3.4 NOISE

This chapter evaluates noise and vibration impacts associated with the implementation of the proposed project. Included in this chapter is a description of existing ambient noise and vibration conditions at the project site and its vicinity, as well as a summary of applicable regulations. The noise analysis in this chapter assesses noise and vibration conditions of short-term construction, demolition, traffic noise increases and long-term operational noise and vibration impacts, compatibility of on-site and surrounding land uses with on-site noise levels, and land use compatibility relative to applicable noise criteria associated with the proposed project. Mitigation measures are recommended where necessary to reduce project-related noise impacts. Noise worksheets are included in Appendix C.

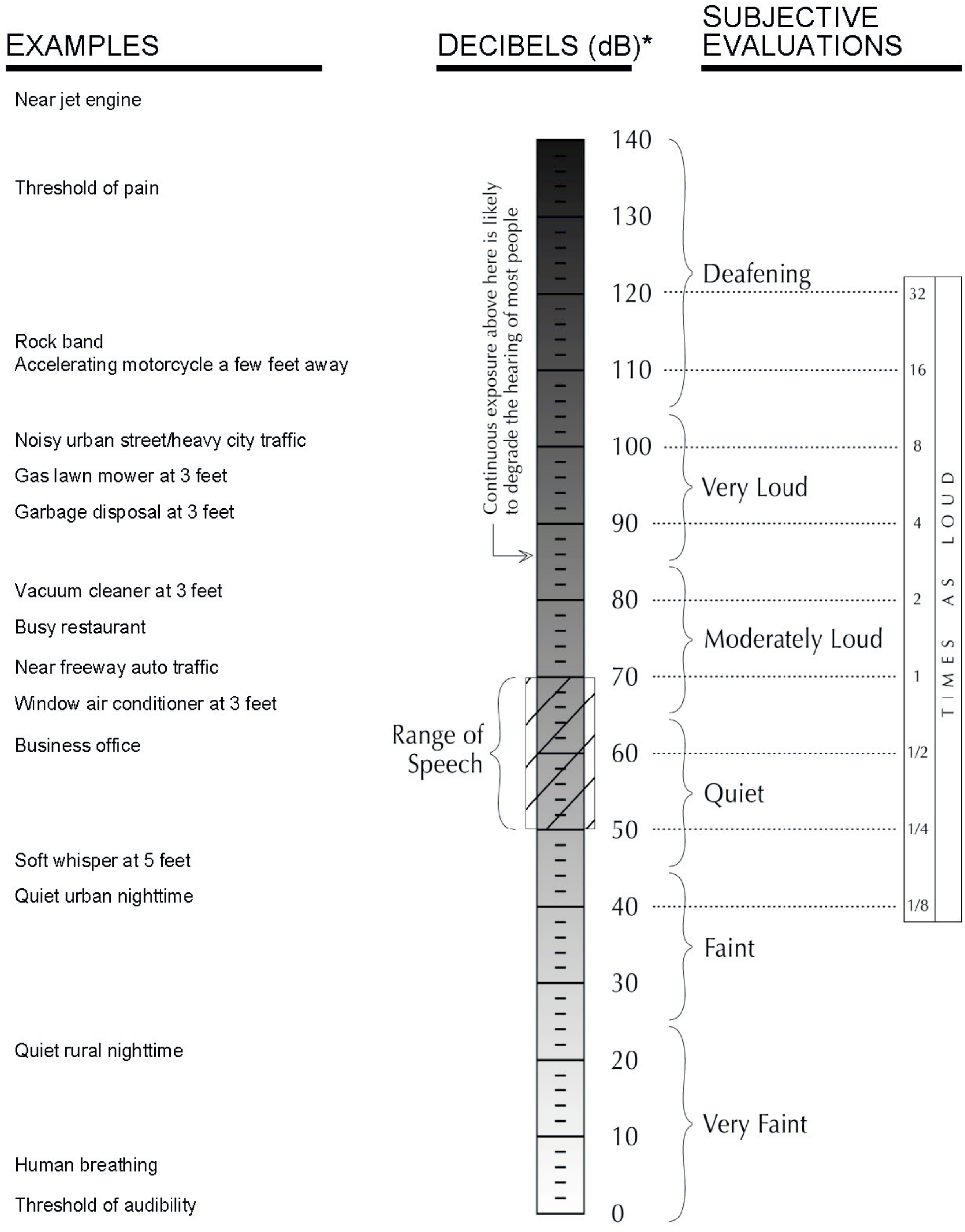
3.4.1 ENVIRONMENTAL SETTING

ACOUSTIC FUNDAMENTALS

Acoustics is the scientific study that evaluates perception, propagation, absorption, and reflection of sound waves. Sound is a mechanical form of radiant energy, transmitted by a pressure wave through a solid, liquid, or gaseous medium. Sound that is loud, disagreeable, unexpected, or unwanted is generally defined as noise; consequently, the perception of sound is subjective in nature and can vary substantially from person to person. Common environmental noise sources and noise levels are presented in Figure 3.4-1.

A sound wave is initiated in a medium by a vibrating object (e.g., vocal chords, the string of a guitar, or the diaphragm of a radio speaker). The wave is composed of minute variations in pressure, oscillating above and below the ambient atmospheric pressure. The number of pressure variations occurring per second is referred to as the frequency of the sound wave and is expressed in hertz (Hz), which is equivalent to one complete cycle per second.

Directly measuring sound pressure fluctuations would require the use of a very large and cumbersome range of numbers. To avoid this and have a more usable numbering system, the decibel scale was introduced. A sound level expressed in decibels is the logarithmic ratio of two like pressure quantities, with one pressure quantity being a reference sound pressure. For sound pressure in air, the standard reference quantity is generally considered to be 20 micropascals (μPa), which directly corresponds to the threshold of human hearing. The use of the decibel is a convenient way to handle the millionfold range of sound pressures to which the human ear is sensitive. A decibel is logarithmic; as such, it does not follow normal algebraic methods and cannot be directly added. For example, a 65-decibel (dB) source of sound, such as a truck, when joined by another 65-dB source results in a sound amplitude of 68 dB, not 130 dB (i.e., doubling the source strength increases the sound pressure by 3 dB). A sound level increase of 10 dB corresponds to 10 times the acoustical energy, and an increase of 20 dB equates to a hundredfold increase in acoustical energy.



* dB are "average" values as measured on the A-scale of a sound-level meter.
From Concepts in Architectural Acoustics: M. David Egan, McGraw Hill, 1972 and U.S. Department of Housing and Urban Development, Office of Community Planning and Development "The Noise Guidebook."

Figure 3.4-1
Typical Noise Levels

The loudness of sound preserved by the human ear depends primarily on the overall sound pressure level and frequency content of the sound source. The human ear is not equally sensitive to loudness at all frequencies in the audible spectrum.

To better relate overall sound levels and loudness to human perception frequency-dependent weighting networks were developed. The standard weighting networks are identified as A through E. There is a strong correlation between the way humans perceive sound and A-weighted sound levels (dBA). For this reason the dBA can be used to predict community response to environmental and transportation noise. Sound levels expressed as dB in this chapter are A-weighted sound levels, unless noted otherwise.

Noise can be generated by a number of sources, including mobile sources (transportation) such as automobiles, trucks, and airplanes; and stationary sources (nontransportation) such as construction sites, machinery, and commercial and industrial operations. As acoustic energy spreads through the atmosphere from the source to the receptor, noise levels attenuate (reduce) depending on ground absorption characteristics, atmospheric conditions, and the presence of physical barriers (walls, building façades, berms). Noise generated from mobile sources generally attenuates at a rate of 4.5 dB per doubling of distance (dB/DD). Stationary noise sources spread with more spherical dispersion patterns, which attenuate at a rate of 6 dB to 7.5 dB/DD. Table 3.4-1 shows the relationship of various noise levels to commonly experienced noise events.

TABLE 3.4-1
TYPICAL NOISE LEVELS

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	— 110 —	Rock band
Jet fly-over at 1000 feet		
	— 100 —	
Gas lawn mower at 3 feet		
	— 90 —	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	— 80 —	Garbage receptor at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	**— 70 —**	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	**— 60 —**	
		Large business office
Quiet urban daytime	**— 50 —**	Dishwasher next room
Quiet urban nighttime	**— 40 —**	Theater, large conference room (background)
Quiet suburban nighttime		
	— 30 —	Library
Quiet rural nighttime		Bedroom at night, concert
	— 20 —	
		Broadcast/recording studio
	— 10 —	
Lowest threshold of human hearing	**— 0 —**	Lowest threshold of human hearing

Source: California Department of Transportation 2009.

Atmospheric conditions such as wind speed, turbulence, temperature gradients, and humidity may additionally alter the propagation of noise and affect levels at a receptor. Furthermore, the presence of a large object (barrier) between the source and the receptor can provide significant attenuation of noise levels at the receptor. The amount of noise level reduction or "shielding" provided by a barrier primarily depends on the size of the barrier, the location of the barrier in relation to the source and receptors, and the frequency spectra of the noise. Natural barriers such as berms or hills, and human-made features such as buildings and walls may be used as noise barriers.

Noise Descriptors

The intensity of environmental noise changes over time. This chapter uses several different descriptors of time-averaged noise levels. The selection of a proper noise descriptor for a specific source depends on the spatial and temporal distribution, duration, and fluctuation of both the noise source and the environment. The noise descriptors most often used to describe environmental noise are defined below:

L_{eq} (Equivalent Noise Level): The energy mean (average) noise level, the steady state sound level in a specified period of time that contains the same acoustical energy as a varying sound level over the same time period.

L_{dn} (Day-Night Noise Level): The 24-hour L_{eq} with a 10 dB "penalty" applied during nighttime noise-sensitive hours, which are 10:00 p.m. through 7:00 a.m. The L_{dn} attempts to account for the fact that noise during this specific period of time is a potential source of disturbance with respect to normal sleeping hours.

CNEL (Community Noise Equivalent Level): The CNEL is similar to the L_{dn} described above, but with an additional 5-dB "penalty" for the noise-sensitive hours between 7:00 p.m. to 10:00 p.m., which are typically reserved for relaxation, conversation, reading, and television. If using the same 24-hour noise data, the CNEL is typically 0.5 dB higher than the L_{dn}.

Effects of Noise on Humans

Excessive and chronic exposure to elevated noise levels can result in auditory and nonauditory effects in humans. Auditory effects of noise on people are those relating to temporary or permanent noise-induced hearing loss. Nonauditory effects of exposure to elevated noise levels are those relating to behavioral and physiological effects. The nonauditory behavioral effects of noise on humans are primarily associated with the subjective effects of annoyance, nuisance, and dissatisfaction, which lead to interference with activities such as communications, sleep, and learning. The nonauditory physiological health effects of noise on humans have been the subject of considerable research efforts attempting to discover correlations between exposure to elevated noise levels and health problems, such as hypertension and cardiovascular disease. The mass of research infers that noise-related health issues are predominantly the result of behavioral stressors (physiological) and not a direct noise-induced response. The degree to which noise contributes to nonauditory health effects remains a subject of considerable research, with no definitive conclusions.

The degree to which noise results in annoyance and interference is highly subjective and may be influenced by a number of nonacoustic factors. The number and effect of these nonacoustic environmental and physical factors vary depending on individual characteristics of the noise environment, including sensitivity, level of activity, location, time of day, and length of exposure. One key aspect in the prediction of human response to new noise environments is the individual level of adaptation to an existing noise environment. The greater change in noise levels that are attributed to a new noise source, relative to the environment an individual has become accustomed to, the less tolerable the individual will be to the new noise source. With regard to human perception of increases in sound levels expressed in dB, a change of 1 dB is generally not perceivable, excluding controlled conditions and pure tones. Outside of controlled laboratory conditions, the average human ear barely perceives a change of 3 dB. A change of 5 dB generally fosters a noticeable change in human response, and an increase of 10 dB is subjectively heard as a doubling of loudness.

VIBRATION CHARACTERISTICS AND EFFECTS

Vibration is the periodic oscillation of a medium or object with respect to a given reference point. Sources of vibration include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, landslides) and those introduced by human activity (e.g., explosions, machinery, traffic, trains, construction equipment). Vibration sources may be continuous, such as operating factory machinery, or transient in nature, such as explosions. Vibration levels can be depicted in terms of amplitude and frequency, relative to displacement, velocity, and acceleration.

Vibration amplitudes are commonly expressed in peak particle velocity (PPV) or root mean square (RMS) vibration velocity. PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal. PPV is typically used in the monitoring of transient and impact vibration and has been found to correlate well to the stresses experienced by buildings.[1,2] PPV and RMS vibration velocity are normally described in inches per second (in/sec).

Although PPV is appropriate for evaluating the potential for building damage, it is not always suitable for evaluating human response. The response of the human body to vibration relates well to average vibration amplitude; therefore, vibration impacts on humans are evaluated in terms of RMS vibration velocity. Similar to airborne sound, vibration velocity can be expressed in decibel notation as vibration decibels (VdB). The logarithmic nature of the decibel serves to compress the broad range of numbers required to describe vibration.

Typical outdoor sources of perceptible groundborne vibration include construction equipment, steel-wheeled trains, and traffic on rough roads. Although the effects of vibration may be imperceptible at low levels, effects may result in detectable vibrations and slight damage to nearby structures at moderate and high levels, respectively. At the highest levels of vibration, damage to structures is primarily architectural

1 Federal Transit Administration. *Transit Noise and Vibration Impact Assessment*. Washington, D.C. May 2006.

2 California Department of Transportation (Caltrans). *Transportation and Construction Induced Vibration Guidance Manual*. Sacramento, CA. June 2004.

(e.g., loosening and cracking of plaster or stucco coatings) and rarely damages structural components. The range of vibration important to the proposed project occurs from approximately 50 VdB, which is the typical background vibration-velocity level, to 100 VdB, which is the general threshold where vibrations cause minor damage in fragile buildings.[3]

EXISTING ENVIRONMENTAL SETTING

The existing noise environment within the project area is typical of an urban community. The existing noise environment is primarily influenced by traffic noise emanating from Atlantic Avenue, Artesia Boulevard, Myrtle Avenue, and SR 91. Outdoor noise (e.g., people talking, dogs barking, etc.) from school activities and Houghton Park, as well as noise from commercial aircraft over-flights contribute to the existing noise environment to a lesser extent.

Existing Noise Environment

An ambient noise survey was conducted on March 7, 2013 and March 12, 2013, to document the existing noise environment at noise-sensitive receptors within the immediate project area and noise sources emanating from school property. The measurement of noise levels were taken in accordance with American National Standards Institute standards at using a Larson Davis Laboratories Model 824, Type 1 precision integrating sound level meter. Noise from vehicles travelling on adjacent major roadways (i.e., SR 91, Atlantic Avenue, and Artesia Boulevard) is the most prominent noise in the vicinity of the project. Other community noise sources include incidental noise from nearby residences and commercial uses (e.g., landscaping activity and domestic animals). A summary of the ambient noise survey results are provided in Table 3.4-2.

As shown in Table 3.4-2, ambient noise levels near the project site range from 56 to 63 dBA L_{eq} (over 15-minute measurement periods). Heating, ventilation and air conditioning (HVAC) equipment noise was measured at 70 dBA at a distance of 6 feet. Maximum noise levels reach up to 76 dBA as a result of students screaming, vehicle pass-bys, and aircraft over-flights.

Existing Vibration Environment

The existing vibration environment within and surrounding the project site is dominated by traffic from nearby roadways. Heavy-duty trucks can generate groundborne vibration that varies depending on vehicle type, weight, and pavement conditions. Field observations indicated that heavy-duty truck travel is minimal along Atlantic Avenue, Artesia Boulevard, and Myrtle Avenue. Vibration levels from adjacent roadways are not perceptible at the project site.

[3] Federal Transit Administration. *Transit Noise and Vibration Impact Assessment*. Washington, D.C. May 2006.

TABLE 3.4-2
EXISTING AMBIENT NOISE LEVELS

Noise Monitoring Locations	Noise Source (s)	Sound Level (dBA, L_{eq})	Sound Level dBA (L_{max})
Noise Monitoring Location 1: Southern boundary of the existing project site	Traffic on Atlantic Ave., SR 91 and I-710, playground noise, bird vocalizations, basketball, and dogs barking in park. Event causing L_{max}: student screaming	56	69
Noise Monitoring Location 2: East side of Myrtle Ave. in front of single-family residence	Traffic on Myrtle Ave., bird vocalizations, school activity, and people talking on sidewalk. Event causing L_{max}: vehicle	56	71
Noise Monitoring Location 3: Northern boundary of the existing project site	HVAC equipment (2), bird vocalizations, and airplane. Event causing L_{max}: airplane	58	70
Noise Monitoring Location 4: West side of Atlantic Ave. in front of Paradise Garden apartment homes	Traffic on Atlantic Ave., helicopter, traffic on SR 91 and I-710, airplane. Event causing L_{max}: helicopter	63	75
Noise Monitoring Location 5: Approximately 6 feet from HVAC at northeast corner of project site	HVAC equipment (6 feet), school activity, bird vocalizations, traffic, and emergency siren (all drowned out by HVAC equipment). Event causing L_{max}: vehicle	70	76
Noise Monitoring Location 6: Northern portion of project site among existing portable classrooms	Bird vocalizations, HVAC equipment, and students talking. Event causing L_{max}: student screaming	57	74

Source: AECOM 2013.

Sensitive Receptors

Noise-sensitive land uses include residential uses or locations where the presence of unwanted sound could adversely affect the use of a property. Residences, schools, hospitals, hotels, libraries, and recreation areas are considered to be noise-sensitive and may warrant unique measures for protection from intruding noise.

Vibration-sensitive land uses include fragile/historic buildings, commercial buildings where low ambient vibration is essential for operations within the buildings (e.g., computer chip manufacturers and hospitals), residential uses, and hotels.

The noise and vibration sensitive receptors that are located in the immediate vicinity of the project site include the following:

- Jordan High School (project site)

- Occupied single-family residential properties adjacent to the northern boundary of the project site;
- Occupied single-family residential properties on the east side of Myrtle Avenue, located approximately 60 feet east of the project site; and
- Occupied multi-family residential properties (two- and three-story apartment buildings) located on the west side of Atlantic Avenue, approximately 150 feet west of the project site.

These sensitive receptors represent the nearest land uses with the potential to be impacted by the proposed project. Additional single- and multi-family residences are located in the surrounding community and may be impacted to a lesser extent than the sensitive receptors listed above.

3.4.2 REGULATORY SETTING

Various private and public agencies have established noise guidelines and standards to protect citizens from potential hearing damage and various other adverse physiological and social effects associated with noise. The federal, state, and local regulations discussed below are applicable to the proposed project regarding noise and vibration standards.

FEDERAL

The U.S. Environmental Protection Agency (EPA), Office of Noise Abatement and Control was originally established to coordinate federal noise control activities. After inception, EPA's Office of Noise Abatement and Control issued the federal Noise Control Act of 1972, establishing programs and guidelines to identify and address the effects of noise on public health and welfare, and the environment. In 1981, the Administrators of EPA determined that subjective issues such as noise would be better addressed at lower levels of government. Consequently, in 1982 responsibilities for regulating noise control policies were transferred to state and local governments. However, noise control guidelines and regulations contained in the rulings by EPA in prior years remain upheld by designated federal agencies, allowing more individualized control for specific issues by designated federal, state, and local government agencies.

The Acoustical Society of America develops, maintains, and revises its American National Standards on Acoustics in accordance with procedure approved by the American National Standards Institute. The use of American National Standards is considered completely voluntary and does not apply to noise generated within the classroom.[4]

To address the human response to groundborne vibration, the Federal Transit Administration (FTA) has guidelines for maximum-acceptable vibration criteria for different types of land uses. These guidelines recommend 65 VdB referenced to 1μ in/sec and based on the RMS velocity amplitude for land uses

[4] American National Standard Institute. Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, ANSI S12.60-2002. Melville, NY. June 2002.

where low ambient vibration is essential for interior operations (e.g., hospitals, high-tech manufacturing, laboratory facilities); 80 VdB for residential uses and buildings where people normally sleep; and 83 VdB for institutional land uses with primarily daytime operations (e.g., schools, churches, clinics, offices).[5]

STATE

The State of California has adopted noise standards in areas of regulation not preempted by the federal government. State standards regulate noise levels of motor vehicles, sound transmission through buildings, occupational noise control, and noise insulation.

Title 5 of the California Code of Regulations

The California Department of Education siting requirements for school projects establishes noise standards in Title 5 of the California Code of Regulations Division 1, Chapter 13, Subchapter 1, "School Facilities Construction." The following articles are applicable to the proposed project:

The *State of California General Plan Guidelines 2003,* published by the California Governor's Office of Planning and Research, provides guidance for the acceptability of projects within areas of specific noise exposure. Table 3.4-3 presents acceptable and unacceptable community noise exposure limits for various land use categories.[6] The guidelines also present adjustment factors that may be used to arrive at noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution.

Title 24 of the California Code of Regulations

Title 24 of the California Code of Regulations establishes standards governing interior noise levels that apply to all new multi-family residential units in California. These standards require that acoustical studies be performed before construction begins at locations where the existing L_{dn} exceeds 60 dBA. Such acoustical studies are required to establish mitigation measures that limit maximum L_{dn} levels to 45 dBA in any habitable room. Although no generally applicable interior noise standards are pertinent to all uses, many communities in California have adopted an L_{dn} of 45 dBA as an upper limit on interior noise in all residential units.

5 Federal Transit Administration. *Transit Noise and Vibration Impact Assessment*. Washington, DC. Prepared by: Harris Miller Miller & Hanson Inc. Burlington, MA. May 2006.

6 Governor's Office of Planning and Research. *General Plan Guidelines*, Pages 250–251. Sacramento, CA. 2003.

TABLE 3.4-3
LAND USE NOISE COMPATIBILITY GUIDELINES

Land Use Category	Community Noise Exposure (L_{dn} or CNEL, dB)			
	Normally Acceptable[1]	Conditionally Acceptable[2]	Normally Unacceptable[3]	Clearly Unacceptable[4]
Residential-Low Density Single Family, Duplex, Mobile Home	<60	55–70	70–75	75+
Residential-Multiple Family	<65	60–70	70–75	75+
Transient Lodging, Motel, Hotel	<65	60–70	70–80	80+
School, Library, Church, Hospital, Nursing Home	<70	60–70	70–80	80+
Auditorium, Concert Hall, Amphitheater		<70	65+	
Sports Arenas, Outdoor Spectator Sports		<75	70+	
Playground, Neighborhood Park	<70		67.5–75	72.5+
Golf Courses, Stable, Water Recreation, Cemetery	<75		70–80	80+
Office Building, Business Commercial and Professional	<70	67.5–77.5	75+	
Industrial, Manufacturing, Utilities, Agriculture	<75	70–80	75+	

[1] Specified land use is satisfactory, based on the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.
[2] New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features are included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice.
[3] 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 insulation features included in the design. Outdoor areas must be shielded.
[4] New construction or development should generally not be undertaken.
Source: California Governor's Office of Planning and Research 2003.

LOCAL

City of Long Beach General Plan

The City of Long Beach General Plan Noise Element provides goals and for noise in several different categories.[7] These goals were created to express a general vision for the City. The goals pertinent to the proposed project include:

- Reduce the level of noise exposure to the population caused by demolition and construction activities;
- Reduce the level of outdoor noise exposure to which the population is subjected; and
- Reduce the level of incoming and outgoing noise into and from residential dwellings within the City.

[7] City of Long Beach. Noise Element of the General Plan. 1975.

The City of Long Beach General Plan Noise Element has also established construction noise standards of 70-dBA L_{eq} for projects "away from main roads" and 75 dBA L_{eq} for projects "near main roads". For the purposes of the noise analysis presented in this chapter, Atlantic Avenue is considered a main road and Myrtle Avenue is considered a non-main road.

City of Long Beach Municipal Code

The City of Long Beach Municipal Code Section 8.80.202 allows construction activities to occur between the hours of 7:00 a.m. and 7:00 p.m. on weekdays and federal holidays. Construction activities are allowed to occur on Saturdays between the hours of 9:00 a.m. and 6:00 p.m. Construction activities are prohibited from occurring on Sundays unless authorized by a building official or by permit issued by the noise control officer.[8]

Section 8.80.150 of the City of Long Beach Municipal Code sets forth exterior noise standards for enforcement of noise that projects from one property to another, and unless otherwise specifically indicated, shall apply to all residential property within a designated receiving land use district. The project site is within District 1. Noise level limits for this district are shown in Table 3.4-4.

TABLE 3.4-4
CITY OF LONG BEACH DISTRICT 1 EXTERIOR NOISE LEVEL LIMITS

Noise Level Limits: 7:00 a.m. to 10:00 p.m.				
For 30 minutes of any hour	For 15 minutes of any hour	For 5 minutes of any hour	For 1 minutes of any hour	For any period of time
50	55	60	65	70
Noise Level Limits: 10:00 p.m. to 7:00 a.m.				
For 30 minutes of any hour	For 15 minutes of any hour	For 5 minutes of any hour	For 1 minutes of any hour	For any period of time
45	50	55	60	65

The City of Long Beach Municipal Code also states that "if the measured ambient level exceeds that permissible within any of the first four noise limit categories presented in Table 3.4-5, the allowable noise exposure standard shall be increased in five-decibel increments in each category as appropriate to encompass or reflect the ambient noise level. In the event the ambient noise level exceeds the fifth noise limit category presented in Table 3.4-5, the maximum allowable noise level under said category shall be increased to reflect the maximum ambient noise level."

8 City of Long Beach Municipal Code, Section 8.80.202 Construction activity—Noise regulations.

TABLE 3.4-5
CITY OF LONG BEACH DISTRICT 1 EXTERIOR NOISE LEVEL LIMITS
(ADJUSTED FOR AMBIENT NOISE LEVELS)

Noise Level Limits: 7:00 a.m. to 10:00 p.m.				
For 30 minutes of any hour	For 15 minutes of any hour	For 5 minutes of any hour	For 1 minute of any hour	For any period of time
50	60	65	70	80
Noise Level Limits: 10:00 p.m. to 7:00 a.m.				
For 30 minutes of any hour	For 15 minutes of any hour	For 5 minutes of any hour	For 1 minute of any hour	For any period of time
45	50	55	60	65

Section 8.80.170 of the City of Long Beach Municipal Code sets forth interior noise level limits for residences, schools and hospitals. These limits are presented in Table 3.4-6.

TABLE 3.4-6
CITY OF LONG BEACH NOISE ORDINANCE INTERIOR NOISE LEVEL LIMITS

Receiving Land Use Designation	Type of Land Use	Time Interval	Allowable Interior Noise Level (dBA)
All	Residential	10:00 p.m. to 7:00 a.m. 7:00 a.m. to 10:00 p.m.	35 45
All	School	7:00 a.m. to 10:00 p.m. (While school is in session)	45
All	Hospital, designated quiet zones and noise sensitive zones	Anytime	40

Source: Long Beach 1977.

3.4.3 ENVIRONMENTAL IMPACTS

THRESHOLDS OF SIGNIFICANCE

As part of the Initial Study (see Appendix A), it was determined that the proposed project would not result in a substantial permanent increase in ambient noise levels or airport-related noise impacts. Accordingly, these issues are not further analyzed in the EIR.

Pursuant to the CEQA Guidelines, the proposed project would have a significant effect on noise if it would:

- Result in exposure of persons to or generation of noise levels in excess of applicable standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

- Result in exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels; and/or

- Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

Generally, a project may have a significant effect on the environment if it would substantially increase the ambient noise levels for adjoining areas or expose people to severe noise levels. In practice, more specific professional standards have been implemented. These standards state that a noise impact may be considered significant if it would generate noise that would conflict with local planning criteria or ordinances or substantially increase noise levels at noise-sensitive land uses.

For the proposed project, the significance of anticipated noise effects on the public is based on a comparison between predicted noise levels and noise criteria defined by the City of Long Beach. For this project, noise impacts are considered significant if existing or proposed noise-sensitive land uses would be exposed to noise levels in excess of the City of Long Beach Municipal Code standards as described Subsection 3.4.2 above.

CEQA states that the potential for any excessive groundborne noise and vibration levels must be analyzed; however, it does not define the term “excessive” vibration. Caltrans guidelines recommend a standard of 0.2 in/sec PPV not be exceeded for the protection of normal residential buildings and 0.08 in/sec PPV not be exceeded for the protection of old or historically significant structures.[9] With respect to human response within residential uses (i.e., annoyance), the FTA recommends a maximum acceptable vibration standard of 78 VdB for school uses.[10] The FTA and Caltrans adopted vibration standards for buildings are used to evaluate potential impacts related to project construction. Based on the FTA and Caltrans criteria, construction impacts relative to groundborne vibration would be considered significant if the following were to occur:

- Project construction activities would cause a PPV groundborne vibration level to exceed 0.5 inches per second at any building that is constructed with reinforced-concrete, steel, or timber;
- Project construction activities would cause a PPV groundborne vibration level to exceed 0.3 inches per second at any engineered concrete and masonry buildings;
- Project construction activities would cause a PPV groundborne vibration level to exceed 0.2 inches per second at any non-engineered timber and masonry buildings; or
- Project construction activities would cause a PPV ground-borne vibration level to exceed 0.12 inches per second at any historical building or building that is extremely susceptible to vibration damage.

---

[9] California Department of Transportation. *Transportation and Construction Induced Vibration Guidance Manual.* Sacramento, CA. June 2004.

[10] Federal Transit Administration. *Transit Noise and Vibration Impact Assessment*. Washington, DC. May 2006.

In addition to the criteria discussed above, the degradation of the existing ambient noise environment must be considered. In community noise assessments, it is "generally not significant" if no noise-sensitive sites are located within the plan area, or if increases in community noise levels associated with implementation of the project would not exceed +3 dB at noise-sensitive locations in the project vicinity.[11]

ANALYSIS METHODOLOGY

Data included in Chapter 2.0, Project Description of this EIR, and obtained during on-site noise monitoring have been used to determine potential locations of noise-sensitive receptors and potential noise-generating land uses on the project site. Noise-sensitive land uses and major noise sources near the project site have been identified based on existing documentation (e.g., equipment noise levels and attenuation rates) and site reconnaissance data.

To assess the potential short-term noise impacts from construction, sensitive receptors and their relative exposure (considering intervening building façades and distance) have been identified. Construction noise generated by the proposed project is predicted using the Federal Transit Noise and Vibration Impact Assessment methodology for construction noise prediction.[12] Reference emission noise levels and usage factors are based on the Federal Highway Administration Roadway Construction Noise Model.[13] Noise levels of specific construction equipment operated and resultant noise levels at sensitive receptor locations have been calculated.

Predicted noise levels have been compared with applicable standards for determination of significance. Feasible mitigation measures have been developed to reduce significant and potentially significant noise impacts.

IMPACT ANALYSIS

NOISE-1 *The proposed project would expose persons to or generate noise levels in excess of applicable standards established in the local general plan or noise ordinance, or applicable standard of other agencies. This impact would be significant and mitigation measures are required. However, even with the implementation of mitigation measures, the construction noise levels may continue to exceed applicable thresholds. A significant and unavoidable impact would occur.*

11 California Department of Transportation. *Technical Noise Supplement*. Sacramento, CA. October 1998.

12 Federal Transit Administration. *Transit Noise and Vibration Impact Assessment*. Washington, DC. Prepared by: Harris Miller Miller & Hanson Inc.. Burlington, MA. May 2006.

13 Federal Highway Administration. *Roadway Construction Noise Model Version 1.0 (FHWA RCNM V. 1.0).* Washington D.C. January 2006.

Construction

Project construction noise levels in the vicinity of the project site would fluctuate depending on the particular type, number, and duration of usage for the various types of equipment required to construct the proposed project. The effects of construction noise largely depends on the type of construction activities occurring on any given day, noise levels generated by those activities, the distance from the construction activities to noise-sensitive receptors, and the existing ambient noise environment in the vicinity of the noise-sensitive receptors. The construction of the proposed project would occur in approximately six phases. Construction of Phases 1, 2, and 4 would begin in January 2014 and end in the fall of 2020. Phases 3, 5, and 6 would be constructed over the next several years starting in approximately 2020 and subject to the availability of funding. Each phase of construction may require different equipment, which have varied noise characteristics. These phases alter the characteristics of the noise environment generated on the project site and in the surrounding community for the duration of the construction process.

The site preparation phase for construction would typically generate the loudest sustained average noise levels. Site preparation involves demolition, grading, compacting, and excavating. Equipment and vehicles that may be used during site preparation would include backhoes, bulldozers, loaders, excavation equipment (e.g., graders and scrapers), and compaction equipment.

As mentioned in Chapter 2.0, Project Description of this EIR, during the construction of phases 1B, 1C, and 2B of the proposed project, stone column (rammed aggregate pier) installation would be required on the project site prior to construction of foundations for the new buildings proposed for the northern and western portion of the project site. The geotechnical study prepared for the proposed project recommends that each stone column be 3 feet in diameter at no more than 9 feet apart (center to center) and placed in a rectangular pattern with a depth of at 35 feet below ground surface.[14] The stone columns would be installed beneath all the building footprints. The geotechnical study also recommend that at least one stone column be installed in the area beneath each building column, with the center of the stone column within one foot of the building column centers. A continuous row of stone columns at the perimeter of each new building is also recommended with at least two rows of stone columns installed outside the building perimeters extending at least 15 feet from the building footprint. Where space is limited, the stone columns may be installed nearer to the new buildings to fit within the available space. The installation of a stone column may reach noise levels of up to 90 dBA L_{eq} at 50 feet.[15] Up to two stone columns would be installed simultaneously. Compaction grouting, in lieu of stone columns, would be required in localized areas where stone columns may have the potential to cause excessive disturbance, such as adjacent to the Auditorium building, because the compaction grouting process is less intense than the installation of stone columns.

---

[14] Koury Geotechnical Services, Inc. *Phase 1, North Campus Geotechnical and Geological Engineering Investigation Report*. April 15, 2013.

[15] Geopier Foundation Company, Inc. Technical Bulletin No. 9, Vibration and Noise Levels. 2006.

The construction of buildings and mechanical systems may require the use of a crane, which would also generate substantial noise levels. Table 3.4-7 depicts the noise levels generated by various types of construction equipment, which may be used during the construction of the proposed project.

TABLE 3.4-7
CONSTRUCTION EQUIPMENT NOISE LEVELS

Equipment Type[1]	Typical Noise Level (dB) at 50 Feet
Air Compressor	78
Asphalt Paver	77
Backhoe	78
Compactor	83
Concrete Breaker	82
Concrete Pump	81
Concrete Saw	90
Crane, Mobile	81
Dozer	82
Front-End Loader	79
Generator	81
Grader	85
Hoe Ram Extension	90
Jack Hammer	89
Pneumatic Tools	85
Scraper	84
Trucks	74 - 81
Water Pump	81

[1]All equipment fitted with properly maintained and operational noise control device, per manufacturer specifications.
Source: Bolt, Beranek and Newman 1981, FTA 2006:12-6; data compiled by AECOM in 2008.

Construction equipment can be either mobile or stationary. Mobile equipment (e.g., loaders, graders, dozers) are moved around a construction site performing tasks in a recurring manner. Stationary equipment (e.g., air compressor, generator, concrete saw) are operated in a given location for an extended period of time to perform continuous or periodic operations. The characteristics of heavy construction equipment are typified by short periods of full power operation followed by extended periods of operation at lower power, idling, or powered-off conditions.

As indicated in Table 3.4-4, noise levels associated with typical construction activities would generate instantaneous noise levels ranging from 74 dB to 90 dB at a distance of 50 feet. Continuous combined noise levels generated by the concurrent operation of the loudest pieces of equipment would result in noise levels of 93 dB at 50 feet. Accounting for the usage factor of individual pieces of equipment (operation of a hoe ram and a concrete saw for 20 percent of the hour), construction activities on the project site are expected to result in hourly average noise levels of 86 dB L_{eq}, at a distance of 50 feet. Maximum noise levels generated by construction activities are not predicted to exceed 90 dB L_{eq} at 50 feet. The installation of stone columns in phases 1B, 1C, and 2B would generally occur two at a time near the northern boundary of the project site, reaching noise levels of up to 93 dBA L_{eq} at 50 feet.

The nearest off-site noise-sensitive receptors in the project vicinity are the single-family residential properties that abut the northern boundary of the project site. The worst case noise levels at adjacent residential properties north of the project site may reach up to 104 dBA L_{eq}, assuming equipment is operating within ten feet of the property line. This noise level would naturally drop off by 6 dB with each doubling of distance from the construction equipment. For example, the worst case project construction noise levels at sensitive receptors would be 98 dBA at 20 feet from the equipment, 92 dBA at 40 feet from the equipment, etc. Intervening structures would provide additional noise attenuation.

Other off-site noise-sensitive receptors in the project vicinity include single-family residential properties located approximately 60 feet east of the project site, on the east side of Myrtle Avenue. Noise associated with the demolition, construction, and renovation activities occurring near the eastern boundary of the project site would reach up to 88 dBA L_{eq} at the residential properties located on the east side of Myrtle Avenue. In addition, multi-family residential properties are located approximately 150 feet west of the project site, on the west side of Atlantic Avenue. Noise associated with the project construction activities near the western boundary of the project site would generate noise levels of up to 80 dBA L_{eq} at the nearest multiple-family residential property on the west side of Atlantic Avenue.

On-site noise-sensitive receptors would include occupied classroom buildings and interim housing (portable classrooms) operating on the project site during the construction of the proposed project. The previously mentioned construction equipment would be utilized in the immediate vicinity of these existing on-site noise-sensitive receptors. Exterior noise levels may reach up to 104 dBA L_{eq} at these facilities.

The proposed project would be required to comply with the City of Long Beach Municipal Code, Section 8.80.202, which allows construction activities only between 7:00 a.m. and 7:00 p.m. on weekdays and between 9:00 a.m. and 6:00 p.m. on Saturdays. Construction activities are prohibited from occurring on Sundays. Although project construction would adhere to the City's permitted construction hours, the City's General Plan Noise Element criteria of 70 and 75 dBA would be exceeded, which would not be consistent with the goals of the General Plan. The construction noise impact could be significant. As such, the implementation of mitigation measures NOISE-A through NOISE-F is necessary to reduce these construction noise impacts. However, even with the implementation of mitigation measures, the construction noise levels may continue to exceed applicable thresholds. A significant and unavoidable temporary impact would occur during construction.

Operations

The City of Long Beach is a built out, urban area that is surrounded by other urban areas and cities. Noise levels due to traffic traveling on roadways adjacent to the project site are not expected to increase substantially with the proposed project because the student enrollment and capacity would not increase. Therefore, existing noise levels taken along these road segments are considered to represent built out, urban noise levels. In addition, other roadways in the project area influence noise levels at the project site, including Artesia Boulevard, SR 91, and I-710. Ambient noise levels range from 63 dBA L_{eq} along Atlantic Avenue and the western boundary of the project site, to 56 dBA L_{eq} along the southern boundary.

These noise levels would not exceed what is considered to be a conditionally acceptable outdoor noise level for schools. The new buildings proposed with the project would be required to meet the City of Long Beach interior noise standard of 45 dBA L_{dn} for schools. A majority of the new buildings would be constructed within the central and northern portions of the project site. Due to their distance from Atlantic Avenue and to the location of intervening buildings, proposed active outdoor use areas would not be as affected by traffic noise associated with Atlantic Avenue.

Forty-nine new and relocated portable classrooms (interim housing) would be temporarily located on the existing athletic fields that are adjacent to Myrtle Avenue. The interim housing would be occupied with students from approximately fall of 2014 through fall of 2020, and would be demolished or removed following the completion of Phase 2 construction activities. This operation of interim housing at this location would result in a change in the type of noise that the single-family residences located east of the project site currently experience. Instead of noise associated with physical education classes, baseball games and tennis court activities, the single-family residences would be exposed to HVAC equipment, school bells, and student activity and conversation noise between classes.

A representative noise measurement was taken of an existing HVAC equipment unit located on the project site. The operation of the HVAC equipment reached a noise level of 70 dBA L_{eq} at 6 feet from the source. School bells and student conversation vary from 56 dBA L_{eq} to 73 dBA L_{eq} with maximum noise levels reaching 76 dBA, and would occur intermittently throughout the day at this location. Breaks between classes typically range from 5 to 10 minutes and occur five or six times a day. The adjusted maximum noise level allowed at affected residential properties is 80 dBA. The existing environment is urban with multiple emergency vehicle pass-bys that cause noise levels of up to 76 dBA at nearby residential properties. Noise associated with HVAC equipment, student conversation, and school bells would not exceed City standards at the nearest residential properties. No other operational components of the proposed project would result in a noticeable increase in ambient noise levels. Further, the replacement of several existing campus buildings with new buildings and newer HVAC equipment is likely to reduce operational noise associated with HVAC equipment and building maintenance.

At buildout, the existing athletic field bleachers would be relocated from the west side of the athletic field, to the east side of the athletic field, which would bring them approximately 370 feet closer to the single-family residential properties located east of the project site. However, the directional orientation of the bleachers would be altered from east-facing to west-facing. Noise measurements representative of the athletic field bleacher were taken at a big league baseball field in 2002.[16] The data showed noise levels between 54 and 62 dBA L_{eq} at 50 feet. The proposed project would result in an approximate 295-foot distance between the athletic field stands and the nearest residential property line, which would attenuate bleacher noise to between 39 and 47 dBA L_{eq}. These noise levels are below existing ambient noise levels at the project site. The relocation of the athletic field bleachers nearer to noise-sensitive receptors east of the project site would not increase ambient noise levels at these sensitive receptors.

[16] ESA. Initial Study and Mitigated Negative Declaration prepared for Early College Academic and Technical School Project. 2009.

Ambient noise levels at the site boundary range from 56 dBA L_{eq} along Atlantic Avenue, to 63 dBA L_{eq} along the project site's southern boundary. These noise levels do not exceed what is considered to be a conditionally acceptable outdoor noise level for schools. Overall, traffic noise levels affecting the proposed project would not exceed applicable exterior and interior (with windows closed) noise standards. Operational impacts would be less than significant, and no mitigation measures are required.

NOISE-2 *The proposed project would expose persons to or generation of excessive groundborne vibration or groundborne noise levels. The implementation of mitigation measures would be required to reduce this significant impact. However, even after the implementation of mitigation measures, construction groundborne vibration may continue to exceed the threshold. Significant and unavoidable impacts would occur.*

Construction

Typical outdoor sources of perceptible groundborne vibration include construction equipment and traffic on rough roads. Construction activity can also result in varying degrees of groundborne vibration, depending on the type of equipment, methods employed, and the geology of the project site. Representative vibrations source levels associated with various types of construction equipment are presented in Table 3.4-8.

TABLE 3.4-8

REPRESENTATIVE VIBRATION SOURCE LEVELS FOR CONSTRUCTION EQUIPMENT

Equipment	Groundborne Vibration PPV at 25 Feet (in/sec)	Groundborne Noise Approximate Lv[1] (VdB) at 25 feet (1 micro-inch/second)
Vibratory Roller	0.210	94
Hoe Ram	0.089	87
Large bulldozer	0.089	87
Caisson drilling	0.089	87
Loaded trucks	0.076	86
Jackhammer	0.035	79
Small bulldozer	0.003	58

[1] Lv is the root mean square velocity expressed in vibration decibels (VdB), assuming a crest factor of 4.
Source: FTA 2006.

Vibration associated with the proposed stone column installation required during Phases 1B, 1C, and 2B within the northern portion of the project site, may result in vibration levels of up to 3.19 in/sec PPV at a distance of 10 feet from the installation equipment and site.[17]

Ground vibrations from construction activities do not often reach levels that can damage structures, but they can be noticeable in buildings located in close proximity to construction activities. Building and structural damage are a major area of concern with regard to construction vibration, which is assessing in terms of PPV. The rumbling sound caused by the vibration of room surfaces is called groundborne noise.

[17] Geopier Foundation Company, Inc. Technical Bulletin No. 9, Vibration and Noise Levels. 2006.

Groundborne noise related to human annoyance is generally related to root mean square velocity levels expressed in vibration decibels (VdB). In contrast to airborne noise, groundborne noise is not a phenomenon that most people experience on a daily basis. The background vibration velocity level in residential areas is typically 50 VdB or lower, which is well below the threshold of perception for humans (approximately 65 VdB).

Vibratory equipment including loaded trucks, large bulldozers and a hoe ram would be utilized during the concrete, asphalt, and building demolition activities included with the proposed project. A vibratory roller, loaded trucks, and potentially, a jackhammer would be utilized to renovate existing buildings and to construct new buildings. The vibratory roller would primarily be used during the laying down of new asphalt, and a jackhammer may be utilized during utility relocations or installations.

The previously mentioned construction equipment would potentially be utilized within 25 feet of occupied classrooms and interim housing. In addition, off-site sensitive receptors, including single-family residential properties, that would be susceptible to project vibration are located adjacent to the northern boundary of the project site, as well as approximately 60 feet east of the project site. Groundborne noise and vibration levels were predicted based on the VdB and PPV reference vibration levels presented in Table 3.4-9. This table shows the results of calculated construction/demolition vibration levels at various locations on- and off-site.

TABLE 3.4-9
MODELED VIBRATION SOURCE LEVELS FOR CONSTRUCTION/DEMOLITION ACTIVITIES

Location	Distance from Property Line (feet)	PPV (in/sec)	Approximate Lv (VdB)[1]	Exceeds Threshold?	
				PPV (in/sec)	Lv (VdB)
Residences north of the project site and classrooms adjacent to construction work area	10	0.831	106	YES	YES
Residences east of the project site	60	0.037	79	NO	YES
Residences west of the project site	150	0.014	71	NO	NO

[1] Lv is the root mean square velocity expressed in vibration decibels (VdB), assuming a crest factor of 4.
Source: FTA 2006; Data modeled by AECOM 2013.

Calculated groundborne noise and vibration levels would range from 71 VdB to 106 VdB, and .0014 in/sec PPV and 0.831 in/sec PPV for typical construction activities. Installation of the proposed stone columns may result in vibration levels of up to 3.19 in/sec PPV at a distance of 10 feet from the equipment.[18] Therefore, vibration-induced construction activities would exceed the recommended Caltrans standard of 0.2 in/sec PPV regarding the prevention of structural damage for normal buildings, as well as FTA's maximum acceptable vibration standard of 78 VdB regarding human response (i.e., annoyance) at nearby vibration-sensitive land uses (i.e., school, residential properties). The construction vibration impact would be significant. The implementation of mitigation measures NOISE-G through NOISE-I would be required to minimize the significant groundborne noise and vibration impact.

18 Ibid.

However, even after the implementation of mitigation measures, the construction vibration levels may continue to exceed the thresholds. As such, a significant and unavoidable impact is anticipated regarding construction groundborne noise and vibration.

Operations

There are currently no vibratory activities or sources of vibration on the project site. Once all construction activities are completed, the operation of Jordan High School would be similar to the existing condition and would not result in an increase in groundborne noise or groundborne vibration. No impact would occur.

NOISE-3 *The proposed project would result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project. This impact would be significant and the implementation of mitigation measures would be required. However, even with the implementation of mitigation measures, the construction noise levels may continue to exceed applicable thresholds. A significant and unavoidable impact would occur.*

The construction of the proposed project would result in average hourly noise levels of 90 dB L_{eq}, at a distance of 50 feet. Maximum noise levels generated by construction activities are not anticipated to reach 99 dBA L_e at a distance of 50 feet. These noise levels are substantially higher (i.e., an increase of 10 dBA or higher (i.e., a perceived doubling of noise) than measured existing noise levels that were measure from 56 to 70 dBA L_{eq} and up to 76 dBA L_{ex} at or near the project site.

The proposed project would be required to comply with the City of Long Beach Municipal Code, which allows construction activities only between the hours of 7:00 a.m. and 7:00 p.m. on weekdays and between 9:00 a.m. and 6:00 p.m. on Saturdays, with construction prohibited on Sundays. Although project construction would adhere to the City's allowed hours of construction, the implementation of mitigation measures NOISE-A through NOISE-F are required to reduce the significant construction noise impacts. However, even with the implementation of mitigation measures, the construction noise levels would continue to exceed applicable thresholds. As such, a significant and unavoidable impact regarding a temporary increase in ambient noise would occur.

3.4.4 Mitigation Measures

NOISE-A Prior to construction, the contractor shall submit a list of equipment and activities required during construction to the LBUSD in order to ensure proper planning of the most intense construction activities during time periods that would least impact the campus operation.

NOISE-B At the start of construction, the construction contractor shall install a sign on the project site that provides project contact information that can be utilized to submit questions or concerns regarding the project construction activities.

NOISE-C Noisy construction activities shall not occur during academic testing periods.

NOISE-D During construction, the construction contractor shall outfit all equipment, fixed or mobile, with properly operating and maintained exhaust and intake mufflers, consistent with manufacturers' standards.

NOISE-E The construction contractor shall combine noisy operations proposed during the same phase to occur in the same time period.

NOISE-F If feasible, impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for construction activities shall be hydraulically or electrically powered wherever possible to avoid noise associated with compressed air exhaust from pneumatically powered tools. Where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used. External jackets on the tools themselves shall be used. Quieter procedures, such as use of drills rather than impact tools, shall be used.

NOISE-G The construction contractor shall use as small an impact device to accomplish necessary tasks while minimizing excess vibration.

NOISE-H The construction contractor shall select non-impact demolition and/or construction methods, such as removal for off-site demolition or hydraulic jack splitting, instead of high impact methods.

NOISE-I The construction contractor shall limit, when possible, the use of pavement breakers and vibratory rollers and packers near sensitive receptors.

3.4.5 Significance after Mitigation

The construction of the proposed project would expose persons to or generate noise levels in excess of applicable standards established in the local general plan or noise ordinance, or applicable standard of other agencies. The construction of the proposed project would also result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project. The implementation of mitigation measures NOISE-A through NOISE-F would be required to minimize significant construction noise impacts. However, even after the implementation of mitigation measures, construction noise levels may continue to exceed applicable thresholds, and a significant and unavoidable impact would occur.

The construction of the proposed project would expose persons to or generation of excessive groundborne vibration or groundborne noise levels. The implementation of mitigation measures NOISE-G through NOISE-I would be required to reduce this significant impact. However, even after the implementation of mitigation measures, construction groundborne vibration may continue to exceed the threshold. Significant and unavoidable impacts would occur.