4.5 NOISE AND VIBRATION

A. INTRODUCTION

This section addresses the potential noise and vibration effects the Project may have on the surrounding community. The noise and vibration impact analysis is based on measurements conducted to identify existing conditions, as well as on modeling to project future noise and vibration levels from Project construction and operation activities. The Project vehicle noise is calculated based on the traffic volumes provided by the City of Pasadena Department of Transportation.

B. ENVIRONMENTAL SETTING

1. Noise and Vibration Fundamentals

Sound is mechanical energy transmitted by pressure waves in a compressible medium, such as air. Noise can be defined as unwanted sound. Sound is characterized by various parameters that include the rate of oscillation of sound waves (frequency), the speed of propagation, and the pressure level or energy content (amplitude). In particular, the sound pressure level is the most common descriptor used to characterize the loudness of an ambient sound level. The decibel (dB) scale is used to quantify sound intensity. Because sound pressure can vary enormously within the range of human hearing, a logarithmic loudness scale is used to keep sound intensity numbers at a convenient and manageable level. The human ear is not equally sensitive to all frequencies in the entire spectrum, so noise measurements are weighted more heavily for frequencies to which humans are sensitive in a process called A-weighting, written dB(A). The A-weighted sound level is measured on a logarithmic scale such that a doubling of sound energy results in a 3.0 dB(A) increase in noise level. In general, changes in a noise level less than 3.0 dB(A) are not typically noticed by the human ear.[1] Changes from 3 to 5 dB(A) may be noticed by some individuals who are extremely sensitive to changes in noise. An increase greater than 5 dB(A) is readily noticeable, while the human ear perceives a 10 dB(A) increase in sound level to be a doubling of sound volume. Common noise levels associated with certain activities are shown on **Figure 4.5-1, Common Noise Levels.**

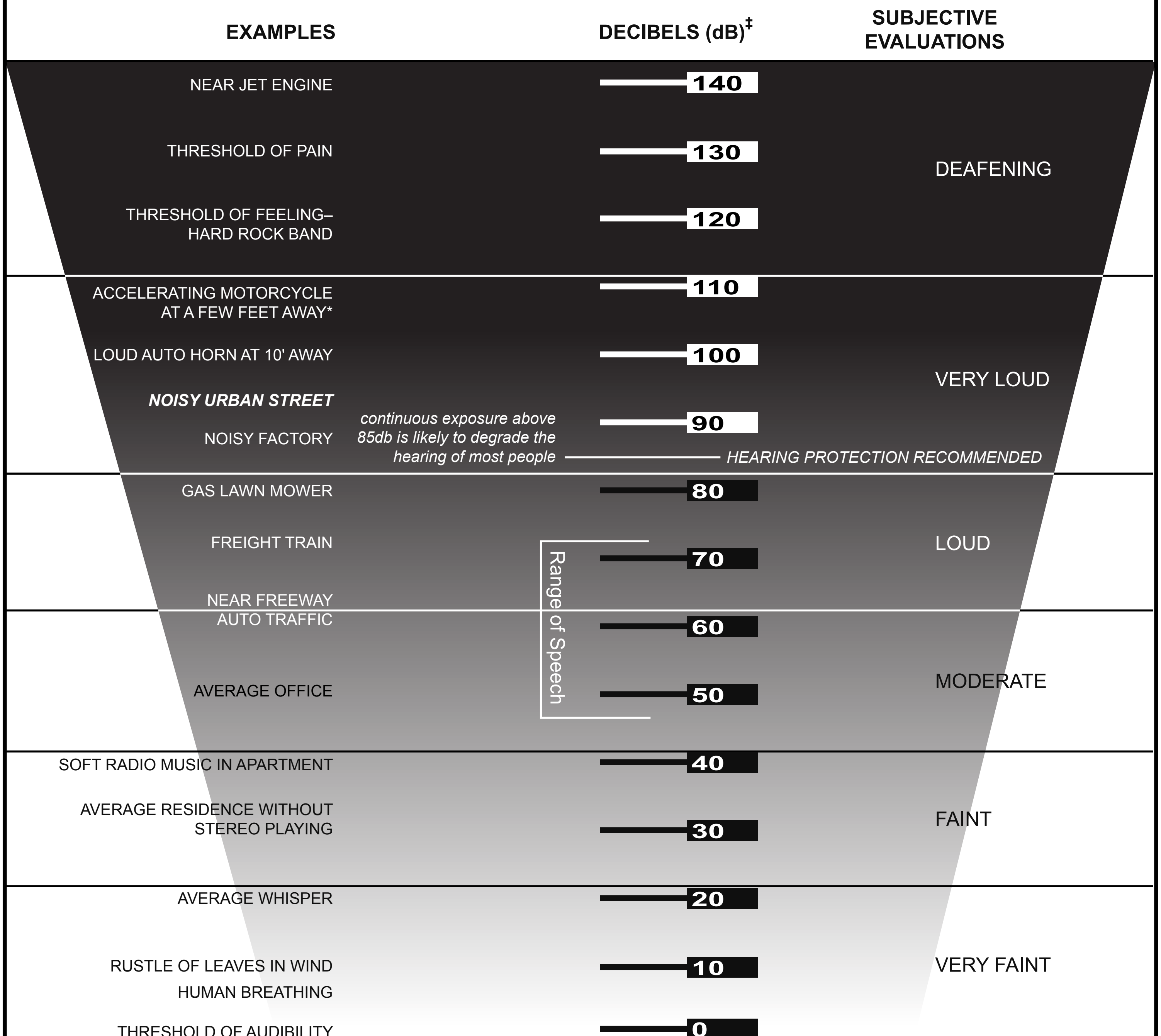
1 US Department of Transportation, Federal Highway Administration (FHA), *Fundamentals and Abatement of Highway Traffic Noise* (Springfield, VA: US Department of Transportation, Federal Highway Administration, September 1980), 81.

a. Noise Terminology

Different types of scales are used to characterize the time-varying nature of sound. Applicable scales include the maximum noise level (Lmax), equivalent noise level (Leq), and the Community Noise Equivalent Level (CNEL). Lmax is the maximum noise level measured during a specified period. Leq is the average A-weighted sound level measured over a given time interval. Leq can be measured over any period, but is typically measured for 1-minute, 15-minute, 1-hour, or 24-hour periods. CNEL is an average A-weighted sound level measured over a 24-hour period. However, this noise scale is adjusted to account for some individuals' increased sensitivity to noise levels during the evening and nighttime hours. A CNEL noise measurement is obtained by adding 5 dB(A) to sound levels occurring during the evening, from 7:00 PM to 10:00 PM, and 10 dB(A) to sound levels occurring during the nighttime, from 10:00 PM to 7:00 AM. The 5 dB(A) and 10 dB(A) "penalties" are applied to account for increased noise sensitivity during the evening and nighttime hours, respectively. Day-night average level (Ldn) is the A-weighted equivalent sound level for a 24-hour period with an additional 10 dB imposed on the equivalent sound levels for the nighttime hours of 10:00 PM to 7:00 AM. **Table 4.5-1, Noise Descriptors,** identifies various noise descriptors developed to measure sound levels over different periods of time.

b. Noise Barrier Attenuation

The introduction of a barrier between a noise source and a sensitive receptor redistributes the sound energy into several paths, including a diffracted path over the top of the barrier, a transmitted path through the barrier, and a reflected path directed away from the sensitive receptor. Diffraction is the bending of sound waves over the top of a barrier. The area behind the barrier in which diffraction occurs is known as a "shadow zone," and sensitive receptors located in this area will experience some sound attenuation. The amount of attenuation is related to the magnitude of the diffraction angle. The diffraction angle will increase if the barrier height increases or if the distance from sensitive receptors is decreased to the barrier. In addition to diffraction with the use of barriers, sound can travel through the barrier itself. The level of sound transmission through the barrier depends on factors relating to the composition of the barrier (such as its weight and stiffness), the angle of incidence of the sound, and the frequency spectrum of the sound. The rating of a material's ability to transmit noise is called transmission loss. Transmission loss is related to the ratio of the incident noise energy to the transmitted noise energy, and it is normally expressed in decibels, which represents the amount noise levels will be reduced when the sound waves pass through the material of the barrier.



** 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 **4.5-1**

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Common Noise Levels

Table 4.5-1
Noise Descriptors

Term	Definition
Sound	A disturbance created by a vibrating object, which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.
Noise	Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
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 (dB[A])	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 Continuous 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.
Day-Night Level (Ldn)	The energy average of the A-weighted sound levels occurring during a 24-hour period with 10 dB(A) added sound levels occurring from 10 PM to 7 AM.
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 dB(A) for the evening, 7:00 PM to 10:00 PM, and add 10 dB(A) for the night, 10:00 PM to 7:00 AM. The 5 and 10 decibel penalties are applied to account for increased noise sensitivity during the evening and nighttime hours, respectively. The logarithmic effect of adding these penalties to the 1-hour Leq measurements typically results in a CNEL measurement that is within approximately 3 dB(A) of the peak-hour Leq.
sound pressure level	The sound pressure is the force of sound on a surface area perpendicular to the direction of the sound. The sound pressure level is expressed in dB.
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.

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

Noise energy can also be reflected by a barrier wall. The reflected sound energy thus would not affect the sensitive receptor but may affect sensitive receptors to the left and right of the developed barrier.[2] Man-made or natural barriers can also attenuate sound levels, as illustrated in **Figure 4.5-2, Noise Barrier Diffraction**. A solid wall or berm may reduce noise levels by 5 to 10 dB(A).

2 US Department of Housing and Urban Development, Office of Community Planning and Development, *The Noise Guidebook* (n.d.), 21–23.

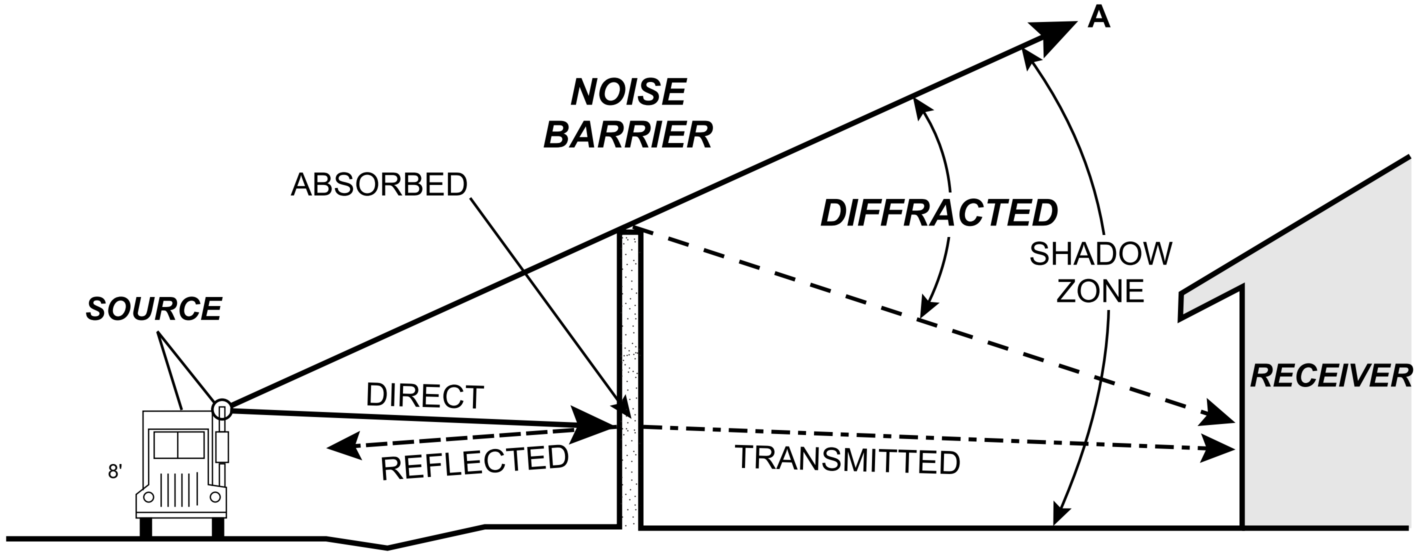

FIGURE 4.5-2

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Noise Barrier Diffraction

Contemporary wood-frame construction techniques in California typically provide about 25 dB(A) reduction in exterior to interior noise levels. This is due to structural means used to comply with California regulations, such as the Title 24 energy conservation standards. The minimum attenuation of exterior to interior noise provided by typical structures in California is provided in **Table 4.5-2, Noise Attenuation of Typical Structures.**

Table 4.5-2
Noise Attenuation of Typical Structures

Building Type	Open Windows (dB[A])	Closed Windows (dB[A])[a]
Residences	17.0	25.0
Churches	20.0	30.0
Hospitals/Convalescent homes	17.0	25.0
Offices	17.0	25.0
Theaters	20.0	30.0
Hotels/Motels	17.0	25.0

Source: Transportation Research Board, National Research Council, Highway Noise A Design for Highway Engineers, National cooperative Highway Research Program Report 117.
[a] As shown, structures with closed windows can attenuate exterior noise by a minimum of 25.0 to 30.0 dB(A).

c. Vibration

Vibration consists of waves transmitted through a solid medium. Ground-borne vibration propagates from the source through the ground to adjacent buildings by surface waves. A vibration may be a single pulse, a series of pulses, or a continuous oscillatory motion. The frequency of a vibrating object describes how rapidly it is oscillating, measured in hertz (Hz). Most environmental vibrations consist of a composite, or "spectrum," of many frequencies, and are generally classified as broadband or random vibrations. **Figure 4.5-3, Typical Levels of Ground-borne Vibration**, identifies typical ground-borne vibration levels.

The normal frequency range of most ground-borne vibration that can be felt starts from a low frequency of less than 1 Hz to a high of about 200 Hz. Vibration is often measured in terms of the peak particle velocity (PPV) in inches per second (in/sec) because it is related to the stresses that are experienced by buildings. Vibration is also measured in vibration decibels (VdB). The human threshold of perception 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. Vibration levels are acceptable at approximately 85 VdB if there are an infrequent number of events per day.[3]

3 US Department of Transportation, Federal Transit Administration (FTA), Office of Planning and Environment, *Transit and Vibration Impact Assessment*, FTA-VA-90-1003-06 (May 2006). p. 7-8.

HUMAN/ STRUCTURAL RESPONSE	PPV AMPLITUDE IN INCHES PER SECOND [1]	VELOCITY LEVEL IN VdB	RMS VELOCITY AMPLITUDE IN INCHES PER SECOND [2]	TYPICAL SOURCES: EFFECT 50 FEET FROM SOURCE
THRESHOLD, MINOR COSMETIC DAMAGE TO FRAGILE BUILDINGS	0.4	100	0.1	BLASTING FROM CONSTRUCTION PROJECTS
DIFFICULTY WITH TASKS SUCH AS READING A VDT MONITOR/TV	0.1264	90	0.0316	BULLDOZER AND OTHER HEAVY-TRACKED CONSTRUCTION EQUIPMENT
RESIDENTIAL ANNOYANCE, INFREQUENT EVENTS (E.G., COMMERCIAL RAIL)	0.04	80	0.01	COMMUTER RAIL, UPPER RANGE RAPID TRANSIT, UPPER RANGE
RESIDENTIAL ANNOYANCE, FREQUENT EVENTS (E.G., RAPID TRANSIT)	0.01264	70	0.00316	COMMUTER RAIL, TYPICAL BUS OR TRUCK OVER BUMP RAPID TRANSIT, TYPICAL
LIMIT FOR VIBRATION-SENSITIVE EQUIPMENT				BUS OR TRUCK, TYPICAL
APPROXIMATE THRESHOLD FOR HUMAN PERCEPTION OF VIBRATION	0.004	60	0.001	NEAR FREEWAY AUTO TRAFFIC
AVERAGE RESIDENCE WITHOUT STEREO PLAYING	0.00126	50	0.000316	TYPICAL GROUND VIBRATION
AVERAGE WHISPER				

[1] PPV is typically a factor 1.7 to 6 times greater than RMS vibration velocity. A factor of 4 was used to calculate noise levels.

[2] Vibration levels in terms of velocity levels are defined as: $V = 20 \times \log_{10} (a/r)$
V=velocity levels in decibels
a=RMS velocity amplitude
r=reference amplitude (accepted reference quantities for vibration velocity are 1×10^{-6} inches/second in the United States)

FIGURE **4.5-3**

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Typical Levels of Ground-borne Vibration

Vibration energy attenuates as it travels through the ground, causing the vibration amplitude to decrease with distance away from the source.[4] High-frequency vibrations reduce much more rapidly than low frequencies, so that in the far-field from a source, the low frequencies tend to dominate. Soil properties also affect the propagation of vibration. When ground-borne vibration interacts with a building, there is usually a ground-to-foundation coupling loss, but the vibration can also be amplified by the structural resonances of the walls and floors. Vibration in buildings is typically perceived as rattling of windows or of items on shelves, or the motion of building surfaces.

Ground-borne vibration is generally limited to areas within a few hundred feet of certain types of construction activities, especially pile driving. Road vehicles rarely create enough ground-borne vibration to be perceptible to humans unless the road surface is poorly maintained and there are potholes or bumps. If traffic, typically heavy trucks, induces perceptible vibration in buildings, such as window rattling or shaking of small loose items, then it is most likely an effect of low-frequency airborne noise or ground characteristics. Human annoyance by vibration is related to the vibration energy and the number and duration of events, as well as the setting in which the person experiences the vibration. As discussed previously, vibration can be amplified by the structural resonances of the walls and floors of buildings. The more the events or the greater the duration, the more annoying it will be to humans.

2. Existing Noise Environment

a. Project-Area Noise Levels

The Project Site is surrounded by transportation and stationary sources of noise that contribute to the existing ambient noise environment. The Project Site is bounded by Corson Street to the north, N. Oakland Avenue to the east and N. Los Robles Avenue to the west. Mobile noise sources include those associated with vehicle traffic along surrounding streets, including Interstate 210 (I-210) to the north.

The existing ambient noise environment in the Project Site was determined by conducting noise measurements. Noise monitoring was conducted over 15-minute intervals with a Larson Davis 831 Sound Level Meter. The ambient noise environment results are provided in **Table 4.5-3, Noise Measurements in Project Vicinity**. As shown, average ambient noise levels along the busier streets with heavy mobile vehicle traffic (Los Robles Avenue, Corson Street, and Walnut Street) is in the 71.7 to 72.3 dBA range whereas along less busier streets with less mobile vehicle traffic (Oakland Avenue) was only 58.8 dBA.

4 California Department of Transportation, *Transportation and Construction Vibration Guidance Manual (2013)*

Table 4.5-3
Noise Measurements in Project Vicinity

Site	Location	Time Period	15-minute (Leq)
1	Along Corson Street (north of the Project Site), between N. Los Robles Avenue and N. Oakland Avenue	8:07 AM–8:22 AM	72.1
2	Along N. Los Robles Avenue (west of the Project Site), between Corson Street and E. Walnut Street	8:23 AM–8:38 AM	70.5
3	Along N. Oakland Avenue (east of the Project Site), between Corson Street and E. Walnut Street	8:44 AM–8:59 AM	58.8
4	Along E. Walnut Street (south of the Project Site), between N. Los Robles Avenue and N. Oakland Avenue	9:03 AM–9:18 AM	72.3
5	Along N. Los Robles Avenue (southwest of the Project Site), between E. Walnut Street and Ford Place	9:21 AM–9:36 AM	71.7

Source:
*Refer to **Appendix E1, Ambient Noise Measurements** for monitoring data sheets.*
Note: Noise measurements were conducted on December 13, 2016.

b. Existing Off-Site Roadway Noise Levels

To characterize the ambient roadway noise environment near the Project Site, noise prediction modeling was conducted based on vehicular traffic volumes along nearby roadway segments. Existing roadway noise levels were modeled using the Federal Highway Administration Highway Prediction Noise Model (FHWA-RD-77-108). This 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 3 dB(A) noise reduction per doubling of distance) and assumes 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. The noise prediction model used daily traffic volumes to determine average daily trips (ADTs) along the analyzed roadway segments. The estimated existing roadway noise levels are provided in **Table 4.5-4, Modeled Existing Roadway Noise Levels**. Note that these calculated noise levels only consider the traffic volumes along the identified street segment and do not include other noise sources that may contribute to the ambient noise level at that location. The purpose of these calculations is to compare existing to future based specifically on the traffic volume for each roadway segment.

As indicated in **Table 4.5-4**, the existing vehicle-generated noise levels along roadway segments near the Project Site range from a low of 45.3 dB(A) CNEL along Oakland Avenue, north of Walnut Street (Intersection 7) to a high of 62.2 dB(A) CNEL along Los Robles Avenue, south of Walnut Street (Intersection 6) at a distance of 75 feet from the center of the roadway.

Table 4.5-4
Modeled Existing Roadway Noise Levels

Intersection	Roadway Segment	Roadway Noise Level (dB[A] CNEL)
Maple Street		
	West of Marengo Avenue	60.1
	East of Marengo Avenue	60.5
	East of Los Robles Avenue	58.3
	West of El Molino Avenue	58.3
	East of El Molino Avenue	58.2
Marengo Avenue		
	North of Maple Street	58.2
	South of Maple Street	60.0
	North of Corson Street	60.1
	South of Corson Street	61.0
	North of Walnut Street	59.5
	South of Walnut Street	60.0
Corson Street		
	West of Marengo Avenue	58.4
	East of Marengo Avenue	59.4
	West of Los Robles Avenue	57.2
	East of Los Robles Avenue	57.4
	West of El Molino Avenue	56.8
Walnut Street		
	West of Marengo Avenue	60.5
	East of Marengo Avenue	60.5
	West of Los Robles Avenue	60.0
	East of Los Robles Avenue	59.9
	West of Oakland Avenue	59.9
	East of Oakland Avenue	59.9
	West of El Molino Avenue	59.8
	East of El Molino Avenue	59.8
Los Robles Avenue		
	North of Maple Street	61.1
	South of Maple Street	61.4
	North of Corson Street	61.6
	South of Corson Street	62.0
	North of Walnut Street	62.1
	South of Walnut Street	62.2

Intersection	Roadway Segment	Roadway Noise Level (dB[A] CNEL)
Oakland Avenue		
	North of Walnut Street	45.3
	South of Walnut Street	46.3
El Molino Avenue		
	North of Maple Street	55.2
	South of Maple Street	56.2
	North of Corson Street	56.7
	South of Corson Street	56.8
	North of Walnut Street	56.3
	South of Walnut Street	56.0

Noise model results are provided in ***Appendix E2, Roadway Noise.***
Note: Roadway noise levels are modeled 75 feet from the center of the roadway.

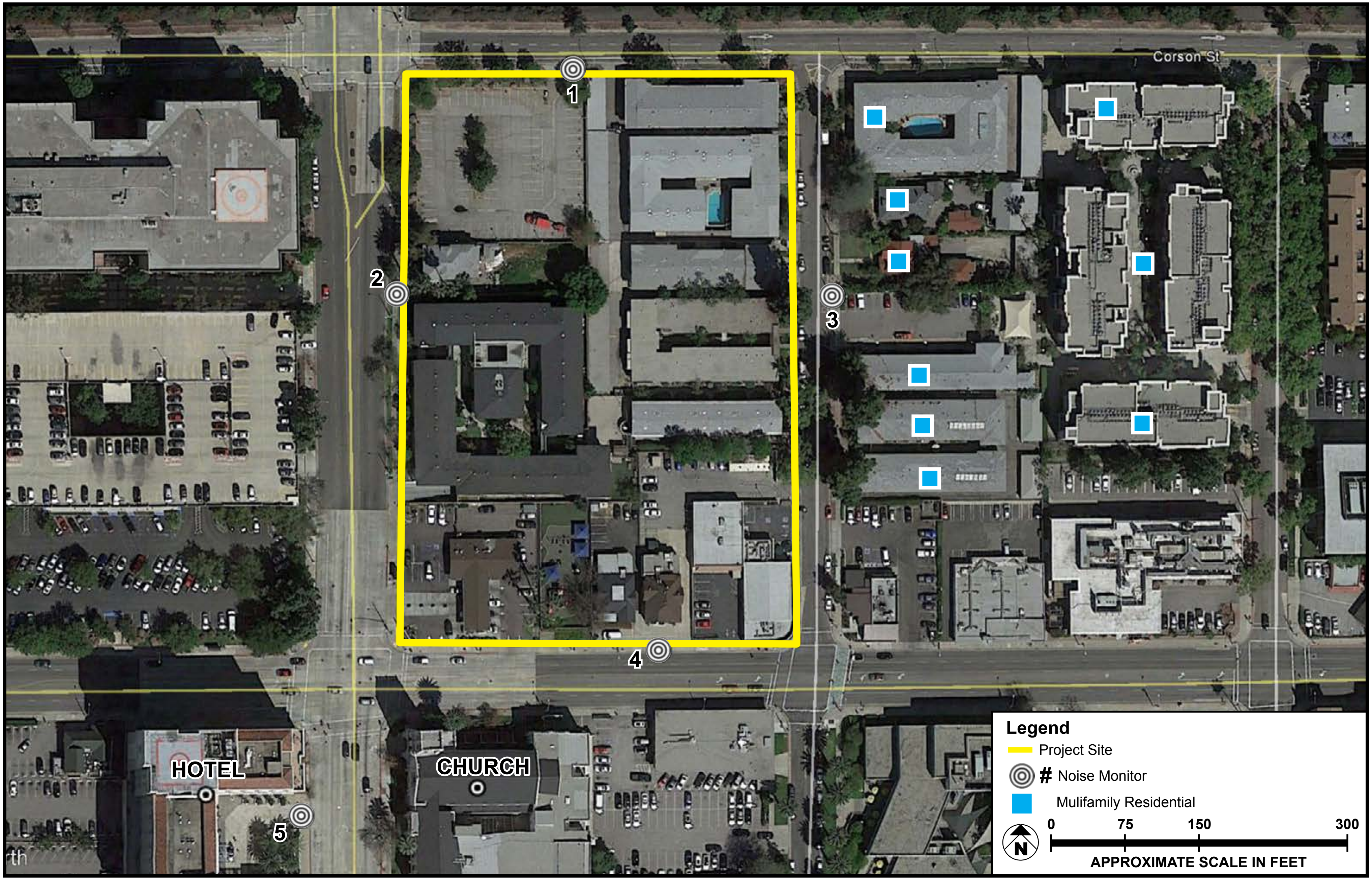
c. Existing Vibration Conditions

The primary source of existing ground-borne vibration in the vicinity of the Project Site is vehicle traffic along Corson Street and I-210 to the north, and E. Walnut Street to the south. According to the FTA,[5] typical road traffic-induced vibration levels are unlikely to be perceptible by people. In part, FTA indicates that "it is unusual for vibration from traffic including buses and trucks to be perceptible, even in a location close to major roadways." Trucks and buses typically generate 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. Therefore, based on FTA published vibration data, the existing ground vibration environment in the Project vicinity would be below the perceptible levels.

d. Location of Sensitive Noise Receptors

Noise- and vibration-sensitive uses include residences, schools, libraries, health care facilities, and open space/recreation areas where quiet environments are necessary for enjoyment, public health, and safety. Noise-sensitive land uses which surround the Project Site include the residential units along N. Oakland Avenue to the east and the Westin Pasadena hotel to the southwest, as shown in **Figure 4.5-4, Sensitive Receptors**.

5 California Department of Transportation, *Transportation- and Construction-Induced Vibration Guidance Manual*, June 2004.



SOURCE: Google Earth - 2017

FIGURE **4.5-4**

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Sensitive Receptors

148-001-16

C. REGULATORY SETTING

1. Federal

a. Department of Housing and Urban Development

The U.S. Department of Housing and Urban Development (HUD) has set a goal of 65 dB(A) CNEL as a desirable maximum exterior standard for residential uses developed under HUD funding. While HUD does not specify acceptable interior noise levels, standard construction of residential uses constructed under Title 24 standards typically provides in excess of 20 dB(A) of attenuation with the windows closed. Based on this premise, the interior CNEL should not exceed 45 dB(A) CNEL.[6]

b. Federal Transit Administration

The FTA has published guidelines for assessing the impacts of ground-borne vibration associated with construction activities, which have been applied by other jurisdictions to other types of projects. The FTA's measure of the threshold of architectural damage for conventional sensitive structures (e.g., residential units) is 0.2 inch per second PPV.[7] The vibration threshold of perception is 0.01 inch per second PPV. With respect to human annoyance, the FTA provides criteria for various land use categories and based on the frequency of vibration events. According to the FTA, a vibration criterion of 72 VdB should be used for residential land uses. With respect to potential building damage (primarily from construction activities), the FTA provides guidelines for the evaluation of potential ground-borne vibration damage applicable to various building categories. According to FTA guidelines, a vibration criterion of 0.20 inches per second, or 106 VdB, should be considered as the significant impact level for non-engineered timber and masonry buildings. Structures engineered with concrete and masonry (no plaster) have vibration damage criteria of 0.3 inches per second, or 110 VdB. All structures or buildings constructed of reinforced-concrete, steel, or timber, have vibration damage criteria of 0.50 inches per second, or 114 VdB. The general human response to different levels of ground-borne vibration velocity levels are as follows: 65 VdB is the approximate threshold of perception for many people; 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible; and 85 VdB is the vibration acceptable only if there are an infrequent number of events per day.

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6 Code of Federal Regulations, tit. 24, sec. 51, Housing and Urban Development, Environmental Criteria and Standards (revised April 1, 2004).

7 FTA, *Transit Noise*.

2. State

a. State of California Noise Standards

The State of California, Office of Planning and Research has published, with regard to community noise exposure, recommended guidelines for land use compatibility. These guidelines rate land use compatibility in terms of being *normally acceptable, normally unacceptable,* and *clearly unacceptable*. Each jurisdiction is required to consider these guidelines when developing a General Plan Noise Element and when determining acceptable noise levels within its community. These guidelines are representative of various land uses that include residential, commercial/mixed-use, industrial, and public facilities. **Figure 4.5-5, Land Use Compatibility to Noise,** identifies the acceptable noise exposure for various land use categories within the City. Noise exposure for single-family uses is "normally acceptable" when the CNEL at exterior residential locations is equal to or below 60 dB(A); "conditionally acceptable" when the CNEL is between 55 to 70 dB(A); and "normally unacceptable" when the CNEL exceeds 70 dB(A).

In addition, the California Commission of Housing and Community Development officially adopted interior noise standards in 1974. In 1988, the Building Standards Commission approved revisions to the standards (Title 24, Part 2, California Code of Regulations). As revised, Title 24 establishes an interior noise standard of 45 dB(A) CNEL for residential space.

b. CalGreen Building Standards

Buildings must be designed to include the green building measures specified as mandatory in the application checklist contained within this code.[8] The Environmental Comfort element of the CalGreen Building Standard describes the exterior noise transmission for both prescriptive and performance methods. Voluntary green building measures are also included in the application checklist and may be included in the design and construction of structures covered by this code, but are not required unless adopted by a city, county, or city and county as specified in Section 101.7.

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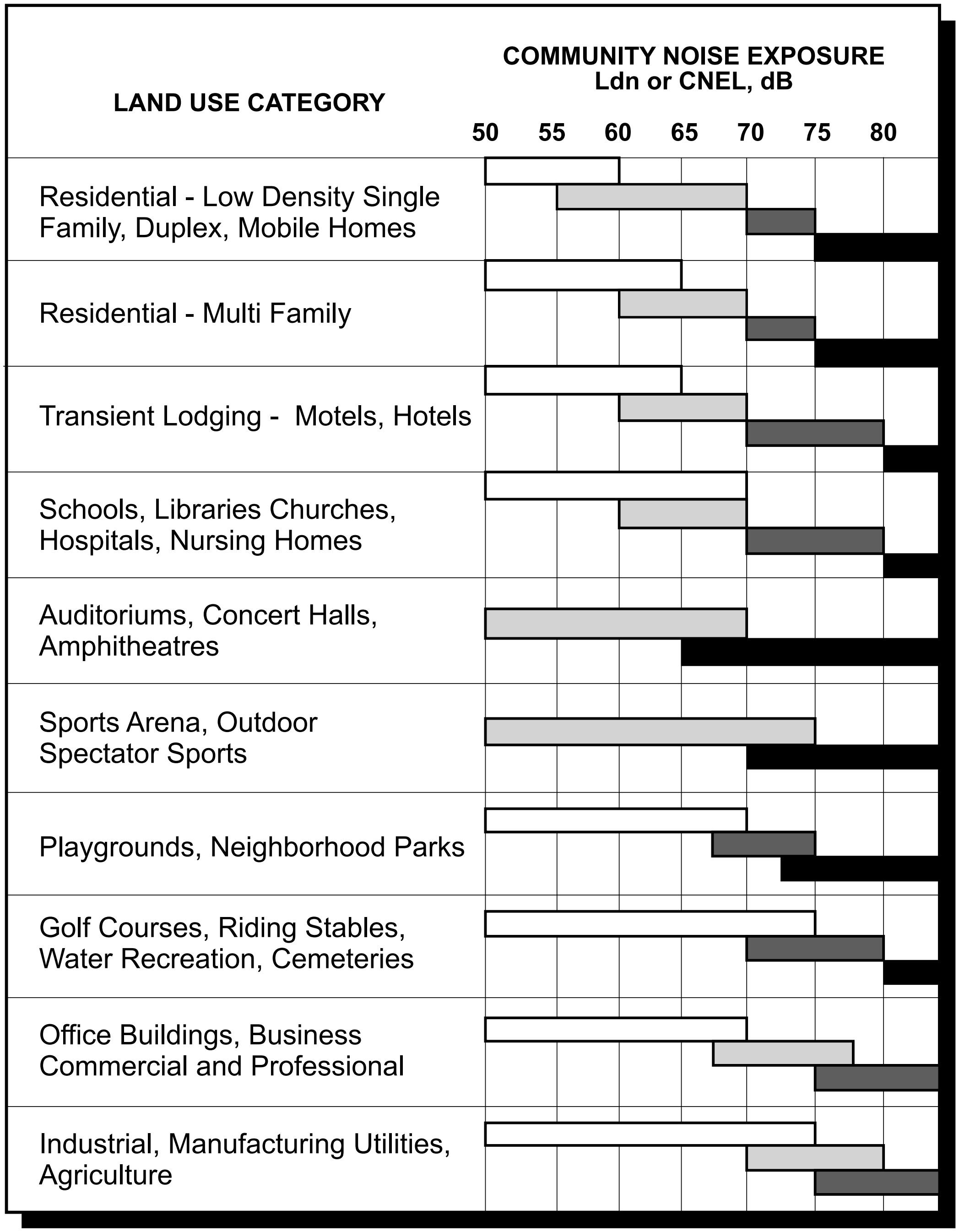
8 2016 Green Building Standards Code, Part 11 (effective January 1, 2017).



NORMALLY ACCEPTABLE
Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

CONDITIONALLY ACCEPTABLE
New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

NORMALLY UNACCEPTABLE
New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise reduction features included in the design.

CLEARLY UNACCEPTABLE
New construction or development should generally not be undertaken.

SOURCE: California Governor's Office of Planning and Research, State of California General Plan Guidelines, Appendix C: Guidelines for the Preparation and Content of Noise Elements of the General Plan, October 2003.

FIGURE **4.5-5**

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Land Use Compatibility to Noise

3. Local

a. City of Pasadena Noise Element

The Noise Element of the City's General Plan establishes a number of goals and policies to provide an acceptable noise environment for noise-sensitive developments with the City. The implementation measures for the Noise Element policies include, but are not limited to, noise study triggers, site design considerations, traffic calming measures, and coordination with other local agencies, regional agencies, state agencies, and federal agencies.

The Noise Element provides guidelines for noise compatible land uses that specify clear acceptable, normally acceptable, conditionally acceptable, and normally unacceptable noise levels for a range of land uses within the City. Commercial uses are "normally acceptable" at 67–77 dB(A) and conditionally acceptable above 85 dB(A). Multifamily and mixed-commercial/residential uses are "normally acceptable" at 60–70 dB(A) and "conditionally acceptable" from 70-75 dB(A).

The Noise Element defines the general methodology to be followed in the evaluation of potential noise problems associated with new development in Pasadena including:

1. First Approach
    a. Site layout, including setbacks, open space separation and shielding of noise sensitive uses with non-noise-sensitive uses; then
2. Second Approach
    b. Acoustical treatment of buildings (see Standard Mitigation Packages below for the types of treatment normally required depending upon the amount of noise reduction needed); then
3. Third Approach (will be used only if neither the First or Second Approach will achieve desired noise conditions)
    c. Structural measures: Construction of earthen berms or wood or concrete barriers.

Standard mitigation measures that can be used to mitigate interior building noise if the needed noise reduction is 30 dB(A) or less and the noise problem is from a single source are listed in the Noise Element:[9]

9 City of Pasadena, *Revised Noise Element of the General Plan—Objectives, Policies, and Implementation* (December 2002).

1. If a 15–20 dB(A) reduction is needed, the following may suffice:
    a. Air conditioning or a mechanical ventilation system; and
    b. Windows and sliding glass doors should be double-paned glass and mounted in low air infiltration rate frames (0.5 cubic feet per minute or less, per American National Standard Institute [ANSI] specifications); and
    c. Solid core exterior doors with perimeter weather stripping and threshold seals
2. If a 20–25 dB(A) reduction is needed, the following may suffice:
    a. Same as No. 1a–c; and
    b. Exterior walls consist of stucco or brick veneer. Wood siding with a ½ inch minimum thickness fiberboard underlayer may also be used; and
    c. Glass in both windows and doors should not exceed 20% of the floor area in a room; and
    d. Roof or attic vents facing the noise source should be baffled.
3. If a 25–30 dB(A) reduction is needed, the following may suffice:
    a. Same as No. 2a–d; and
    b. The interior sheetrock of exterior wall assemblies should be attached to studs by resilient channel. Staggered studs or double walls are acceptable alternatives; and

Window assemblies should have a laboratory-tested STC rating of 30 or greater (Windows that provide superior noise reduction capability and that are laboratory-tested are sometime called "sound-rated" windows. In general, these windows have thicker glass and/or increased air space between panes. In contrast, standard energy conservation double-pane glazing).

b. Noise Ordinance

The City has jurisdiction over noise regulation, as stated in the City's Municipal Code, Title 9, Chapter 36, Noise Restrictions. The noise ordinance generally limits intrusive noise from exceeding the ambient level at the property line by more than 5 dB. The ambient is the actual measured ambient noise level. Section 9.36.060 sets the interior noise limit for multifamily residential uses to 60 dB(A) between 7:00 AM and 10:00 PM, and 50 dB(A) between 10:00 PM and 7:00 AM.

Construction noise is regulated by Section 9.36.070, which restricts construction activities "within a residential district or within a radius of 500 feet" to between 7:00 AM and 7:00 PM Monday through Friday, and between 8:00 AM and 5:00 PM on Saturdays. Construction activities are prohibited on Sundays and holidays. Additionally, Section 9.36.080 further restricts noise levels from construction equipment to 85 dB(A) Leq measured at 100 feet from each piece of equipment. At a distance of 100 feet or more from working equipment, the noise level would be 85 dB or lower. A worst-case scenario is used for this analysis and assumes that all equipment to be operating on the Project Site boundary at the closest point to a sensitive receptor.

c. Pasadena 2015 General Plan Update

As part of the 2015 General Plan Update, the City identified the potential for significant construction noise impacts from future projects. Therefore, the City adopted Mitigation Measures in connection with the adoption of the General Plan Update. The measures applicable to this Project include:

- Prior to issuance of any grading and construction permits, applicants for individual projects that involve vibration-intensive construction activities, such as pile drivers, jack hammers, and vibratory rollers, within 25 feet of sensitive receptors (e.g., residences and historic structures) shall prepare and submit to the City of Pasadena Planning Division a study to evaluate potential construction-related vibration impacts. The study shall be prepared by an acoustical engineer and shall identify measures to reduce impacts to habitable structures to below the FTA vibration annoyance criterion. If construction-related vibration is determined to be perceptible at vibration-sensitive uses, additional requirements, such as use of less-vibration-intensive equipment or construction technique, shall be implemented during construction (e.g., drilled piles, static rollers, and nonexplosive rock blasting). Identified measures shall be included on all construction and building documents and submitted for verification to the City of Pasadena Planning Division.

- Prior to issuance of construction permits, applicants for new development projects within 500 feet of noise-sensitive receptors shall implement the following best management practices to reduce construction noise levels:

  - Consider the installation of temporary sound barriers for construction activities immediately adjacent to occupied noise-sensitive structures.

  - Equip construction equipment with mufflers.

  - Restrict haul routes and construction-related traffic.

  - Reduce nonessential idling of construction equipment to no more than five minutes.

  The identified best management practices shall be noted on all site plans and/or construction management plans and submitted for verification to the City of Pasadena Planning Division.

D. ENVIRONMENTAL IMPACTS

1. Methodology

a. Construction

Construction of the Project would require demolition, site clearing, grading, asphalt paving, building construction, and building finishing activities. These activities typically involve the use of heavy equipment, such as tractors, dozers, and cranes. While construction would be temporary, the use of these types of equipment would generate both steady state and episodic noise that would be heard both on and off the Project Site.

Construction Noise

Typical maximum noise levels and duty cycles of representative types of equipment are presented in **Table 4.5-5, Typical Maximum Noise Levels for Construction Equipment.** These values were obtained from Federal Highway Administration documented observation of noise levels at 50 feet. It is expected that noise levels would decrease by 6 dB for every doubling of distance. Thus, at 100 feet, noise levels would be 6 dB less than shown in the table. 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 4.5-5
Typical Maximum Noise Levels for Construction Equipment

Equipment Description	Actual Measured (Lmax)		Typical Duty Cycle (%)
	Noise Level at 50 feet (dB[A])	Noise Levels at 100 feet (dB[A])	
Auger drill rig	84	78	20
Backhoe	78	72	40
Chain saw	84	78	20
Compressor (air)	78	72	40
Concrete mixer truck	79	73	40
Concrete pump truck	81	75	20
Concrete/Industrial saw	90	84	20
Crane	81	75	16
Dozer	82	76	40
Dump truck	76	70	40
Excavator	81	75	40
Front end loader	79	73	40
Generator (25 kVA or less)	73	67	50

Equipment Description	Actual Measured (Lmax)		Typical Duty Cycle (%)
	Noise Level at 50 feet (dB[A])	Noise Levels at 100 feet (dB[A])	
Generator (more than 25 kVA)	81	75	50
Grader	85	79	40
Paver	77	71	50
Pneumatic tool	85	79	50
Pump	81	75	50
Rock drill	81	75	20
Scraper	84	78	40
Tractor	84	78	40
Vacuum excavator (vac-truck)	85	79	40
Vibratory concrete mixer	80	74	20

Source: U.S. DOT, Construction Noise Handbook – Chapter 9.0 Construction Equipment and Noise Level Ranges.

Construction Vibration

Construction-related ground-borne vibration impacts were evaluated using the FTA's *Transit Noise and Vibration Impact Assessment* guidance document.[10] The potential vibration source in the Project Site includes construction equipment in operation during Project construction. Ground-borne vibration impacts were evaluated by identifying potential vibration sources and estimating the vibration levels at the affected receptor.

b. Operation

Roadway Noise

Traffic noise levels were modeled using the FHWA Noise Prediction Model (FHWA-RD-77-108). This model calculates the average noise level in dB(A) CNEL along a given roadway segment based on traffic volumes, vehicle mix, posted speed limits, roadway geometry, and site conditions. The model calculates noise associated with a specific line source and the results characterize noise generated by motor vehicle traffic along the specific roadway segment. The model incorporates an alpha factor that characterizes the surface conditions of the area. An acoustically hard site uses an alpha factor of zero, while an acoustically soft site uses an alpha factor of 0.5. The greater the alpha factor, the greater the noise attenuates with increasing distance. Average vehicle noise rates utilized in the FHWA model have been modified to reflect

10 FTA, *Transit Noise*.

average vehicle noise rates identified for California by Caltrans. According to data collected by Caltrans, California automobile noise is 0.8 to 1.0 dB(A) louder than national levels, while medium and heavy truck noise is 0.3 to 3.0 dB(A) quieter than national levels.[11] Roadway traffic data was obtained from the traffic impact study for the Project (see **Appendix E**). Noise levels were evaluated with respect to the following modeled traffic scenarios:

- Existing (2017) Conditions
- Existing (2017) with Project Conditions

Stationary Noise

Stationary point-source noise impacts were evaluated by identifying the noise levels generated by outdoor stationary noise sources such as rooftop mechanical equipment, outdoor recreational areas, parking areas, etc.; estimating the noise level from each noise source at surrounding residential property locations; and comparing such noise levels to ambient noise levels to determine significance. Operational noise levels were calculated for the hourly Leq from each noise source to surrounding sensitive receptors based on past field monitoring of similar uses conducted by Meridian Consultants or published noise references. Noise levels were then compared against the applicable exterior noise threshold.

Operation Vibration

The majority of the Project's operational-related vibration sources, such as mechanical and electrical equipment, would incorporate vibration attenuation mounts, as required by the particular equipment specifications. Therefore, operation of the Project would not increase the existing vibration levels in the immediate vicinity of the Project and, as such, vibration impacts associated with the Project would be minimal. Therefore, the ground borne vibration analysis is limited to Project-related construction activities.

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11 Rudolf W. Hendriks, *California Vehicle Noise Emission Levels,* NTIS, FHWA/CA/TL-87/03 (1987).

2. Thresholds of Significance

The Project is considered to have a significant noise impact if it would:

Threshold 4.5-1: **Expose persons to noise levels in excess of standards established in the local General Plan or noise ordinance, or applicable standards of other agencies.**

Threshold 4.5-2: **Expose persons to excessive ground-borne vibration or ground-borne noise levels.**

Threshold 4.5-3: **Create a substantial permanent increase in ambient noise levels in the vicinity of the project.**

Threshold 4.5-4: **Create a substantial temporary or periodic increase in ambient noise levels in the vicinity of the project.**

The City's Noise Ordinance prohibits the operation of construction equipment from generating noise in excess of 85 dB(A) at a distance of 100 feet. For the purposes of this analysis, project construction that produces noise that exceeds 85 dB(A) at a distance of 100 feet would be significant.

The City prohibits generation of noise in excess of 5 dB(A) over the existing ambient noise level, with adjustments made for steady audible tones, repeated impulsive noise, and noise occurring for limited time periods. For the purposes of this analysis, project operation that produces noise that exceeds existing ambient exterior Leq noise levels by 5 dB(A) or more at a sensitive receptor site (with the adjustments specified in the City's Noise Ordinance) would be significant.

Based on Caltrans and Federal Transit Administration (FTA) guidelines for vibration damage potential, a vibration threshold of 0.12 PPV in/sec is identified for "extremely fragile historic buildings, ruins, ancient monuments", and a vibration criterion of 0.20 inches per second is the construction vibration damage criteria for non-engineered timber and masonry buildings. Therefore, for the purposes of this analysis, construction and operation that exposes historic structures to vibration levels that exceed 0.12 in/sec or that exposes non-engineered timber and masonry buildings to vibration levels that exceed 0.20 in/sec would be a significant impact. Caltrans estimates that vibration levels of 0.24 in/sec would be distinctly perceptible to a human. Therefore, project construction and operation that exposes vibration sensitive receptors to vibration levels that exceed 0.24 in/sec could be a cause for human annoyance and impacts would be significant.

3. Project Impacts

Threshold 4.5-1: Would the project expose persons to noise levels in excess of standards established in the local General Plan or noise ordinance, or applicable standards of other agencies?

Construction

Noise impacts are localized in nature and decrease with distance. Construction noise impacts have the potential to occur and contribute to the local ambient noise environment. The City's Noise Ordinance prohibits the operation of construction equipment from generating noise in excess 85 dB(A) at a distance of 100 feet. As discussed below in **Table 4.5-8**, construction noise equipment operated during each phase would not exceed the 85 dB(A) threshold at a distance of 100 feet. In addition, the City's Noise Ordinance limits construction activity to between 7:00 AM and 7:00 PM on weekdays and between 8:00 AM and 5:00 PM on Saturdays within a residential district or within a radius of 500 feet therefrom. No construction activities are permitted on Sundays or holidays. Consistent with the City's Noise Ordinance, the Project would limit construction activities to the timeframes and days identified above. Therefore, the Project would be in conformance with the City's Noise Ordinance and impacts would be less than significant.

Operation

As discussed in **Threshold 4.5-3**, the Project would contribute a negligible increase in vehicle related noise along adjacent roadways. These levels would be consistent with existing vehicle related noise levels and would not increase roadway noise volumes by more than 3 dB(A) CNEL. Therefore, impacts would be considered less than significant.

Threshold 4.5-2: Exposure of persons to excessive ground-borne vibration or ground-borne noise levels?

Construction activities can generate varying degrees of ground vibration depending on the construction procedures and the construction equipment used. The operation of construction equipment generates vibrations that spread through the ground and diminish in amplitude with distance from the source. The results from vibration can range from no perceptible effects at the lowest vibration levels, to low rumbling sounds and perceptible vibration at moderate levels, to slight damage at the highest levels. The primary and most intensive vibration source associated with the development of the Project would be the use of earth-moving equipment during construction. Expected equipment to be operated during construction are identified in **Table 4.5-6, Vibration Source Levels from Construction Equipment.** The quantities listed identify the total number of vehicles and equipment per construction day. Thus, during grading, 30 dump trucks and 1 water truck are expected to operate at the site during the course of a day.

Table 4.5-6
Vibration Source Levels from Construction Equipment

Construction Phase	Equipment	Quantity per phase	PPV at 25 feet per unit (in/sec)	Approximate PPV at 30 feet (in/sec)
Demolition	Concrete/Industrial Saws	1	0.018	0.014
	Dumpers/Tenders	2	0.076	0.116
	Excavators	2	0.040	0.061
	Pressure Washers	1	0.076	0.058
	Rubber Tired Dozers	2	0.071	0.108
	Tractors/Loaders/Backhoes	1	0.040	0.030
Site Preparation	Rubber Tired Dozers	3	0.071	0.162
	Tractors/Loaders/Backhoes	4	0.040	0.122
Grading	Dumpers/Tenders	31	0.076	1.792
	Excavators	3	0.040	0.091
	Forklifts	1	0.020	0.015
	Pressure Washers	1	0.076	0.058
	Pumps	1	0.014	0.011
	Rubber Tired Dozers	1	0.071	0.054
	Rubber Tired Loaders	1	0.071	0.054
	Tractors/Loaders/Backhoes	3	0.040	0.091
Building Construction	Cranes	1	0.057	0.043
	Forklifts	1	0.020	0.015
Paving	Cement and Mortar Mixers	2	0.040	0.061
	Pavers	1	0.063	0.048
	Paving Equipment	2	0.063	0.096
	Rollers	2	0.020	0.015
	Tractors/Loaders/Backhoes	1	0.040	0.030
Architectural Coating	Air Compressors	1	0.090	0.068

*Refer to **Appendix C4** through **C6,** Section 3.0—Construction Detail, for equipment inventory information.*

As indicated in **Table 4.5-6,** the operation of 31 dumpers/tenders simultaneously would generate approximately 1.792 ppv at 30 feet, which is the distance to the nearest adjacent structure to the south of the Project Site. The calculated vibration noise level is based on a worst-case scenario assumption that all equipment operates simultaneously at the closest point to the receptor. In reality, the 31 dumpers/tenders and other pieces of equipment would be operated at different times of the day and at locations further from the nearest receptors. Furthermore, the dumpers/tenders would utilize local streets and designated haul routes for hauling of material from the Project Site.

Construction equipment would be operated as far as reasonably feasible from sensitive receptors and so emitted vibration is directed away from these receptors. With implementation of **MM N-1**, construction activities that have the potential to generate significant vibration, would be phased to avoid simultaneous vibration sources. Thus, with the reduced number of equipment operating simultaneously, actual vibration would be below the threshold of 0.20 inches per second at offsite receptors. Construction activities are permitted to be limited to between the hours of 7:00 AM and 7:00 PM Monday through Friday and between the hours of 8:00 AM and 5:00 PM on Saturday. With implementation of the mitigation measure, and compliance with local regulatory ordinances, impacts related from vibration would be less than significant.

Threshold 4.5-3: A substantial permanent increase in ambient noise levels in the vicinity of the project?

Roadway Noise

Roadway noise levels were modeled using the Federal Highway Administration Prediction Model (FHWA-RD-88-108) to determine if operation of the Project would increase levels greater than 3 dB(A) along local roadways. This model considers roadway noise levels from local street segments that would have an increase or decrease in vehicle traffic as a result of the Project. The average daily trips (ADT) for these local roadway segments were obtained from the traffic data provided by the City of Pasadena Department of Transportation.

Existing (2017) plus Project

Table 4.5-7, Existing plus Project, illustrates the change in CNEL from existing traffic volumes and from traffic generated by the Project. The difference in traffic noise between existing conditions and existing plus Project conditions represents the increase in noise attributable to Project-related traffic. As shown in **Table 4.5-7**, Project-related traffic would not cause noise levels along the analyzed roadways to increase by more than 3.0 dB(A). The maximum noise level increase along existing roadways would be 1.1 dB(A) on Oakland Avenue, north of Walnut Street (Intersection 7). Consequently, noise impacts under the Existing plus Project scenario would be less than significant.

Table 4.5-7
Existing plus Project

Intersection	Roadway Segment	Existing	Existing plus Project	Noise Level Increase	Significant Impact?
Maple Street					
	West of Marengo Avenue	60.1	60.2	0.1	No
	East of Marengo Avenue	60.5	60.5	0.0	No
	East of Los Robles Avenue	58.3	58.3	0.0	No
	West of El Molino Avenue	58.3	58.3	0.0	No
	East of El Molino Avenue	58.2	58.2	0.0	No
Marengo Avenue					
	North of Maple Street	58.2	58.2	0.0	No
	South of Maple Street	60.0	60.0	0.0	No
	North of Corson Street	60.1	60.1	0.0	No
	South of Corson Street	61.0	61.0	0.0	No
	North of Walnut Street	59.5	59.5	0.0	No
	South of Walnut Street	60.0	60.0	0.0	No
Corson Street					
	West of Marengo Avenue	58.4	58.4	0.0	No
	East of Marengo Avenue	59.4	59.4	0.0	No
	West of Los Robles Avenue	57.2	57.2	0.0	No
	East of Los Robles Avenue	57.4	57.4	0.0	No
	West of El Molino Avenue	56.8	56.8	0.0	No
Walnut Street					
	West of Marengo Avenue	60.5	60.6	0.1	No
	East of Marengo Avenue	60.5	60.6	0.1	No
	West of Los Robles Avenue	60.0	60.1	0.1	No
	East of Los Robles Avenue	59.9	59.9	0.0	No
	West of Oakland Avenue	59.9	59.9	0.0	No
	East of Oakland Avenue	59.9	60.0	0.1	No
	West of El Molino Avenue	59.8	59.8	0.0	No
	East of El Molino Avenue	59.8	59.8	0.0	No
Los Robles Avenue					
	North of Maple Street	61.1	61.1	0.0	No
	South of Maple Street	61.4	61.4	0.0	No
	North of Corson Street	61.6	61.6	0.0	No
	South of Corson Street	62.0	62.0	0.0	No
	North of Walnut Street	62.1	62.1	0.0	No

Intersection	Roadway Segment	Existing	Existing plus Project	Noise Level Increase	Significant Impact?
	South of Walnut Street	62.2	62.2	0.0	No
Oakland Avenue					
	North of Walnut Street	45.3	46.4	1.1	No
	South of Walnut Street	46.3	46.3	0.0	No
El Molino Avenue					
	North of Maple Street	55.2	55.2	0.0	No
	South of Maple Street	56.2	56.2	0.0	No
	North of Corson Street	56.7	56.7	0.0	No
	South of Corson Street	56.8	56.8	0.0	No
	North of Walnut Street	56.3	56.3	0.0	No
	South of Walnut Street	56.0	56.1	0.1	No

*Source: Noise model results are provided in **Appendix E2**, Roadway Noise.*
Note: Roadway noise levels are modeled 75 feet from the center of the roadway.

Stationary Noise

The new residences constructed as part of the Project may include exterior mechanical equipment such as HVAC units and exhaust fans. Although the operation of this equipment would generate noise, the design of these on-site HVAC units and exhaust fans would be required to comply with the regulations under Section 9.36.090 of the Pasadena Municipal Code, which prohibits noise from air conditioning, refrigeration, heating, pumping, and filtering equipment from exceeding the ambient noise level on the premises of other occupied properties by more than 5 dB. New HVAC units and haves generate noise levels up to 76 dB at the source. Typical noise reduces approximately 8 dB 3 feet from the unit, 14 dB approximately 6 feet from the unit, on up to 32 dB approximately 45 feet from the unit.[12] Accordingly, noise levels from on-site HVAC units would generate 44 dB approximately 45 feet from the unit, consistent with measured ambient noise levels. In addition, the on-site equipment would be designed such that they would be shielded and appropriate noise muffling devices would be installed on the equipment to reduce noise levels that affect nearby uses. Nighttime noise limits would be applicable to any equipment items required to operate between the hours of 10:00 PM and 7:00 AM. The use of residential HVAC equipment would not create a substantial impact to the ambient noise levels at the residential community such that the resulting noise would exceed the acceptable noise standards for residential uses. As such, potential impacts related to stationary noise sources would be less than significant.

12 ANSI/AHRI Standard 275-2010, Application of Outdoor Unitary Equipment A-Weighted Sound Power Ratings, Table 4, Distance Factor.

Threshold 4.5-4: A substantial temporary or periodic increase in ambient noise levels in the vicinity of the project?

Noise impacts would be a function of noise generated by construction equipment, the equipment location, and their relative distance to noise sensitive receptors, and timing and duration of the noise-generating activities. To reiterate, Leq is the average A-weighted sound (i.e., adjusted to sensitivity range of a typical human ear) level measured over a given time interval. Leq can be measured over any time period, but is typically measured for 1-minute or 1-hour periods.

Construction activities would occur within close proximity to sensitive receptors. The nearest sensitive receptors subject to elevated construction noise levels include the multi-family residential uses located approximately 50 feet to the east of the Project Site.

Noise levels generated during each of the Project phases are presented in **Table 4.5-8, Typical Maximum Noise Levels for Construction Equipment.** Equipment estimates used for the analysis include demolition, site preparation, building construction, and asphalt paving noise levels representative of worst-case conditions since they assume several pieces of equipment operating simultaneously. These values are derived from Federal Highway Administration observation of noise levels at 50 feet. It is expected that noise levels would decrease by 6 dB for every doubling of distance. Thus, at 100 feet, noise levels would be 6 dB less than shown in the table.

The potential noise impact generated during construction depends on the phase of construction and the percentage of time the equipment operates over the weekday. The noisiest phase of construction would be during grading and excavation for the subterranean levels for the parking structure, and would last approximately 8 months. As shown in **Table 4.5-8**, the primary noise sources would be the operation of the dumpers/tenders. No pile driving or blasting would occur during construction of the proposed Project. Following excavation and grading, there would be less use of heavy equipment, resulting in a reduction of construction noise levels. However, construction noise estimates used for the analysis are representative of worst-case conditions because it is very unlikely that all equipment contain on site would operate simultaneously.

Table 4.5-8
Typical Maximum Noise Levels for Construction Equipment

Phase	Equipment Description	Noise Level at 100 feet (dB[A])	Quantity	Typical Duty Cycle (%)	Sum (dB[A])
Demolition	Concrete/Industrial saws	84	1	20	71
	Dumpers/Tenders	70	2	40	69
	Excavators	75	2	40	74
	Pressure washers	76	1	10	66
	Rubber-tired dozers	76	2	40	75
	Tractors/Loaders/Backhoes	72	1	40	68
Site Preparation	Rubber-tired dozers	76	3	40	77
	Tractors/Loaders/Backhoes	72	4	40	74
Grading	Dumpers/Tenders	70	31	40	81
	Excavators	75	3	40	76
	Forklifts	76	1	40	72
	Pressure washers	79	1	10	66
	Pumps	71	1	50	72
	Rubber-tired dozers	76	1	40	72
	Rubber-tired loaders	79	1	40	75
	Tractors/Loaders/Backhoes	72	3	40	73
Building Construction	Cranes	75	1	16	67
	Forklifts	76	1	40	72
Paving	Cement and mortar mixers	79	2	40	72
	Pavers	71	1	50	68
	Paving equipment	71	2	50	71
	Rollers	74	2	20	70
	Tractors/Loaders/Backhoes	72	1	40	68
Architectural Coating	Compressor (air)	72	1	40	68

Source: U.S. DOT, FHWA Construction Equipment and Noise Level Ranges.

The Project would be required to comply with the General Plan mitigation measures described previously that would further reduce construction noise. Furthermore, construction equipment noise levels for dumpers/tenders would be reduced to below the City's Noise Ordinance limit for construction equipment noise of 85 dB(A) and impacts would be less than significant.

E. CUMULATIVE IMPACTS

1. Construction

Noise impacts are localized in nature and decrease with distance. 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. The nearest related projects are the 417 N. Madison Avenue Project located approximately 0.13 miles to the northwest across the I-210 and the 277 N. El Molino Avenue Project located approximately 0.13 miles to the east of the Project Site. Accordingly, the Project does not incrementally contribute to the construction noise impacts from these cumulative projects. Furthermore, it is expected that, as with the Project, the related projects would implement the General Plan mitigation measures, which would minimize any noise-related nuisances during construction. Therefore, the combined construction noise impact of the related projects and the Project's contribution would not a cause a significant cumulative impact.

Related projects are not located close enough to the Project Site (greater than 125 feet) to result in vibration impacts from concurrent construction. Therefore, the combined vibration impact of the related projects and the Project's contribution would not cause a significant cumulative impact.

2. Operation

With regard to stationary sources, cumulative significant noise impacts may result from cumulative development. Stationary sources of noise that could be introduced in the area by cumulative projects could include mechanical equipment, (e.g., HVAC systems) loading docks, and parking lots. Since projects are required to adhere to the City's noise standards, all the stationary sources would be required to provide shielding or other noise abatement measures so as not to cause a substantial increase in ambient noise levels. Moreover, due to distance, it is unlikely that noise from multiple cumulative projects would interact to create a significant combined noise impact.

The 2015 General Plan Draft EIR examined the increase in traffic noise associated with buildout of the General Plan land uses. Traffic noise when the City of Pasadena reaches buildout would result in a noise increase of less than 5 dB.[13] As such, it is not anticipated that a significant cumulative increase in permanent ambient noise levels would occur and, therefore, the impact would be less than significant. Therefore, the Project's incremental contribution to cumulative noise impacts is not cumulatively considerable.

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13 City of Pasadena, *Pasadena General Plan Draft EIR,* Section 5.09, Noise, p. 5.9-18 (January 2015)

F. MITIGATION MEASURES

The following mitigation measures have been identified to reduce potentially significant construction-related vibration impacts to nearby sensitive receptors.

MM N-1: **Construction Management Plan**
Construction activities that have the potential to generate significant vibration, namely excavation, including haul trucks, and grading/compaction, shall be phased to avoid simultaneous occurrence of multiple vibration sources.

G. LEVEL OF SIGNIFICANCE AFTER MITIGATION

The Project would be required to implement the mitigation measures adopted as part of the 2015 General Plan update and would be required to comply with the Pasadena Noise Ordinance. In addition, the Project would implement mitigation measure MM N-1 described above. Upon implementation of these requirements, impacts would be less than significant.