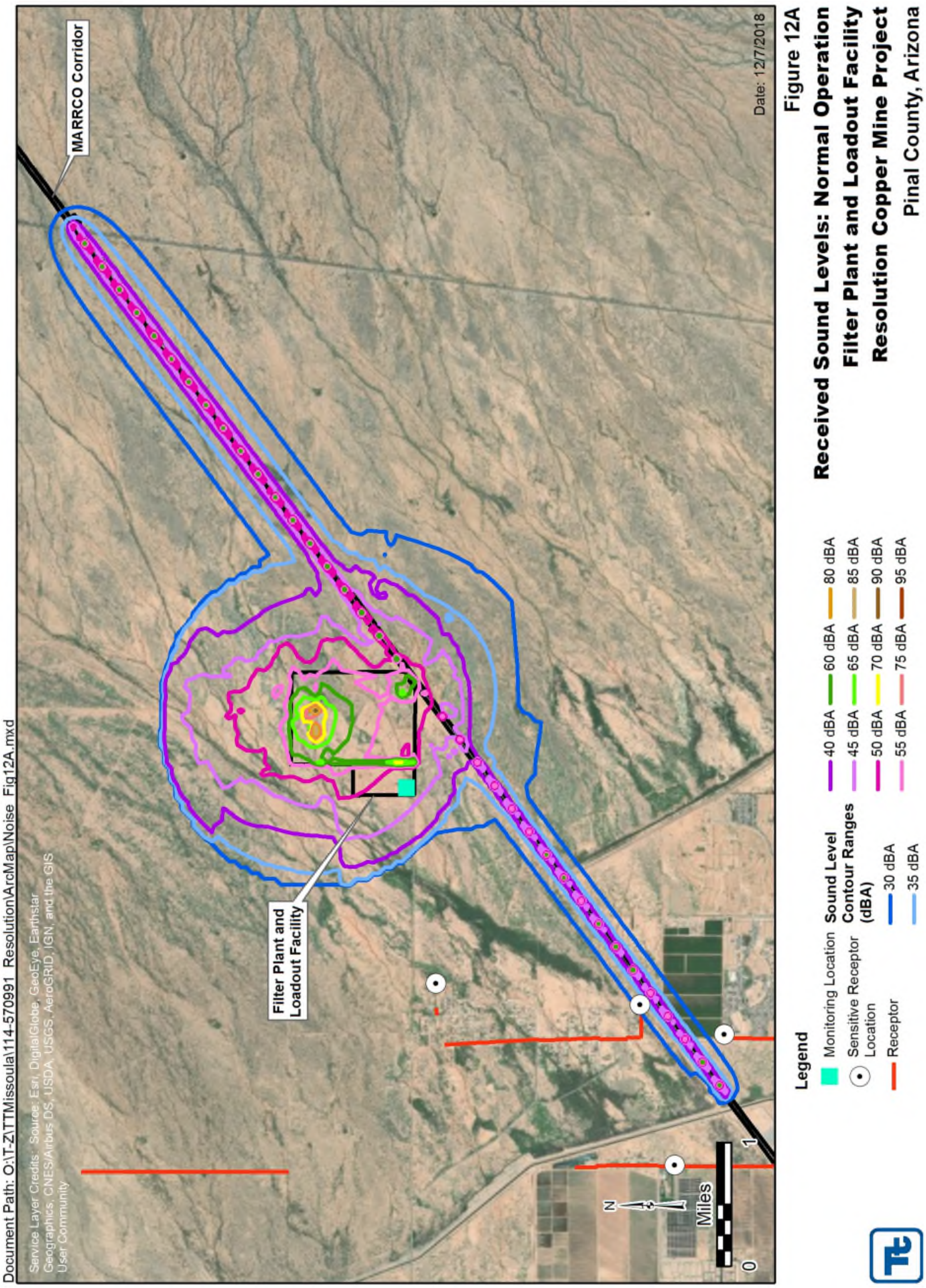


Figure 12a: Received Sound Levels: Normal Operation – Near West TSF Location



4.3.2 Silver King TSF Noise Model Results

Table 20 shows the projected exterior sound levels resulting from under full, normal operation of the Silver King TSF scenario at the identified measurement and noise sensitive receptor locations. The noise levels in **Table 20** show that operations will comply with the Pinal County nighttime noise threshold limits.

Table 20. Silver King TSF Acoustic Modeling Results Summary

Project Component	Sensitive Receptors	Pinal County Nighttime Noise Threshold Limit (dBA L_{eq})	Project Noise Level (dBA L_{eq})
WPS	WPS Noise Monitor	55	47
	Residences in Superior	55	47
	Residences between US 60 and Main Street	55	53
EPS	EPS Noise Monitor	---	61
	Oak Flat Campground	55	43
	Apache Leap Special Management Area	55	46
NWTSF	NWTSF Noise Monitor	55	29
	Hewitt Station	55	31
	Residences in Queen Valley	55	<10
	Boyce Thompson Arboretum	55	22
	Arizona Trail	55	26
Filter Plant/MARRCO Corridor	Filter Plant/ MARRCO Corridor Noise Monitor	---	20
	Westernstar Road	55	<10
	Lind Road	55	32
	Felix Road	55	26
	Attaway Road	55	21
Silver King TSF	Silver King TSF Noise Monitor	---	52
	Arizona Trail	55	43

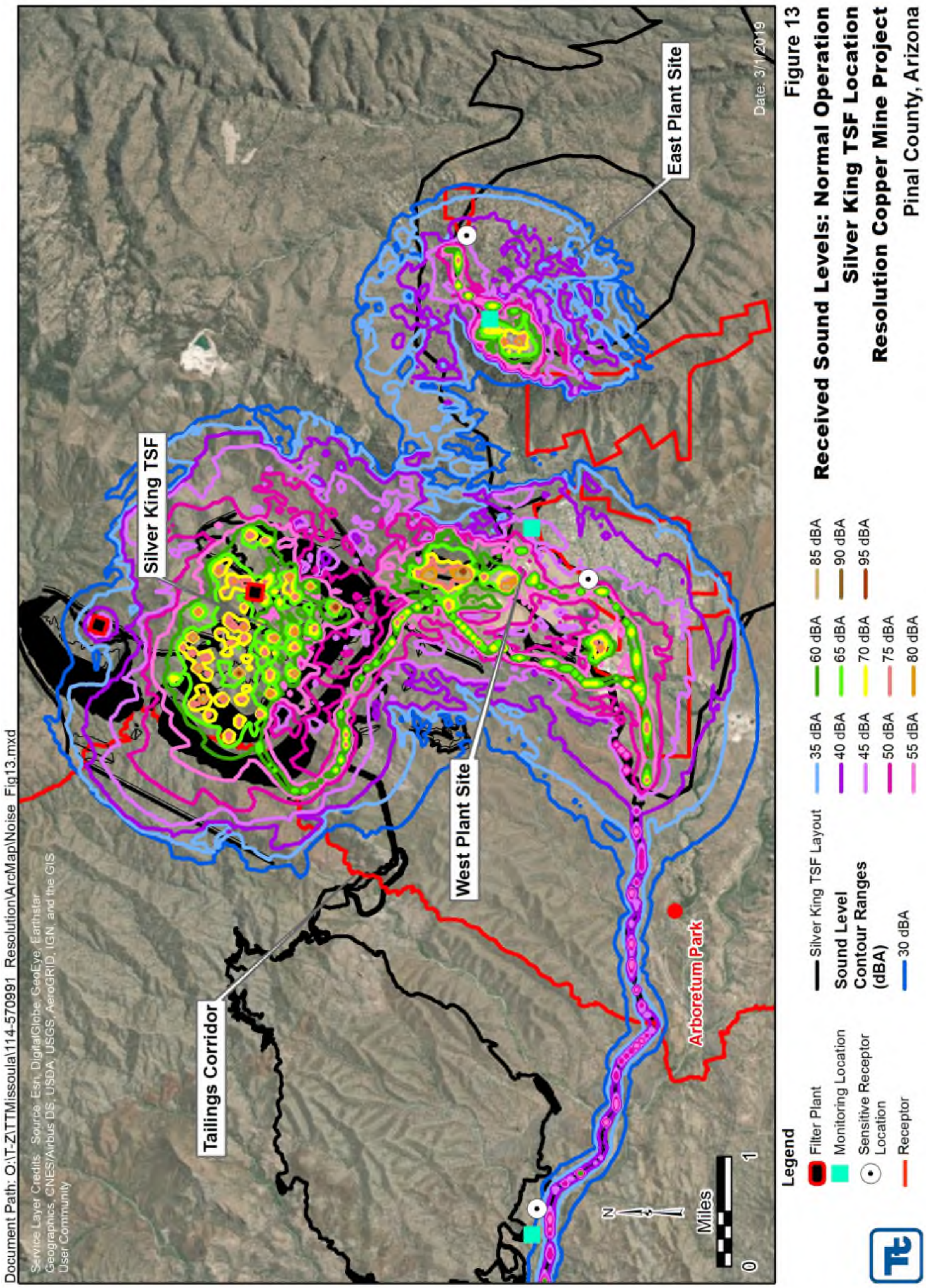
Table 21 shows the predicted mean increase in sound energy based on the daytime and nighttime L_{eq} measurement data ranges. The predicted mean sound level increases range from <1 dBA at several of the isolated receptors to 14 dBA at the both the Silver King TSF monitor location and the Filter Plant and Loadout Facility monitor location.

Table 21. Silver King TSF Predicted Sound Level Increase

Project Component	Sensitive Receptors	Measured Sound Level Range (dBA L_{eq})	Project Noise Level (dBA L_{eq})	Average Increase in Sound Level (dBA)
WPS	WPS Noise Monitor	33-47	47	5
	Residences in Superior	33-47	47	5
	Residences between US 60 and Main Street1	38-54	53	4
EPS	EPS Noise Monitor	45-50	61	12
	Oak Flat Campground2	31-50	43	1
	Apache Leap Special Management Area2	31-50	46	2
NWTSF	NWTSF Noise Monitor	32-43	29	<1
	Hewitt Station	32-43	31	<1
	Residences in Queen Valley2	26-43	<10	<1
	Boyce Thompson Arboretum	32-43	22	<1
	Arizona Trail2	26-43	26	<1
Filter Plant/MARRCO Corridor	Filter Plant/ MARRCO Corridor Noise Monitor	27-45	20	<1
	Westernstar Road	27-45	<10	<1
	Lind Road	27-45	32	<1
	Felix Road	27-45	26	<1
	Attaway Road	27-45	21	<1
Silver King TSF	Silver King TSF Noise Monitor	27-41	52	14
	Arizona Trail	27-41	43	6

[1]Lower and upper levels are based on the expected sound levels due to the vicinity of the highway.
[2]The expected lower level was applied to be conservative.

Figure 13: Received Sound Levels: Normal Operation – Silver King TSF Location



4.3.3 Peg Leg TSF Noise Model Results

Error! Reference source not found. shows the projected exterior sound levels resulting from under full, normal o peration of the Peg Leg TSF scenario at the identified measurement and noise sensitive receptor locations. The noise levels in Error! Reference source not found. show that the Project operations for Peg Leg TSF scenario will c omply with the Pinal County noise threshold limits.

Table 22. Peg Leg TSF Acoustic Modeling Results Summary

Project Component	Sensitive Receptors	Pinal County Nighttime Noise Threshold Limit (dBA L_{eq})	Project Noise Level (dBA L_{eq})
WPS	WPS Noise Monitor	55	47
	Residences in Superior	55	47
	Residences between US 60 and Main Street	55	53
EPS	EPS Noise Monitor	---	61
	Oak Flat Campground	55	43
	Apache Leap Special Management Area	55	46
NWTSF	NWTSF Noise Monitor	55	<10
	Hewitt Station	55	<10
	Residences in Queen Valley	55	<10
	Boyce Thompson Arboretum	55	20
	Arizona Trail	55	26
Filter Plant / MARRCO Corridor	Filter Plant/ MARRCO Corridor Noise Monitor	---	20
	Westernstar Road	55	<10
	Lind Road	55	32
	Felix Road	55	26
	Attaway Road	55	21
Peg Leg TSF	Peg Leg TSF Noise Monitor	---	56
	Arizona Trail	55	34

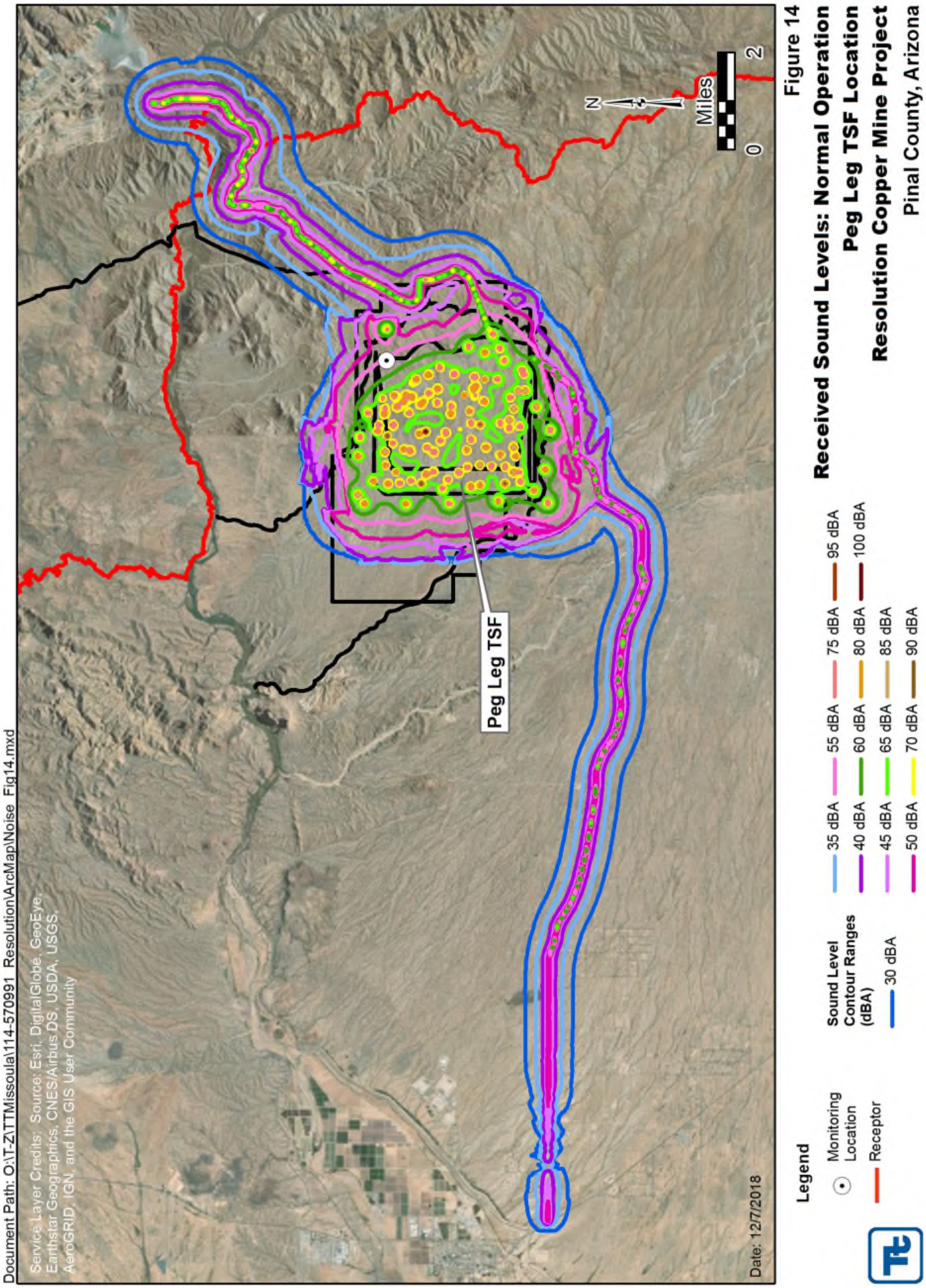
Table 23 shows the predicted mean increase in sound energy based on the daytime and nighttime L_{eq} measurement data ranges. The predicted mean sound level increases range from <1 dBA at several of the isolated receptors to 15 dBA at the Peg Leg TSF monitor location.

Table 23. Peg Leg TSF Predicted Sound Level Increase

Project Component	Sensitive Receptors	Measured Sound Level Range (dBA L_{eq})	Project Noise Level (dBA L_{eq})	Average Increase in Sound Level (dBA)
WPS	WPS Noise Monitor	33-47	47	5
	Residences in Superior	33-47	47	5
	Residences between US 60 and Main Street[1]	38-54	53	4
EPS	EPS Noise Monitor	45-50	61	12
	Oak Flat Campground[2]	31-50	43	1
	Apache Leap Special Management Area[2]	31-50	46	2
NWTSF	NWTSF Noise Monitor	32-43	<10	<1
	Hewitt Station	32-43	<10	<1
	Residences in Queen Valley[2]	26-43	<10	<1
	Boyce Thompson Arboretum	32-43	20	<1
	Arizona Trail[2]	26-43	26	<1
Filter Plant/ MARRCO Corridor	Filter Plant/ MARRCO Corridor Noise Monitor	27-45	20	<1
	Westernstar Road	27-45	<10	<1
	Lind Road	27-45	32	<1
	Felix Road	27-45	26	<1
	Attaway Road	27-45	21	<1
Peg Leg	Peg Leg TSF Noise Monitor	26-51	56	9
	Arizona Trail	26-51	34	<1

[1]Lower and upper levels are based on the expected sound levels due to the vicinity of the highway.
[2]The expected lower level was applied to be conservative.

Figure 14: Received Sound Levels: Normal Operation – Peg Leg TSF Location



4.3.4 Skunk Camp TSF Noise Model Results

Table 24 shows the projected exterior sound levels resulting from under full, normal operation of the Alternative 6 scenario at the identified measurement and noise sensitive receptor locations. The nearest receptors are residneces along Dripping Springs Road approximately 2 miles southeast of the Skunk Camp TSF. These receptors are also located along the Skunk Camp TSF entrance route. Other sensitive receptors are located in the town of Kearny, which is over 7 miles from the Skunk Camp TSF. The noise levels in **Table 24** show that the Project operations for the Skunk Camp TSF will comply with the Pinal County noise threshold limits at all receptor locations with the exception of the receptors along Dripping Springs Road.

Table 24. Skunk Camp TSF Acoustic Modeling Results Summary

Project Component	Sensitive Receptors	Pinal County Nighttime Noise Threshold Limit (dBA L_{eq})	Project Noise Level (dBA L_{eq})
WPS	WPS Noise Monitor	55	47
	Residences in Superior	55	47
	Residences between US 60 and Main Street	55	53
EPS	EPS Noise Monitor	---	61
	Oak Flat Campground	55	43
	Apache Leap Special Management Area	55	46
NWTSF	NWTSF Noise Monitor	55	<10
	Hewitt Station	55	<10
	Residences in Queen Valley	55	<10
	Boyce Thompson Arboretum	55	20
	Arizona Trail	55	26
Filter Plant/MARRCO Corridor	Filter Plant/ MARRCO Corridor Noise Monitor	---	20
	Westernstar Road	55	<10
	Lind Road	55	32
	Felix Road	55	26
	Attaway Road	55	13
Skunk Camp TSF	Dripping Springs Road	55	60
	Arizona Trail	55	<10

Table 25 shows the predicted mean increase in sound energy based on the daytime and nighttime L_{eq} measurement data ranges. The predicted mean sound level increases range from <1 dBA at several of the isolated receptors to 12 dBA along Dripping Springs Road.

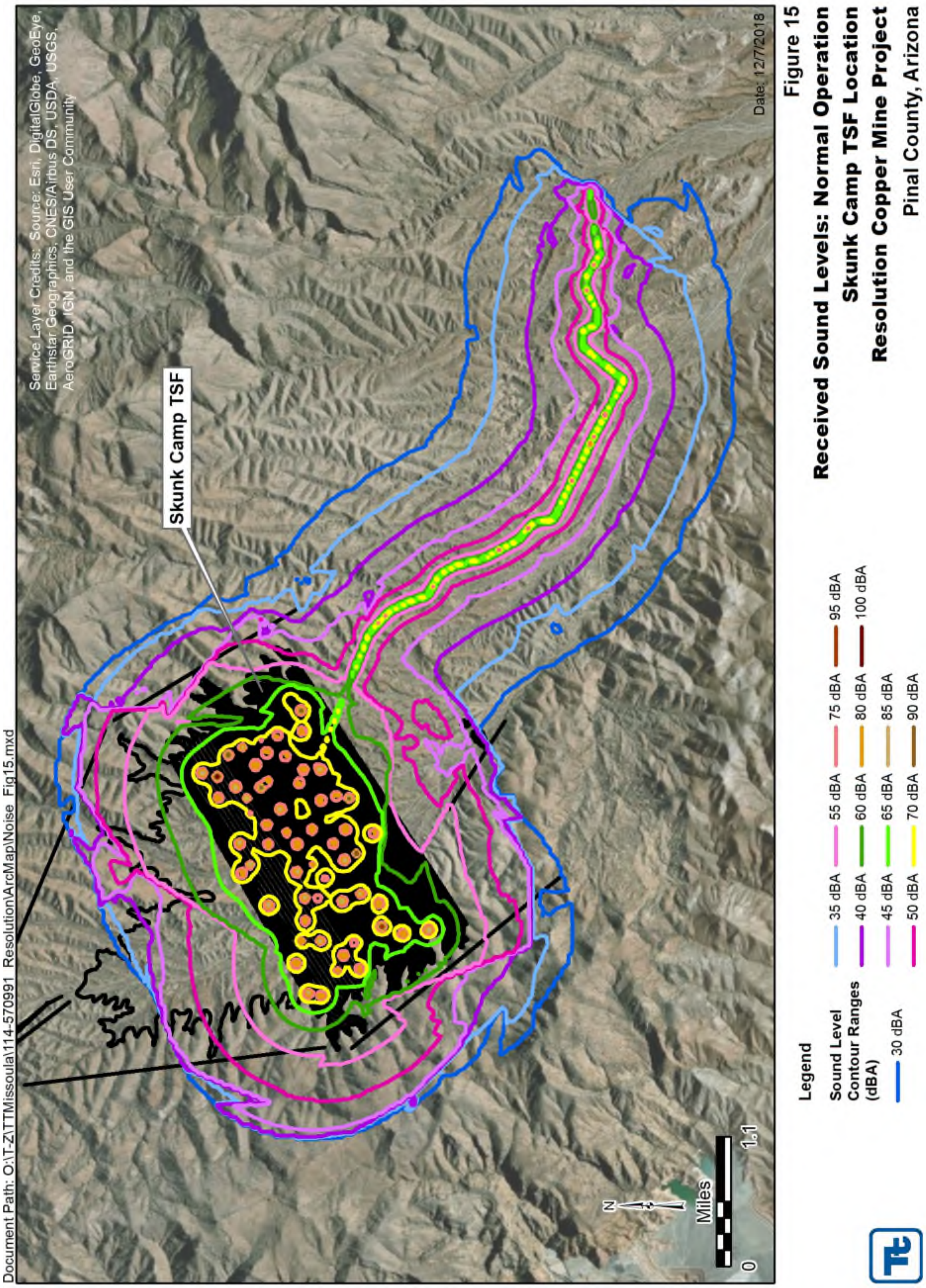
Table 25. Skunk Camp TSF Predicted Sound Level Increase

Project Component	Sensitive Receptors	Measured Sound Level Range (dBA L_{eq})	Project Noise Level (dBA L_{eq})	Average Increase in Sound Level (dBA)
WPS	WPS Noise Monitor	33-47	47	5
	Residences in Superior	33-47	47	5
	Residences between US 60 and Main Street[1]	38-54	53	4
EPS	EPS Noise Monitor	45-50	61	12
	Oak Flat Campground[2]	31-50	43	1
	Apache Leap Special Management Area[2]	31-50	46	2
NWTSF	NWTSF Noise Monitor	32-43	<10	<1
	Hewitt Station	32-43	<10	<1
	Residences in Queen Valley[2]	26-43	<10	<1
	Boyce Thompson Arboretum	32-43	20	<1
	Arizona Trail[2]	26-43	26	<1
Filter Plant/ MARRCO Corridor	Filter Plant/ MARRCO Corridor Noise Monitor	27-45	20	<1
	Westernstar Road	27-45	<10	<1
	Lind Road	27-45	32	<1
	Felix Road	27-45	26	<1
	Attaway Road	27-45	13	<1
Skunk Camp TSF	Dripping Springs Road	26-51	60	12
	Arizona Trail[3]	26-51	<10	<1

[1]Lower and upper levels are based on the expected sound levels due to the vicinity of the highway.
[2]The expected lower level was applied to be conservative.
[3]The lower and upper levels are based on the Peg Leg TSF sound monitor.

The noise levels at Dripping Springs from the Skunk Camp TSF operations will exceed the Pinal County nighttime noise threshold limit of 55 dBA L_{eq} and will result in an increase to the existing ambient noise level of 12 dB. These noise impacts are primarily due to the entrance road that runs adjacent to the residences along Dripping Springs Road. Therefore, to reduce the noise levels at these residences the Skunk Camp TSF entrance road will be relocated so that it does not run adjacent to residences. Mitigation of this noise impact may include relocation of the entrance way. With the relocation of the entrance way it is expected that the Skunk Camp TSF noise levels will comply with the Pinal County noise threshold limits.

Figure 15: Received Sound Levels: Normal Operation – Skunk Camp TSF Location



5.0 CONSTRUCTION NOISE ANALYSIS

Construction of the operational facilities including the WPS, EPS and Filter Plant and Loadout facility is anticipated to require less than 2 years. Construction is expected to occur in ten-hour daytime shifts during weekdays. Nighttime work is not expected for the construction of the operational facilities. The following sections provide an estimate of anticipated construction sound levels experienced during daytime construction shifts.

5.1 NOISE CALCULATION METHODOLOGY

Acoustic emission levels for activities associated with Facilities construction were based upon typical ranges of energy equivalent noise levels at construction sites, as documented by the USEPA (USEPA 1971), the USEPA's "Construction Noise Control Technology Initiatives" (USEPA 1980), and the Federal Highway Administration "Construction Noise Handbook" (FHWA 2006). The USEPA methodology distinguishes between type of construction and construction phase.

Using those energy equivalent noise levels as input to a basic propagation model, construction noise levels were calculated at the nearest Facility Site boundary and associated NSAs.

The basic model assumed spherical wave divergence from a point source located at the acoustic center of the Facility Site. Furthermore, the model conservatively assumed that all pieces of construction equipment associated with an activity would operate simultaneously for the duration of that activity. An additional level of conservatism was built into the construction noise model by excluding potential shielding effects due to intervening structures and buildings along the propagation path from the site to receiver locations.

5.2 PROJECTED NOISE LEVELS DURING CONSTRUCTION

The WPS construction is located directly north of the Town of Superior. The construction activities are expected to occur over an 18-month period. The proposed construction activities include:

- Improvements to the main site entrance at Lone Tree Road
- Construction of the administration building
- Construction of the warehouse
- Construction of the contractor laydown yard
- Construction of the concentrator site
- Construction of a new SRP substation
- Improvements to Silver King Road

The construction at EPS will consist of improvements within the Resolution Copper property boundary near shafts #9 and #10. The construction activities are expected to occur over 12 months. The proposed EPS construction activities include:

- Expansion of the shaft pad
- Surface infrastructure to support the underground development and operations.

The Filter Plant and Loadout Facility construction would include activities at the facility location as well as along improvements along the Resolution Copper owned Magma Arizona rail line, Skyline Road, and the MARRCO corridor. The construction actives for the Filter plant and Loadout Facility are expected to occur over 18-months. The proposed construction activities include:

- Construction of the Filter Plant Facility
- Improvements along the Magma Arizona rail line
- Improvement along Skyline Road
- Improvements for the pipe lines, well fields, booster station sites, and access points.

The construction equipment expected to be used at WPS, EPS, and the Filter Plant and Loadout Facility are expected to be similar. The expected construction equipment, noise emission levels, and calculated noise levels at incremental distances to 1000 feet are summarized in **Table 26** Based on sound propagation calculations, construction sound levels are predicted to range from 89 dBA L_{eq} at 50 feet to 63 dBA L_{eq} dBA at 1,000 feet. Periodically sound levels may be higher or lower than those presented in **Table 26**; however, the overall sound levels should generally be lower due to excess attenuation and the trend toward quitter equipment in the intervening decades since this data was developed.

Table 26. Estimated Noise Levels from Operation Facilities Construction Activities

Sound Source	Quantity			Utilization Factor	dBA L_{eq}[1]				
	WPS	EPS	Filter Plant Load Out Facility	%	50 Feet	100 feet	250 feet	500 feet	1000 feet
Dozer	6	5	1	40	81	75	67	61	55
Grader	3	3	1	40	81	75	67	61	55
Compactor	2	2	1	20	73	67	59	53	47
Scraper	3	3	1	40	81	75	67	61	55
Water Truck	2	1	1	40	80	74	66	60	54
Fuel/Lube Truck	1	1	1	40	80	74	66	60	54
Excavator	2	2	1	40	81	75	67	61	55
Loader	1	1	0	40	6	70	62	56	50
Haul Truck	1	1	0	40	80	74	66	60	54
Pickup Truck	3	3	0	40	51	45	37	31	25
Combine Noise Levels					89	83	75	69	63

[1]Calculations assume only one sound source is in operation.

The construction activities for the operational facilities will occur for ten-hour daytime shifts during weekdays. Receptors located within 100 feet may experience short-term increases to the existing noise levels. However, due to the infrequent nature of loud construction activities at the site and limited hours of construction, the noise from the construction of the operational facilities are not expected to result in an adverse impact at NSAs.

6.0 NON-BLASTING PROJECT VIBRATION LEVELS

Each project component will incorporate mechanical equipment that will generate vibration levels. Significant vibration producing source will be earth moving equipment such as bull dozers. Pile driving is not expected occur. Blasting will occur but was evaluated under a separate study. This study evaluates the worst-case non-blasting source, which will be earth moving equipment

Vibration levels for activities associated with the project components are based on average of source levels in PPV published with the FTA Noise and Vibration Manual (FTA 2006), which documents several types of heavy equipment measured under a wide variety of activities. Using the documented vibration levels as input into a basic propagation model, non-blasting project vibration levels were calculated at various distances from the source.

Each of the project components will incorporate earth moving equipment. These vibration levels are evaluated based on the worst-case vibration source, which will be bull dozers. Based on vibration propagation calculations, the vibration levels from the earth moving operations will be 0.089 PPV in/sec (87 VdB) at 25 feet from the source and will be 0.001 PPV in/sec (48 VdB) at 500 feet from the source. The vibration levels past 500 feet would not be distinguishable from ambient vibration levels. Based vibration criteria established the U.S. Department of the

Interior, Bureau of Mines and the FTA safe level of vibrations for residential type structures is 0.5 PPV in/sec. Annoyance to humans is typically occurs at vibration levels above 80 VdB. **Table 27** provides the vibration levels in 25-foot increments from the source. Based on the calculated vibration levels damage to structures could occur within 25 feet from the source and human annoyance could occur within 50 feet from the source. There are no sensitive receptors that will be located 50 feet or less from the earth moving equipment. There impacts from non-blasting vibrations sources are unlikely to occur.

Table 27. Worst-Case Calculated Non-Blasting Vibration Levels

Feet from Source	Calculated Non-Blasting Vibration Levels	
	PPV In/sec	VdB
25	0.0890	87
50	0.0315	78
75	0.0171	73
100	0.0111	69
125	0.0080	66
150	0.0061	64
175	0.0048	62
200	0.0039	60
225	0.0033	58
250	0.0028	57
275	0.0024	56
300	0.0021	55
325	0.0019	54
350	0.0017	53
375	0.0015	52
400	0.0014	51
425	0.0013	50
450	0.0012	49
475	0.0011	49
500	0.0010	48

7.0 NOISE AND VIBRATION BLAST MONITORING

In January of 2018 blasting operations at the EPS 4,000 level started. The blasting operations incorporated 225-pound charges that occurred periodically from January 30 to March 19, 2018. During these blasting operations noise and vibration monitors were deployed at the EPS noise monitor location. The methodology for this data collection was the same as the methodology discussed in Section 3.3.1 of this report. However, the vibration monitor was set to record additional data including waveforms for frequency analysis for vibration levels exceeding 0.01 PPV in/sec. **Table 28** shows the surface level maximum vibration levels recorded during the blasting events. These levels did not exceed the 0.01 PPV in/sec so no frequency analysis was conducted. The noise data collected did not show any influence from the blasting operations. Appendix D provides the full noise and vibration measurement dataset during the blasting periods.

Table 28. East Plant Blasting – 4,000 Level – Surface Vibration Levels

Blasting Date	Blasting Time	Maximum Vibration Level During Blasting Period (PPV in/sec)
1/30/2018	2:25:00 AM	0.0028
1/30/2018	10:55:00 AM	0.0034
1/31/2018	9:15:00 PM	0.0028
2/2/2018	10:50:00 PM	0.0025
2/3/2018	9:55:00 PM	0.0025
2/4/2018	12:05:00 PM	0.004
2/6/2018	2:55:00 PM	0.004
2/7/2018	11:20:00 AM	0.0034
2/10/2018	9:30:00 PM	0.0028
2/12/2018	8:40:00 PM	0.0031
2/15/2018	1:10:00 AM	0.0037
2/18/2018	4:25:00 PM	0.0028
2/25/2018	10:55:00 AM	0.0025
2/26/2018	7:10:00 PM	0.0028
2/28/2018	11:10:00 PM	0.0053
3/1/2018	10:48:00 PM	0.0037
3/2/2018	9:52:00 PM	0.0028
3/5/2018	9:00:00 PM	0.0028
3/6/2018	3:30:00 PM	0.0034
3/7/2018	12:25:00 AM	0.0025
3/8/2018	1:30:00 AM	0.0028
3/8/2018	10:00:00 PM	0.0025
3/9/2018	3:30:00 PM	0.004
3/11/2018	9:05:00 PM	0.0025
3/16/2018	5:40:00 AM	0.0043
3/16/2018	5:30:00 PM	0.0031
3/17/2018	5:35:00 PM	0.0028
3/18/2018	7:00:00 AM	0.0037
3/19/2018	5:35:00 PM	0.0025

Vibration levels collected during the blasting events were not distinguishable from ambient vibration levels. Therefore, the data collected shows that blasting events at the EPS 4,000 level was will within the blasting criteria limits established by the U.S. Department of the Interior, Bureau of Mines.

8.0 CONCLUSIONS

Projected exterior sound levels resulting range from less than 10 dBA at several isolated receptors to 61 dBA at the EPS monitor location. However, noise levels from the Skunk Camp TSF alternative will exceed the Pinal County nighttime threshold at residences located along Dripping Springs Road. These exceedances are primarily due to the entrance road that runs adjacent to the residences along Dripping Springs Road. Therefore, the noise levels at these residences the Skunk Camp TSF entrance road will need to be mitigated. With the relocation of the entrance way it is expected that the Skunk Camp TSF noise levels will comply with the Pinal County noise threshold limit. Furthermore all other scenarios will comply with the Pinal County nighttime threshold limit.

Each of the alternatives show an average increase in sound level ranging from <1 dBA to 14 dBA. However, maximum sound level increases above 10 dBA are shown to occur at residences adjacent to WPS and at residence along Dripping Springs Road adjacent to the Skunk Camp entrance way (see Appendix F). The increase at the residences adjacent to WPS is shown to occur near the WPS entrance at Main Street. It is expected that sound levels at this location will be higher due to the proximity of US 60. Therefore, with elevated baseline noise level from US 60 the actual sound level increase will be less than 10 dBA. The increase at residences along Dripping Springs Road is due to the Skunk Camp TSF entrance way. Furthermore, reasonable efforts will be made to minimize the impact of noise resulting from Project activities at proximate noise sensitive areas, which will be the priority. Compliance with MSHA/OSHA standards will be achieved through equipment mitigation practices, use of personal protective equipment such as hearing protection devices, and limitations on exposure.

The construction activities for the operational facilities will occur for 18 months or less incorporating ten-hour daytime shifts during weekdays. Receptors located within 100 feet may experience short-term increases to the existing noise levels. However, due to the infrequent nature of loud construction activities at the site and limited hours of construction, the noise from the construction of the operational facilities are not expected to result in an adverse impact at NSAs.

Each of the project components will incorporate earth moving equipment. These vibration levels are evaluated based on the worst-case vibration source, which will be bull dozers. Based on vibration propagation calculations, the vibration levels from the earth moving operations will be 0.089 PPV in/sec (87 VdB) at 25 feet from the source and will be 0.001 PPV in/sec (48 VdB) at 500 feet from the source. The vibration levels past 500 feet would not be distinguishable from ambient vibration levels. Based vibration criteria established the U.S. Department of the Interior, Bureau of Mines and the FTA safe level of vibrations for residential type structures is 0.5 PPV in/sec. Annoyance to humans is typically occurs at vibration levels above 80 VdB. Based on the calculated vibration levels damage to structures could occur within 25 feet from the source and human annoyance could occur within 50 feet from the source. There are no sensitive receptors that will be located 50 feet or less from the earth moving equipment. There impacts from non-blasting vibrations sources are unlikely to occur.

In January of 2018 blasting operations at the EPS 4,000 level started. The blasting operations incorporated 225-pound charges that occurred periodically from January 30 to March 19, 2018. Vibration levels collected during the blasting events were not distinguishable from ambient vibration levels. Therefore, the data collected shows that blasting events at the EPS 4,000 level was will within the blasting criteria limits established by the U.S. Department of the Interior, Bureau of Mines.

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APPENDIX A: CALIBRATION CERTIFICATION DOCUMENTATION

Calibration Certificate

Part Number: 721A2501
Description: Micromate ISEE Base Unit

Serial Number: UM10191
Calibration Date: MAY 06 2016
Calibration Equipment: 714J7403

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications.

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: [signature]
Xiaoming Yang

Instantel

71408901 Rev 01

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Calibration Certificate

Part Number: 721A2501
Description: Micromate ISEE Base Unit

Serial Number: UM10397
Calibration Date: MAY 0 6 2016
Calibration Equipment: 714J7403

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Calibrated By: ______________________
Xiaoming Yang

Instantel

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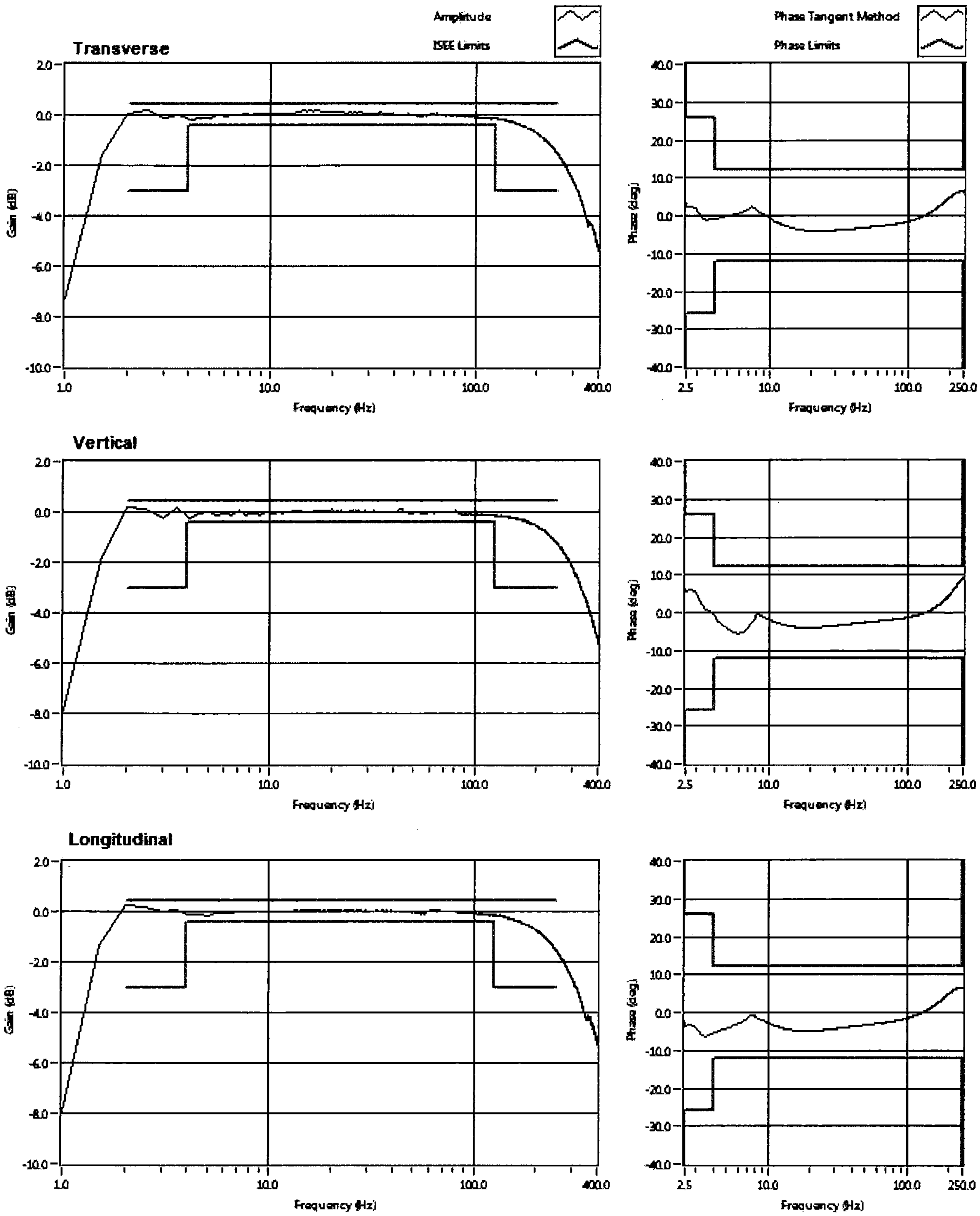
Frequency Response of UM10397



Calibration Certificate

Part Number:	721A2501
Description:	Micromate ISEE Base Unit
Serial Number:	UM10398
Calibration Date:	MAY 06 2016
Calibration Equipment:	714J7403

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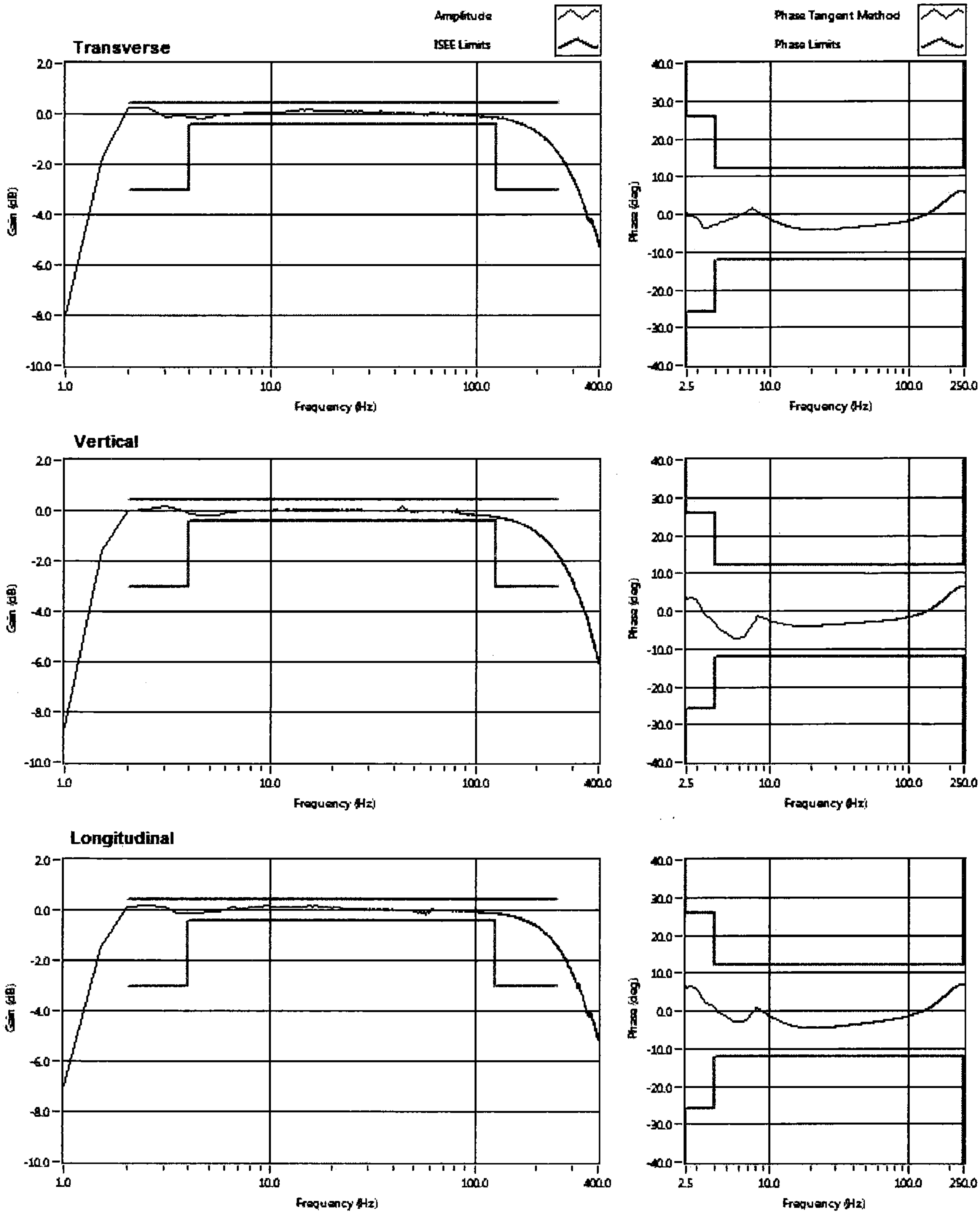
Frequency Response of UM10398



Calibration Certificate

Part Number: 721A2501
Description: Micromate ISEE Base Unit

Serial Number: UM10400
Calibration Date: MAY 06 2016
Calibration Equipment: 714J7403

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Calibrated By: ____________
Xiaoming Yang

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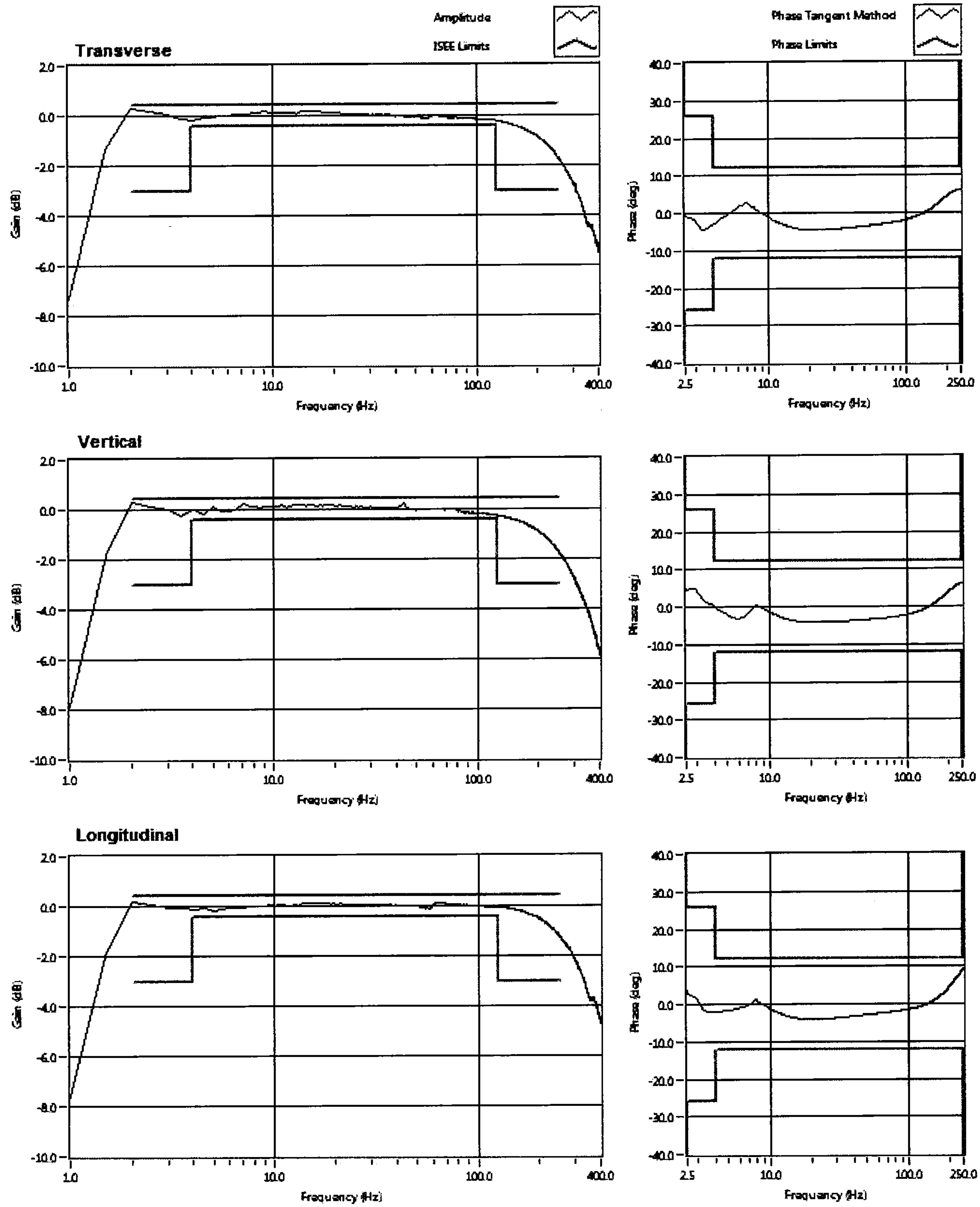
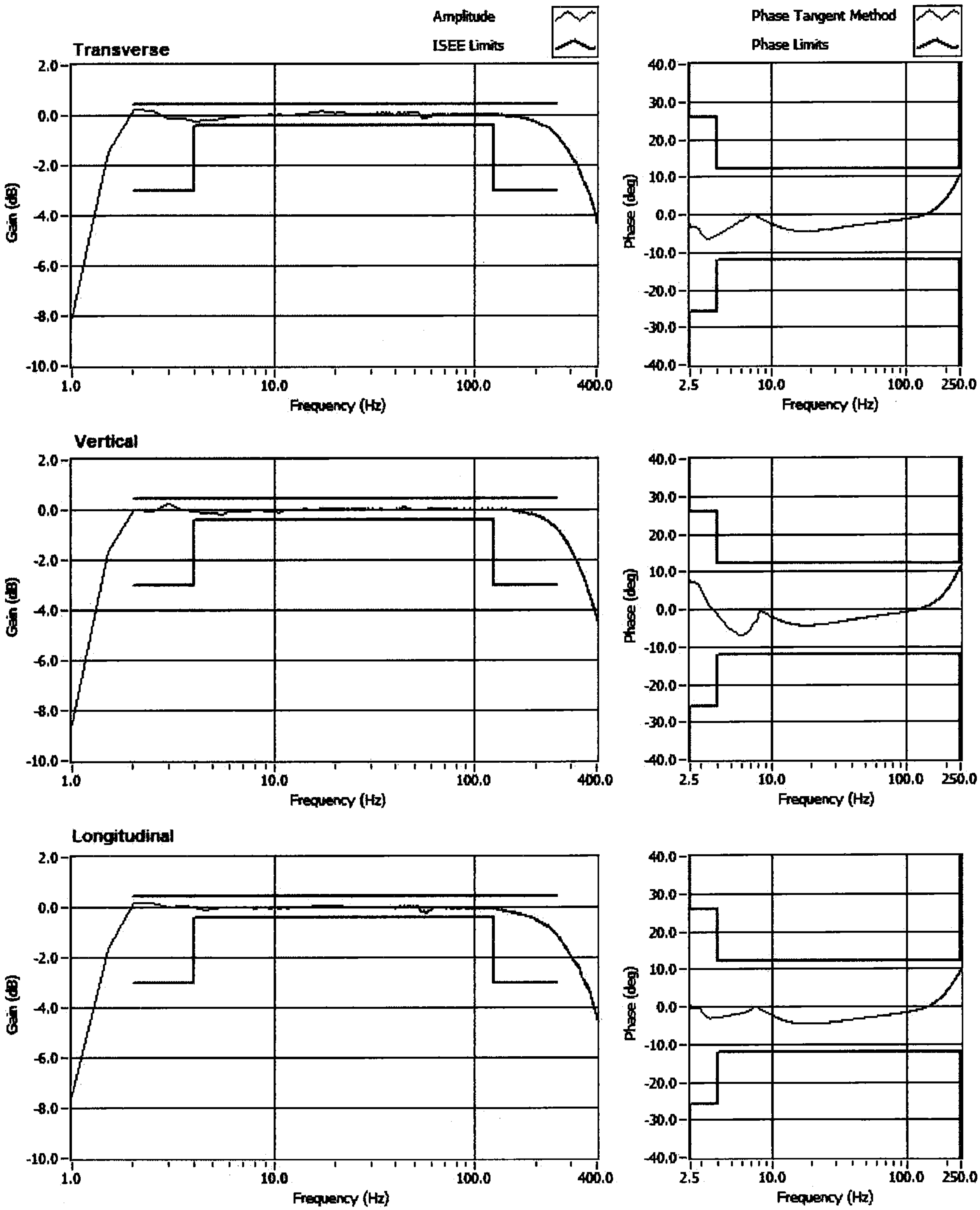
Frequency Response of UM10400



Frequency Response of UM10191



PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2013-180376

Instrument Model MPR001, Serial Number B5397, was calibrated on 03OCT2013. The instrument meets factory specifications per Procedure D0001.8159.

Instrument found to be in calibration as received: YES
Date Calibrated: 03OCT2013
Calibration due: 03OCT2014

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	LDSigGn/2209	0612 / 0102	12 Months	07JAN2014	2013-168437
PCB	377A13	134649	12 Months	13FEB2014	2013-169955
PCB	426B03	1603	12 Months	16APR2014	2013-172781

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 23 ° Centigrade

Relative Humidity: 31 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"As Received" data is the same as shipped data.

Signed: Nick Rasmussen
Technician: Nick Rasmussen

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

Larson Davis Microphone and Preamp Data
Model: MPR001 Serial Number: B5397

Sensitivity @ 1 KHz: 3.36 mV/Pa

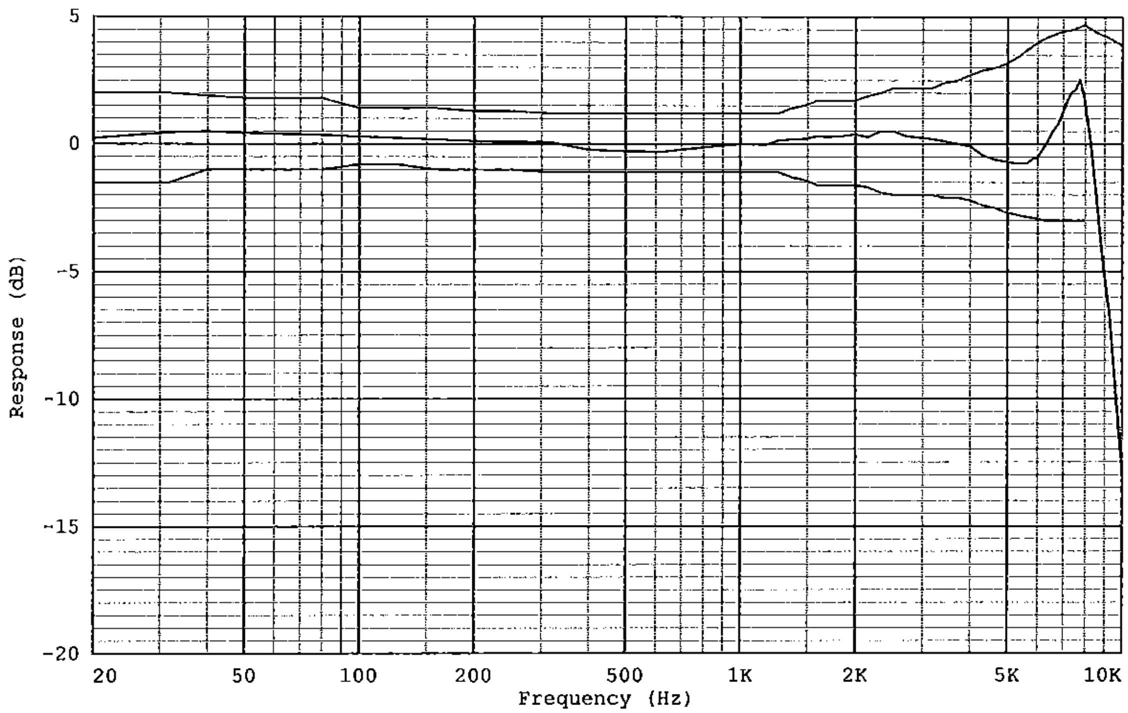
Test Conditions:

Powered by LD Spark 706RC. Compared to PCB 377A13 microphone in Larson Davis CAL291. Corrected to 0° free field response.

Data taken with LD 2900.

2900 Serial Number: 0612 | CAL291 Serial Number: 0128

377A13 Serial Number: 134649 | Spark 706RC Serial Number: 17000



Frequency Response with reference at 1 KHz

Frequency	Response	Limits	Frequency	Response	Limits	Frequency	Response	Limits
19.95	0.23	-1.50/2.00	1258.93	0.14	-1.10/1.20	5411.70	-0.75	-2.80/3.50
25.12	0.34	-1.50/2.00	1359.36	0.18	-1.30/1.40	5623.41	-0.75	-2.85/3.70
31.62	0.45	-1.50/2.00	1467.80	0.20	-1.40/1.50	5843.41	-0.56	-2.90/3.90
39.81	0.49	-1.00/1.90	1584.89	0.30	-1.60/1.70	5994.84	-0.53	-2.93/4.00
50.12	0.43	-1.00/1.80	1711.33	0.29	-1.60/1.70	6150.20	-0.24	-2.97/4.10
63.10	0.39	-1.00/1.80	1847.85	0.31	-1.60/1.70	6309.57	-0.01	-3.00/4.20
79.43	0.35	-1.00/1.80	1995.26	0.37	-1.60/1.70	6473.08	0.35	-3.00/4.26
100.00	0.29	-0.80/1.40	2154.43	0.28	-1.70/1.90	6640.83	0.61	-3.00/4.33
125.89	0.22	-0.80/1.40	2326.31	0.51	-1.90/2.00	6812.92	0.84	-3.00/4.40
158.49	0.18	-1.00/1.40	2511.89	0.51	-2.00/2.20	6989.47	1.24	-3.00/4.43
199.53	0.11	-1.00/1.30	2712.27	0.32	-2.00/2.20	7170.60	1.70	-3.00/4.47
251.19	0.07	-1.00/1.30	2928.64	0.25	-2.00/2.20	7356.42	2.06	-3.00/4.50
316.23	0.08	-1.10/1.20	3162.28	0.20	-2.00/2.20	7547.06	2.16	-3.00/4.56
398.11	-0.23	-1.10/1.20	3414.55	0.11	-2.10/2.40	7742.64	2.54	-3.00/4.63
501.19	-0.28	-1.10/1.20	3686.95	0.01	-2.10/2.50	7943.28	1.90	-3.00/4.70
630.96	-0.30	-1.10/1.20	3981.07	-0.07	-2.20/2.70	8254.04	0.06	-∞ /4.55
794.33	-0.14	-1.10/1.20	4298.66	-0.43	-2.40/2.90	8576.96	-2.26	-∞ /4.40
1000.00	0.00	-1.10/1.20	4641.59	-0.61	-2.50/3.00	8912.51	-4.66	-∞ /4.30
1079.78	-0.01	-1.10/1.20	5011.87	-0.70	-2.70/3.20	9261.19	-6.64	-∞ /4.20
1165.91	-0.03	-1.10/1.20	5207.95	-0.74	-2.75/3.35	10000.00	-12.92	-∞ /3.90

Tested by Nick Rasmussen on 30CT2013

Calibration Certificate

Certificate Number 2016004484

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	CAL150	***Procedure Number***	D0001.8386			
Serial Number	3555	***Technician***	Scott Montgomery			
Test Results	**Pass**	***Calibration Date***	23 May 2016			
		Calibration Due	23 May 2017			
Initial Condition	Adjusted	***Temperature***	23	°C	± 0.3 °C	
Description	Larson Davis CAL150 Calibrator	***Humidity***	28	%RH	± 3 %RH	
		Static Pressure	101.3	kPa	± 1 kPa	

Evaluation Method The data is aquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity. Data reported in dB re 20 μPa.

Compliance Standards Compliant to Manufacturer Specifications per D0001.8190 and the following standards:
IEC 60942:2003 ANSI S1.40-2006

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	09/04/2015	09/04/2016	001021
Sound Level Meter / Real Time Analyzer	04/07/2016	04/07/2017	001051
Microphone Calibration System	08/20/2015	08/20/2016	005446
1/2" Preamplifier	10/09/2015	10/09/2016	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/20/2015	08/20/2016	006507
1/2 inch Microphone - RI - 200V	08/17/2015	08/17/2016	006511
Pressure Transducer	10/12/2015	10/12/2016	007204

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Calibration Certificate

Certificate Number 2016004613

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	706RC	***Procedure Number***	D0001.8380		
Serial Number	17540	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
		Temperature	22.53	°C	± 0.01 °C
Description	Spark Model 706RC Dosimeter	***Humidity***	29.1	%RH	± 0.5 %RH
		Static Pressure	86.09	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 µPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
SRS DS360 Ultra Low Distortion Generator	01/25/2016	01/25/2017	006239
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798

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Calibration Certificate

Certificate Number 2016004623

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001	***Procedure Number***	D0001.8390		
Serial Number	B5379	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
Description	3/8 inch Microphone - RI - 0V	***Temperature***	21.40	°C	± 0.01 °C
		Humidity	30.20	%RH	± 0.5 %RH
		Static Pressure	101.34	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

Calibration Certificate

Certificate Number 2016004614

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	705+	***Procedure Number***	D0001.8380		
Serial Number	41093	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
Description	Spark Model 705+ Dosimeter	***Temperature***	22.54	°C	± 0.01 °C
		Humidity	29.1	%RH	± 0.5 %RH
		Static Pressure	86.09	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 μPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798
SRS DS360 Ultra Low Distortion Generator	03/17/2016	03/17/2017	007174

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Calibration Certificate

Certificate Number 2016004624

Customer:

Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001	***Procedure Number***	D0001.8390		
Serial Number	B5382	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
		Temperature	21.29	°C	± 0.01 °C
Description	3/8 inch Microphone - RI - 0V	***Humidity***	29.40	%RH	± 0.5 %RH
		Static Pressure	101.37	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

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Calibration Certificate

Certificate Number 2016004615

Customer:

Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	705+	***Procedure Number***	D0001.8380
Serial Number	41094	***Technician***	Nicholas Rasmussen
Test Results	**Pass**	***Calibration Date***	25 May 2016
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017
Description	Spark Model 705+ Dosimeter	***Temperature***	22.54 °C ± 0.01 °C
		Humidity	29.1 %RH ± 0.5 %RH
		Static Pressure	86.09 kPa ± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 μPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798
SRS DS360 Ultra Low Distortion Generator	06/18/2015	06/18/2016	007117

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Calibration Certificate

Certificate Number 2016004625

Customer:

Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001	***Procedure Number***	D0001.8390		
Serial Number	B5385	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
Description	3/8 inch Microphone - RI - 0V	***Temperature***	21.29	°C	± 0.01 °C
		Humidity	29.90	%RH	± 0.5 %RH
		Static Pressure	101.58	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

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Calibration Certificate

Certificate Number 2016004616

Customer:

Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	705+	***Procedure Number***	D0001.8380		
Serial Number	41095	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
Description	Spark Model 705+ Dosimeter	***Temperature***	22.56	°C	± 0.01 °C
		Humidity	29	%RH	± 0.5 %RH
		Static Pressure	86.09	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 μPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	**Cal Date**	**Cal Due**	**Cal Standard**
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798
SRS DS360 Ultra Low Distortion Generator	07/07/2015	07/07/2016	007118

Calibration Certificate

Certificate Number 2016004626

Customer:

Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001
Serial Number	B5397
Test Results	**Pass**
Initial Condition	AS RECEIVED same as shipped
Description	3/8 inch Microphone - RI - 0V

Procedure Number	D0001.8390		
Technician	Nicholas Rasmussen		
Calibration Date	25 May 2016		
Calibration Due	25 May 2017		
Temperature	21.27	°C	± 0.01 °C
Humidity	29.60	%RH	± 0.5 %RH
Static Pressure	101.41	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

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Calibration Certificate

Certificate Number 2016004617

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	705+	***Procedure Number***	D0001.8380		
Serial Number	41096	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
		Temperature	22.59	°C	± 0.01 °C
Description	Spark Model 705+ Dosimeter	***Humidity***	28.7	%RH	± 0.5 %RH
		Static Pressure	86.08	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 μPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
SRS DS360 Ultra Low Distortion Generator	06/24/2015	06/24/2016	006311
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798

Calibration Certificate

Certificate Number 2016004627

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001	***Procedure Number***	D0001.8390		
Serial Number	B5417	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
		Temperature	20.84	°C	± 0.01 °C
Description	3/8 inch Microphone - RI - 0V	***Humidity***	28.10	%RH	± 0.5 %RH
		Static Pressure	101.50	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

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LARSON DAVIS
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Calibration Certificate

Certificate Number 2016004618

Customer:

Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	705+
Serial Number	41097
Test Results	**Pass**
Initial Condition	AS RECEIVED same as shipped
Description	Spark Model 705+ Dosimeter

Procedure Number	D0001.8380		
Technician	Nicholas Rasmussen		
Calibration Date	25 May 2016		
Calibration Due	25 May 2017		
Temperature	22.83	°C	± 0.01 °C
Humidity	28.9	%RH	± 0.5 %RH
Static Pressure	86.06	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 μPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
SRS DS360 Ultra Low Distortion Generator	01/25/2016	01/25/2017	006239
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798

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Calibration Certificate

Certificate Number 2016004628

Customer:

Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001	***Procedure Number***	D0001.8390		
Serial Number	B5437	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
		Temperature	20.92	°C	± 0.01 °C
Description	3/8 inch Microphone - RI - 0V	***Humidity***	29.00	%RH	± 0.5 %RH
		Static Pressure	101.34	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	**Cal Date**	**Cal Due**	**Cal Standard**
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

Calibration Certificate

Certificate Number 2016004619

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	705+	***Procedure Number***	D0001.8380		
Serial Number	44420	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
		Temperature	22.83	°C	± 0.01 °C
Description	Spark Model 705+ Dosimeter	***Humidity***	28.9	%RH	± 0.5 %RH
		Static Pressure	86.06	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 µPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798
SRS DS360 Ultra Low Distortion Generator	03/17/2016	03/17/2017	007174

Calibration Certificate

Certificate Number 2016004629

Customer:

Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001	***Procedure Number***	D0001.8390		
Serial Number	B10125	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
		Temperature	21.14	°C	± 0.01 °C
Description	3/8 inch Microphone - RI - 0V	***Humidity***	29.50	%RH	± 0.5 %RH
		Static Pressure	101.72	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

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Calibration Certificate

Certificate Number 2016004620

Customer:

Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	705+
Serial Number	44421
Test Results	**Pass**
Initial Condition	AS RECEIVED same as shipped
Description	Spark Model 705+ Dosimeter

Procedure Number	D0001.8380		
Technician	Nicholas Rasmussen		
Calibration Date	25 May 2016		
Calibration Due	25 May 2017		
Temperature	22.83	°C	± 0.01 °C
Humidity	28.9	%RH	± 0.5 %RH
Static Pressure	86.06	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 μPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798
SRS DS360 Ultra Low Distortion Generator	06/18/2015	06/18/2016	007117

Calibration Certificate

Certificate Number 2016004630

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001	***Procedure Number***	D0001.8390		
Serial Number	B10123	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
Description	3/8 inch Microphone - RI - 0V	***Temperature***	21.26	°C	± 0.01 °C
		Humidity	29.80	%RH	± 0.5 %RH
		Static Pressure	101.40	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

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Calibration Certificate

Certificate Number 2016004621

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	705+	***Procedure Number***	D0001.8380		
Serial Number	44422	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
		Temperature	22.88	°C	± 0.01 °C
Description	Spark Model 705+ Dosimeter	***Humidity***	28.8	%RH	± 0.5 %RH
		Static Pressure	86.06	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 μPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798
SRS DS360 Ultra Low Distortion Generator	07/07/2015	07/07/2016	007118

Calibration Certificate

Certificate Number 2016004631

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001
Serial Number	B10124
Test Results	**Pass**
Initial Condition	AS RECEIVED same as shipped
Description	3/8 inch Microphone - RI - 0V

Procedure Number	D0001.8390		
Technician	Nicholas Rasmussen		
Calibration Date	25 May 2016		
Calibration Due	25 May 2017		
Temperature	21.21	°C	± 0.01 °C
Humidity	29.90	%RH	± 0.5 %RH
Static Pressure	101.56	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

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Calibration Certificate

Certificate Number 2016004622

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	705+
Serial Number	44423
Test Results	**Pass**
Initial Condition	AS RECEIVED same as shipped
Description	Spark Model 705+ Dosimeter

Procedure Number	D0001.8380		
Technician	Nicholas Rasmussen		
Calibration Date	25 May 2016		
Calibration Due	25 May 2017		
Temperature	22.89	°C	± 0.01 °C
Humidity	28.7	%RH	± 0.5 %RH
Static Pressure	86.06	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an adaptor substituted for the microphone and gain set at 0 dB unless noted. Data reported in dB re 20 μPa assuming a microphone sensitivity of 6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards:

IEC 60651:1979 Type 2	ANSI S1.4:1983 (R2006) Type 2
IEC 60804:1985 Type 2	ANSI S1.43:1997 (R2007) Type 2
IEC 61252:2000	ANSI S1.25:1991 (R2007)

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
SRS DS360 Ultra Low Distortion Generator	06/24/2015	06/24/2016	006311
Hart Scientific 2626-H Temperature Probe	06/17/2015	06/17/2016	006798

Calibration Certificate

Certificate Number 2016004632

Customer:
Resolution Copper Mining
102 Magma Heights
Superior, AZ 85273, United States

Model Number	MPR001	***Procedure Number***	D0001.8390		
Serial Number	B10122	***Technician***	Nicholas Rasmussen		
Test Results	**Pass**	***Calibration Date***	25 May 2016		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	25 May 2017		
		Temperature	21.02	°C	± 0.01 °C
Description	3/8 inch Microphone - RI - 0V	***Humidity***	31.00	%RH	± 0.5 %RH
		Static Pressure	101.48	kPa	± 0.03 kPa

Evaluation Method Tested acoustically using a comparison coupler.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	08/27/2015	08/27/2016	005376
Sound Level Meter / Real Time Analyzer	06/10/2015	06/10/2016	006508
LD 2209 External Attenuator	06/10/2015	06/10/2016	006509
NI USB-4431 signal acquisition module	03/25/2016	03/25/2017	006903
Hart Scientific 2626-S Humidity/Temperature Sensor	06/08/2015	06/08/2016	006946
1/2 inch Microphone - P - 0V	02/01/2016	02/01/2017	007101
Pressure Transducer	06/17/2015	06/17/2016	007203
PCB 1/4" ICP® Preamplifier	04/14/2016	04/14/2017	007286

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APPENDIX B: SOUND MONITORING DATA

See attachments to PDF:

AppendixB_EastPlantNoiseData20180628.xlsx

AppendixB_FilterPlantNoiseData20180628.xlsx

AppendixB_NearWestNoiseDataSummer20180628.xlsx

AppendixB_NearWestNoiseDataWinter20180730.xlsx

AppendixB_PegLegNoiseData20180730.xlsx

AppendixB_SilverKingNoiseData20180730.xlsx

AppendixB_WestPlantNoiseData20180630.xlsx

APPENDIX C: VIBRATION MONITORING DATA

See spreadsheet attachment to PDF

Appendix C_VibrationData.xlsx

APPENDIX D: BLASTING NOISE AND VIBRATION MONITORING DATA

See spreadsheet attachment to PDF

AppendixD-EastPlantBlastingNoiseData20180730.xlsx

AppendixD-ResolutionMineBlastData.xlsx”

APPENDIX E: MOBILE EQUIPMENT COUNT TABLES

See 2 spreadsheet attachments to PDF:

Appendix E – mobile equipment extimate pmo for all alternatives.xlsx

Appendix E - Operation Facilities Mobile Equipment.xlsx

APPENDIX F: CALCULATED NOISE LEVEL TABLES

See spreadsheet attachment to PDF:

Appendix F – Predicted Sound Level Increase 3-27-2019.xlsx