3.12 NOISE

This section includes a description of terminology and acoustic fundamentals, a summary of applicable regulations related to noise and vibration, a description of ambient-noise conditions, and an analysis of potential short-term construction and long-term operational-source noise impacts from campus development under the 2021 LRDP. Mitigation measures are recommended as necessary to reduce significant noise impacts. Additional data is provided in Appendix H, including noise modeling calculations referenced in the analysis of this section.

Comments received on the NOP (see Appendix B) related to noise asked for an analysis of noise generated by individuals using campus recreational facilities, traffic noise, and construction and operational noise impacts both on and off campus.

3.12.1 Terminology and Acoustic Fundamentals

Prior to discussing the noise setting for the 2021 LRDP, background information about sound, noise, vibration, and common noise descriptors is presented below to provide context and a better understanding of the technical terms referenced throughout this section.

NOISE

Sound, Noise, and Acoustics

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air) to a human ear. Noise is defined as loud, unexpected, annoying, or unwanted sound.

In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receiver determines the sound level and characteristics of the noise perceived by the receiver. The field of acoustics deals primarily with the propagation and control of sound.

Frequency

Continuous sound can be described by frequency (pitch) and amplitude (loudness). A low-frequency sound is perceived as low in pitch. Frequency is expressed in terms of cycles per second, or hertz (Hz) (e.g., a frequency of 250 cycles per second is referred to as 250 Hz). The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

Sound Pressure Levels and Decibels

The amplitude of pressure waves generated by a sound source determines the loudness of that source. Sound pressure amplitude is measured in micro-Pascals (mPa). One mPa is approximately one hundred billionth (0.00000000001) of normal atmospheric pressure. Sound pressure amplitudes for different kinds of noise environments can range from less than 100 to 100,000,000 mPa. Because of this large range of values, sound is rarely expressed in terms of mPa. Instead, a logarithmic scale is used to describe sound pressure level (SPL) in terms of decibels (dB).

Because decibels are logarithmic units, SPLs expressed in dB cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two identical sources are each producing sound of the same loudness at the same time, the resulting sound level at a given distance would be 3 dB higher than if only one of the sound sources was producing sound under the same conditions. For example, if one idling truck generates an SPL of 70 dB, two trucks idling simultaneously would not produce 140 dB; rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level approximately 5 dB louder than one source.

A-Weighted Decibels

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Although the intensity (energy per unit area) of the sound is a purely physical quantity, the loudness or human response is determined by the characteristics of the human ear.

Human hearing is limited in the range of audible frequencies as well as in the way it perceives the SPL in that range. In general, people are most sensitive to the frequency range of 1,000–8,000 Hz and perceive sounds within this range better than sounds of the same amplitude with frequencies outside of this range. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending on the human sensitivity to those frequencies. Then, an "A-weighted" sound level (expressed in units of A-weighted decibels) can be computed based on this information.

The A-weighting approximates the frequency response of the average young ear when listening to most ordinary sounds. When people make judgments of the relative loudness or annoyance of a sound, their judgment correlates well with the A-scale sound levels of those sounds. Thus, noise levels are typically reported in terms of A-weighted decibels. All sound levels discussed in this section are expressed in A-weighted decibels. Table 3.12-1 describes typical A-weighted noise levels for various noise sources.

Table 3.12-1 Typical A-Weighted Noise Levels

Common Outdoor Activities	Noise Level (dB)	Common Indoor Activities
	— 110 —	Rock band
Jet fly-over at 1,000 feet	— 100 —	
Gas lawn mower at 3 feet	— 90 —	
Diesel truck at 50 feet at 50 miles per hour	— 80 —	Food blender at 3 feet, Garbage disposal at 3 feet
Noisy urban area, daytime, Gas lawn mower at 100 feet	— 70 —	Vacuum cleaner at 10 feet, Normal speech at 3 feet
Commercial area, Heavy traffic at 300 feet	— 60 —	
Quiet urban daytime	— 50 —	Large business office, Dishwasher next room
Quiet urban nighttime	— 40 —	Theater, large conference room (background)
Quiet suburban nighttime	— 30 —	Library, Bedroom at night
Quiet rural nighttime	— 20 —	
	— 10 —	Broadcast/recording studio
Lowest threshold of human hearing	— 0 —	Lowest threshold of human hearing

Source: Caltrans 2013a: Table 2-5.

Human Response to Changes in Noise Levels

As described above, the doubling of sound energy results in a 3 dB increase in the sound level. However, given a sound level change measured with precise instrumentation, the subjective human perception of a doubling of loudness will usually be different from what is measured.

Under controlled conditions in an acoustical laboratory, the trained, healthy human ear can discern 1 dB changes in sound levels when exposed to steady, single-frequency ("pure-tone") signals in the mid-frequency (1,000–8,000 Hz) range. In general, the healthy human ear is most sensitive to sounds between 1,000 and 5,000 Hz and perceives both higher and lower frequency sounds of the same magnitude with less intensity (Caltrans 2013a: 2-18). In typical noisy environments, changes in noise of 1–2 dB are generally not perceptible. However, it is widely accepted that people can begin to detect sound level increases of 3 dB in typical noisy environments. Further, a 5 dB increase is generally perceived as a distinctly noticeable increase, and a 10 dB increase is generally perceived as a doubling of loudness (Caltrans 2013a: 2-10). Therefore, a doubling of sound energy (e.g., doubling the volume of traffic on a highway) that would result in a 3 dB increase in sound would generally be perceived as barely detectable.

Sound Propagation

When sound propagates over a distance, it changes in level and frequency content. The manner in which a noise level decreases with distance depends on geometric spreading, ground absorption, atmospheric effects, and shielding by natural or human-made features, described in detail below.:

Geometric Spreading

Sound from a localized source (i.e., a point source) propagates uniformly outward in a spherical pattern. The sound level attenuates (or decreases) at a rate of 6 dB for each doubling of distance from a point source. Roads and highways consist of several localized noise sources on a defined path and hence can be treated as a line source, which approximates the effect of several point sources, thus propagating at a slower rate in comparison to a point source. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of 3 dB for each doubling of distance from a line source.

Ground Absorption

The propagation path of noise from a source to a receiver is usually very close to the ground. Noise attenuation from ground absorption and reflective wave–canceling provides additional attenuation associated with geometric spreading. Traditionally, this additional attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is usually sufficiently accurate for distances of less than 200 feet. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receiver, such as a parking lot or body of water), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface between the source and the receiver, such as soft dirt, grass, or scattered bushes and trees), additional ground-attenuation value of 1.5 dB per doubling of distance is normally assumed. When added to the attenuation rate associated with cylindrical spreading, the additional ground attenuation results in an overall drop-off rate of 4.5 dB per doubling of distance. This would also hold true for point sources, resulting in an overall drop-off rate of up to 7.5 dB per doubling of distance.

Atmospheric Effects

Receivers located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels, as wind can carry sound. Other factors such as air temperature, humidity, and turbulence can also affect sound attenuation.

Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receiver attenuate noise levels at the receiver. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. A barrier that breaks the line of sight between a source and a receiver will typically result in at least 5 dB of noise reduction (Caltrans 2013a:2-41; FTA 2018:42). Barriers higher than the line of sight provide increased noise reduction (FTA 2018:16). Vegetation between the source and receiver is rarely effective in reducing noise because it does not create a solid barrier unless there are multiple rows of vegetation of sufficient height (FTA 2018:15, 104, 106).

Health Effects of Environmental Noise

The World Health Organization (WHO) is perhaps the best source of current knowledge regarding the health effects of noise impacts because European nations have continued to study noise and its health effects, while the US Environmental Protection Agency (EPA) all but eliminated its noise investigation and control program in the 1970s. According to WHO, sleep disturbance can occur when continuous indoor noise levels exceed 30 dBA or when intermittent interior noise levels reach 45 dBA, particularly if background noise is low. With a bedroom window slightly open (a reduction from outside to inside of 15 dB), the WHO criteria suggest that exterior continuous (ambient) nighttime noise levels should be 45 dBA or below, and short-term events should not generate noise in excess of 60 dBA. WHO also notes that maintaining noise levels within the recommended levels during the first part of the night is believed to be effective for the ability of people to initially fall asleep (WHO 1999).

Other potential health effects of high noise levels identified by WHO include decreased performance for complex cognitive tasks, such as reading, attention span, problem solving, and memorization; physiological effects such as hypertension and heart disease (after many years of constant exposure, often by workers, to high noise levels); and hearing impairment (again, generally after long-term occupational exposure, although shorter-term exposure to very high noise levels, for example, exposure several times a year to concert noise at 100 dBA, can also damage hearing). Finally, noise can cause annoyance and can trigger emotional reactions like anger, depression, and anxiety. WHO reports that, during daytime hours, few people are seriously annoyed by activities with noise levels below 55 dBA or moderately annoyed with noise levels below 50 dBA.

Vehicle traffic and continuous sources of machinery and mechanical noise contribute to ambient noise levels. Short-term noise sources, such as truck backup beepers, the crashing of material being loaded or unloaded, and car doors slamming contribute very little to= 24-hour noise levels but are capable of causing sleep disturbance and annoyance. The importance of noise to receptors depends on both time and context. For example, long-term high noise levels from large traffic volumes can make conversation at a normal voice level difficult or impossible, while short-term peak noise levels, if they occur at night, can disturb sleep.

Noise Descriptors

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, while some are random. Some noise levels fluctuate rapidly, but others fluctuate slowly. Some noise levels vary widely, but others are relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors used throughout this section.

- **Equivalent Continuous Sound Level (L_{eq}):** L_{eq} represents an average of the sound energy occurring over a specified period. In effect, L_{eq} is the steady-state sound level containing the same acoustical energy as the time-varying sound level that occurs during the same period (Caltrans 2013a:2-48). For instance, the 1-hour equivalent sound level, also referred to as the hourly L_{eq}, is the energy average of sound levels occurring during a 1-hour period (Caltrans 2013a:2-47; FTA 2018:210).
- **Maximum Sound Level (L_{max}):** L_{max} is the highest instantaneous sound level measured during a specified period (Caltrans 2013a:2-48; FTA 2018:207–208).
- **Day-Night Level (L_{dn}):** L_{dn} is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10-dB "penalty" applied to sound levels occurring during nighttime hours between 10 p.m. and 7 a.m. (Caltrans 2013a:2-48; FTA 2018:214).
- **Community Noise Equivalent Level (CNEL):** CNEL is the energy average of the A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to sound levels occurring during the nighttime hours between 10 p.m. and 7 a.m. and a 5-dB penalty applied to the sound levels occurring during evening hours between 7 p.m. and 10 p.m. (Caltrans 2013a:2-48).

VIBRATION

Vibration is the periodic oscillation of a medium or object with respect to a given reference point. Ground-borne vibration is vibration of and through the ground. Ground-borne vibration can range from levels that are imperceptible to humans to levels that can create substantial damage to buildings and structures. Sources of ground-borne 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, (e.g., operating factory machinery) or transient in nature (e.g., explosions). Vibration levels can be depicted in terms of amplitude and frequency, relative to displacement, velocity, or acceleration.

Ground-borne vibration amplitudes are commonly expressed in peak particle velocity (PPV) or root-mean-square (RMS) vibration velocity. PPV and RMS vibration velocity are normally described in inches per second (in/sec) or in millimeters per second. 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 (FTA 2018:110; Caltrans 2013a:6).

Although PPV is appropriate for evaluating the potential for building damage, it is not always suitable for evaluating human response. It takes some time for the human body to respond to vibration signals. In a sense, the human body responds to average vibration amplitude. The RMS of a signal is the average of the squared amplitude of the signal, typically calculated over a 1-second period. As with airborne sound, the RMS velocity is often expressed in decibel notation as vibration decibels (VdB), which serves to compress the range of numbers required to describe vibration (FTA 2018:110, 199; Caltrans 2013b:7). This is based on a reference value of 1 microinch per second.

The typical background ground-borne vibration-velocity level in residential areas is approximately 50 VdB. Ground vibration is normally perceptible to humans at approximately 65 VdB. For most people, a vibration-velocity level of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels (FTA 2018:120; Caltrans 2013b:27).

Typical outdoor sources of perceptible ground vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If a roadway is smooth, the ground vibration is rarely perceptible. The range of interest is from approximately 50 VdB, which is the typical background vibration-velocity level, to 100 VdB, which is the general threshold where minor damage can occur to fragile buildings. Construction activities can generate sufficient ground vibrations to pose a risk to nearby structures. Constant or transient vibrations can weaken structures, crack facades, and disturb occupants (FTA 2018:113).

Ground vibration levels generated by construction activity can be transient, random, or continuous. Transient construction vibrations are generated by blasting, impact pile driving, and wrecking balls. Continuous vibrations are generated by vibratory pile drivers, large pumps, and compressors. Random vibration can result from jackhammers, pavement breakers, and heavy construction equipment.

Table 3.12-2 summarizes the general human response to different ground vibration-velocity levels.

Table 3.12-2 Human Response to Different Levels of Ground Noise and Vibration

Vibration-Velocity Level	Human Reaction
65 VdB	Approximate threshold of perception.
75 VdB	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find that transportation-related vibration at this level is unacceptable.
85 VdB	Vibration acceptable only if there are an infrequent number of events per day.

Notes: VdB = vibration decibels referenced to 1 microinch/second and based on the root mean square (RMS) velocity amplitude.

Source: FTA 2018:120.

3.12.2 Regulatory Setting

FEDERAL

The U.S. Environmental Protection Agency (EPA) Office of Noise Abatement and Control was originally established to coordinate Federal noise control activities. In 1981, EPA administrators determined that subjective issues such as noise would be better addressed at more local levels of government. Consequently, in 1982 responsibilities for regulating noise control policies were transferred to state and local governments. However, documents and research completed by the EPA Office of Noise Abatement and Control continue to provide value in the analysis of noise effects.

Federal Transit Administration Vibration Impact Criteria

To address the human response to ground vibration, the Federal Transit Administration (FTA) has set forth guidelines for maximum-acceptable vibration criteria for different types of land uses. These guidelines are presented in Table 3.12-3.

Table 3.12-3 FTA Ground-Borne Vibration Impact Criteria for Human Response

Land Use Category	GBV Impact Levels for Human Response (VdB re 1 microinch/sec) Frequent Event[1]	GBV Impact Levels for Human Response (VdB re 1 microinch/sec) Occasional Events[2]	GBV Impact Levels for Human Response (VdB re 1 microinch/sec) Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	80 VdB

Notes: GBV = ground-borne vibration

[1] "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.

[2] "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.

[3] "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

[4] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels.

Source: FTA 2018:123-126

STATE

California Code of Regulations

The California Noise Insulation Standards found in California Code of Regulations (CCR), Title 24 Section 1207.4 establish requirements for new residential units that may be subject to relatively high levels of exterior noise. In this case, the noise insulation criterion is 45 dB L_{dn}/CNEL inside noise-sensitive spaces.

California General Plan Guidelines

Though not adopted by law, the *State of California General Plan Guidelines 2017*, published by the California Governor's Office of Planning and Research (OPR 2017), provide guidance for the compatibility of projects within areas of specific noise exposure. Acceptable and unacceptable community noise exposure limits for various land use categories have been determined to help guide new land use decisions in California communities. In many local jurisdictions, these guidelines are used to derive local noise standards and guidance.

Normally acceptable noise levels for single-family homes are levels below 55 dB L_{dn}/CNEL and conditionally acceptable levels range from 55 dB to 70 dB L_{dn}/CNEL. For multifamily homes levels below 60 dB L_{dn}/CNEL are normally acceptable and levels between 60 dB and 70 dB L_{dn}/CNEL are conditionally acceptable.

California Department of Transportation

In 2013, Caltrans published the Transportation and Construction Vibration Manual, which provides general guidance on vibration issues associated with construction and operation of projects in relation to structural damage. Table 3.12-4 below presents recommendations for levels of vibration that could result in damage to structures exposed to continuous vibration.

Table 3.12-4 Caltrans Recommendations Regarding Vibration Levels

PPV (in/sec)	Effect on Buildings
0.4-0.6	Architectural damage and possible minor structural damage
0.2	Risk of architectural damage to normal dwelling houses
0.1	Virtually no risk of architectural damage to normal buildings
0.08	Recommended upper limit of vibration to which ruins and ancient monuments should be subjected
0.006-0.019	Vibration unlikely to cause damage of any type

Notes: PPV= Peak Particle Velocity

Source: Caltrans 2013b

UNIVERSITY OF CALIFORNIA

UC Santa Cruz Major Events Policy

UC Santa Cruz Major Events Policy (UC Santa Cruz 2017) includes guidelines regarding on-campus amplified sound which applies to all major events hosted by the Division of Student Success, Colleges, Housing, and Educational Services, and Office of Physical Education, Recreation and Sports. Dances and concerts must meet additional policy provisions as outlined in this policy. This policy is a supplement to, and in case of inconsistency takes precedence over, the stipulations articulated in the UC Santa Cruz Student Policies and Regulations Handbook that require prior authorization for the use of sound amplification equipment, as well as any facility regulations and procedures governing use of particular facilities on the campus (UC Santa Cruz 2017). The guidelines that are relevant to the analysis of the noise effects of the project include the following:

- Outdoor Amplified Sound. The peace and quiet of the campus and adjacent neighborhoods should not be disturbed by the amplified sound from events; California Penal Code 415 concerning the disturbance of the peace is enforceable by the University Police Department. The completion and approval of Appendix A (Request for Outdoor Amplified Sound) is required during the planning stage for the event (minimum 3 weeks in advance of event). The following also apply:
    1) Outdoor events with amplified sound must be posted on the Campus Calendar.
    2) All possible effort must be taken to ensure that the level of amplified sound does not extend beyond the immediate audience.
    3) Sound equipment must be positioned carefully in order to prevent sound from disturbing persons not in the immediate area. The set should be carefully checked by the Sponsor before the event and monitored during the event by the Sponsor.
    4) Outdoor use of amplified sound for non-music events is permitted with prior approval in the [college areas, OPERS facilities, and Quarry Plaza] and in accordance with the conditions specified above. All other areas are by exception only.
    5) Outdoor amplification that will extend past 6:00 p.m. should be directed away from the city or nearby residential areas. Outdoor amplification should not extend past 10:00 p.m. unless an exemption is approved by the College Administrative Officer and/or Associate College Administrative Officer; or Residential Manger in the (non-college/residential living areas), as applicable, and posed to the Campus Calendar. Generally, exemptions will be granted for Fridays and Saturdays only. In all exemption cases, the amplified music may not continue past midnight.
    6) If the campus receives a complaint about the noise from either on or off-campus the amplification must be lowered. If a subsequent complaint is received, the music or other noise must cease.
    7) No outdoor amplified sound will be allowed during final examination periods without approval of the Vice Provost, Student Success.
- Contracts or agreements with performers or musicians should contain a statement that allows the Sponsor to regulate the level of amplified sound. When the sound level is excessive, the Sponsor will take the necessary corrective action, which may include, but is not restricted to, cancellation of the event.
- In the case of an outdoor dance or concert, all those who might be affected by the noise of such an event must be notified by (via phone call or email to units) three weeks prior to the event.

UC Santa Cruz Campus Standards Handbook

Part II of the UC Santa Cruz Campus Standards Handbook, "General Building Requirements" (UC Santa Cruz 2010) includes the following guidelines applicable to the analysis of the noise effects of the project:

2. Mechanical System Noise

- Design Classrooms, Libraries, Study Halls, and general Office spaces within NC 30 Standards. For large Lecture Halls, Auditoriums, Concert Halls, Recording Studios etc., (where more stringent controls are desirable), consult with the Project Manager to set standards suitable for the intended uses. Design all other areas within the NC standards recommended in the most recent ASHRAE handbooks. Inform the Project Manager during the Design Development stage if necessary that sound control measures will be adding a high cost value to the project.
- Mechanical equipment noise and vibration shall be aggressively controlled.

LOCAL

As noted in Section 3.0.2, "University of California Autonomy," UC Santa Cruz, a constitutionally created State entity, is not subject to municipal regulations of surrounding local governments for uses on property owned or controlled by UC Santa Cruz that are in furtherance of the university's educational purposes. However, UC Santa Cruz may consider, for coordination purposes, aspects of local plans and policies of the communities surrounding the campus when it is appropriate and feasible, but it is not bound by those plans and policies in its planning efforts.

County of Santa Cruz General Plan

The County of Santa Cruz General Plan Noise Element (Santa Cruz County 2020) includes the following noise policies that may be relevant to the 2021 LRDP:

- **Policy 9.1.1.** Consider Table 9-2 [shown as Table 3.12-5 in this EIR, as the tables in the City and County General Plans list the same standards], *Acceptable through Unacceptable Ranges of Exterior Noise Exposure by Land Use* in the planning and permitting processes for new development to reduce noise exposure on future occupants of the new development to acceptable noise levels.
- **Policy 9.1.2.** Where noise sensitive developments would be exposed to noise levels that exceed those considered "normally acceptable," require the incorporation of noise reduction design elements as recommended by a site-specific acoustical study or using prescriptive or performance methods to reduce interior noise levels to the standards set forth in Title 24 of the California Code of Regulations for both residential and non-residential uses.
- **Policy 9.1.3.** Noise levels in common outdoor use areas in multi-unit residential development should not exceed [L_{dn}] 60 dB. Where this goal cannot be met by reasonable measures, such as strategic site layout and noise barriers, [L_{dn}] 65 dB might be considered acceptable. Outdoor noise limits do not apply to private exterior balconies.
- **Policy 9.2.2.** Require site-design and noise reduction measures for any project, including transportation projects, that would cause significant degradation of the noise environment due to project effects that could:

  (a) Increase the noise level at existing noise-sensitive receptors or areas by 5 dB or more, where the post project CNEL or [L_{dn}] will remain equal to or below 60 dB;

  (b) Increase the noise level at existing noise-sensitive receptors or areas by 3 dB or more, where the post project CNEL or [L_{dn}] would exceed 60 dB.

  This policy shall not be interpreted in a manner that would limit the ability of the County to require noise related mitigation measures or conditions of approval for projects that may generate lesser increases than the above. Special consideration may also be applied to special events or activities subject to permit requirements, or to land use development permits for uses and activities exempted from County noise control regulations.

- **Policy 9.2.3.** Incorporate noise considerations into the site plan review process, particularly with regard to parking and loading areas, ingress/egress points and refuse collection areas.
- **Policy 9.2.4.** For all new commercial and industrial developments which would increase noise levels above the normally acceptable standards in Table 9-2 [Table 3.12-5 in this EIR] or the maximum allowable standards in Table 9-3 (shown as Table 3.12-6 in this EIR), the best available control technologies shall be used to minimize noise levels. In no case shall the noise levels exceed the standards in Table 9-3 [Table 3.12-6 in this EIR].

Table 3.12-5 County of Santa Cruz Land Use – Noise Compatibility Standards

Use	Community Noise Exposure (L_{dn} or CNEL, dBA) Normally Acceptable[1]	Community Noise Exposure (L_{dn} or CNEL, dBA) Conditionally Acceptable[2]	Community Noise Exposure (L_{dn} or CNEL, dBA) Normally Unacceptable[3]	Community Noise Exposure (L_{dn} or CNEL, dBA) Clearly Unacceptable[4]
Residential/Lodging –Single Family, Duplex, Mobile Homes, Multi Family	Under 60	60-75	N/A	Above 75
Schools, Libraries, Religious Institutions, Meeting Halls, Hospitals	Under 60	60-75	N/A	Above 75
Outdoor Sports Arena or Facility, Playgrounds, Neighborhood Parks	Under 65	65-70	70-80	Above 80
Office Buildings, Business Commercial and Professional	Under 65	65-80	N/A	Above 80
Industrial, Manufacturing, Utilities, Agriculture	Under 70	Above 70	N/A	N/A

Notes: N/A=Not applicable

[1] Specific land use is satisfactory, based upon the assumption that any buildings involved are of conventional construction, without any special noise insulation requirements, and can meet the indoor noise standards.

[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 included in the design to meet interior and exterior noise standards, where applicable.

[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 conducted and needed noise insulation features included in the design to meet interior and exterior noise standards, where applicable.

[4] New construction or development should generally not be undertaken.

Source: Santa Cruz County 2020: Table 9-2.

Table 3.12-6 County of Santa Cruz Maximum Allowable Noise Exposure for Stationary Noise Sources[1]

	Daytime (7 a.m. to 10 p.m.)[2]	Nighttime (10 p.m. to 7 a.m.)[2, 3]
Hourly L_{eq} (dB)	50	45
Maximum level (dB)	70	65
Maximum level, Impulsive Noise (dB)	65	60

Notes: dB = decibel

[1] Noise levels are to be determined at the property line of the receiving land use. When determining the effectiveness of noise mitigation measures, the standards may be applied on the receptor side of noise barriers or other property line noise mitigation measures.

[2] Allowable levels shall be raised to the ambient noise levels where the ambient levels exceed the allowable levels. Allowable levels shall be reduced by 5 dB if the ambient hourly L_{eq} is at least 10 dB lower than the allowable level.

[3] Nighttime standards only apply where the receiving land use operates or is occupied during nighttime hours.

Source: Santa Cruz County 2020: 9-14.

- **Policy 9.2.5.** The following noise mitigation strategies are preferable to construction of conventional masonry noise barriers where these strategies are a feasible option to reduce impacts on sensitive uses:
  - Avoid placement of noise sensitive uses in noisy areas.

- Avoid placement of significant noise generators in noise sensitive areas.
- Increase setbacks between noise generators and noise sensitive uses.
- Orient buildings such that the noise sensitive portions of a project (e.g. bedrooms) are shielded from noise sources (such as through careful design of floor plan).
- Use sound-attenuating architectural design and building features.
- Employ technologies that reduce noise generation, such as alternate pavement materials on roadways, when appropriate.
- Employ traffic calming measures where appropriate.

► **Policy 9.2.6.** Require mitigation and/or best management practices to reduce construction noise as a condition of project approvals, particularly if noise levels would exceed 75 dB at neighboring sensitive land uses or if construction would occur for more than 7 days.

Santa Cruz County Code

Chapters 8.30 and 13.15 of the Santa Cruz County Code include the following regulations regarding noise:

Section 8.30.010. Offensive noise.

A) No person shall make, cause, suffer, or permit to be made any offensive noise.

B) "Offensive noise" means any noise which is loud, boisterous, irritating, penetrating, or unusual, or that is unreasonably distracting in any other manner such that it is likely to disturb people of ordinary sensitivities in the vicinity of such noise, and includes, but is not limited to, noise made by an individual alone or by a group of people engaged in any business, activity, meeting, gathering, game, dance, or amusement, or by any appliance, contrivance, device, tool, structure, construction, vehicle, ride, machine, implement, or instrument.

C) The following factors shall be considered when determining whether a violation of the provisions of this section exists:

1) Loudness (Intensity) of the Sound.

a) Day and Evening Hours. For purposes of this factor, a noise shall automatically be considered offensive if it occurs between the hours of 8:00 a.m. and 10:00 p.m. and it is:

i) Clearly discernible at a distance of 150 feet from the property line of the property from which it is broadcast; or

ii) In excess of 75 decibels at the edge of the property line of the property from which the sound is broadcast, as registered on a sound measuring instrument meeting the American National Standard Institute's Standard S1.4-1971 (or more recent revision thereof) for Type 1 or Type 2 sound level meters, or an instrument which provides equivalent data.

A noise not reaching this intensity of volume may still be found to be offensive depending on consideration of the other factors outlined below.

b) Night Hours. For purposes of this factor, a noise shall be automatically considered offensive if it occurs between the hours of 10:00 p.m. and 8:00 a.m. and it is:

i) Made within 100 feet of any building or place regularly used for sleeping purposes; or

ii) Clearly discernible at a distance of 100 feet from the property line of the property from which it is broadcast; or

iii) In excess of 60 decibels at the edge of the property line of the property from which the sound is broadcast, as registered on a sound measuring instrument meeting the American National Standard Institute's Standard S1.4-1971 (or more recent revision thereof) for Type 1 or Type 2 sound level meters,

or an instrument which provides equivalent data. A noise not reaching this intensity of volume may still be found to be offensive depending on consideration of the other factors outlined below.

2) Pitch (frequency) of the sound, e.g., garbage collecting, street repair, permitted construction activities;

3) Duration of the sound;

4) Time of day or night;

5) Necessity of the noise, e.g., garbage collecting, street repair, permitted construction activities;

6) The level of customary background noise, e.g., residential neighborhood, commercial zoning district, etc.; and

7) The proximity to any building regularly used for sleeping purposes.

Section 13.15.040. Exemptions.

A) Noise sources normally and reasonably associated with construction, repair, remodeling, or grading of any real property, provided a permit has been obtained from the County as required, and provided said activities take place between the hours of 8:00 a.m. and 5:00 p.m. on weekdays unless the Building Official has in advance authorized said activities to start at 7:00 a.m. and/or continue no later than 7:00 p.m. Such activities shall not take place on Saturdays unless the Building Official has in advance authorized said activities, and provided said activities take place between 9:00 a.m. and 5:00 p.m. and no more than three Saturdays per month. Such activities shall not take place on a Sunday or federal holiday, or during earlier morning or later evening hours of a weekday or Saturday.

B) Emergency Work. The provisions of this chapter shall not apply to the emission of sound for the purpose of alerting persons to the existence of an emergency or in the performance of emergency work.

C) Entertainment or Special Events. The provisions of this chapter shall not apply to those reasonable sounds emanating from authorized school bands, school athletic and school entertainment events, and occasional noncommercial private outdoor or indoor gatherings and community events, conducted between the hours of 8:00 a.m. and 10:00 p.m. or the applicable permitted timeframe, in compliance with Chapter 8.30 SCCC, Noise, (governing offensive noise) and as long as any applicable requirements for special event permits or temporary use permits are met.

Section 13.15.050. General noise regulations and unlawful noise.

B) Backup emergency generators shall only be operated during power outages and for other temporary purposes. If the generator is located within 100 feet of a residential dwelling unit, noise attenuation measures shall be included to reduce noise levels to an A-weighted maximum exterior noise level of 60 dB at the property line and a maximum interior noise level of 45 dB within nearby residences.

Section 13.15.060. Special requirements for air conditioning/mechanical units in or near residential uses. Where the intruding noise source is a residential air-conditioning unit, or a commercial air-conditioning or other mechanical unit located within 100 feet of any building or place regularly used for sleeping purposes, that operates more or less continually and/or during most hours, the A-weighted exterior noise level when measured at any neighboring property line shall not exceed 60 dB for units installed before, and 55 dB for units installed after, the effective date of this chapter, and a maximum interior noise level of 45 dB within nearby residences. In permitting or designing buildings with air conditioning or mechanical units, such units shall be located away from rooms used for sleeping purposes and shall incorporate sound-attenuating measures if feasible, and/or shall provide mitigation for such rooms, such as sound-rated windows or other measures as approved by the Building Official.

City of Santa Cruz General Plan

The Hazards, Safety, and Noise Element of the City of Santa Cruz 2030 General Plan (City of Santa Cruz 2012) includes the following policies related to noise in the city that may be relevant to the 2021 LRDP:

- **Policy HZ3.1.1.** Require land uses to operate at noise levels that do not significantly increase surrounding ambient noise.
- **Policy HZ3.1.2.** Use site planning and design approaches to minimize noise impacts from new development on surrounding land uses.
- **Policy HZ3.1.3.** Ensure that construction activities are managed to minimize overall noise impacts on surrounding land uses.
- **Policy HZ3.1.4.** Minimize the impacts of intermittent urban noise on residents.
- **Policy HZ3.1.6.** Require evaluation of noise mitigation measures for projects that would substantially increase noise.
- **Policy HZ3.1.7.** Protect residential areas from excessive noise from traffic and from road projects.
- **Policy HZ3.1.9.** Limit truck traffic in residential and commercial areas to designated truck routes.
- **Policy HZ3.1.11.** Require soundwalls, earth berms, setbacks, and other noise reduction techniques for new development, when appropriate and necessary, as conditions of approval.
- **Policy HZ3.2.** Ensure that noise standards are met in the siting of noise-sensitive uses.
- **Policy HZ3.2.1.** Apply noise and land use compatibility table and standards to all new residential, commercial, and mixed-use proposals, including condominium conversions in accordance with standards set forth in the Land Use-Noise Compatibility Standards Figure 2 [shown as Table 3.12-7 in this EIR].

Table 3.12-7 City of Santa Cruz Land Use – Noise Compatibility Standards

Use	Community Noise Exposure (L_{dn} or CNEL, dBA) Normally Acceptable[1]	Community Noise Exposure (L_{dn} or CNEL, dBA) Conditionally Acceptable[2]	Community Noise Exposure (L_{dn} or CNEL, dBA) Normally Unacceptable[3]	Community Noise Exposure (L_{dn} or CNEL, dBA) Clearly Unacceptable[4]
Residential – Low Density Single Family, Duplex, Mobile Homes	Under 60	55-70	70-75	Above 75
Residential – Multi Family	Under 65	60-70*	70-75	Above 75
Transient Lodging - Motels, Hotels	Under 65	60-70	70-80	Above 80
Schools, Libraries, Churches, Hospitals, Nursing Homes	Under 70	60-70	70-80	Above 80
Auditoriums, Concert Halls, Amphitheaters	N/A	Under 70	N/A	Above 65
Sports Arenas, Outdoor Spectator Sports	N/A	Under 75	Above 70	N/A
Playgrounds, Neighborhood Parks	Under 70	67.5-75	Above 72.5	N/A
Golf Courses, Riding Stables, Water Recreation, Cemeteries	Under 70	N/A	70-80	Above 80
Office Buildings, Business Commercial and Professional	Under 70	67.5-75.5	Above 75	N/A
Industrial, Manufacturing, Utilities, Agriculture	Under 75	70-80	Above 75	N/A

Notes: N/A=Not applicable

1 Specified land use is satisfactory assuming all buildings involved are of conventional construction, without special noise insulation requirements.

2 New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is conducted, and needed noise attenuation features are included in the construction or development.

3 New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be conducted and needed noise attenuation features shall be included in the construction or development.

4 New construction or development shall not be undertaken.

Source: City of Santa Cruz 2012: Figure 2.

- **Policy HZ3.2.2.** Establish L_{dn} noise level targets of 65 dBA for outdoor activity areas in new multifamily residential developments.
- **Policy HZ3.2.3.** Require that interior noise in all new multifamily housing not exceed a L_{dn} of 45 dBA with the windows and doors closed (State of California Noise Insulation Standards) and extend the requirement to single-family homes.

City of Santa Cruz Municipal Code

The City of Santa Cruz Municipal Code Section 9.36 includes the following noise regulations:

Section 9.36.010. Curfew – Offensive Noise

(a) No person shall between the hours of 10:00 p.m. and 8:00 a.m. make, cause, suffer or permit to be made any offensive noise (1) which is made within one hundred feet of any building or place regularly used for sleeping purposes, or (2) which disturbs, or would tend to disturb, any person within hearing distance of such noise.

(e) Subsection (a) shall not apply to any person engaged in the performance of a public or private construction project where either the chief building official, public works director, planning and community development director or water department director, in his or her sole discretion, determines that the specific tasks herein below delineated to be undertaken in connection with the subject construction project require an extended period of time to complete or, due to concerns based on public health and safety, those tasks should be undertaken between the hours of 10:00 p.m. and 8:00 a.m. When this determination has been made, the chief building official, public works director, planning and community development director or water department director may authorize such tasks to commence, be completed or be undertaken between the hours of 10:00 p.m. and 8:00 a.m.; however, no such tasks shall be undertaken during these hours without the express written permission of the chief building official, public works director, planning and community development director or water department director and then only to the extent and between the hours specifically authorized in writing by the chief building official, public works director, community development director or water department director. At a minimum, notice of the dates and times such tasks will be undertaken shall be provided by the contractor in accordance with city instructions to all residents, tenants and property owners who occupy or own property within three hundred feet of the site at which such tasks will be performed.

3.12.3 Environmental Setting

SENSITIVE LAND USES

Noise-sensitive land uses are generally considered to include those uses where noise exposure could result in health-related risks to individuals, as well as places where quiet is an essential element of their intended purpose. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels, and because of the potential for nighttime noise to result in sleep disruption. Additional noise-sensitive land uses include schools, transient lodging, historic sites, places of worship, daycare centers, and hospitals. These land use types are also considered vibration-sensitive, as are commercial and industrial buildings where vibration could interfere with operations within the building, such as the operation of sensitive equipment which could be affected at vibration levels that may be well below those associated with human annoyance.

As shown in Chapter 2, "Project Description," the LRDP area is made up of the UC Santa Cruz main residential campus and the Westside Research Park. The northern part of the main residential campus, north campus, is bordered by primarily undeveloped, unincorporated Santa Cruz County to the north, east, and west, with the exception of the Cave Gulch neighborhood located along a portion of the main residential campus' northwestern border. The central campus is bordered by primarily undeveloped and/or recreational land to the east and west. The lower campus is bordered by the undeveloped land to the west and primarily residential development to the south and east. As shown in Figure 3.12-1, existing noise-sensitive receptors located in close proximity to the main residential campus include:

- Medium to low-density residences located south and southeast of the main residential campus along High Street and Bay Drive;
- Low-density residences southeast of the main residential campus along Limestone Lane, Quarry Lane, Rockridge Lane, and Spring Court;
- Santa Cruz Waldorf School and low-density residences in the Cave Gulch neighborhood west of the main residential campus, specifically along Llama Ranch Lane, El Refugio Way, and Cave Gulch; and
- Westlake Elementary School and United Church of Christ located southeast of the main residential campus along High Street.

No sensitive receptors were identified to the east or north of the main residential campus. As shown in Figure 3.12-1, the elementary school and residences in the Cave Gulch neighborhood are the only noise-sensitive receptors located in the unincorporated county. All other identified sensitive receptors are located within the city of Santa Cruz.

As shown in Figure 3.12-1, existing noise-sensitive receptors located in proximity to Westside Research Park include residences to the east along Natural Bridges Drive and along Delaware Avenue to the southwest and southeast, as well as the Pacific Shores Apartment Complex along Shaffer Road to the northwest.

Several noise-sensitive receptors are located within the main residential campus. The northern portion of the main residential campus is largely undeveloped, providing recreational trails to students, staff, and visitors. Educational facilities located within the LRDP area are generally concentrated in the central part of the main residential campus. Existing sensitive receptors in the central part of the main residential campus include the McHenry Library, Early Education Services (i.e., childcare center), and student housing facilities (e.g., Redwood Grove Apartments, Graduate Student Housing, dormitories, and housing in the colleges). Housing facilities for staff and faculty are also primarily located in the lower portion of the main residential campus (e.g., Ranch View Terrace, Hagar Court) and student housing at the Village.

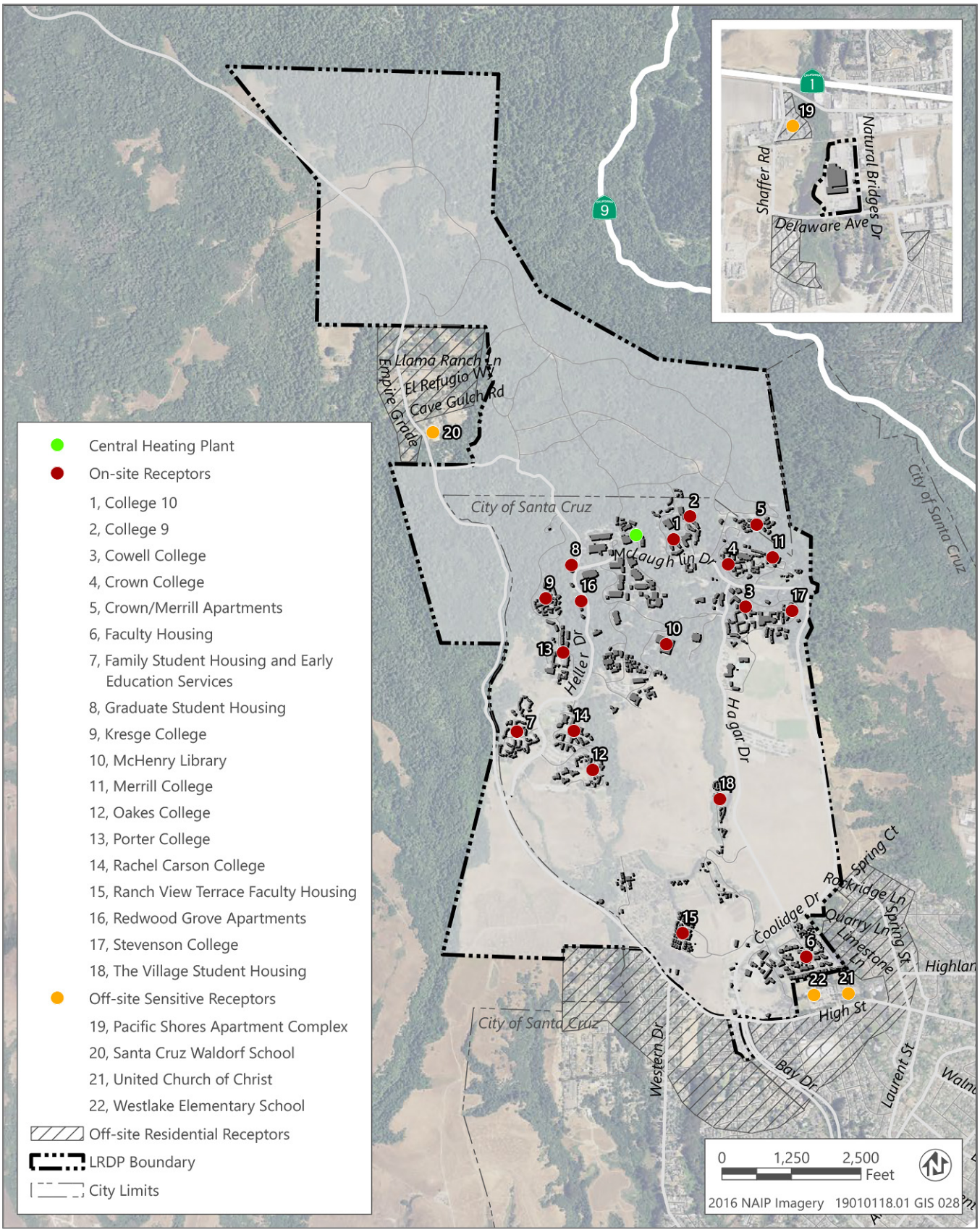
EXISTING NOISE ENVIRONMENT

The sound levels in most communities fluctuate, depending on the activity of nearby and distant noise sources, time of the day, or season of the year (i.e., periods when school is in session or not). Within and in the vicinity of the LRDP area, regional noise sources include traffic on roadways and highways, freight and passenger rail service (e.g., seasonal and special event recreational service), special events occurring on the UC Santa Cruz campus and in the City of Santa Cruz, and noise associated with typical residential, commercial, and agricultural uses. Due to the COVID-19 pandemic, the main residential campus and the Westside Research Park have not operated under normal conditions during EIR preparation and noise-generating activity levels in the LRDP area are not considered representative. For example, because more students are taking classes remotely, fewer students, staff, and faculty are commuting to and from campus, which affects traffic noise levels. Additionally, social distancing restrictions have reduced the number and magnitude of events and gatherings (e.g., sport practices, student club meetings) that would typically occur on-campus. These conditions are anticipated to be temporary in nature; and thus, noise measurements were not collected to characterize the ambient noise environment. However, the predominant expected noise in the area is traffic noise, and this is addressed below.

Mobile Source Noise

The existing noise environment in the LRDP area is primarily influenced by noise from vehicular traffic on the surrounding roadway network. Most vehicles enter the main residential campus at one of two main entrances, located at the intersection of High and Bay Streets and at the intersection of Empire Grade and Heller Drive. The main on-campus roadway system follows a loop formed by Coolidge Drive, Hagar Drive, McLaughlin Drive, and Heller Drive. Vehicular traffic is heaviest during the daytime and comprises mostly of passenger vehicles and buses.

Westside Research Park is surrounded on two sides by natural open space. Vehicular traffic on Natural Bridges Drive and Delaware Avenue is the predominant existing noise source near Westside Research Park, along with noise associated with the industrial and commercial land uses located to the north and east.



Source: Adapted by Ascent in 2020

Figure 3.12-1 Noise Sensitive Receptors

Existing traffic noise levels (using pre-COVID-19 traffic data) on roadway segments within the LRDP area and the surrounding roadway network were modeled using calculation methods consistent with FHWA Traffic Noise Model, Version 2.5 (FHWA 2004). The modeling is based on the reference noise emission levels for automobiles, medium trucks, and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and ground attenuation factors. Average daily traffic (ADT) volumes were obtained from Fehr & Peers based on the transportation modeling and analysis.

Table 3.12-8 below summarizes the modeled existing traffic noise levels at 100 feet from the centerline of each area roadway segments, and lists distances from each roadway centerline to the 65 and 60 L_{dn} traffic noise contours. For further details on traffic-noise modeling inputs and parameters, refer to Appendix H.

Table 3.12-8 Summary of Modeled Existing Traffic Noise Levels

Roadway[1]	Predicted Noise Level (L_{dn}) 100 ft from Centerline	Predicted Distance (feet) to 60 dB (L_{dn}) Noise Contour	Predicted Distance to 65 dB (L_{dn}) Noise Contour
Bay Street	62.1	162	51
Empire Grade	61.2	130	41
Coolidge Drive	60.7	117	37
Hagar Drive	62.7	187	59
Heller Drive	55.9	39	12
High Street[2]	62.4	88	28
State Route (SR) 17	72.4	1754	555
McLaughlin Drive	52.6	18	6
Mission Street/Cabrillo Highway	65.2	328	104
Natural Bridges Drive	57.2	53	17
Western Drive	54.5	28	9

Note: L_{dn} = Day-Night Noise Level.

[1] Based on results from the Regional Transportation Commission modeling, as summarized in Section 3.16, "Transportation," and provided in Appendix I, the segment with the largest ADT volume was modeled and displayed for each applicable roadway to ensure a conservative analysis.

[2] Predicted traffic noise levels modeled at 50 feet from centerline due to noise sensitive receptors being located closer than 100 feet from the roadway centerline.

Sources: Noise levels modeled by Ascent Environmental in 2020. Refer to Appendix H.

Stationary Source Noise

Noise within the LRDP area is also generated by the operation of stationary and area noise sources, including recreational areas (i.e., sport fields, playgrounds), school events (e.g., graduation, orientation), and building mechanical equipment (e.g., HVAC systems). The Central Heating Plant located in the northeastern corner of Science Hill contains cooling towers, a cogeneration plant, and other infrastructure machinery that generate localized noise in this part of the campus.

3.12.4 Environmental Impacts and Mitigation Measures

SIGNIFICANCE CRITERIA

Based on Appendix G of the State CEQA Guidelines, the 2021 LRDP would result in a potentially significant noise impact if it would result in:

- Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Generation of excessive groundborne vibration or groundborne noise levels.

- For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, the exposure of people residing or working in the project area to excessive noise levels.

Because the 2021 LRDP would generate noise and vibration from a variety of sources, the various criterion noise levels and definitions that are used in the analysis of each noise source are provided in Table 3.12-9.

Table 3.12-9 Thresholds of Significance for Noise Analysis

Noise Source	Criterion Noise Level
Construction Noise (Temporary)	**On-Campus** ▶ Daytime (8 a.m. to 10 p.m.) construction noise levels at or above 80 dB L_{eq} at the on-campus noise-sensitive uses (e.g., student or employee housing). ▶ Nighttime (10 p.m. to 8 a.m.) construction noise levels at or above 70 dB L_{eq} at on-campus noise-sensitive uses (e.g., student or employee housing). **Off-Campus** ▶ Daytime (8 a.m. to 10 p.m.) construction noise levels at or above 70 dB L_{max} at a residential property line.[1] ▶ Nighttime (10 p.m. to 8 a.m.) construction noise levels at or above 65 dB L_{max} at a residential property line.[1]
Construction Vibration	▶ Vibration levels at or in excess of 0.2 PPV in/sec for potential damage to structures.[2] ▶ Vibration levels at or in excess of 80 VdB for human disturbance.[3] ▶ Vibration levels at or in excess of 65 VdB for sensitive laboratory equipment.[4]
Operational Noise - Roadway/Vehicular Sources	▶ A 5 dB increase in traffic-related noise, where the post-project noise level would remain equal to or lower than 60 dB L_{dn}, or a 3 dB increase in traffic-related noise where the post-project noise level would exceed 60 dB L_{dn}.[5]
Operational Noise - Stationary Sources	▶ Daytime (8 a.m. to 10 p.m.) stationary source noise levels at or above 70 dB L_{max} or 50 dB L_{eq} at a residential property line or at an on-campus structure with noise-sensitive uses (e.g., student or employee housing, childcare). Nighttime (10 p.m. to 8 a.m.) stationary source noise levels at or above 65 dB L_{max} or 45 dB L_{eq} at a residential property line or at on-campus noise-sensitive uses.[6]

Notes: CNEL = Community Noise Equivalent Level; dB = A-weighted decibels; L_{eq} = hourly average noise level

1. Adapted from County of Santa Cruz General Plan Policy 9.2.4. The County's L_{max} standards for stationary noise are applied because this type of noise source best represents construction noise, and the City has not established any construction-specific standards.

2. Adapted from Caltrans as an industry-standard threshold for structural damage from construction vibration. These standards are shown in Table 3.12-4.

3. Adapted from FTA as an industry-standard threshold for human disturbance from construction vibration. These standards are shown in Table 3.12-3.

4. Adapted from FTA as an industry-standard threshold for disturbance to sensitive interior operations (e.g., laboratory equipment) from construction vibration. These standards are shown in Table 3.12-3.

5. Adapted from the County of Santa Cruz General Plan Policy 9.2.2. The County's incremental noise increase standard for noise-sensitive receptors is applied because the City has not established any transportation-specific noise standards.

6. Based on the County of Santa Cruz General Plan Policy 9.2.4 and the stationary noise standards shown in Table 3.12-6. The County's stationary noise standards are applied because the City has not established any standards specific to stationary noise sources.

ANALYSIS METHODOLOGY

Construction activities as part of the development or redevelopment of campus facilities and additional roadway traffic generated by student and faculty increases would be the primary noise sources associated with implementation of the project. Other noise sources would include those associated with the general operations of the campus, including noise generated by stationary equipment for building operations (e.g., HVAC equipment); regular and infrequent facility maintenance activities, and intermittent special events on campus (e.g., sporting events, conferences). Because noise would be generated from a variety of noise sources, each source was evaluated using different methodologies, which are discussed separately and in further detail below.

Construction Noise and Vibration

To assess potential short-term (construction-related) noise and vibration impacts, sensitive receptors and their relative exposure were identified. Potential LRDP-related construction source noise and vibration levels were determined based on methodologies, reference emission levels, and usage factors from FHWA's *Roadway Construction Noise Model User's Guide* (FHWA 2006). Reference levels for noise and vibration emissions for specific equipment or activity types are well documented and the usage thereof is common practice in the field of acoustics. Construction noise impacts were evaluated based on the applicable noise and vibration standards.

Operational Noise and Vibration

With respect to operational noise from non-transportation sources (e.g., stationary) associated with project implementation, the assessment of long-term (operational-related) impacts was based on reconnaissance data, reference noise emission levels, and measured noise levels for activities and equipment associated with project operation (e.g., heating, ventilation and air conditioning [HVAC] units, parking facilities), and standard attenuation rates and modeling techniques.

To assess potential long-term (operation-related) noise impacts due to project-generated increases in traffic, noise levels were estimated using calculations consistent with the Federal Highway Administration's Traffic Noise Model Version 2.5 (FHWA 2004) and project-specific traffic data obtained from the traffic analysis prepared for the project (Appendix H). The analysis is based on the reference noise emission levels for automobiles, medium trucks, and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and ground attenuation factors. Truck usage and vehicle speeds on area roadways were estimated from field observations and the project-specific traffic data. Note that the modeling conducted does not account for any natural or human-made shielding (e.g., the presence of walls or buildings) or reflection off building surfaces.

Operational groundborne vibration levels were evaluated qualitatively, based on representative vibration levels commonly associated with project operation (e.g., traffic, stationary sources).

ISSUES NOT EVALUATED FURTHER

Operational Vibration Levels

Implementation of the 2021 LRDP would not introduce any major sources of long-term or permanent ground vibration (in contrast to construction vibration, which is evaluated in impact analysis, below). Additionally, no major stationary sources of groundborne vibration were identified in the LRDP area that would result in the long-term exposure of on- or off-campus receptors to unacceptable levels of ground vibration. Thus, long-term or permanent groundborne vibration levels are not anticipated as a result of implementation of the 2021 LRDP, and this issue is not discussed further.

Airport/Airstrip-Related Noise Exposure

The LRDP area is not located within an airport use plan or within 2 miles of a public airport, public use airport, or private airstrip. The nearest airport to the LRDP area is Bonny Doon Village Airport, a private, single-runway airport located four miles from the LRDP area boundary. Therefore, the project would not result in the exposure of people to excessive noise levels associated with airport activity, and this issue is not discussed further.

IMPACTS AND MITIGATION MEASURES

Impact 3.12-1: Generate Substantial Temporary Construction Noise

Implementation of the 2021 LRDP would result in construction activities associated with the development of on-campus facilities to accommodate future growth in support of the UC Santa Cruz's academic mission. Although construction activities would be intermittent and temporary, construction noise could reach high levels at nearby noise-sensitive land uses, resulting in human disturbance. Therefore, this impact would be **significant**.

Development of on-campus facilities to support UC Santa Cruz's academic mission and accommodate increases in student, faculty, and staff populations would result in increases in noise-generating construction activities. The projected increases in building space under the 2021 LRDP include academic and support space as well as residential space, requiring a total of approximately 5.6 million asf (assignable square feet) of new building space.

Noise generated during construction of buildings and associated structures is typically associated with the operation of heavy-duty equipment and vehicles such as heavy trucks, excavators, pavers, and building equipment. Noise levels associated with construction activities during the more noise-sensitive evening and nighttime hours (10 p.m. to 8 a.m.) are of increased concern because noise generated during these times can result in increased annoyance and potential sleep disturbance in nearby residential areas.

Construction equipment and methods used at a given time would vary depending on the phase of construction and specific activities underway. Typical construction activities include grubbing/clearing of project sites; excavation and relocation of soil/rock; backfilling and compaction of soils; construction of utilities (i.e., potable and non-potable water conveyance, wastewater conveyance, storm water drainage facilities, and electrical and natural gas infrastructure); and construction of proposed buildings. Typical noise levels generated at 50 feet from the source by various types of construction equipment likely to be used are identified in Table 3.12-10.

Table 3.12-10 Typical Construction Equipment Noise Levels

Equipment	Noise Level (dBA at 50 feet) L_{max}
Backhoes	80
Air Compressors	80
Cranes	85
Concrete Pump Truck	82
Drill Rigs	84
Dump Trucks	84
Excavator	85
Generator	82
Grader	85
Front End Loaders	80
Pneumatic Tools	85
Pumps	77
Rollers	85
Scrapers	85
Tractor	84

Source: FHWA 2006

Short-term construction noise levels near a particular project site would fluctuate depending on the type, number, and duration of use of different pieces of equipment. The noise effects of construction largely depend on the type of construction activities being performed, noise levels generated by those activities, distances to noise-sensitive receptors, existing ambient noise levels, and the relative locations of noise-attenuating features such as vegetation and existing structures. Typically, the site preparation/grading phase generates the most noise because the heaviest, loudest equipment (e.g., graders, excavators, dozers, etc.) is used for these activities.

As shown in Figure 2-4 of Chapter 2, "Project Description," it is anticipated that the majority of development under the 2021 LRDP would occur in the central and lower campus. Implementation of individual projects proposed under the 2021 LRDP would necessitate construction activities near existing development, both on- and off-campus. Construction activities generally occur in phases and would be dispersed throughout the campus. However, construction activities could also occur adjacent to existing residential land uses and could, depending on the

equipment used and distance to nearby noise-sensitive land uses, exceed the acceptable daytime noise levels of 80 dB L_{eq} (see Table 3.12-9) at existing on-campus sensitive land uses and 70 dB L_{max} at off-campus sensitive land uses. Specific construction-related details (e.g., location, schedule, equipment) for individual projects are unknown at this time. Therefore, as an example, construction noise levels were modeled conservatively assuming that up to six pieces of heavy construction equipment would operate simultaneously along the border of the construction site. Based on the modeling conducted, construction-related noise levels could be approximately 93 dB L_{max} and 89 L_{eq} at 50 feet from a construction site. Based on the estimated construction noise levels, implementation of individual projects proposed under the 2021 LRDP would exceed the daytime construction noise standard (i.e., 80 dB L_{eq}) for existing on-campus sensitive land uses at approximately 140 feet. The 70 dB L_{max} construction noise standards for off-campus sensitive land uses would be exceeded at approximately 690 feet. See Appendix H for detailed noise modeling and inputs.

While the majority of construction activities would occur during the daytime (i.e., 8:00 a.m. to 10:00 p.m.) when higher construction noise levels are acceptable and allowed, some activity may be required outside of these hours depending on the circumstance and location. Outdoor construction would be permitted to occur during the nighttime hours only if there are no other reasonable options. For example, some foundation designs require that once the pouring of concrete begins, the pour must continue without pause until complete. In some instances, such a concrete pour may take 20 hours or more, requiring work to occur during nighttime hours. It is unknown at this time if the 2021 LRDP would include construction that would require outdoor nighttime construction. Therefore, to ensure a comprehensive evaluation of potential environmental effects, this EIR assumes the potential for outdoor nighttime construction activity. Depending on the type of construction activities required, equipment used, and distance to noise-sensitive land uses, nighttime construction could exceed the acceptable nighttime noise levels of 70 dB L_{eq} (see Table 3.12-9) at existing on-campus sensitive land uses and 65 dB L_{max} at off-campus sensitive land uses. Based on the estimated construction noise levels, implementation of individual projects proposed under the 2021 LRDP would exceed the nighttime construction noise standard (i.e., 70 dB L_{eq}) for existing on-campus sensitive land uses at approximately 440 feet. The 65 dB L_{max} construction noise standards for off-campus sensitive land uses would be exceeded at 1,225 feet.

Because both daytime and nighttime construction activities associated with implementation of the 2021 LRDP could result in the exceedance of both daytime and nighttime construction noise standards, this impact would be **significant**.

Mitigation Measures

Mitigation Measure 3.12-1: Implement Construction Noise Reduction Measures

As part of construction of new/renovated facilities associated with 2021 LRDP implementation, UC Santa Cruz shall implement or incorporate the following noise reduction measures into construction specifications for the contractor(s) to implement during project construction:

- All construction equipment shall be properly maintained and equipped with noise-reduction intake and exhaust mufflers and engine shrouds, in accordance with manufacturer recommendations. Equipment engine shrouds shall be closed during equipment operation.
- Where available and feasible, construction equipment with back-up alarms shall be equipped with either audible self-adjusting backup alarms or alarms that only sound when an object is detected. Self-adjusting backup alarms shall automatically adjust to 5 dBA over the surrounding background levels. All non-self-adjusting backup alarms shall be set to the lowest setting required to be audible above the surrounding noise levels.
- All construction equipment and equipment staging areas shall be located as far as feasible from nearby noise-sensitive land uses and, when feasible, staging areas shall be located such that existing or constructed noise attenuating features (e.g., temporary noise wall or blankets) block line-of-sight between affected noise-sensitive land uses and construction staging areas.

- Individual operations and techniques shall be replaced with quieter procedures (e.g., using welding instead of riveting, mixing concrete off-site instead of on-site) where feasible, and shall be consistent with building codes and other applicable laws and regulations.
- Stationary noise sources such as generators or pumps shall be located as far away from noise-sensitive uses as feasible.
- No less than 1 week prior to the start of construction activities at a particular location, notification shall be provided to nearby off-campus, noise-sensitive land uses (e.g., residential uses, elementary schools) that are located within 690 feet of the construction site and where projected construction noise levels are anticipated to exceed acceptable daytime L_{max} noise standards.
- When construction would occur within 140 feet of on-campus housing or 690 feet of off-campus noise-sensitive uses (e.g., residences, elementary schools, churches) and may result in temporary noise levels in excess of established standards at the exterior of the adjacent noise-sensitive structure, temporary noise barriers (e.g., noise-insulating blankets or temporary plywood structures) shall be erected, if deemed to be feasible and effective, between the noise source and sensitive receptor such that construction-related noise levels are reduced to acceptable noise levels at the receptor.
- Loud construction activity (i.e., construction activity such as jackhammering, concrete sawing, asphalt removal, and large-scale grading operations) shall not be scheduled during the Campus's finals week.
- When construction of a project requires material hauling, a haul route plan shall be prepared for the project, for review and approval by UC Santa Cruz, that designates haul routes as far as feasible from sensitive receptors.
- The contractor shall designate a disturbance coordinator and post that person's telephone number conspicuously around the construction site, as well as provide it to nearby residences. The disturbance coordinator shall receive all public complaints and be responsible for determining the cause of the complaint and implementing any feasible measures to alleviate the problem.
- Construction activities (excluding activities that would result in a safety concern to the public or construction workers) shall be limited to between the hours of 8:00 a.m. and 10:00 p.m., when feasible. For any construction activity that must extend beyond the daytime hours of 8:00 a.m. and 10:00 p.m. and occurs within 440 feet of an on-campus residential building or 1,225 feet of an off-campus sensitive land use, UC Santa Cruz shall require the use of one or more of the following or equivalent measures to reduce interior noise levels to less than 45 dB L_{eq} at the nearest receptor:
  - Use of noise-reducing enclosures around stationary noise-generating equipment (e.g., concrete mixers, generators, compressors).
  - Installation of temporary noise curtains installed as close as possible to the boundary of the construction site within the direct line of sight path of the nearby sensitive receptor(s). The curtains shall consist of durable, flexible composite material featuring a noise barrier layer bounded to sound-absorptive material on one side. The noise barrier layer shall consist of rugged, impervious, material with a surface weight of at least one pound per square foot.
  - Retain a qualified noise specialist to develop a noise monitoring plan and conduct noise monitoring to ensure that noise reduction measures are achieved the necessary reductions such that levels at the receiving land uses do not exceed exterior noise levels of 45 dBA L_{eq} for construction activity occurring during noise-sensitive nighttime hours.
  - If restricting construction activities to daytime hours (8 a.m. to 10 p.m.) is infeasible and the application of all feasible mitigation, as listed above, does not successfully reduce interior noise levels to lower than 45 dB L_{eq} at the nearest residential noise-sensitive receptor, UC Santa Cruz will offer hotel accommodations to residents who would temporarily be exposed to nighttime interior noise levels that exceed the interior noise standard of 45 L_{eq}. Alternative overnight accommodations should be in a location that is not adversely affected by nighttime construction noise.

Significance after Mitigation

The implementation of Mitigation Measure 3.12-1 would limit the time periods during which construction activities in the vicinity of nearby noise-sensitive land uses would occur. Additionally, Mitigation Measure 3.12-1 would provide substantial reductions in levels of construction noise exposure at noise-sensitive receptors by requiring the use of properly maintained equipment, alternatively powered equipment, exhaust mufflers, engine shrouds, equipment enclosures, and temporary noise barriers (noise curtains typically can reduce noise by up to 10 dBA [EPA 1971]). Additionally, short-term lodging would be offered to residents if they would be temporarily exposed to nighttime (after 10PM) interior noise levels that exceed the interior noise standard of 45 L_{eq}.

Although substantial noise reduction would be achieved through implementation of these measures, due to the uncertainty related to specific construction details (e.g., proximity to receptors, schedule, equipment) for individual projects, it cannot be ensured that the reductions necessary to comply with the daytime and nighttime construction noise standards would be achieved with the implementation of Mitigation Measure 3.12-1. Additionally, it cannot be ensured that Mitigation Measure 3.12-1 would mitigate nighttime noise levels to a less-than-significant level in all cases as it would require the resident accepting the hotel accommodation offer, and if the offer was not accepted, exposure to the elevated noise levels would still occur. Furthermore, running equipment at reduced power would reduce ambient noise levels, as the primary noise would be associated with engine noise; however, such a measure is not considered enforceable and could result in hazardous conditions for construction workers. As a result, it is considered infeasible. Thus, even with implementation of all feasible mitigation, construction noise associated with some projects under the 2021 LRDP could still potentially exceed applicable noise standards. Therefore, this impact would be **significant and unavoidable**.

Impact 3.12-2: Generate Substantial Temporary (Construction) Vibration Levels

Implementation of the 2021 LRDP would include construction activities that may require the use of vibration-generating equipment. If pile driving would be required during construction of future projects, nearby sensitive receptors could be exposed to levels of ground vibration resulting in structural damage and/or human disturbance. Therefore, this impact would be **significant**.

As shown in Table 3.12-11, construction activities generate varying degrees of temporary ground vibration depending on the specific construction equipment used and activities involved. Ground vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increased distance. Construction-related ground vibration is normally associated with impact equipment, such as pile drivers and jackhammers, and the operation of some heavy-duty construction equipment, such as dozers and trucks. Blasting activities also generate relatively high levels of ground vibration and vibration noise. The effects of ground vibration may be imperceptible at low levels. At moderate levels, ground vibration may be detectible as low rumbling sounds; whereas at high levels, ground vibration cause annoyance or sleep disturbance.

Table 3.12-11 Representative Ground Vibration Levels for Construction Equipment

Equipment	PPV (in/sec)[1] at 25 feet	Approximate VdB at 25 feet[2]
Impact Pile Driver	1.518	112
Blasting	1.13	109
Sonic Pile Driver	0.734	105
Vibratory Roller	0.21	94
Large Bulldozer	0.089	87
Loaded Truck	0.076	86
Jackhammer	0.035	79
Small Bulldozer	0.003	58

Notes: PPV = peak particle velocity; VdB = vibration decibels.

Source: FTA 2018:184

As shown in Table 3.12-11, pile driving and blasting are the construction activities that typically generate the greatest levels of ground vibration. However, construction associated with the 2021 LRDP is not anticipated to include the use of impact or sonic pile driving or blasting. Construction activities would often occur in close proximity to existing on- and off-site sensitive receptors, though the locations of individual project sites, specific construction methods used, and the distance to the nearest sensitive receptors is not known at this time. Table 3.12-12 shows the distances at which vibrations generated by anticipated equipment, which excludes pile-driving equipment and blasting, to be used during construction within the LRDP area would exceed the significance threshold of 0.2 in/sec PPV for building structural damage and the significance thresholds of 80 VdB for human disturbance and 65 VdB for sensitive (i.e., laboratory) equipment.

Table 3.12-12 Estimated Distance at Which Ground Vibration for Construction Equipment Would Exceed Thresholds

Equipment	Distance (feet) at Which 0.2 PPV (in/sec)[1] Would Be Exceeded	Distance (feet) at Which 80 VdB Would Be Exceeded	Distance (feet) at Which 65 VdB Would Be Exceeded
Vibratory Roller	25	75	235
Large Bulldozer	15	45	125
Loaded Truck	15	40	125
Jackhammer	10	25	75
Small Bulldozer	2	5	15

Notes: PPV = peak particle velocity; VdB = vibration decibels.

For further details on vibration modeling inputs and parameters, refer to Appendix H.

Source: Modeled by Ascent Environmental in 2020 using data from FTA 2018

As shown in Table 3.12-12, depending on the distance to the nearest sensitive receptor, construction equipment could exceed the thresholds for building structural damage, human disturbance, and sensitive (e.g., laboratory) equipment. Depending on the location of specific structures that would be constructed under the 2021 LRDP, implementation of the 2021 LRDP could expose existing on- and off-site sensitive receptors and structures to levels of ground vibration that could exceed applicable thresholds, and this impact would be **significant**.

Mitigation Measures

Mitigation Measure 3.12-2a: Implement Measures to Reduce Ground Vibration

For any future construction activity that would involve construction activities within 75 feet of an existing sensitive land use or occupied building, the following measures shall be implemented:

- Earthmoving and ground-impacting operations shall be phased so as not to occur simultaneously in areas close to sensitive receptors (i.e., within 75 feet). The total vibration level produced could be significantly less when each vibration source is operated at separate times.
- In the event that simultaneous earthmoving and ground-impacting operations in close proximity to sensitive receptors (i.e., within 75 feet) cannot be avoided, no such construction activities shall be undertaken without prior approval from UC Santa Cruz. Prior to the commencement of such activities, the contractor shall apply for and obtain an exemption from UC Santa Cruz. The application for exemption shall be submitted to UC Santa Cruz and shall include the following information:
  - Explanation as to why operating earthmoving and ground-impacting operations in close proximity to sensitive receptors (i.e., within 75 feet) at separate times is not feasible.
  - Dates and times that the simultaneous earthmoving and ground-impacting operations construction activities would occur.
  - Distance from sensitive receptors at which simultaneous earthmoving and ground-impacting operations construction activities would occur.

  - Identify the on- and off-site sensitive receptors and structures that could be exposed to levels of ground vibration that could exceed applicable thresholds and apply Mitigation Measure 3.12-2b if applicable.

- Rubber-tired equipment shall be used, where feasible, instead of tracked equipment.
- Where there is flexibility in the location of use of heavy-duty construction equipment, the equipment shall be operated as far away (up to 250 feet) from vibration-sensitive sites.

Mitigation Measure 3.12-2b: Develop and Implement a Vibration Control Plan

To assess and, when needed, reduce vibration and noise impacts from construction activities, the following measures shall be implemented:

- A vibration control plan shall be developed prior to initiating any construction activities within 50 feet of a sensitive use (75 feet if vibratory equipment is required) and within 125 feet of a structure with laboratory or other similarly sensitive equipment (235 feet if vibratory equipment is required). Applicable elements of the plan shall be implemented before, during, and after construction activities. The plan will include measures sufficient to reduce vibration at sensitive receptors to levels below applicable thresholds (i.e., 0.2 in/sec PPV for building structural damage, 80 VdB for human disturbance and 65 VdB for sensitive equipment). Items that will be addressed in the plan may include, but are not limited to, the following:
  - Pre-construction surveys shall be conducted to identify any pre-existing structural damage to buildings that may be affected by project-generated vibration.
  - Identification of minimum setback requirements for different types of ground-vibration-producing activities (e.g., use of a vibratory roller) for the purpose of preventing damage to nearby structures and preventing adverse effects on people. Factors to be considered include the nature of the vibration-producing activity, local soil conditions, and the fragility/resiliency of the nearby structures. Initial setback requirements can be reduced if a project- and site-specific analysis is conducted by a qualified geotechnical engineer or ground vibration specialist that indicates that no structural damage to buildings or structures would occur.
  - Identification of vibration-sensitive equipment and existing vibration control measures for the identified equipment. If, upon evaluation and prior to construction, vibration levels at the nearby equipment would exceed 65 VdB, UC Santa Cruz shall either provide additional vibration dampening (e.g., mounting) for the equipment or relocate the equipment to another suitable location on campus until construction vibration would decrease to below 65 VdB.
  - Vibration levels shall be monitored and documented at the nearest sensitive land use within the aforementioned distances to document that applicable thresholds are not exceeded. Recorded data shall be submitted on a twice-weekly basis to UC Santa Cruz. If it is found at any time that thresholds are exceeded, construction activities shall cease in that location, and methods shall be implemented to reduce vibration to below applicable thresholds, or an alternative pile installation method shall be used at that location.

Significance after Mitigation

Implementation of Mitigation Measures 3.12-2a and 3.12-2b would require the contractor(s) to minimize vibration exposure at nearby receptors by locating equipment far from receptors and phasing operations. Further, if pile driving would be required, a vibration control plan would be prepared and implemented to refine appropriate setback distances and identify other measures to reduce vibration, if necessary, and identify and implement alternative methods to pile driving if required. These measures would ensure compliance with recommended levels to prevent damage to structures and human annoyance. Thus, this impact would be reduced to a **less-than-significant** level.

Impact 3.12-3: Generate Substantial Long-Term Stationary Noise

The new buildings and facilities constructed as part of the 2021 LRDP may result in increased noise levels as a result of new stationary noise sources and equipment (e.g., HVAC units, backup generators), and other new sources such as gathering spaces, loading docks, corporation yards, and parking lots. Depending on the distance to noise-sensitive receptors, intervening shielding, and noise-reduction features incorporated in the project, noise levels associated with new stationary noise sources could result in the exceedance of exterior noise limits at existing noise-sensitive land uses, resulting in disturbance to human activities during the daytime or sleep disruption at night. Therefore, this impact would be **significant**.

Implementation of the 2021 LRDP would result in the expansion of on-campus housing, academic/administrative building space, and the Campus Natural Reserve, and a reduction in recreation and athletic areas. Expansion of on-campus housing and academic building space would result in the construction and installation of new stationary sources on the campus including outdoor event space, other gathering spaces, loading docks, corporation yards, and building mechanical equipment such as HVAC units and emergency generators.

Activities occurring within the Campus Natural Reserve (e.g., outdoor classes, habitat/ecological research activities) and other open space areas on-campus are not anticipated to generate substantial noise due to the nature of these land uses. The 2021 LRDP would result in a net decrease in recreation and athletic facilities; and thus, noise levels associated with these facilities are not anticipated to increase as a result of 2021 LRDP implementation. Additionally, the proposed area designated for recreation and athletics, as shown in Figure 2-5 in Chapter 2, "Project Description," is located adjacent to the central campus and is not located near any off-campus noise-sensitive receptors. Further, the 2021 LRDP does not propose the construction of any new facilities where large outdoor events (e.g., concerts, sporting events) would occur. Large events, such as graduation and student orientation, are a part of existing conditions, occur infrequently, and are required to follow UC policies regarding large events, obtaining the applicable permits when necessary. Therefore, noise levels associated with large events are not anticipated to increase as a result of 2021 LRDP implementation. While the 2021 LRDP may include construction of parking facilities, such development would be limited and consolidated at the periphery of the academic core. The 2021 LRDP would emphasize public transit provided by Santa Cruz Metropolitan Transit District (METRO) and internal campus shuttles, as well as expanding and improving pedestrian and bicycle facilities. Personal automobile access would be restricted throughout many parts of campus, and it is not anticipated that expanded parking facilities would generate substantial noise levels at on- or off-campus sensitive receptors. Finally, operational maintenance activities (e.g., landscaping, trash pickup) are not expected to generate noise levels substantially higher than existing conditions near new noise-sensitive receptors because the 2021 LRDP would not include an expansion of the campus boundary, and no land use types that do not already exist on-campus are being proposed under the 2021 LRDP.

On-campus Gatherings

Development throughout campus as implemented under the 2021 LRDP would likely include small gathering spaces such as courtyards where groups would occasionally meet, such as for student clubs or academic functions. Although these on-campus gatherings would not utilize broadly amplified sound through large loudspeakers, small, portable speakers may occasionally be used to project music or speech in the direct vicinity of the gathering. Such gatherings would involve a small number of people, would occur intermittently, and would be required to follow all UC policies related to noise and events. Therefore, on-campus gatherings are not anticipated to expose off-site receptors to noise levels that would exceed applicable standards, including no outdoor amplification beyond 10 p.m.

Loading Dock and Corporation Yard Activity

Some buildings constructed as part of the 2021 LRDP may have loading docks or designated areas for receiving shipments by commercial trucks. Additionally, corporation yards constructed or expanded as part of the 2021 LRDP would be used for storage of fleet vehicles and equipment (e.g., garbage trucks, maintenance trucks), as well as for providing operational maintenance and support facilities such as vehicle fueling facilities, repair facilities, and office space. Noise generated by loading docks and corporation yard activities would be similar in nature by virtue of the primary noise source for both uses being truck activity. Noise sources from truck activity associated with delivery

areas and corporation yards are usually short-term and can include activities such as vehicle idling, engine revving, and the release of air brakes on heavy trucks. Measured noise levels for these noise-generating activities are summarized in Table 3.12-13. Most of the noise-generating activities listed in Table 3.12-13 last for a period ranging from a few seconds (e.g., release of air brakes) to a few minutes (e.g., idling) and can reoccur multiple times during a single truck visit.

As shown in Table 3.12-13, the loudest measured truck-related noise is the release of a truck's air brakes after it comes to a stop, which generates noise levels as high as 86 dB L_{max} at 50 feet. Due to the short-term nature of loading dock and corporation yard truck noise and because the County standards are more stringent, the County's daytime and nighttime L_{max} standards for stationary noise are applied in this analysis. Based on the highest noise level (86 dB L_{max} at 50 feet) listed in Table 3.12-13, noise levels would attenuate to the County's daytime standard of 70 dB L_{max} at a distance of 320 feet and the County's nighttime standard of 65 dB L_{max} at a distance of 560 feet. Depending on the distance to noise-sensitive receptors, intervening shielding, and noise-reduction features incorporated into the loading dock or corporation yard design, on- or off-campus noise-sensitive receptors located close to on-site delivery areas or corporation yards could be exposed to noise levels that exceed the County's daytime and nighttime standards of 70 dB L_{max} and 65 dB L_{max}, respectively.

Table 3.12-13 Noise Levels Generated by Truck Activity at Delivery Areas

Noise-Generating Activity	Noise Level (dB L_{max}) at 50 feet
Idling 18-wheel heavy truck	64–65
Truck with trailer driving at 5 mph	65
Truck with trailer driving at 10 mph	66–68
Truck revving engine	69-80
Truck releasing air brakes at a stop	74–86

Notes: dB = decibel; mph = miles per hour.

Sources: Measurement data collected by EDAW in August 2006 and presented in the Merced Wal-Mart Distribution Center EIR (City of Merced 2009:4.8-21)

Building Mechanical Equipment

Implementation of the 2021 LRDP would result in increased stationary source noise levels associated with building mechanical equipment, primarily emergency generators and HVAC units. Emergency/back-up generators would only be used for continued periods of time during power outages or building equipment malfunctions and, therefore, do not substantially contribute to increases in average ambient noise levels. Further, back-up equipment would be tested periodically for short periods of time during the daytime hours (i.e., 8:00 a.m. to 10:00 p.m.)., consistent with typical work shifts of maintenance personnel. Thus, due to the infrequent, intermittent, and temporary use characteristics of these noise sources, in combination with that fact that typical maintenance activity would occur during the less sensitive times of the day, noise generated from new emergency/back-up generators would not be considered a substantial permanent increase in noise that could disturb nearby receptors.

Detailed information regarding the stationary equipment to be installed for facilities constructed under the 2021 LRDP is not available at this time. However, noise levels commonly associated with larger commercial-use air conditioning systems can reach levels of up to 78 dB at 3 feet (Lennox 2019). Commonly installed building equipment, such as HVAC systems, can be located in the interior of the structure, on rooftops, or in direct line-of-sight to adjacent land uses. Based on the reference noise level, HVAC units would generate a noise level of 54 dB L_{eq} at 50 feet. Due to the long-term and ambient nature of HVAC noise, the aforementioned daytime and nighttime L_{eq} standards for stationary noise are applied in this analysis. Based on the reference noise level, HVAC noise would attenuate to the County's daytime standard of 50 L_{eq} at a distance of 75 feet and the County's nighttime standard of 45 L_{eq} at a distance of 135 feet. Although noise-sensitive receptors could be located within these distances, individual projects constructed under the 2021 LRDP would be required to follow all requirements in the UC Santa Cruz Campus Standards Handbook regarding noise generated by building mechanical equipment, including selection of HVAC systems that are appropriate for the project and its location and appropriate controls, as needed. Thus, the increase

in ambient noise levels associated with HVAC systems at nearby noise-sensitive land uses would not exceed applicable noise standards.

Summary

On-campus gatherings are not anticipated to expose off-site receptors to noise levels that exceed applicable standards. Additionally, building mechanical equipment would not generate substantial operational noise levels and their design would be required to follow all UC building regulations. However, depending on the distance to noise-sensitive receptors, intervening shielding, and noise-reduction features incorporated into the loading dock or corporation yard design, noise-generating activity at these land uses could expose nearby noise-sensitive receptors to noise levels that exceed noise thresholds. Therefore, this impact would be **significant** regarding noise generated by loading dock and corporation yard activity.

Mitigation Measures

Mitigation Measure 3.12-3a: Implement Noise Reduction Measures to Reduce Long-Term Noise Impacts from Loading Dock Activity

To minimize noise levels generated by loading docks and delivery activity to levels that do not exceed the daytime standard of 70 dB L_{max} or nighttime standard of 65 dB L_{max}, the following measures shall be implemented for construction projects that include loading docks:

- New loading docks only used during daytime hours (8 a.m. to 10 p.m.) shall be located at least 320 feet from all residential receptors, and new loading docks used during daytime and nighttime hours shall be located at least 560 feet from all residential receptors. If this is not feasible, UC Santa Cruz shall reduce the noise level at all residential receptors to 70 dB L_{max} during daytime hours and 65 dB L_{max} during nighttime hours by incorporating one or more of the following mitigation strategies, the effectiveness of which shall be determined on a project-level basis by an acoustical professional:
  - Design and build sound barriers near loading docks and delivery areas that block the line of sight between truck activity areas and residential land uses. Sound barriers may consist of a wall, earthen berm, or combination thereof.
  - Constructing loading dock pits that are below grade relative to the surrounding parking area or placing loading docks on the side of a building that does not directly face noise-sensitive receptors.
  - Incorporate a setback distance from loading docks to noise-sensitive receptors, and prohibit truck travel and activity within the setback area by posting signs and/or by installing gates that restrict truck access

Mitigation Measure 3.12-3b: Implement Noise Reduction Measures to Reduce Long-Term Noise Impacts from Corporation Yard Activity

To minimize noise levels generated by corporation yard activity to levels that do not exceed the daytime standard of 70 dB L_{max} or nighttime standard of 65 dB L_{max}, the following measures shall be implemented for the construction of new corporation yards:

- New corporation yards only used during daytime hours (8 a.m. to 10 p.m.) shall be located at least 320 feet from all residential receptors, and new corporation yards used during daytime and nighttime hours shall be located at least 560 feet from all residential receptors. If this is not feasible, UC Santa Cruz shall reduce the noise level at all residential receptors to 70 dB L_{max} during daytime hours and 65 dB L_{max} during nighttime hours by incorporating one or more of the following mitigation strategies, the effectiveness of which shall be determined on a project-level basis by an acoustical professional:
  - Design and build sound barriers around corporation yards that block the line of sight between truck activity areas and residential land uses. Sound barriers may consist of a wall, earthen berm, or combination thereof.

- Incorporate a setback distance from corporation yards to noise-sensitive receptors, and prohibit travel and activity of trucks or other heavy equipment within the setback area by posting signs and/or by installing gates that restrict truck access.

Significance after Mitigation

Implementation of Mitigation Measures 3.12-3a and 3.12-3b would ensure that both on- and off-campus residential land uses would not be exposed to noise generated by loading dock or corporation yard activity such that the daytime or nighttime noise standards of 70 and 65 dB L_{max}, respectively, would be exceeded. For instance, a specific loading dock may utilize a 100-foot setback and a sound wall offering 5-dB of attenuation to ensure that residential receptors would not be exposed to noise levels that exceed the daytime noise standard of 70 dB L_{max}. Alternatively, setback distances could be shorter if more noise-reducing design features were implemented or if loading docks were placed strategically relative to noise-sensitive land uses. Therefore, implementation of Mitigation Measures 3.12-3a and 3.12-3b would reduce impacts related to loading dock and corporation yard activities to **less than significant**.

Impact 3.12-4: Generate a Substantial Increase in Permanent (Traffic) Noise Levels

Population growth and development associated with implementation of the 2021 LRDP would increase traffic within and outside UC Santa Cruz main residential campus and Westside Research Park. However, project-generated traffic volumes would not be at levels high enough to cause substantial increases in traffic noise (i.e., 5 dB increase in traffic-related noise, where the post-project noise level would remain equal to or lower than 60 dB L_{dn}, and a 3 dB increase in traffic-related noise where the post-project noise level would exceed 60 dB L_{dn}). This impact would be **less than significant**.

Development associated with the 2021 LRDP would result in some increases in traffic volumes along affected roadway segments and potentially generate an increase in traffic source noise levels. Generally, a doubling of a noise source (such as twice as much traffic) is required to result in an increase of 3 dB, which is perceived as noticeable by people (Caltrans 2013a: 2-10). This analysis focuses on the potential for the additional roadway volumes associated with implementation of the 2021 LRDP to exceed the aforementioned incremental noise increase standard for sensitive receptors (i.e., 5 dB increase in traffic-related noise, where the post-project noise level would remain equal to or lower than 60 dB L_{dn}, and a 3 dB increase in traffic-related noise where the post-project noise level would exceed 60 dB L_{dn}) in the absence of other applicable transportation-specific noise standards.

To assess this impact, traffic noise levels associated with the 2021 LRDP under existing and existing-plus-project conditions were modeled for select roadway segments. See Appendix H for detailed modeling assumptions. Table 3.12-14 summarizes the increases in noise on project-affected roadway segments.

Table 3.12-14 Predicted Increases in Traffic Noise Levels

Roadway[1]	Predicted dBA L_{dn}, 100 Feet from Centerline Existing	Predicted dBA L_{dn}, 100 Feet from Centerline Existing Plus Project	Predicted Change (dBA)	Applicable Incremental Noise Increase Standard (dBA)	Significant Increase?
Bay Street	62.1	63.0	0.9	3	No
Empire Grade	61.2	62.3	1.1	3	No
Coolidge Drive	60.7	61.9	1.2	3	No
Hagar Drive	62.7	63.5	0.8	3	No
Heller Drive	55.9	59.1	3.2	5	No
High Street[2]	62.4	63.4	1.0	3	No
SR 17	72.4	72.5	0.1	3	No
McLaughlin Drive	52.6	55.8	3.2	5	No
Mission Street/ Highway 1	65.2	65.4	0.2	3	No
Natural Bridges Drive	57.2	57.3	0.1	5	No
Western Drive	54.5	55.7	1.2	5	No

Notes: Traffic noise levels were calculated using methods consistent with the FHWA roadway noise prediction model, based on data obtained from the traffic analysis prepared for this project; dBA=A-weighted decibel; Ldn = Day-Night Noise Level.

[1] Based on results from the Regional Transportation Commission modeling, as summarized in Section 3.16, "Transportation," and provided in Appendix I, the segment with the largest ADT volume was modeled and displayed for each applicable roadway to ensure a conservative analysis.

[2] Predicted traffic noise levels modeled at 50 feet from centerline due to noise sensitive receptors being located closer than 100 feet from the roadway centerline.

Source: Modeled by Ascent Environmental, Inc, in 2020

As shown in Table 3.12-14, development of the 2021 LRDP would result in predicted increases in traffic noise levels ranging from approximately 0.1 to 3.2 dBA along affected area roadway segments. Additionally, as shown in Table 3.12-14, the incremental traffic noise increase standards applicable to each individual roadway would not be exceeded. Therefore, implementation of the project would not result in a substantial increase (i.e., 5 dB increase where the post-project noise level would remain equal to or lower than 60 dB L_{dn}, and 3 dB where the post-project noise level would exceed 60 dB L_{dn}) in traffic noise. This impact would be **less than significant**.

Mitigation Measures

No mitigation is required.

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