4.5 NOISE

INTRODUCTION

This section evaluates the potential noise and vibration impacts associated with the proposed Project. Specifically, the analysis describes the existing noise environment near the Project site; estimates future noise and vibration levels at surrounding sensitive land uses resulting from construction and operation of the proposed Project; identifies the potential for significant impacts; and provides mitigation to address significant impacts.

The proposed Project roadway noise levels were modeled using the Federal Highway Administration Prediction Noise Model (FHWA-RD-77-108). Noise calculation worksheets are included in **Appendix F** of this Draft EIR**.**

ENVIRONMENTAL SETTING

Fundamentals of Sound

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise is generally defined as unwanted sound. Sound is characterized by various parameters that describe the physical properties of sound waves. These properties include the rate of oscillation (frequency); the distance between successive troughs or crests, the speed of propagation; and the pressure level or energy content of a given sound wave. In particular, the sound pressure level has become the most common descriptor used to characterize the loudness of an ambient sound level.

The unit of sound pressure expressed as a ratio to the faintest sound detectable to a person with normal hearing is called a decibel (dB). Sound or noise can vary in intensity by more than 1 million times within the range of human hearing. A logarithmic loudness scale similar to the Richter scale for earthquake magnitude is used to keep sound intensity numbers at a convenient and manageable level. The human ear is not equally sensitive to all sound frequencies within the entire spectrum. Noise levels at maximum human sensitivity are factored more heavily into sound descriptions in a process called A weighting, written as dBA. Further reference to decibels in this analysis should be understood to be A-weighted.

Alternatively, a statistical description of the sound level that is exceeded over some fraction of a given observation period can also be used to describe typical time-varying instantaneous noise. This is referred to as equivalent sound level, or Leq. Finally, because community receptors are more sensitive to unwanted noise intrusion during the evening and nighttime hours, State law requires that an artificial decibel increment be added to quiet time noise levels. The 24-hour noise descriptor with a specified evening and nocturnal penalty is called the community noise equivalent level (CNEL). A similar metric called the day–night level, written as Ldn, is also commonly used. In practice, CNEL and Ldn are almost identical.

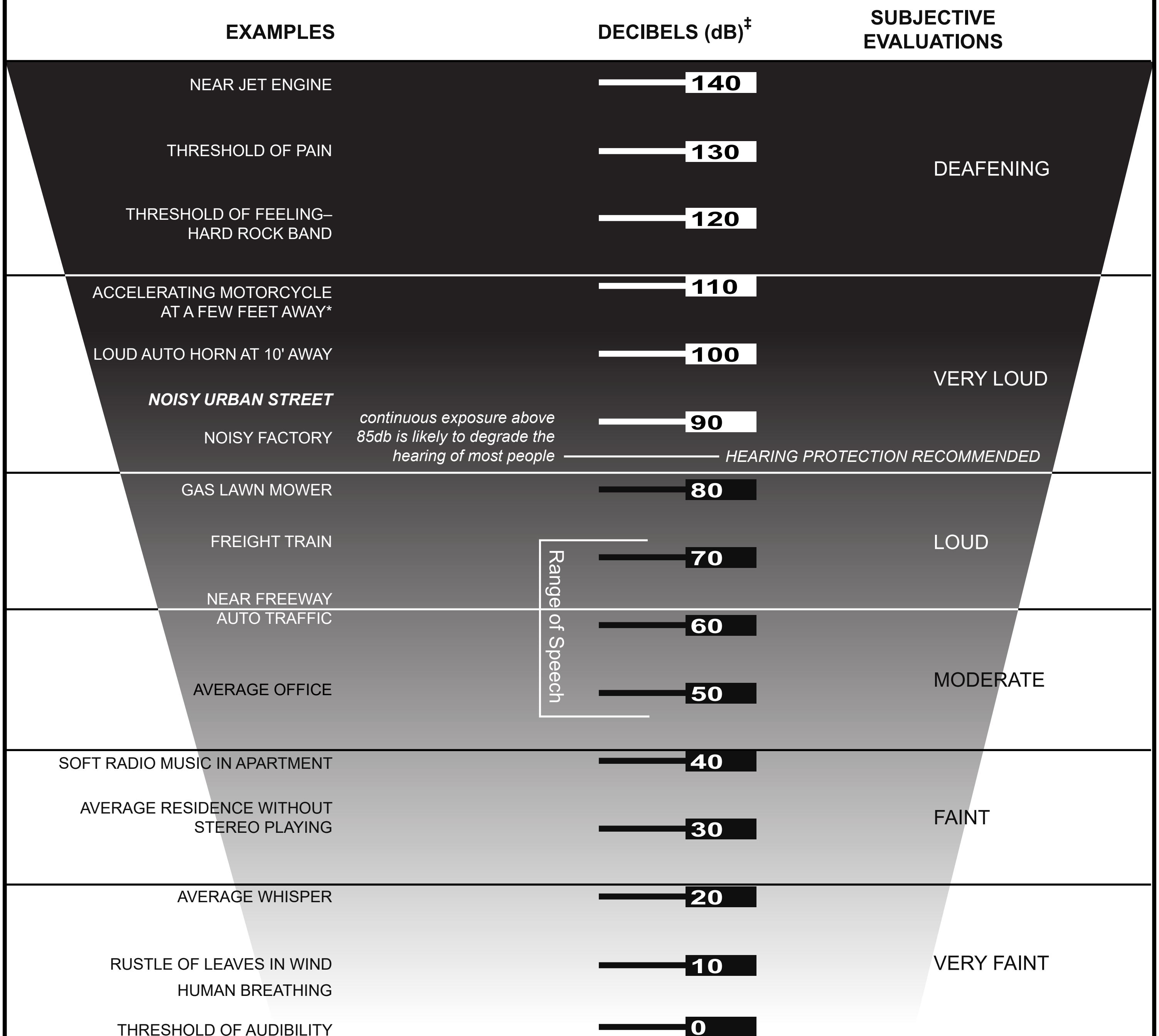
Table 4.5-1: Noise Descriptors provides a summary of the noise descriptors used to measure sound levels over different periods of time.

Table 4.5-1
Noise Descriptors

Term	Definition
Decibel (dB)	The unit for measuring the volume of sound equal to 10 times the logarithm (base 10) of the ratio of the pressure of a measure sound to a reference pressure.
A-weighted decibel (dBA)	A sound measurement scale that adjusts the pressure of individual frequencies according to human sensitivities. The scale accounts for the fact that the region of highest sensitivity for the human ear is between 2,000 and 4,000 cycles per second (hertz).
Equivalent sound level (Leq)	The sound level containing the same total energy as a time-varying signal over a given time period. The Leq is the value that expresses the time-averaged total energy of a fluctuating sound level. Leq can be measured over any time period, but is typically measured for 1-minute, 15-minute, 1-hour, or 24-hour periods.
Community noise equivalent level (CNEL)	A rating of community noise exposure to all sources of sound that differentiates between daytime, evening, and nighttime noise exposure. These adjustments add 5 dBA for the evening, 7:00 PM to 10:00 PM, and add 10 dBA for the night, 10:00 PM to 7:00 AM. The 5 and 10 dB penalties are applied to account for increased noise sensitivity during the evening and nighttime hours. The logarithmic effect of adding these penalties to the 1-hour Leq measurements typically results in a CNEL measurement that is within approximately 3 dBA of the peak-hour Leq.[a]
Sound pressure level	Sound pressure is the force of sound on a surface area perpendicular to the direction of the sound. Sound pressure level is expressed in decibels.
Ambient noise	The level of noise that is all encompassing within a given environment, being usually a composite of sounds from many and varied sources near to and far from the observer. No specific source is identified in the ambient environment.

[a] California Department of Transportation, Technical Noise Supplement; A Technical Supplement to the Traffic Noise Analysis Protocol (Sacramento, California: November 2009), N51–N54.

Noise sources can generally be categorized as one of two types: (1) point sources, such as stationary mechanical equipment; and (2) line sources, such as a roadway. In addition, noise can also be generated by mobile sources, such as trucks and construction equipment. Noise levels generated by a variety of activities, as shown in **Figure 4.5-1: Common Noise Levels.** As shown in this figure, noise levels up to 60 dBA are generally considered moderate by most people, with noise levels above 60 dBA considered loud.



** NOTE: 50' from motorcycle equals noise at about 2000' from a four-engine jet aircraft.*

‡NOTE: dB are “average” values as measured on the A–scale of a sound–level meter.

FIGURE 3

Meridian Consultants

Common Noise Levels

234-001-18

The noise level inside homes generally ranges from 30 to 45 dBA. The noise generated by speech ranges from 50 to 70 dBA. Of the typical noise events that occur in an urban environment, a loud horn from a car or a motorcycle accelerating can produce noise above 100 dBA.

Noise levels from a particular source decline as the distance to the receptor increases. Other factors, such as weather and reflecting or shielding, also help to lower intensity or reduce noise levels at any given location. A commonly used rule of thumb for roadway noise is that for every doubling of distance from the source, the noise level is reduced by about 6 dBA acoustically at “hard” locations (i.e., the area between the noise source and the receptor is nearly complete asphalt, concrete, hard-packed soil, or other solid materials) and 7.5 dBA at acoustically “soft” locations (i.e., the area between the source and receptor is normal earth or has vegetation, including grass).1 When the noise source is a continuous line, such as vehicle traffic on a highway, sound levels decrease by about 3 dB for every doubling of distance.

Noise levels may also be reduced by intervening structures; generally, a single row of buildings between the receptor and the noise source reduces the noise level by about 5 dBA, whereas a solid wall or berm reduces noise levels by 5 to 10 dBA. In addition, noise is substantially reduced from outdoor to indoor areas as a result of structural designs that attenuate noise. Windows are a common feature used by building occupants to control the effects of outdoor noise on interior noise levels. The exterior-to-interior reduction of noise for newer residential units is generally 20 dBA or more. The minimum attenuation of exterior-to-interior noise provided by typical structures in California is provided in **Table 4.5-2: Outside-to-Inside Noise Attenuation**.

1 United States Department of Transportation (DOT), Federal Transportation Authority (FTA), *Transit Noise and Vibration Impact Assessment* (2006), pp. 2-12 and 6-41, https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf; DOT, *FHWA Highway Traffic Noise Analysis: Abatement Policy and Guidance* (December 2011), 10.

Table 4.5-2
Outside-to-Inside Noise Attenuation

Building Type	Reduction in dBA	
	Open Windows	Closed Windows
Residences	17	25
Schools	17	25
Churches	20	30
Hospitals/Convalescent homes	17	25
Offices	17	25

Source: C. G. Gordon, et al., Highway Noise: A Design for Highway Engineers*, National Cooperative Highway Research Program Report 117 (Washington, DC: Transportation Research Board, 1971).*

Fundamentals of Vibration

Vibration is commonly defined as an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. The peak particle velocity (PPV) or the root-mean-square (RMS) velocity is usually used to describe vibration amplitudes. PPV is defined as the maximum instantaneous peak of the vibration signal, while RMS is defined as the square root of the average of the squared amplitude of the signal. PPV is typically used for evaluating potential building damage, whereas RMS is typically more suitable for evaluating human response to ground-borne vibration. The RMS vibration velocity level can be presented in inches per second (ips) or in vibration decibels (VdB, a decibel unit referenced to 1 microinch per second). Generally, ground-borne vibration generated by man-made activities (i.e., road traffic, construction activity) attenuates rapidly with distance from the source of the vibration.

The vibration velocity level threshold of perception for humans is approximately 65 VdB. A vibration velocity of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels for many people. Most perceptible indoor vibration is caused by sources within buildings such as the operation of mechanical equipment, the movement of people, or the slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If a roadway is smooth, the ground-borne vibration from traffic is barely perceptible. The range of interest is from approximately 50 VdB, which is the typical background vibration velocity, to 100 VdB, which is the threshold where minor damage can occur in fragile buildings.

Regulatory Framework

a. Federal

There are no federal noise standards that directly regulate environmental noise related to the construction or operation of the proposed Project. With regard to noise exposure and workers, the Office of Safety and Health Administration (OSHA) regulations safeguard the hearing of workers exposed to occupational noise. OSHA is responsible for the protection against the effects of noise exposure when sound levels exceed those, listed in **Table 4.5-3: Permissible Noise Exposures for Workers**, when measured on the A scale of a standard sound level meter at slow response.[2]

Table 4.5-3
Permissible Noise Exposures for Workers

Work Duration per Day (hours)	Sound level (dBA)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Source: Occupational Safety and Health Administration, "Occupational Noise Exposure," https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10625.

Federal Transit Administration Vibration Guidelines

The Federal Transit Administration (FTA) has published a technical manual, *Transit Noise and Vibration Impacts Assessment*, that provides ground-borne vibration impact criteria with respect to building damage during construction activities.[3] Building vibration damage is measured in PPV. According to the FTA guidelines, a vibration criterion of 0.20 PPV should be considered as the significant impact level for

2 OSHA, "Occupational Noise Exposure," https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10625.

3 FTA, *Transit Noise and Vibration Impact Assessment*.

nonengineered timber and masonry buildings. Structures or buildings constructed of reinforced concrete, steel, or timber have a vibration damage criterion of 0.50 PPV based on the FTA guidelines.

The human reaction to various levels of vibration is highly subjective and varies from person to person. **Table 4.5-4: Ground-borne Vibration Criteria—Human Annoyance** shows the FTA's vibration criteria to evaluate vibration-related annoyance due to resonances of the structural components of a building. These criteria are based on extensive research that suggests humans are sensitive to vibration velocities in the range of 8 to 80 Hz.[4]

Table 4.5-4
Ground-borne Vibration Criteria—Human Annoyance

Land Use Category	Max Lv (VdB)	Description
Workshop	90	Distinctly felt vibration; appropriate to workshops and nonsensitive areas
Office	84	Felt vibration; appropriate to offices and nonsensitive areas
Residential: Daytime	78	Barely felt vibration; adequate for computer equipment
Residential: Nighttime	72	Vibration not felt, but ground-borne noise may be audible inside quiet rooms

Source: United States Department of Transportation, Federal Transportation Authority, Transit Noise and Vibration Impact Assessment *(May 2006).*
Note: For Max Lv (VdB), Lv is the velocity level in decibels as measured in 1/3 octave bands of frequency over the frequency ranges of 8 to 80 Hz

Structures amplify ground-borne vibration, and wood-frame buildings, such as typical residential structures, are more affected by ground vibration than are heavier buildings. The level at which ground-borne vibration is strong enough to cause architectural damage has not been determined conclusively. The most conservative estimates are reflected in the FTA standards, shown in **Table 4.5-5: Ground-borne Vibration Criteria—Architectural Damage**.[5]

4 FTA, *Transit Noise and Vibration Impact Assessment.*
5 FTA, *Transit Noise and Vibration Impact Assessment.*

Table 4.5-5
Ground-borne Vibration Criteria—Architectural Damage

Building Category	PPV (ips)	Lv (VdB)
I. Reinforced concrete, steel, or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

Source: United States Department of Transportation, Federal Transportation Authority, Transit Noise and Vibration Impact Assessment *(May 2006).*
Note: For Max Lv (VdB), Lv = the velocity level in decibels as measured in 1/3 octave bands of frequency over the frequency ranges of 8 to 80 Hz; VdB = vibration decibels; Hz = hertz; ips = inches per second.

b. State

State Noise Standards

The State of California has adopted noise compatibility guidelines for general land use planning. The types of land uses addressed by the State and the acceptable noise categories for each land use are included in the *State of California General Plan Guidelines* guidance document, which is published and updated by the Governor's Office of Planning Research.[6] The level of acceptability of the noise environment is dependent on the activity associated with the particular land use. Noise exposure for single-family uses is normally acceptable when the CNEL at exterior residential locations is equal to or below 60 dBA; conditionally acceptable when the CNEL is between 55 and 70 dBA; and normally unacceptable when the CNEL exceeds 70 dBA. These guidelines apply to noise sources such as vehicular traffic, aircraft, and rail movements.

An interior CNEL of 45 dB is mandated by the State of California Noise Insulation Standards Title 24 for 2016 Building Energy Efficiency Standards for multiple family dwellings and hotel and motel rooms.[7] Furthermore, projects must comply with the California Code of Regulations, Title 24 and Title 25 for California Building Code Interior and Exterior Noise Standards. In 1988, the State Building Standards Commission expanded that standard to include all habitable rooms in residential use, including single-family dwelling units. Because typical noise attenuation within residential structures with closed windows is at least 20 dB, an exterior noise exposure of 65 dB CNEL is generally the noise land-use compatibility guideline for new residential dwellings in California. Because commercial and industrial uses are not

6 Governor's Office of Planning and Research, *State of California General Plan Guidelines* (2017), http://www.opr.ca.gov/docs/OPR_COMPLETE_7.31.17.pdf.
7 California Code of Regulations, Public Resources Code, sec. 25402, 2016 Building Energy Efficient Standards, tit. 24, pt. 6, sec. T25–T28.

occupied on a 24-hour basis, the exterior noise exposure standard for less-sensitive land uses generally is somewhat less stringent.

The California Department of Education prepared the School Site Selection and Approval Guide. As indicated in the Education Code, Section 17251, and the California Code of Regulations, Title 5, Sections 14001 through 14012, outlines the powers and duties for the Department regarding school sites and the construction of school buildings. The California Department of Transportation considers sound at 50 dB near a school to be the point at which corrective action.[8]

c. Local

City of South Pasadena

General Plan Safety and Noise Element

The City of South Pasadena developed a Noise Element for its General Plan (1975) for us in local project planning. [9] The goal of the Noise Element is to identify present noise levels and set forth a program for the control of noise levels that would be harmful to the health, safety and general welfare of the community. Some general objectives of the Element include limiting the noise levels within residential areas, establishing compatible land use adjacent to transportation facilities, and maintaining an ambient noise level within the City that will not be physically or psychologically detrimental to the residents of South Pasadena. Lastly, it is the objective of the element to establish appropriate standards and criteria for desirable sound levels and the identification of means available to achieve the sound levels in the community.

The League of California Cities has suggested that community ambient (average noise level of all background sounds) noise levels stay below the following levels identified in **Table 4.5-6 Community Ambient Noise Levels** shown below.

---

8 California Department of Education, *School Site Selection and Approval Guide* (December 28, 2017), https://www.cde.ca.gov/ls/fa/sf/schoolsiteguide.asp.

9 City of South Pasadena, *General Plan,* “Noise Element” (1975).

Table 4.5-6
Community Ambient Noise Levels

		Presumed Ambient Noise Level (dB(A))[a]	
Zone	**Time**	**Quiet**	**Slightly Noisey**
R-1 and R-2	10:00 PM – 7:00 AM 7:00 AM – 7:00 PM 7:00 PM – 10:00 PM	45 dBA 55 dBA 50 dBA	50 dBA 60 dBA 55 dBA
R-3	10:00 PM – 7:00 AM 7:00 AM – 10:00 PM	50 dBA 55 dBA	55dBA 60 dBA
Commercial	10:00 PM – 7:00 AM 7:00 AM – 10:00 PM	55 dBA 60 dBA	60 dBA 65 dBA
Industrial	anytime	70 dBA	65

[a]: dBA = a-weighted decibels.
Source: City of South Pasadena, General Plan, Safety and Noise Element, Table VIII-3.

Municipal Code

The South Pasadena Municipal Code (SPMC) regulates noise levels in the City.[10] The SPMC makes it unlawful for any person to make any loud, unnecessary, and unusual noise that disturbs the peace or quiet of any neighborhood or causes discomfort or annoyance to any reasonable person of normal sensitiveness residing in the area.

Construction noise in the City is regulated by Article 3 of the SPMC. Specifically, the SPMC states:

> *It is unlawful for any person to perform any construction activity within a residential zone or within 500 feet thereof on Monday through Friday before 8:00 AM and after 7:00 PM, Saturday before 9:00 AM and after 7:00 PM, and on Sundays and city recognized holidays before 10:00 AM and after 6:00 PM.*

Existing Conditions

Ambient Noise Levels

Existing noise levels around the Project site were measured using a Larson-Davis Model 831 sound level meter, which satisfies the ANSI for general environmental noise measurement instrumentation and for Type 1 accuracy.[11] The sound level meter and microphone were mounted on a tripod 5 feet above the ground and equipped with a windscreen during all measurements. The sound level meter was set to

[10] City of South Pasadena, Municipal Code
11 ASHA, "American National Standard on Classroom Acoustics.".

"slow" time constant mode to record noise levels using the A-weighting filter network. These measurements are representative of typical ambient noise levels at nearby commercial and residential locations.

Short-term sound monitoring was conducted at five (5) locations to measure the ambient sound environment in the Project vicinity. Measurements were taken over 15-minute intervals at each location on March 4, 2019, as indicated in **Table 4.5-7: Ambient Noise Measurements**. **Figure 4.5-2: Noise Monitoring Locations** depicts locations where ambient noise measurements were conducted. As shown in **Table 4.5-7,** ambient noise levels ranged from a low of 57.4 dBA (Site 2 and 4) to a high of 66.1 dBA along Mission Street.

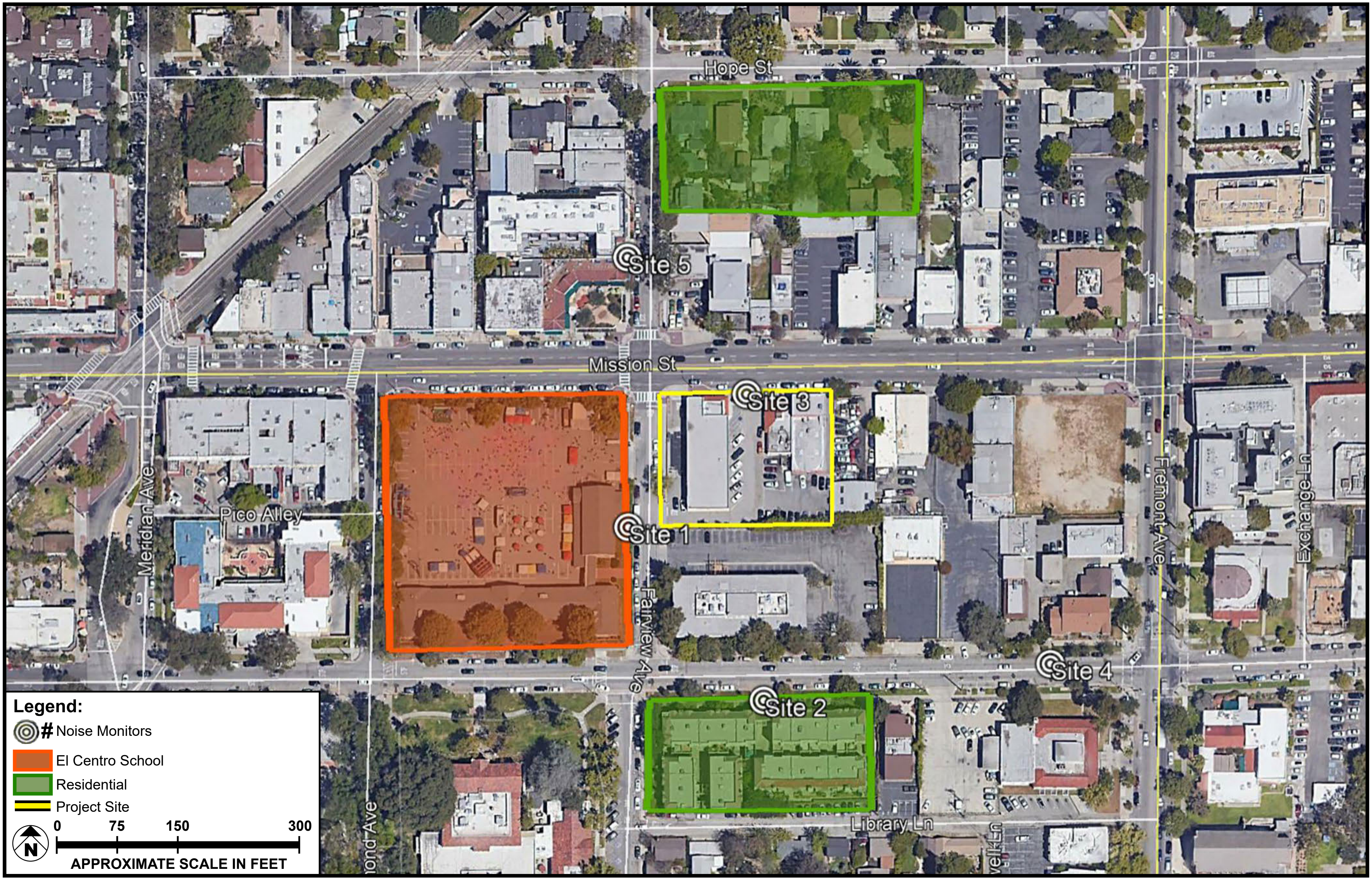
Site 1 is located on Fairview Avenue, west of the Project site between Mission Street and El Centro Street. This location is adjacent to a school, with public and residential uses to the south. Dominant noise sources at this site include pedestrian traffic and light vehicle traffic along Fairview Avenue.

Site 2 is located on El Centro Street just south of the Project site. This location is surrounded by multi-family residential uses to the south. Dominant noise sources at this site include pedestrian and vehicle traffic along El Centro Street.

Site 3 is located on Mission Street just north of the Project site. This location is surrounded by commercial uses to the north. Dominant noise sources at this site include pedestrian and vehicle traffic along Mission Street.

Site 4 is located on El Centro Street southeast of the Project site, just west of Fremont Avenue. This location is surrounded by commercial uses to the north, east, and south, with multi-family residential uses to the west. Dominant noise sources at this site include pedestrian and vehicle traffic along El Centro Street.

Site 5 is located northwest of the Project site along Fairview Avenue, north of Mission Street. This location is surrounded by commercial and residential uses. Dominant noise sources at this site include pedestrian and light vehicle traffic along Fairview Avenue.



SOURCE: Google Earth - 2019; Meridian Consultants - 2019

FIGURE **4.5-2**

Meridian Consultants

Noise Monitoring Locations

234-001-18

Table 4.5-7
Ambient Noise Measurements

Location Number/Description		Nearest Use	Time Period	Noise Source	dBA Leq
1	West of the Project site along Fairview Avenue between Mission Street and El Centro Street	School	1:40 PM–1:55 PM	Pedestrian and light traffic along Fairview Avenue	57.8
2	South of the Project site along El Centro Street	Multifamily residential	1:57 PM–2:12 PM	Pedestrian and traffic along El Centro Street	57.4
3	North of the Project site along Mission Street	Project site	2:18 PM–2:33 PM	Pedestrian and traffic along Mission Street	66.1
4	Southeast of the Project site along El Centro Street west of Fremont Avenue	Commercial	2:57 PM–3:12 PM	Pedestrian and traffic along El Centro Street	59.6
5	Northwest of the Project site along Fairview Avenue north of Mission Street	Commercial/ Residential	2:35 PM–2:50 PM	Pedestrian and light traffic along Fairview Avenue	57.4

Source: Refer to ***Appendix F*** *for noise monitoring data sheets.*
Notes: dBA = A-weighted decibels; Leq = average equivalent sound level.

Vibration Conditions

Based on field observations, the primary source of existing ground-borne vibration in the vicinity of the Project site is vehicle traffic on local roadways. According to the Federal Transit Administration,[12] typical road traffic–induced vibration levels are unlikely to be perceptible by people. Trucks and buses typically generate ground-borne vibration velocity levels of approximately 63 VdB (at a 50-foot distance), and these levels could reach 72 VdB when trucks and buses pass over bumps in the road. A vibration level of 72 VdB is above the 60 VdB level of perceptibility.

Existing Roadway Noise

The estimated existing roadway noise levels are provided in **Table 4.5-8: Existing Roadway Noise Levels.** As indicated in **Table 4.5-8**, the existing modeled vehicle-generated noise levels along roadway segments near the Project site, at a distance of 75 feet from each roadway’s centerline, range from a low of 54.7 dB(A) CNEL along El Centro Street east of Fair Oaks Avenue (intersection 4) during the AM peak hour to a high of 67.0 dB(A) CNEL along Fair Oaks Avenue north of Mission Street during the PM peak hour.

12 Federal Transit Administration, *Transit Noise and Vibration Impact Assessment,* FTA report no. 0123 (September 2018), accessed December 2018, https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf.

Table 4.5-8
Existing Roadway Noise Levels

Intersection	Roadway Segment	Time Period	dBA CNEL
1	Meridian Avenue north of Mission Street	AM	55.5
		PM	56.0
	Meridian Avenue south of Mission Street	AM	56.8
		PM	56.6
	Mission Street east of Meridian Avenue	AM	60.1
		PM	61.1
	Mission Street west of Meridian Avenue	AM	60.5
		PM	61.2
2	Freemont Avenue north of Mission Street	AM	64.5
		PM	64.9
	Freemont Avenue south of Mission Street	AM	64.4
		PM	64.9
	Mission Street east of Freemont Avenue	AM	61.7
		PM	62.4
	Mission Street west of Freemont Avenue	AM	61.7
		PM	62.6
3	Fair Oaks Avenue north of Mission Street	AM	66.5
		PM	67.0
	Fair Oaks Avenue south of Mission Street	AM	66.0
		PM	66.7
	Mission Street east of Fair Oaks Avenue	AM	61.9
		PM	62.1
	Mission Street west of Fair Oaks Avenue	AM	61.2
		PM	62.3
4	Fair Oaks Avenue north of El Centro Street	AM	66.1
		PM	66.8
	Fair Oaks Avenue south of El Centro Street	AM	66.2
		PM	66.9
	El Centro Street east of Fair Oaks Avenue	AM	54.7
		PM	57.3
	El Centro Street west of Fair Oaks Avenue	AM	56.5
		PM	58.6

Note: Refer to ***Appendix F*** *for roadway noise worksheets*
Note: Roadway noise levels are modeled 75 feet from the center of the roadway.

Sensitive Receptors

Certain land uses are particularly sensitive to noise and vibration. These uses include schools, residences, hospital facilities, religious facilities, and open space/recreation areas where quiet environments are necessary for the enjoyment, public health, and safety of the community. Commercial and industrial uses are not considered noise and vibration-sensitive uses.

Land uses surrounding the Project site consist of single and multifamily residential uses to the north, west, and east and a mix of residential and commercial to the south. The analysis found herein is a "worst-case scenario" for the sensitive receptors within 50 feet of the Project site.

Existing Vibration Levels

Based on field observations, the primary source of existing ground-borne vibration near the Project site is vehicle traffic on local roadways. According to the FTA, typical road traffic-induced vibration levels are unlikely to be perceptible by people. Trucks and buses typically generated ground-borne vibration velocity levels of approximately 63 VdB (at 50 feet distance), and these levels could reach 72 VdB when trucks and buses pass over bumps in the road. A vibration level of 72 VdB is above the 60 VdB level of perceptibility.

ENVIRONMENTAL IMPACTS

Methodology

Ambient Noise Measurements

Noise-level monitoring was conducted by Meridian Consultants on March 4, 2019, at three locations within the Project area vicinity, as shown in **Figure 6: Noise Monitoring Locations.** Noise-level monitoring was conducted for 15-minute intervals at each location using a Larson Davis Model 831 sound-level meter. This meter satisfies the American National Standards Institute (ANSI) standard for general environmental noise measurement instrumentation. The ANSI specifies several types of sound-level meters according to their precision. Types 1, 2, and 3 are referred to as "precision," "general-purpose," and "survey" meters, respectively. Most measurements carefully taken with a Type 1 sound-level meter will have a margin of error not exceeding 1 dB.

The Larson Davis Model 831 is a Type 1 precision sound-level meter. This meter meets all requirements of ANSI S1.4-1983 and ANSI1.43-1997 Type 1 standards, as well as International Electrotechnical Commission (IEC) IEC61672-1 Ed. 1.0, IEC60651 Ed 1.2, and IEC60804 Type 1, Group X standards.

The sound-level meter was located approximately 5 feet above ground and was covered with a Larson Davis windscreen. The sound-level meter was field calibrated with an external calibrator prior to operation.

Construction Scenario

Project construction is anticipated to last approximately 24 months. Construction would occur over five phases: (1) demolition; (2) grading; (3) building construction; (4) paving; and (5) architectural coating.

Each phase of construction would result in varying levels of intensity and number of construction personnel. The construction workforce would consist of approximately 10 worker trips per day and 43 total hauling trips during demolition; 5 worker trips per day and 2,963 total hauling trips during grading; 50 worker trips per day and 13 total vendor trips during building construction; 10 worker trips per day during architectural coating; and 18 worker trips per day during paving.

Ground-Borne Vibration

Ground-borne vibration impacts were evaluated by identifying potential vibration sources, estimating the distance between vibration sources and surrounding structure locations and surrounding structure locations and vibration sensitive receptors, and making a significance determination based on the significance thresholds.

City of South Pasadena Noise Element

The City of South Pasadena General Plan Safety and Noise Element establishes goals and policies to adequately protect indoor and outdoor living areas, and noise-sensitive uses such as schools and convalescent homes, from transportation noise impacts. The Noise Element considers the noise impacts of new projects involving increases in noisy activities or traffic. An increase of 3 dBA or noise in excess of 65 dBA in sensitive areas shall be considered significant.

Construction

Construction Noise

Construction activities that would occur during the construction phases (demolition, grading, building construction, architectural coating, and paving) would generate both steady-state and episodic noise that would be heard both on and off the Project site. Each phase involves the use of different types of construction equipment and, therefore, has its own distinct noise characteristics. Grading and excavation would typically include equipment such as concrete saws, dozers, and tractors/loaders/backhoes; building construction would typically include equipment such as cranes, forklifts, and tractors/loaders/backhoes; architectural coating would typically include equipment such as air compressors; and paving would typically include equipment such as concrete mixers, pavers, rollers, and tractors/loaders/backhoes. The proposed Project would be constructed using typical construction techniques; no blasting, impact pile driving, or jackhammers would be required.

Typical maximum noise levels and duty cycles of representative types of equipment that would potentially be used during construction for this proposed Project are presented in **Table 4.5-9: Typical Maximum Noise Levels for Project Construction Equipment**. Construction equipment noise would not be constant because of the variations of power, cycles, and equipment locations. For maximum noise events, this analysis considers equipment operating at the edge of the property line of the Project site.

Table 4.5-9
Typical Maximum Noise Levels for Project Construction Equipment

Equipment Description	Typical Duty Cycle (%)	Spec Lmax (dBA)	Actual Lmax (dBA)
Air compressor	40	80.0	77.7
Backhoe	40	80.0	77.6
Concrete mixer	40	85.0	78.8
Concrete/Industrial saw	20	90.0	89.6
Crane	16	85.0	80.6
Dozer	40	85.0	81.7
Forklift	40	85.0	N/A
Grader	40	85.0	N/A
Paver	50	85.0	77.2
Roller	20	85.0	80.0

Source: FHWA Roadway Construction Noise Model (RCNM) version 1.1

Construction Vibration

Some construction equipment can generate ground-borne noise or vibration that may affect nearby structures or residents. Large bulldozers, vibratory rollers, pile drivers, drilling equipment, and loaded trucks are examples of such equipment. Vibration levels were estimated for large bulldozers, loaded trucks, and other similar equipment using peak PPV levels in in/sec published by the Federal Transit Administration[13] adjusted for distance to the nearest sensitive receptor.

Various types of construction equipment and their respective velocity levels are shown in **Table 4.5-10: Vibration Source Levels for Construction Equipment.** It should be noted that there is a considerable variation in reported ground vibration levels from construction activities. The data provides a reasonable estimate for a wide range of soil conditions. For purposes of this analysis, Project construction and operation producing vibration levels that exceed 0.3 in/sec would be considered significant.

13 FHWA, *Construction Noise Handbook* (2006).

Table 4.5-10
Vibration Source Levels for Construction Equipment

Equipment	PPV at 25 feet (in/sec)	Approximate VdB at 25 feet
Air compressor	0.090	87
Backhoe	0.040	80
Cement and mortar mixer	0.040	80
Concrete saw	0.018	73
Excavator	0.040	80
Loader	0.071	85
Paver	0.063	84
Roller	0.020	74

Source: Office of Planning and Environment, Federal Transit Administration, Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06 (May 2006), 12-9.

Roadway Noise

Noise-prediction modeling was conducted and based on vehicular traffic volumes along nearby roadway segments to determine the ambient roadway noise environment related to traffic near the Project site. The average daily trips (ADTs) for these local roadway segments were obtained from the traffic impact analysis.

Existing roadway noise levels were modeled using the Federal Highway Administration Prediction Noise Model (FHWA-RD-77-108). The model calculates the average noise level in dB(A) CNEL at a given roadway segment based on traffic volumes, vehicle mix, average speeds, roadway geometry, and site conditions. The noise model assumes a “hard” site condition (i.e., providing for the minimum amount of sound attenuation allowed by the traffic noise model), a 6.0 dB[A] noise reduction per doubling of distance and no barriers between the roadway and receivers. Traffic noise levels were calculated for sensitive receptors at distances of 75 feet from the center of the roadway. Noise levels were evaluated with respect to the following modeled traffic scenarios:

- Existing Conditions
- Existing plus Project
- Future Conditions
- Future plus Project

Thresholds of Significance

To assist in determining whether the proposed Project would have a significant effect on the environment, the City finds the proposed Project may be deemed to have a significant impact related to noise if it would:

Threshold NOI-1: **Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards in the local general plan or noise ordinance, or applicable standards of other agencies.**

Threshold NOI-2: **Generation of excessive groundborne vibration or groundborne noise levels?**

Threshold NOI-3: **For a project located within the vicinity of a private airstrip or airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose students or staff to excessive noise levels.**

Project Impact Analysis

Threshold NOI-1: **Result in exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.**

On-Site Construction Noise

The potential noise impact generated during construction depends on the phase of construction and the percentage of time the equipment operates over the workday. However, construction noise estimates used for the analysis are representative of worst-case conditions because it is unlikely that all the equipment contained on site would operate simultaneously. As previously noted, the proposed Project would be constructed using typical construction techniques; no blasting, impact pile driving, or jackhammers would be required. As would be the case for construction of most land use development projects, construction of the proposed Project would require the use of heavy-duty equipment with the potential to generate audible noise above the ambient background noise level. The noise levels at the multifamily residential uses adjacent to the site from construction activity are shown in **Table 4.5-11: Construction Maximum Noise Estimates.**

Table 4.5-11
Construction Maximum Noise Estimates

Use	Distance from Project Site (feet)	Max Leq	Ambient Noise Leq (dBA)	Maximum Noise Increase over Ambient (without Compliance)
Site 1	40	88.5	57.8	+30.7
Site 2	195	69.7	57.4	+12.3
Site 3[a]	--	--	--	--
Site 4	285	66.5	59.6	+6.9
Site 5	155	71.7	57.4	+14.3

Source: FHWA, RCNM, version. 1.1.
[a] Located at the Project site.
*Refer to **Appendix F** for Construction Noise Worksheets*

Construction equipment operates at its nosiest levels for certain percentages of time during operation. Equipment such as excavators, graders, and loaders would operate at different percentages over the course of an hour.[14] During a construction day, the highest noise levels would be generated when multiple pieces of construction equipment are operated concurrently. The proposed Project's estimated construction noise levels were calculated for a scenario in which a reasonable number of construction equipment was assumed to be operating simultaneously, given the physical size of the site and logistical limitations, and with the noise equipment located at the construction area nearest to the affected receptors to present a conservative impact analysis. This is considered a worst-case evaluation because the proposed Project would typically use fewer overall equipment simultaneously at any given time and, as such, would likely generate lower noise levels than reported herein.

Implementation of mitigation measure **MM NOI-1** would include noise reduction techniques which include a construction management plan specifying that all construction equipment, fixed or mobile, will be equipped with properly operating and maintained mufflers and other state-required noise-attenuation devices; identify the maximum distance between construction equipment staging areas and occupied residential areas; and require the use of electric air compressors and similar power tools. Temporary noise barriers can reduce noise level at a minimum of 10 dBA, depending on the performance standard of achieving noise-level reductions. Optimal muffler systems for all equipment and the break in line of sight to a sensitive receptor would reduce construction noise levels by approximately 10 dB or more.[15] Limiting the number of noise-generating, heavy-duty off-road construction equipment (e.g., backhoes, dozers, excavators, loaders, rollers, etc.) simultaneously used on the Project site within 50 feet of off-site noise-

14 Federal Highway Administration, *Traffic Noise Model* (2006).
15 FHWA, *Special Report – Measurement, Prediction, and Mitigation*, updated June 2017, accessed December 2018, https://www.fhwa.dot.gov/Environment/noise/construction_noise/special_report/hcn04.cfm.

sensitive receptors surrounding the site to no more than one or two pieces of heavy-duty, off-road equipment would further reduce construction noise levels by approximately 10 dBA. A sign, legible at a distance of 50 feet, will be posted at the Project construction site providing a contact name and a telephone number where residents can inquire about the construction process and register complaints. This sign will indicate the dates and duration of construction activities. In conjunction with this required posting, a noise disturbance coordinator will be identified to address construction noise concerns received. The contact name and the telephone number for the noise disturbance coordinator will be posted on the sign. The coordinator will be responsible for responding to any local complaints about construction noise and will notify the City to determine the cause and implement reasonable measures to the complaint, as deemed acceptable by the City. With implementation of **MM NOI-1**, construction noise levels would be reduced by a minimum 30 dBA, thus would not increase ambient noise levels by 3 dBA or noise in excess of 65 dBA in sensitive areas.

Off-Site Construction Noise

According to the City's Safety and Noise Element, truck routes are designated to direct large trucks onto roadways constructed for that purpose. In South Pasadena, the following roadways have been designated appropriate for truck travel:

- Pasadena Avenue (West City limits to Mission Street)
- Mission Street (Pasadena Avenue to Fair Oaks Avenue)
- Fair Oaks Avenue (North City limits to Huntington Drive)
- Huntington Drive (South City limits to Garfield Avenue)
- Fremont Avenue (Huntington Drive to South City limits)

Construction of the proposed Project would require haul and vendor truck trips to and from the site to export soil and delivery supplies to the site. Trucks traveling to and from the Project site would be required to travel along a haul route approved by the City. Approximately 2,963 total hauling trips would take place during grading, which total to approximately 50 haul truck trips per workday.

Noise associated with construction truck trips were estimated using the Caltrans FHWA Traffic Noise Model based on the maximum number of truck trips in a day. Project truck trips, which include medium- and heavy-duty trucks, would generate noise levels of approximately 54.2 to 59.1 dBA, respectively, measured at a distance of 25 feet along Mission Street. As shown in **Table 4.5-7,** existing noise levels along Mission Street is 66.1 dBA. The noise-level increases from truck trips would be below the existing ambient noise level and would be below the significance threshold of 3 dBA

Roadway Noise

Existing plus Project

Table 4.5-12: Existing Plus Project, illustrates the change in CNEL from existing traffic volumes and existing plus Project traffic volumes. The difference in traffic noise between existing conditions and Project conditions represents the increase in noise attributable to Project-related traffic. As shown in **Table 4.5-12,** an increase of 3 dBA or more would not occur along roadways adjacent to sensitive uses.

Future plus Project

Table 4.5-13: Future Plus Project, illustrates the change in CNEL from future traffic volumes and future plus Project traffic volumes. The difference in traffic noise between future conditions and Project conditions represents the increase in noise attributable to Project-related traffic. As shown in **Table 4.5-13**, an increase of 3 dBA or more would not occur along roadways adjacent to sensitive uses.

Threshold NOI-2: Generation of excessive groundborne vibration or groundborne noise levels?

Construction Vibration

Table 4.5-14: Construction Vibration Levels Estimates lists the vibration source levels at varying distances of the assumed construction equipment to be used during construction. As shown **in Table 4.5-12**, air compressors are capable of producing approximately 0.193 ips PPV at 15 feet and would not generate vibration levels in excess of 0.5 ips PPV. As such, the multifamily residential units surrounding the Project site with regard to construction vibration activities would not be affected as a result of attenuation of ground-borne vibration. Furthermore, construction activities would be restricted to daytime hours, when people are the least sensitive to vibration instructions.

Table 4.5-12
Existing Plus Project

Intersection	Roadway Segment	Time Period	Existing (dBA CNEL)	Existing plus Project (dBA CNEL)	Noise-Level Increase (dBA CNEL)
1	Meridian Avenue north of Mission Street	AM	55.5	55.6	0.1
		PM	56.0	56.0	0.0
	Meridian Avenue south of Mission Street	AM	56.8	56.8	0.0
		PM	56.6	56.6	0.0
	Mission Street east of Meridian Avenue	AM	60.1	60.2	0.1
		PM	61.1	61.2	0.1
	Mission Street west of Meridian Avenue	AM	60.5	60.6	0.1
		PM	61.2	61.3	0.1
2	Freemont Avenue north of Mission Street	AM	64.5	64.5	0.0
		PM	64.9	64.9	0.0
	Freemont Avenue south of Mission Street	AM	64.4	64.4	0.0
		PM	64.9	64.9	0.0
	Mission Street east of Freemont Avenue	AM	61.7	61.9	0.2
		PM	62.4	62.5	0.1
	Mission Street west of Freemont Avenue	AM	61.7	61.8	0.1
		PM	62.6	62.7	0.1
3	Fair Oaks Avenue north of Mission Street	AM	66.5	66.5	0.0
		PM	67.0	67.0	0.0
	Fair Oaks Avenue south of Mission Street	AM	66.0	66.0	0.0
		PM	66.7	66.8	0.1
	Mission Street east of Fair Oaks Avenue	AM	61.9	61.9	0.0
		PM	62.1	62.1	0.0
	Mission Street west of Fair Oaks Avenue	AM	61.2	61.3	0.1
		PM	62.3	62.4	0.1
4	Fair Oaks Avenue north of El Centro Street	AM	66.1	66.1	0.0
		PM	66.8	66.9	0.1
	Fair Oaks Avenue south of El Centro Street	AM	66.2	66.3	0.1
		PM	66.9	66.9	0.0
	El Centro Street east of Fair Oaks Avenue	AM	54.7	54.7	0.0
		PM	57.3	57.3	0.0
	El Centro Street west of Fair Oaks Avenue	AM	56.5	56.7	0.2
		PM	58.6	58.7	0.1

*Note: Refer to **Appendix F** for roadway noise worksheets*
Note: Roadway noise levels are modeled 75 feet from the center of the roadway.

Table 4.5-13
Future Plus Project

Intersection	Roadway Segment	Time Period	Future	Future plus Project	Noise-Level Increase
			dBA CNEL		
1	Meridian Avenue north of Mission Street	AM	55.6	55.7	0.1
		PM	56.1	56.1	0.0
	Meridian Avenue south of Mission Street	AM	56.9	56.9	0.0
		PM	56.7	56.7	0.0
	Mission Street east of Meridian Avenue	AM	60.3	60.4	0.1
		PM	61.3	61.4	0.1
	Mission Street west of Meridian Avenue	AM	60.7	60.8	0.1
		PM	61.4	61.5	0.1
2	Freemont Avenue north of Mission Street	AM	64.5	64.7	0.1
		PM	65.1	65.1	0.0
	Freemont Avenue south of Mission Street	AM	64.5	64.5	0.0
		PM	65.1	65.1	0.0
	Mission Street east of Freemont Avenue	AM	62.0	62.1	0.1
		PM	62.7	62.8	0.1
	Mission Street west of Freemont Avenue	AM	61.9	62.0	0.1
		PM	62.8	62.9	0.1
3	Fair Oaks Avenue north of Mission Street	AM	66.6	66.6	0.0
		PM	67.1	67.1	0.0
	Fair Oaks Avenue south of Mission Street	AM	66.1	66.1	0.0
		PM	66.9	66.9	0.0
	Mission Street east of Fair Oaks Avenue	AM	62.1	62.1	0.0
		PM	62.4	62.4	0.0
	Mission Street west of Fair Oaks Avenue	AM	61.4	61.5	0.1
		PM	62.6	62.6	0.0
4	Fair Oaks Avenue north of El Centro Street	AM	66.2	66.2	0.0
		PM	66.9	66.9	0.0
	Fair Oaks Avenue south of El Centro Street	AM	66.4	66.4	0.0
		PM	67.1	67.1	0.0
	El Centro Street east of Fair Oaks Avenue	AM	55.3	55.3	0.0
		PM	58.0	58.0	0.0
	El Centro Street west of Fair Oaks Avenue	AM	57.0	57.2	0.2
		PM	59.1	59.2	0.1

*Note: Refer to **Appendix F** for roadway noise worksheets*
Note: Roadway noise levels are modeled 75 feet from the center of the roadway.

Table 4.5-14
Construction Vibration Levels Estimates

	Inches per Second PPV at Adjusted Distance			
Equipment	**Site 1**	**Site 2**	**Site 4**	**Site 5**
Air compressor	0.044	0.004	0.002	0.006
Backhoe	0.020	0.002	0.001	0.003
Cement and mortar mixer	0.020	0.002	0.001	0.003
Concrete saw	0.009	0.002	0.001	0.003
Excavator	0.020	0.003	0.002	0.005
Loader	0.035	0.003	0.002	0.004
Paver	0.031	0.001	0.001	0.001
Roller	0.010	0.001	0.000	0.001

Source: *FHWA RCNM* (2006).

Threshold NOI-3: **For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?**

The Project site is located in South Pasadena. The nearest airport to the Project Site is San Gabriel Airport, located approximately 7.3 miles to the east of the Project site, and it is not within range of any airport land use plan. As such, there would be no impact.

CUMULATIVE IMPACTS

According to the Noise Study, for purposes of analysis, development of the related projects identified in Section 3, Environmental Setting will be considered to contribute to cumulative noise impacts. Noise, by definition, is a localized phenomenon and drastically reduces as distance from the source increases. As a result, only related projects and growth in the general area of the Project site would contribute to cumulative noise impacts. Cumulative construction noise impacts have the potential to occur when multiple construction projects in the local area generate noise within the same time frame and contribute to the local ambient noise environment. It is expected that, as with the proposed Project, the related projects would implement best management practices, which would minimize any noise related nuisances during construction. Therefore, the combined construction noise impacts of the related projects and the Project's contribution would not cause a significant cumulative impact.

MITIGATION MEASURES

The following noise attenuation measures shall be utilized to reduce potential significant noise impacts from construction to less than significant.

MM NOI-1: Implementation of mitigation measure **MM NOI-1** would include noise reduction techniques which include submittal of a construction management plan for approval by the City specifying that all construction equipment, fixed or mobile, will be equipped with properly operating and maintained mufflers and other state-required noise-attenuation devices; identifying the maximum distance between construction equipment staging areas and occupied residential areas; and requiring the use of electric air compressors and similar power tools. Temporary noise barriers can reduce noise level at a minimum of 10 dBA, depending on the performance standard of achieving noise-level reductions. Optimal muffler systems for all equipment and the break in line of sight to a sensitive receptor would reduce construction noise levels by approximately 10 dB or more.[16] Limiting the number of noise-generating, heavy-duty off-road construction equipment (e.g., backhoes, dozers, excavators, loaders, rollers, etc.) simultaneously used on the Project site within 50 feet of off-site noise-sensitive receptors surrounding the site to no more than one or two pieces of heavy-duty, off-road equipment would further reduce construction noise levels by approximately 10 dBA. A sign, legible at a distance of 50 feet, shall be posted at the Project construction site providing a contact name and a telephone number where residents can inquire about the construction process and register complaints. This sign shall indicate the dates and duration of construction activities. In conjunction with this required posting, a noise disturbance coordinator shall be identified to address construction noise concerns received. The contact name and the telephone number for the noise disturbance coordinator shall be posted on the sign. The coordinator shall be responsible for responding to any local complaints about construction noise and shall notify the City to determine the cause and implement reasonable measures to the complaint, as deemed acceptable by the City.

With implementation of **MM NOI-1**, construction noise levels would be reduced by a minimum 30 dBA, thus the implementation of the Project would not increase ambient noise levels by 3 dBA or noise in excess of 65 dBA in sensitive areas.

---

16 FHWA, *Special Report – Measurement, Prediction, and Mitigation*, updated June 2017, accessed December 2018, https://www.fhwa.dot.gov/Environment/noise/construction_noise/special_report/hcn04.cfm.

LEVEL OF SIGNIFICANCE AFTER MITIGATION

With the implementation of **MM NOI-1**, potential impacts would be reduced to less than significant.