4.12 Noise

This section describes the existing noise conditions of the project site and vicinity, identifies associated regulatory requirements, evaluates potential project and cumulative impacts, and identifies mitigation measures for any significant impacts related to implementation of the of the Laguna Creek Diversion Retrofit Project (Proposed Project). The analysis is based on noise modeling conducted for the Proposed Project as part of the preparation of this environmental impact report (EIR). The results of the noise modeling are summarized in this section, and are included in Appendix E.

A summary of the comments received during the scoping period for this EIR is provided in Table 2-1 in Chapter 2, Introduction, and a complete list of comments is provided in Appendix A. There were no comments related to noise.

4.12.1 Existing Conditions

4.12.1.1 Acoustic Fundamentals

Acoustics is the scientific study that evaluates perception, propagation, absorption, and reflection of sound waves. Sound is a mechanical form of radiant energy, transmitted by a pressure wave through a solid, liquid, or gaseous medium. Sound that is loud, disagreeable, unexpected, or unwanted is generally defined as noise; consequently, the perception of sound is subjective in nature, and can vary substantially from person to person. Common sources of environmental noise and relative noise levels are shown in Table 4.12-1.

Table 4.12-1. Typical Noise Levels Associated With Common Activities

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110	Rock Band
Jet Flyover at 1,000 feet		
	100	
Gas Lawn Mower at three feet		
	90	
Diesel Truck at 50 feet, 50 mph		Food Blender at 3 feet
	80	Garbage Disposal at 3 feet
Noisy Urban Area, Daytime		
	70	Vacuum Cleaner at 10 feet
Commercial Area		Normal speech at 3 feet
Heavy Traffic at 300 feet	60	
		Large Business Office
Quiet Urban Daytime	50	Dishwasher (in next room)
Quiet Urban Nighttime	40	Theater, Large Conference Room (background)
Quiet Suburban Nighttime		
	30	Library
Quiet Rural Nighttime		Bedroom at Night, Concert Hall (background)
	20	
		Broadcast/Recording Studio
	10	
Lowest Threshold of Human Hearing (Healthy)	0	Lowest Threshold of Human Hearing (Healthy)

Source: Caltrans 2013.
Notes: dBA = A-weighted decibels.

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

Directly measuring sound pressure fluctuations would require the use of a very large and cumbersome range of numbers. To avoid this and to have a more useable numbering system, the decibel (dB) scale was introduced. Sound level expressed in decibels (dB) is the logarithmic ratio of two like pressure quantities, with one pressure quantity being a reference sound pressure and the second pressure being that of the sound source of concern. For sound pressure in air, the standard reference quantity is generally considered to be 20 micropascals, which directly corresponds to the threshold of human hearing. The use of the decibel is a convenient way to handle the million-fold range of sound pressures to which the human ear is sensitive. A decibel is logarithmic; it does not follow normal algebraic methods and cannot be directly added. For example, a 65-dB source of sound, such as a truck, when joined by another 65-dB source results in a sound amplitude of 68 dB, not 130 dB (i.e., doubling the source strength increases the sound pressure by 3 dB). A sound level increase of 10 dB corresponds to 10 times the acoustical energy, and an increase of 20 dB equates to a 100-fold increase in acoustical energy.

The loudness of sound perceived by the human ear depends primarily on the overall sound pressure level and frequency content of the sound source. The human ear is not equally sensitive to loudness at all frequencies in the audible spectrum. To better relate overall sound levels and loudness to human perception, frequency-dependent weighting networks were developed. The standard weighting networks are identified as A through E. There is a strong correlation between the way humans perceive sound and A-weighted decibels (dBA). For this reason, the dBA can be used to predict community response to noise from the environment, including noise from transportation and stationary sources. Sound levels expressed as dB in this section are A-weighted sound levels, unless noted otherwise.

Noise can be generated by a number of sources, including mobile sources (transportation) such as automobiles, trucks, and airplanes, and stationary sources (non-transportation) such as construction sites, machinery, and commercial and industrial operations. As acoustic energy spreads through the atmosphere from the source to the receiver, noise levels attenuate (decrease) depending on ground absorption characteristics, atmospheric conditions, and the presence of physical barriers (e.g., walls, building façades, berms). Noise generated from mobile sources generally attenuate at a rate of 3 dB (typical for hard surfaces, such as asphalt) to 4.5 dB (typical for soft surfaces, such as grasslands) per doubling of distance, depending on the intervening ground type. Stationary noise sources spread with more spherical dispersion patterns that attenuate at a rate of 6 dB to 7.5 dBA per doubling of distance for hard and soft sites, respectively.

Atmospheric conditions such as wind speed, turbulence, temperature gradients, and humidity may additionally alter the propagation of noise and affect levels at a receiver. Furthermore, the presence of a large object (e.g., barrier, topographic features, or intervening building façades) between the source and the receptor can provide significant attenuation of noise levels at the receiver. The amount of noise level reduction or “shielding” provided by a barrier primarily depends on the size of the barrier, the location of the barrier in relation to the source and receivers, and the frequency spectra of the noise. Natural barriers such as earthen berms, hills, or dense woods as well as built features such as buildings, concrete berms and walls may be effective barriers for the reduction of source noise levels.

4.12.1.2 Noise Descriptors

The intensity of environmental noise levels can fluctuate greatly over time and as such, several different descriptors of time-averaged noise levels may be used to provide the most effective means of expressing the noise levels. The selection of a proper noise descriptor for a specific source depends on the spatial and temporal distribution, duration, and fluctuation of both the noise source and the environment near the receptor(s). Noise descriptors most often used to describe environmental noise are defined as follows:

- **L_{max} (Maximum Noise Level):** The maximum instantaneous noise level during a specific period of time.
- **L_{min} (Minimum Noise Level):** The minimum instantaneous noise level during a specific period of time.
- **Lx (Statistical Descriptor):** The noise level exceeded "X" percent of a specific period of time. For example, L50 is the median noise level, or level exceeded 50% of the time.
- **L_{eq} (Equivalent Noise Level):** The average noise level. The instantaneous noise levels during a specific period of time in dBA are converted to relative energy values. From the sum of the relative energy values, an average energy value is calculated, which is then converted back to dBA to determine the L_{eq} In noise environments determined by major noise events, such as aircraft over-flights, the L_{eq} value is heavily influenced by the magnitude and number of single events that produce the high noise levels.
- **L_{dn} (Day-Night Average Noise Level):** The 24-hour L_{eq} with a 10-dBA "penalty" for noise events that occur during the noise-sensitive hours between 10:00 p.m. and 7:00 a.m. In other words, 10 dBA is "added" to noise events that occur in the nighttime hours, and this generates a higher reported noise level when determining compliance with noise standards. The L_{dn} attempts to account for the fact that noise during this specific period of time is a potential source of disturbance with respect to normal sleeping hours.
- **CNEL (Community Noise Equivalent Level):** The CNEL is similar to the L_{dn} described above, but with an additional 5-dBA "penalty" added to noise events that occur during the noise-sensitive hours between 7:00 p.m. and 10:00 p.m., which are typically reserved for relaxation, conversation, reading, and television. When the same 24-hour noise data are used, the reported CNEL is typically approximately 0.5 dBA higher than the L_{dn}.
- **SEL (Sound Exposure Level):** The cumulative exposure to sound energy over a stated period of time; typically the energy of an event, summed into a 1-second period of time.

Community noise is commonly described in terms of the ambient noise level which is defined as the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent sound level (L_{eq}) which corresponds to the steady-state A-weighted sound level containing the same total energy as the time-varying signal over a given time period (usually 1 hour). The L_{eq} is the foundation of the composite noise descriptors such as L_{dn} and CNEL, as defined above, and shows very good correlation with community response to noise. Use of these descriptors along with the maximum noise level occurring during a given time period provides a great deal of information about the ambient noise environment in an area.

4.12.1.3 Negative Effects of Noise on Humans

Excessive and chronic exposure to elevated noise levels can result in auditory and non-auditory effects on humans. Auditory effects of noise on people are those related to temporary or permanent hearing loss caused by loud noises. Non-auditory effects of exposure to elevated noise levels are those related to behavioral and physiological effects. The non-auditory behavioral effects of noise on humans are associated primarily with the subjective effects of

annoyance, nuisance, and dissatisfaction, which lead to interference with activities such as communications, sleep, and learning. The non-auditory physiological health effects of noise on humans have been the subject of considerable research attempting to discover correlations between exposure to elevated noise levels and health problems, such as hypertension and cardiovascular disease. The majority of research infers that noise-related health issues are predominantly the result of behavioral stressors and not a direct noise-induced response. The extent to which noise contributes to non-auditory health effects remains a subject of considerable research, with no definitive conclusions.

The degree to which noise results in annoyance and interference is highly subjective and may be influenced by several non-acoustic factors. The number and effect of these non-acoustic environmental and physical factors vary depending on individual characteristics of the noise environment such as sensitivity, level of activity, location, time of day, and length of exposure. One key aspect in the prediction of human response to new noise environments is the individual level of adaptation to an existing noise environment. The greater the change in the noise levels that are attributed to a new noise source, relative to the environment an individual has become accustomed to, the less tolerable the new noise source will be to an individual.

With respect to how humans perceive and react to changes in noise levels, a 1-dBA increase is generally imperceptible outside of a laboratory environment, a 3-dBA increase is barely perceptible, a 6-dBA increase is clearly noticeable, and a 10-dBA increase is subjectively perceived as approximately twice as loud (Egan 1988). These subjective reactions to changes in noise levels was developed on the basis of test subjects' reactions to changes in the levels of steady-state, pure tones or broad-band noise and to changes in levels of a given noise source. Perception and reaction to changes in noise levels in this manner is thought to be most applicable in the range of 50 to 70 dBA, as this is the usual range of voice and interior noise levels.

4.12.1.4 Vibration Fundamentals

Vibration is similar to noise in that it is a pressure wave traveling through an elastic medium involving a periodic oscillation relative to a reference point. Vibration is most commonly described in respect to the excitation of a structure or surface, such as in buildings or the ground. Human and structural response to different vibration levels is influenced by a number of factors, including ground type, distance between source and receptor, duration, and the number of perceived vibration events. Sources of vibration include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, landslides) and those introduced by human activity (e.g., explosions, machinery, traffic, trains, construction equipment). Vibration sources may be continuous, (e.g., operating factory machinery) or transient in nature (e.g., explosions, impacts). Vibration levels can be depicted in terms of amplitude and frequency; relative to displacement, velocity, or acceleration.

Vibration amplitudes are commonly expressed in peak particle velocity (PPV) or root-mean-square (RMS) vibration velocity. PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal, or the quantity of displacement measured from peak to trough of the vibration wave. RMS is defined as the positive and negative statistical measure of the magnitude of a varying quantity. The RMS of a signal is the average of the squared amplitude of the signal, typically calculated over a period of one second. 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). PPV and RMS vibration velocity are nominally described in terms of inches per second (in/sec). However, as with airborne sound, vibration velocity can also be expressed using decibel notation as vibration decibels (VdB) with a reference quantity of 1 micro-inch per second. The logarithmic nature of the decibel serves to compress the broad range of numbers required to describe vibration and allow for the presentation of vibration levels in familiar terms.

Although PPV is appropriate for evaluating the potential for building damage, it is not always suitable for evaluating human response. Human response to vibration has been found to correlate well to average vibration amplitude; therefore, vibration impacts on humans are evaluated in terms of RMS vibration velocity.

Typical outdoor sources of perceptible groundborne vibration include construction equipment, steel-wheeled trains, and vehicles on rough roads. Although the effects of vibration may be imperceptible at low levels, effects may result in detectable vibrations and slight damage to nearby structures at moderate and high levels, respectively. At the elevated levels of vibration, damage to structures is primarily architectural (e.g., loosening and cracking of plaster or stucco coatings) and rarely results in damage to structural components. The range of vibration relevant to this analysis occurs from approximately 60 VdB, which is the typical background vibration-velocity level; to 100 VdB, which is the general threshold where minor damage can occur in fragile buildings (FTA 2018). Table 4.12-2 identifies some common sources of vibration, corresponding VdB levels, and associated human perception and potential for structural damage.

Table 4.12-2. Typical Levels of Groundborne Vibration

Human/Structural Response	Velocity Level, VdB (re 1 µ-inch/sec, RMS)	Typical Events (50-foot setback)
Threshold, minor cosmetic damage	100	Blasting, pile driving, vibratory compaction equipment
—	95	Heavy tracked vehicles (Bulldozers, cranes, drill rigs)
Difficulty with tasks such as reading a video or computer screen	90	Commuter rail, upper range
Residential annoyance, infrequent events	80	Rapid transit, upper range
Residential annoyance, occasional events	75	Commuter rail, typical bus or truck over bump or on rough roads
Residential annoyance, frequent events	72	Rapid transit, typical
Approximate human threshold of perception to vibration	65	Buses, trucks, and heavy street traffic
—	60	Background vibration in residential settings in the absence of activity
Lower limit for equipment ultra-sensitive to vibration	50	—

Source: FTA 2018.
Notes: re = in reference to; µ-inch/sec = micro-inch per second; VdB = vibration decibels; RMS = root-mean-square.

4.12.1.5 Existing Noise Environment

The Proposed Project is in the community of Bonny Doon in unincorporated Santa Cruz County, California. The land use designation of the site is Mountain Residential (R-M) and zoning is Timber Production (TP), allowing for the growing and harvesting of timber and other forest products. The project site is surrounded predominantly by undeveloped, heavily forested land, with scattered, low-density residential development to the east, south, and west. The project area has a number of existing noise sources influencing the ambient noise environment, such as, vehicular traffic, aircraft overflights, maintenance and construction operations; general community noise (e.g., landscaping activities and people interacting) and the natural environment (e.g., creek/water flowing) contribute to a lesser extent. The dominant noise source is transportation noise generated from vehicular traffic on Smith Grade.

The existing ambient noise environment was quantified through field surveys, sound level measurements, and the use of industry-standard reference data and noise prediction methodologies. Separate discussions of major noise sources identified in the project area and their respective effects are provided in the following sections.

Noise-Sensitive Land Uses

Noise-sensitive land uses generally include those uses where exposure to noise would result in adverse effects, as well as uses where quiet is an essential element of the 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.

Noise-sensitive land uses in the vicinity of the project site are primarily single-family residences. Noise-sensitive land uses nearest the project site are located approximately 100 feet south of the project site across Smith Grade. Existing land uses in the project vicinity are further described in Chapter 3, Project Description.

Ambient Noise Survey

Sound level measurements were conducted on February 2, 2020, to document the existing noise environment within and adjacent to the project site to establish baseline noise conditions against which to compare project-generated noise levels. All noise measurements were performed in accordance with American National Standards Institute (ANSI) and American Standards for Testing and Measurement guidelines, at three locations in and around the project site, as shown on Figure 4.12-1.

Noise measurements were performed using Larson Davis Laboratories Model 831, Type 1 precision integrating sound-level meters. Field calibrations were performed on the sound-level meters with acoustic calibrators before and after the measurements. All instrumentation components, including microphones, preamplifiers and field calibrators have laboratory certified calibrations traceable to the National Institute of Standards and Technology. The equipment used meets all pertinent specifications of the ANSI for Type 1 sound-level meters (ANSI S1.4-1983 [R2006]). Meteorological conditions during the monitoring periods were fair with temperatures ranging from 50°F to 63°F, light winds from 0 to 3 miles per hour, and partly cloudy skies. No precipitation occurred during the monitoring periods.

Short-term noise monitoring (15-minute duration) was conducted at 3 locations to provide insight into the existing ambient noise environment. Monitoring location ST-1 was located approximately 50-feet east of the existing dam structure centerline to capture existing operational noise levels. Monitoring locations ST-2 and ST-3 were located adjacent to the nearest noise-sensitive receptor, across Smith Grade from the project site. Monitoring equipment was configured to catalog pertinent noise metrics, such as L_{eq}, L_{min}, L_{max} and statistical Lx sound levels. Ambient noise level data cataloged during the short-term monitoring is presented in Table 4.12-3, with locations shown on Figure 4.12-1.

SOURCE: ESRI 2020, City of Santa Cruz 2020, Black & Veatch 2020

DUDEK

0 60 120 Feet

FIGURE 4.12-1

Noise Measurement Locations and Nearest Sensitive Receptor

Laguna Creek Diversion Retrofit Project - EIR

Table 4.12-3. Summary of Short-Term Ambient Noise Measurements

Site	Location	Date/Time	Average Noise Level (dBA)			
			L_{eq}	L_{max}	L50	L90
ST-1	50 feet east of existing dam centerline	02/02/2020 15:29	64.7	66.1	64.7	64.6
ST-2	Adjacent to nearest receptor boundary	02/02/2020 15:40	55.3	75.8	42.5	42.3
ST-3	Adjacent to nearest residential structure	02/02/2020 16:03	50.8	71.7	42.9	40.7

Source: Appendix E.
Notes: Measurement ST-1 was 5 minutes in duration and measurement ST-2, and ST-3 were 15 minutes in duration.
dBA = A-weighted decibels; L_{eq} = average equivalent noise level; L_{max} = maximum noise level; L50 = sound level exceeded 50% of the period; L90 = sound level exceeded 90% of the period.

As shown in Table 4.12-3, existing short-term noise levels range from an average of approximately 51 dBA to 65 dBA L_{eq}, with background (L90) noise levels ranging from approximately 41 dBA to 65 dBA L90 and maximum noise levels from 66 dBA to 76 dBA L_{max}.

Sound levels documented at the ST-1 location were directly attributable to water going over the dam and no mechanical noise sources associated with the existing dam or diversion facility were documented during the measurement. Sound levels at monitoring locations ST-2 and ST-3 were driven primarily by vehicular traffic on Smith Grade, with the dam, aircraft overflights, distant traffic and community noise contributing to a lesser degree.

Traffic Noise

Existing traffic noise levels were modeled for roadway segments in the project vicinity based on the Federal Highway Administration (FHWA) Traffic Noise Model prediction methodologies (FHWA 1998), and traffic volume data from the County of Santa Cruz Department of Public Works (County of Santa Cruz 2020a). Traffic data are not available for the road immediately adjacent to the project site (i.e., Smith Grade); however, information for Empire Grade, which is approximately 2.5 miles east, was available and provided by the County. As such, the traffic data for Empire Grade was used as a proxy for Smith Grade.

The FHWA Traffic Noise Model incorporates sound emissions and sound propagation algorithms based on well-established theory and accepted international standards. The acoustical algorithms contained within the FHWA Traffic Noise Model have been validated with respect to carefully conducted noise measurement programs and show excellent agreement in most cases for sites with and without noise barriers. The noise modeling accounted for factors such as vehicle volume, speed, vehicle type, roadway configuration, distance to the receiver, and propagation over different types of ground (acoustically soft and hard ground).

In order to ensure that modeled existing traffic noise levels correlate with measured traffic noise levels, field observations and data collected during short-term noise monitoring are typically used to calibrate the traffic model. However, due to the low traffic volumes present during the noise monitoring, vehicle pass-bys were insufficient to be utilized within typical Caltrans/FHWA traffic calibration methodology; therefore, no offset was incorporated in to the model.[1]

[1] Using the traffic counts and field observations cataloged during the short-term noise monitoring as an input to the traffic noise model resulted in a calibration offset of less than 1 dB in comparison to the measured traffic noise levels.

Modeled existing traffic noise levels are summarized in Table 4.12-4 at a representative distance of 100 feet from the centerline the roadway. Distances from the roadway centerline to the 60-dBA, 65-dBA, and 70-dBA L_{dn} traffic noise level contours[2] are also presented. As shown in Table 4.12-4, the location of the traffic noise contours in the project vicinity ranges from within the Empire Grade right-of-way to approximately 28 feet from the centerline of the roadway. The extent to which existing land uses in the project area are affected by existing traffic noise depends on their respective proximity to the roadway and their individual sensitivity to noise. Refer to Appendix E of this report for complete modeling inputs and results.

Table 4.12-4. Summary of Modeled Existing Traffic Noise Levels

Roadway	Segment	Average Daily Traffic	L_{dn} at 100 feet from Centerline	Distance to L_{dn} Contour (feet)[1]		
				70 dBA	*65 dBA*	*60 dBA*
Empire Grade	South Chinquapin Road[2]	2,327	51	6	13	28

Source: County of Santa Cruz 2020a.
Notes: dBA = A-weighted decibels; L_{dn} = average day-night noise level.
1 Distance to contour does not account for shielding provided by natural or built intervening objects. Actual distance to real-world noise level contours is dependent upon shielding effects in the environment under consideration.
2 Between Seven Springs Ranch Road and Smith Grade.

Aircraft Operations

During the noise monitoring survey, no aircraft overflights were observed. The project site is located approximately 3 miles south of the private Bonny Doon Village Airport and approximately 20 miles northwest of the Watsonville Municipal Airport. The project site is not located within any currently adopted 60 dB or 65 dB CNEL/L_{dn} airport noise contours. As such, noise associated with aircraft operations in the area is not a substantial contributor to the existing ambient noise environment.

Vibration

Transportation-related vibration from roadways near the project site is the primary source of groundborne vibration. Heavy truck traffic can generate groundborne vibration, which varies considerably depending on vehicle type, weight, and pavement conditions. However, groundborne vibration levels generated from vehicular traffic are not typically perceptible outside of the roadway right-of-way.

4.12.2 Regulatory Framework

4.12.2.1 Federal

Federal Noise Control Act

The U.S. Environmental Protection Agency's (EPA's) Office of Noise Abatement and Control was originally established to coordinate federal noise control activities. After its inception, the EPA's Office of Noise Abatement and Control issued the Federal Noise Control Act of 1972, establishing programs and guidelines to identify and address the effects of noise on public health, welfare, and the environment. In 1981, EPA administrators

2 The distance at which a noise source has attenuated (lessened) to the referenced noise level.

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, noise control guidelines and regulations contained in the EPA rulings in prior years are still adhered to by designated federal agencies where relevant. No federal noise regulations are applicable to the Proposed Project.

Federal Transit Administration Construction Vibration Damage Criteria

The Federal Transit Administration (FTA) has developed standards for use on federally funded mass-transit projects. While these standards and impact assessment methodologies are not directly applicable to the Proposed Project, they are routinely used as guidelines for projects in state and local jurisdictions. The FTA vibration threshold for architectural damage to non-engineered timber and masonry structures is 0.2 in/sec PPV, 0.3 in/sec PPV for engineered concrete and masonry structures, and 0.5 in/sec PPV for concrete structures (FTA 2018).

4.12.2.2 State

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

Governor's Office of Planning and Research General Plan Guidelines

The Governor's Office of Planning and Research (OPR), published the State of California General Plan Guidelines (OPR 2003), which provides guidance for the acceptability of projects within specific L_{dn} contours. Table 4.12-5 summarizes acceptable and unacceptable community noise exposure limits for various land use categories. The guidelines also present adjustment factors that may be used to help craft noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution.

Generally, residential uses (e.g., single-family homes, mobile homes, etc.) are considered to be acceptable in areas where exterior noise levels do not exceed 60 dBA L_{dn}. Residential uses are normally unacceptable in areas exceeding 70 dBA L_{dn} and conditionally acceptable within 55 to 70 dBA L_{dn}. Schools are normally acceptable in areas up to 70 dBA L_{dn} and normally unacceptable in areas exceeding 70 dBA L_{dn}. Commercial uses are normally acceptable in areas up to 70 dBA L_{dn}. Between 67.5 and 77.5 dBA L_{dn}, commercial uses are conditionally acceptable, depending on the noise insulation features and the noise reduction requirements.

California Department of Transportation Guideline Vibration Damage Potential Threshold Criteria

There are no state standards for vibration; however, California Department of Transportation (Caltrans) compiled a synthesis of research on the effects of vibration with thresholds ranging from 0.08 in/sec PPV to 4.0 in/sec PPV for "fragile historic buildings" and "structures of substantial construction," respectively. Based on the synthesis of research, Caltrans developed recommendations for guideline threshold criteria of 0.3 in/sec PPV for older residential structures and 0.25 in/sec PPV for historic buildings and some old buildings exposed to continuous/frequent intermittent sources. For extremely fragile historic buildings, ruins, and ancient monuments, Caltrans recommends a threshold of 0.08 in/sec PPV (Caltrans 2020).

Table 4.12-5. Summary of Land Use Noise Compatibility Guidelines

Land Use Category	Community Noise Exposure (dBA L_{dn})			
	Normally Acceptable[1]	*Conditionally Acceptable*[2]	*Normally Unacceptable*[3]	*Clearly Unacceptable*[4]
Residential—Low-Density Single-Family, Duplex, Mobile Home	<60	55–70	70–75	75+
Residential—Multifamily	<65	60–70	70–75	75+
Transient Lodging—Motel, Hotel	<65	60–70	70–80	80+
Schools, Libraries, Churches, Hospitals, Nursing Homes	<70	60–70	70–80	80+
Auditoriums, Concert Halls, Amphitheaters	—	<70	65+	—
Sports Arena, Outdoor Spectator Sports	—	<75	70+	—
Playgrounds, Neighborhood Parks	<70	—	67.5–75	72.5+
Golf Courses, Riding Stables, Water Recreation, Cemeteries	<75	—	70–80	80+
Office Building, Business Commercial, and Professional	<70	67.5–77.5	75+	—
Industrial, Manufacturing, Utilities, Agriculture	<75	70–80	75+	—

Source: OPR 2003.

Notes: dBA = A-weighted decibels; L_{dn} = day-night average noise level.

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

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

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

4 New construction or development should generally not be undertaken.

4.12.2.3 Local

County of Santa Cruz General Plan

The County of Santa Cruz General Plan Noise Element, Chapter 9 (County of Santa Cruz 2020b) contains updated goals, objectives, and policies intended to protect citizens from exposure to excessive noise. The Noise Element establishes standards and policy to promote compatible noise environments for new development or redevelopment projects and to control excessive noise exposure of existing land uses. The following policies and standards are considered, where relevant, in the noise analysis for the Proposed Project.

Objective 9.2 Noise Exposure of Existing Sensitive Uses and Receptors

Minimize exposure of existing noise-sensitive land uses and receptors to excessive, unsafe or disruptive noise that may be generated by new land uses and development projects.

Policies

9.2.1 Require acoustical studies for all new development projects that may affect the existing noise environment affecting sensitive land uses and receptors and that may not conform to the Normally Acceptable Noise Exposure in Table 9-2 (Table 4.12-6).

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 DNL 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 DNL 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.

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.

9.2.4 For all new commercial and industrial developments which would increase noise levels above the normally acceptable standards in Table 9-2 (shown as Table 4.12-6 in this EIR) or the maximum allowable standards in Table 9-3 (Table 4.12-7 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 of Table 9-3 (Table 4.12-7 in this EIR).

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.

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 dBA at neighboring sensitive land uses or if construction would occur for more than 7 days.

Table 4.12-6. Acceptable through Unacceptable Ranges of Noise Exposure by Land Use

	Land Use	Community Noise Exposure DNL or CNEL dB(A) 55 60 65 70 75 80
A	Residential/Lodging – Single Family, Duplex, Mobile Home, Multi Family	
B	Schools, Libraries, Religious Institutions, Meeting Halls, Hospitals	
C	Outdoor Sports Arena or Facility, Playgrounds, Neighborhood Parks	
D	Office Buildings, Business Commercial and Professional	
E	Industrial, Manufacturing, Utilities, Agriculture	
	Normally Acceptable: Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements, and can meet the indoor noise standards.	
	Conditionally Acceptable: New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design to meet interior and exterior noise standards, where applicable.	
	Normally Unacceptable: New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design to meet interior and exterior noise standards, where applicable.	
	Unacceptable: New construction or development should generally not be undertaken.	

Source: County of Santa Cruz 2020b, Table 9-2.
Note: Outdoor noise exposure measured at the property line of receiving land use.

Table 4.12-7. Maximum Allowable Noise Exposure Stationary Noise Sources

Noise Metric[1]	Daytime[5] (7:00 a.m. to 10:00 p.m.)	Nighttime[2,5] (10:00 p.m. to 7:00 a.m.)
Hourly L_{eq} – average hourly noise level, dB[3]	50	45
Maximum Level, dB[3]	70	65
Maximum Level dB – Impulsive Noise[4]	65	60

Source: County of Santa Cruz 2020b, Table 9-3.
Notes: dB = decibel.

1 As determined at the property line of the receiving land use. When determining 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 Applies only where the receiving land use operates or is occupied during nighttime hours.
3 Sound of the measurements shall be made with "slow" meter response.
4 Sound level measurements shall be made with "fast" meter response
5 Allowable levels shall be raised to the ambient noise level were the ambient level exceeds the allowable levels. Allowable levels shall be reduced five dBA if the ambient hourly Leq is at least 10 dBA lower than the allowable level.

Santa Cruz County Code

The Santa Cruz County Code contains additional guidance with the intent to control noise, to promote and maintain the health, safety and welfare of its citizens. Chapter 8.30 of the Santa Cruz County Code enumerates general standards, limitations and exemptions pertaining to noise within the County. Additionally, Chapter 13.15 institutes "Noise Planning", which codifies General Plan policies and aids in regulating noise throughout the County through land use planning and permitting. The regulations presented below are considered, where relevant, in the noise analysis for the Proposed Project.

8.30.10 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 be automatically 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., very low bass or high screech;

(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.

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 Sunday or a federal holiday unless the Building Official has in advance authorized such work 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.

13.15.050 General Noise Regulations and Unlawful Noise

(A) No use, except a temporary construction operation, shall be permitted which creates noise which is found by the Planning Commission not to conform to the noise parameters established by Table 9-2 and Table 9-3 of the Santa Cruz County General Plan beyond the boundaries of the project site at standard atmospheric pressure.

(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.

13.15.070 Noise Generating Land Use

(A) New commercial and industrial development that would increase noise levels above the normally acceptable range in Table 9-2 or the levels in Table 9-3 of the Santa Cruz County General Plan Noise Element shall require acoustic studies to determine the noise reduction requirements to be included as conditions of approval. Noise levels shall not exceed the standards in Table 9-3, and require, as conditions of approval, site design and sound reducing measures if the project would:

(1) Increase the noise level at existing noise-sensitive receptors or areas by five (5) dB Ldn or more, where the post-project Ldn would remain equal to or below 60 dB.

(2) Increase the noise level at existing noise-sensitive receptors or areas by three (3) dB Ldn or more, where the post-project Ldn would exceed 60 dB.

(B) The standards in this section shall not limit the ability of the County to impose conditions of approval on projects that increase noise levels at existing noise-sensitive receptors or areas by any amount.

13.15.080 Exterior Noise Standards

New development shall not be exposed to noise levels that exceed the normally acceptable levels in Table 9-2 of the Santa Cruz County General Plan Noise Element, which establishes acceptable through unacceptable ranges of noise exposure by land use.

4.12.3 Impacts and Mitigation Measures

This section contains the evaluation of potential environmental impacts associated with the Proposed Project related to noise. The section identifies the standards of significance used in evaluating the impacts, describes the methods used in conducting the analysis, and evaluates the Proposed Project's impacts and contribution to significant cumulative impacts, if any are identified.

4.12.3.1 Thresholds of Significance

The standards of significance used to evaluate the impacts of the Proposed Project related to noise are based on Appendix G of the CEQA Guidelines, as listed below. A significant impact would occur if the Proposed Project would:

A. 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.

B. Result in excessive groundborne vibration or groundborne noise levels.

C. Expose people residing or working in the project area to excessive noise levels in 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 2 miles of a public airport or public use airport.

In analyzing noise and vibration impacts associated with the Proposed Project, pertinent noise standards introduced in the County of Santa Cruz General Plan, discussed above, have been considered and utilized to develop the following quantified significance criteria for Significance Standards A and B above.

- **Significance Standard A**. The Proposed Project would result in the generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project if it would:
    - For temporary construction activities on the project site, a significant impact would result if construction noise exceeds 60 dBA between 10:00 p.m. and 8:00 a.m. or 75 dBA between 5:00 p.m. and 10:00 p.m. Between the hours of 8:00 a.m. to 5:00 p.m. on weekdays, construction noise is not limited, based on Santa Cruz County Code Section 8.30.10.

- For construction and operational traffic noise with the Proposed Project, a significant impact would result if traffic noise results in an increase of 3 dB to 5 dB L_{dn} or more above existing conditions, based on Santa Cruz County Code Section 13.15.070.
- For operational noise, a quantified significance criterion is not identified, given that the Proposed Project would not increase operational noise.

- **Significance Standard B.** The Proposed Project would result in the generation of a substantial temporary ground borne noise or vibration levels in the project vicinity if it would:
  - For structures located outside of the project site, a significant impact would result if groundborne noise or vibration levels exceeded the FTA guidance that suggests 0.2 in/sec PPV as a threshold level for architectural damage to non-engineered timber and masonry structures (FTA 2018).

    For historic structures located within the project site, in the absence of a more appropriate project-specific threshold for the historic dam structure that reflects the actual conditions on the dam, a significant impact would result if groundborne noise or vibration levels exceed the Caltrans threshold for fragile historic structures of 0.08 in/sec PPV (Caltrans 2020).

4.12.3.2 Analytical Methods

Potential noise impacts associated with the Proposed Project were calculated and analyzed based on project construction and operations information; information contained in the traffic analysis and air quality analysis prepared for the Proposed Project; and data obtained during on-site noise monitoring. Observations made during the site survey along with land use information and aerial photography were used to determine potential locations of sensitive receptors near the project site.

Construction

The principal source of project-generated noise would be associated with construction activities on the project site; therefore, the analysis focuses on construction noise and vibration. Construction-related noise effects were assessed with respect to nearby noise-sensitive receptors and their relative exposure (accounting for intervening topography, barriers, distance, etc.), based on application of FHWA Roadway Construction Noise Model and FTA reference noise level data and usage-factors.

Additional noise sources associated with the Proposed Project would be off-site construction traffic on the local and regional roadway network. Project-related traffic was evaluated qualitatively based on the passenger car equivalent (PCE) vehicle trips and existing traffic volumes used as an input.

Groundborne vibration impacts were qualitatively assessed based on existing reference documentation (e.g., vibration levels produced by specific construction equipment operations), through the application of Caltrans methodology outlined within the *Transportation and Construction Induced Vibration Guidance Manual* (Caltrans 2020) and the relative distance to potentially sensitive receptors from a given vibration source.

Operation

As described in Chapter 3, Project Description, the Proposed Project's operation and maintenance activities would generally remain similar to existing activities and would have a similar frequency and intensity. Similar to existing conditions, operation and maintenance would include weekly station checks; monthly cleaning, inspections of equipment, testing of the generator, and landscape maintenance; annual inspections of equipment and service of

the generator; and road maintenance every 5 years. Overall, the activities on the site, use of equipment, and vehicle trips to the site for maintenance would not substantially increase over existing conditions.

4.12.3.3 Project Impact Analysis

Areas of No Impact

The Proposed Project would not **expose people to excessive aircraft noise (Significance Standard C)**. The nearest airstrip to the Proposed Project is the Bonny Doon Village Airport, which is a private use airport located approximately 3 miles north. The nearest public or public-use airport is Watsonville Municipal Airport, which is located approximately 20 miles southeast of the project site. Watsonville Municipal Airport is not part of an adopted airport land use plan, and the project site is not located within the airport influence area (County of Santa Cruz 2020c). Therefore, the Proposed Project would have no impact related to exposure of people in the project area to excessive airport-related noise, and this standard is not further evaluated.

Impacts

This section provides a detailed evaluation of noise impacts associated with the Proposed Project.

Impact NOI-1: **Substantial Increase in Ambient Noise Levels (Significance Standard A).** The Proposed Project would result in generation of a substantial temporary increase in ambient noise levels during construction in the vicinity of the project in excess of applicable standards. However, the Proposed Project would not result in generation of a substantial permanent increase in ambient noise levels during operation. ***(Less than Significant with Mitigation)***

Construction

Construction of the Proposed Project would generate noise associated with the operation of heavy construction equipment and construction-related activities in the project area (e.g., pumps, generators, haul trucks, workers accessing the site, etc.). The effects of construction noise depend largely on the types of construction activities occurring on any given day, noise levels generated by those activities, distances to noise-sensitive receptors, and the existing ambient noise environment in the vicinity of the receiver.

Construction of the Proposed Project would occur in several discrete stages, with each phase varying the equipment mix and the resulting overall noise emission. These phases would alter the characteristics of the noise environment generated on the project site and in the surrounding community for the duration of the construction phase. Construction phases for the Proposed Project are anticipated to include (1) access road improvements, site preparation, and mobilization; (2) cofferdam and temporary stream bypass system; (3) Coanda screen intake structure including dam preparation, foundation work, and concrete formwork and installation of the intake screen, piping, and valves; (4) modifications to the existing intake and sediment control valves; (5) valve vault installation; (6) electrical installations; (7) access stairs and riprap bank stabilization; and (8) startup and testing, site restoration, and construction closeout.

To assess noise levels associated with the various equipment types and operations, construction equipment can be considered to operate in two modes: mobile and stationary. Mobile equipment moves around a construction site performing tasks in a recurring manner. Stationary equipment operates in a given location for an extended period of time to perform continuous or periodic operations. Operation of heavy construction equipment is generally

characterized by short periods of full-power operation followed by periods of operation at lower power, idling, or powered-off conditions. These characteristics are accounted for through the application of typical usage factors (operational percentage) to the reference maximum noise levels and calculation of levels from the "acoustical center" of the construction activity.[3] Based on the Proposed Project's site plan and operation of construction equipment, the acoustical center of construction is calculated to be approximately 114 feet from the nearest noise-sensitive receptor's property line. The FTA and FHWA have measured and documented maximum noise levels and operational characteristics for a wide range of construction machinery, which are summarized in Table 4.12-8.

Table 4.12-8. Typical Construction Equipment Noise Emission Levels

Equipment Description	Acoustical Use Factor (%)	L_{max} at 50 feet (dBA, slow)[1]
Auger Drill Rig	20	85
Backhoe	40	80
Compactor (ground)	20	93
Compressor (air)	40	80
Concrete Mixer Truck	40	85
Concrete Pump Truck	20	82
Concrete Saw	20	90
Crane	16	85
Dozer	40	85
Dump Truck	40	80
Excavator	40	85
Flat Bed Truck	40	84
Front End Loader	40	80
Generator	50	82
Grader	40	85
Jackhammer[2]	20	85
Mounted Impact Hammer (hoe ram)[2]	20	90
Paver	50	85
Pneumatic Tools	50	85
Pumps	50	77
Rock Drill	20	85
Roller	20	85
Scraper	40	85
Tractor	40	84
Vacuum Excavator (Vac-truck)	40	85

Sources: DOT 2006; FTA 2006.
Notes: L_{max} = maximum noise level; dBA = A-weighted decibels.
1 All equipment fitted with a properly maintained and operational noise control device, per manufacturer specifications.
2 Impulsive/impact device.

The construction equipment fleet mix is based on the same information evaluated in the air quality, energy, and greenhouse gas emissions analyses in this EIR (see Appendix B). Based on the reference noise levels for the assumed fleet mixes, usage rates, and operational characteristics discussed above, overall hourly average noise levels attributable to construction activities were calculated by phase for the Proposed Project. The estimated construction noise levels at the property line of the nearest noise-sensitive receptor and the distance from the

[3] Apparent acoustical center of construction equipment operations was assumed to be the geometric mean of the nearest operations point and the farthest operations point.

acoustical center of construction activity to the 60 dBA noise level threshold for nighttime hours (10:00 p.m. to 8:00 a.m.), which would apply to proposed construction between the hours of 7:00 a.m. and 8:00 a.m. (Santa Cruz County Code Section 8.30.10[C][1][b]), are presented by phase in Table 4.12-9. No noise thresholds apply to construction activities between the hours of 8:00 a.m. and 5:00 p.m. on weekdays, based on the Santa Cruz County Code Section 13.15.070.

Table 4.12-9. Construction Noise Model Results Summary

Phase		Noise Levels (dBA L_{eq}) at nearest receptor[1]	Distance to 60 dBA L_{eq} Noise Level Standard (10:00 p.m. to 8:00 a.m.)
No.	Description		
1	Access road improvements, site preparation, and mobilization	74.4	410
2	Cofferdam and temporary stream bypass system	74.8	425
3	Coanda screen intake structure including dam preparation, foundation work, and concrete formwork and installation of the intake screen, piping, and valves	77.6	545
4	Modifications to the existing intake and sediment control valves	77.5	543
5	Valve vault installation	75.2	443
6	Electrical installations	77.6	548
7	Access stairs and bank stabilization	71.8	325
8	Start-up and testing, site restoration, and construction closeout	75.3	443

Notes: dBA = A-weighted decibels; L_{eq} = equivalent sound level

[1] Based on FTA propagation algorithms for calculation of construction noise levels from the acoustical center of construction operations.

As shown in Table 4.12-9, construction activities would generate noise levels ranging from approximately 72 dBA to 78 dBA at the nearest noise-sensitive receptor's property line in the project vicinity, depending on the phase of construction. Construction noise levels generated by the Proposed Project would exceed the 60 dBA property line noise level standard for operations between 10:00 p.m. and 8:00 a.m. As such, project-generated construction noise would result in a potentially significant impact.

As indicated in Chapter 3, Project Description, Standard Construction Practice #26, will provide for the notification of adjacent property owners of any nighttime construction schedules and will identify a Construction Noise Coordinator to respond to and address any local complaints about construction noise. Additionally, MM NOI-1 in Section 4.12.3.5, Mitigation Measures, requires appropriate treatment to noise sources and limits dispersion of the sound levels into the surrounding area. With implementation of MM NOI-1, the Proposed Project's construction-related noise impacts would be reduced to a less-than-significant level. MM NOI-1 also provides best management practices to reduce construction noise, which reflects the provisions of the County's General Plan Policy 9.2.6 (County of Santa Cruz 2020b).

Construction Traffic Noise

In addition to heavy-duty construction equipment noise, the movement of equipment, haul trucks, and workers to and from the site during construction would generate temporary traffic noise along access routes to the project site, including at off-site staging areas used for construction worker parking and/or storage of materials. The transport

of heavy-duty construction equipment onto the project site would be minimized during construction by keeping construction equipment staged on site for the duration of the construction phase. For this reason, the movement of heavy-duty construction equipment would be minimal. Haul truck trips and construction worker commutes would occur on a daily basis, with construction potentially beginning at 7:00 a.m. and ending at 5:00 p.m. Approximately 35 one-way haul truck trips would be required during the 3-month construction period, with two to three trips per week. As described in Section 4.13, Transportation, during the peak of construction activity, the Proposed Project would generate 50 daily trips.

Based on the ambient increase criteria contained in the Santa Cruz County Code (Section 13.15.070), the Proposed Project would have a significant impact if it would result in an increase of 3 dB to 5 dB L_{dn} or more above existing conditions. For the Proposed Project to result in an increase of 3 dB, the average daily trips on a roadway would need to double.

As indicated in Section 4.12.1.5, Existing Noise Environment, traffic data are not available for the road immediately adjacent to the project site (i.e., Smith Grade); however, information for Empire Grade, which is approximately 2.5 miles east, was available and provided by the County. As such, the traffic data for Empire Grade was used as a proxy for Smith Grade. Given that the existing average daily traffic volume on Empire Grade is 2,327 vehicles (County of Santa Cruz 2020a), the 50 peak/maximum daily haul truck and construction worker commute trips to the project site would not cause a doubling of average daily trips in the immediate area. Furthermore, 50 additional trips would not represent a doubling of trips on Smith Grade. As a result, the noise level increases along project area roadways used to reach the site would be less than 3 dB. Therefore, noise impacts associated with construction-related traffic would be less than significant.

Long-Term Traffic Noise

Long-term operation of the Proposed Project is not anticipated to result in changes to the amount of traffic on the roadway network compared to existing operations, as operations would remain consistent with current operation and maintenance activities. Routine maintenance of the facility is expected to continue to consist of weekly, monthly, and annual trips to the site by SCWD personnel in a small truck and road maintenance every 5 years, consistent with current operations.

As previously discussed, the project would need to result in a doubling of roadway traffic volumes for there to be a significant impact associated with traffic noise. As operation of the Proposed Project would not result in a net increase of vehicle trips, traffic noise levels associated with the Proposed Project would be less than significant.

Operations

The Proposed Project does not include any new permanent noise-generating sources, such as heating, ventilation, and air conditioning; mechanical equipment; additional pumps; or power and water requirements. As the sound levels generated from operation of the Proposed Project would not substantially change from the current operations, noise from long-term operations would be less than significant.

Impact NOI-2: **Groundborne Vibration (Significance Standard B).** The Proposed Project would result in the potential generation of excessive groundborne vibration or groundborne noise levels during construction. ***(Less than Significant with Mitigation)***

Off-Site Effects

Construction activities on the project site may result in varying degrees of temporary groundborne vibration or noise, depending on the specific construction equipment used and operations involved. Representative groundborne vibration levels for various types of construction equipment, developed by FTA, are summarized below in Table 4.12-10. Pile driving and blasting would not be utilized in the construction of the Proposed Project. As shown in Table 4.12-10, heavier pieces of construction equipment, such as a bulldozer, that may be expected on the project site, have been documented to generate peak particle velocities of approximately 0.089 in/sec PPV or less at a reference distance of 25 feet (DOT 2006).

Table 4.12-10. Representative Vibration Levels for Construction Equipment

Equipment	PPV at 25 feet (in/sec)[1,2]	Approximate Lv (VdB) at 25 feet[3]
Hoe Ram	0.089	87
Large Bulldozer	0.089	87
Caisson Drilling	0.089	87
Heavy-duty Trucks (Loaded)	0.076	86
Jackhammer	0.035	79
Small Bulldozer	0.003	58

Source: DOT 2006.
Notes:
1 Where PPV is the peak particle velocity.
2 Vibration levels can be approximated at other locations and distances using the above reference levels and the following equation: PPVequip = PPVref (25/D)1.5 (in/sec); where "PPV ref" is the given value in the above table, "D" is the distance for the equipment to the new receiver in feet.
3 Where Lv is the RMS velocity expressed in vibration decibels (VdB), assuming a crest factor of 4.

Groundborne vibration attenuates rapidly, even over short distances. The attenuation of groundborne vibration as it propagates from source to receptor through intervening soils and rock strata can be estimated with equations and reference constants found in FTA and Caltrans guidance. Using standard FTA vibration attenuation formulas, non-pile-driving construction activities would exceed the FTA recommended threshold of significance of 0.2 in/sec PPV for architectural damage to non-engineered timber and masonry structures (FTA 2018) at a distance of 15 feet or less. It is unlikely that heavy construction equipment would operate within 15 feet of any sensitive receptor, as buildings associated with the nearest off-site sensitive receptor structure are located approximately 100 feet from the project site boundary and more than 250 feet from the primary construction areas.

It is notable that groundborne vibrations from construction activities do not often reach the levels that can damage structures or affect activities that are not vibration sensitive, although the vibrations may be felt by nearby persons in close proximity and result in annoyance (FTA 2018). Additionally, the Proposed Project would not include elements that would generate groundborne vibration associated with the long-term operations. As such, the Proposed Project would have a less-than-significant impact related to groundborne vibration and groundborne noise levels.

On-Site Effects to Historic Structures

As discussed in the Section 4.5, Cultural Resources and Tribal Cultural Resources, the dam that is part of the Facility is considered a historical resource under CEQA. The dam may be susceptible to damage from vibration associated with construction of the Proposed Project. Inspection, testing, and analysis of the current condition of the dam was performed in 2018 (B&V 2018). The dam was found to be in satisfactory condition with no signs of distress or major deterioration that would jeopardize its function. Testing indicates the materials for the dam structure are in good condition with no evidence of fatigue, delamination, or weakening and has adequate material strengths for continued service. While the analysis concluded that the overall condition of the dam was favorable for continued use and was in line with modern design parameters for masonry structures, it did not directly identify sensitivity of the dam to vibration.

Both Caltrans and the FTA provide a synthesis of research on the effects of vibration on structures, with thresholds ranging from 0.08 to 4.0 in/sec PPV for "fragile historic buildings" and "structures of substantial construction," respectively. It is currently unknown which threshold would be appropriate for the dam.

As indicated in Section 4.12.3.1, Thresholds of Significance, in the absence of a more appropriate project-specific threshold for the historic dam structure that reflects the actual conditions on the dam, the Caltrans threshold for fragile historic structures of 0.08 in/sec PPV is used in the evaluation of the historic dam (Caltrans 2020). Based on the vibration levels presented in Table 4.12-10 above, the 0.08 in/sec PPV threshold would be exceeded at distances less than 27 feet and the 4.0 in/sec PPV cited by Caltrans for "structures of substantial construction" would be exceeded at distances of less than 2 feet. As a portion of the construction activities would be performed directly on the dam, including notching of the dam and doweling for anchors, there is potential for the structure to be exposed to vibration levels exceeding the Caltrans and FTA threshold criteria. Vibration could potentially damage the dam, resulting in significant impacts to the historic resource.

MM NOI-2 in Section 4.12.3.5, Mitigation Measures, requires that an appropriate threshold be developed by qualified engineering personnel that would prevent vibration impacts to the dam. Development and implementation of a construction vibration monitoring plan would be required and vibration generating construction activities would be monitored to ensure compliance with the developed threshold. With implementation of MM NOI-2, the potential for construction-related vibration impacts to the historic dam structure would be reduced to a less-than-significant level.

4.12.3.4 Cumulative Impacts Analysis

This section provides an evaluation of cumulative noise impacts associated with the Proposed Project and past, present, and reasonably foreseeable future projects, as identified in Table 4.1-1 in Section 4.1, Introduction to Analysis, and as relevant to this topic. The geographic area potentially affected by noise and vibration in the vicinity of the Proposed Project would be limited to lands immediately adjacent to the haul truck and worker access route (i.e., Smith Grade) and those located within approximately 600 feet of the Proposed Project construction.

The Proposed Project would not contribute to cumulative impacts related to aircraft noise (Significance Standard C) because it would have no impact related to this standard as described above. Therefore, this significance standard is not further evaluated.

Impact NOI-3: Cumulative Noise Impacts (Significance Standards A and B). The Proposed Project, in combination with past, present, and reasonably foreseeable future development, would not result in a significant cumulative impact related to noise and vibration. ***(Less than Significant)***

Cumulative noise impacts could occur if sensitive receptors were exposed to noise and vibration from sources at about the same time, if multiple projects were undertaken simultaneously and in close proximity. The known cumulative projects planned within the geographic area of analysis for cumulative impacts related to noise and vibration, which is the project site and immediate vicinity, include the Laguna Pipeline portion of the North Coast System Repair and Replacement Project. The Santa Cruz Water Rights Project and the Reggiardo Diversion upgrade identified in the Anadromous Fisheries Habitat Conservation Plan do not overlap with and are not in the immediate vicinity of the project site. Although the Laguna Pipeline would entail limited construction within the project vicinity, it would occur several years after construction of the Proposed Project.

As indicated in Section 4.1, there are not any known substantive proposed or pending development projects that would overlap with or be located in the immediate vicinity of the Facility that would be under the jurisdiction of the County. However, if any such projects are proposed they would be subject to County approval; such projects that require discretionary approval are assumed to be designed or otherwise conditioned to avoid and minimize noise and vibration impacts. Noise and vibration from the Proposed Project and cumulative projects would not combine to create a significant cumulative noise and vibration impact. Therefore, the Proposed Project, in combination with past, present, and reasonably foreseeable future projects, would result in less-than-significant cumulative impacts to noise and vibration, and no further mitigation measures are required.

4.12.3.5 Mitigation Measures

Implementation of the following mitigation measures would reduce potentially significant noise impacts of the Proposed Project related to noise and vibration identified in Impact NOI-1 and Impact NOI-2 above, to a less-than-significant level.

MM NOI-1: Construction Noise. The Proposed Project shall implement the following measures related to construction noise:

- Restrict construction activities and use of equipment that have the potential to generate significant noise levels (e.g., use of concrete saw, mounted impact hammer, jackhammer, rock drill, etc.) to between the hours of 8:00 a.m. and 5:00 p.m.
- Construction equipment and vehicles shall be fitted with efficient, well-maintained mufflers that reduce equipment noise emission levels at the project site. Internal-combustion-powered equipment shall be equipped with properly operating noise suppression devices (e.g., mufflers, silencers, wraps) that meet or exceed the manufacturer's specifications. Mufflers and noise suppressors shall be properly maintained and tuned to ensure proper fit, function, and minimization of noise.
- Pumps that are not submerged and aboveground conveyor systems shall be located within acoustically treated enclosures, shrouded, or shielded to prevent the propagation of sound into the surrounding areas.
- Portable and stationary site support equipment (e.g., generators, compressors, rock crushers, and cement mixers) shall be located as far as possible from nearby noise-sensitive receptors.

- Impact tools shall have the working area/impact area shrouded or shielded whenever possible, with intake and exhaust ports on power equipment muffled or suppressed. This may necessitate the use of temporary or portable, application-specific noise shields or barriers.
- Construction equipment shall not be idled for extended periods (i.e., 5 minutes or longer) of time in the immediate vicinity of noise-sensitive receptors.

MM NOI-2: **Construction Vibration Effects on Historic Structures.** Prior to the use of construction equipment in the vicinity of the dam, a vibration damage threshold will be established by a qualified engineer under the direction of the City. The vibration damage threshold will be developed through the evaluation of the condition of the dam structure, underlying soil conditions, and type of construction operation to be performed.

At the City's direction, a construction vibration monitoring plan will be prepared and implemented prior to the use of construction equipment near the dam. The monitoring plan shall report on the vibration damage threshold and the methods used to develop the threshold. The plan shall also establish the methodology for characterizing the existing baseline vibration levels present on the site, operational construction vibration monitoring consistent with the established threshold, and reporting to be completed during project construction.

Should the construction vibration analysis undertaken during the preparation of the monitoring plan reveal that the proposed construction methods would exceed the vibration threshold established for the dam, alternative construction methods will be explored to find a method that would allow project construction to move forward while avoiding potential vibration-related damage to the dam during construction.

4.12.4 References

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