4.10 Noise and Vibration

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 or potentially significant impacts related to construction of the of the Newell Creek Pipeline (NCP) 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 D.

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.

4.10.1 Background

4.10.1.1 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 4.10-1.

Table 4.10-1. 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 3 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 2020a.
Notes: dBA = A-weighted decibels; mph = miles per hour.

A sound wave is initiated in a medium by a vibrating object (e.g., vocal cords, 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.

4.10.1.1 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_{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 PM and 7 AM 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 PM and 10 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}.

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.

4.10.1.2 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.

4.10.1.3 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 4.10-2 identifies some common sources of vibration, corresponding VdB levels, and associated human perception and potential for structural damage.

Table 4.10-2. 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: μ-inch/sec = micro-inch per second; re = in reference to; RMS = root-mean-square; VdB = vibration decibels.

4.10.2 Existing Conditions

4.10.2.1 Sensitive Noise Receptors

Certain land uses are particularly sensitive to noise, such as those where exposure to noise would result in adverse effects, as well as uses where quiet is an essential element of the land use. Noise-sensitive land uses can include schools, hospitals, care facilities, educational facilities, places of reflection or worship, and residential uses. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels, especially during evening and nighttime hours when occupants would typically be relaxing or resting.

Existing noise-sensitive land uses are located throughout the proposed project area and include single-family residential, multi-family residential, educational facilities and places of reflection and worship as shown on Figures 4.10-1A and 4.10-1B. The environments in which the existing noise-sensitive land uses are located range from quiet rural mountain settings, to more populated semi-suburban areas. Some residences are within 20 feet of the construction disturbance area in the northern segment and 20-50+ feet from the construction disturbance area in the southern segment.

Several schools and a day care facility are within 0.25 mile of the Project alignment. The Mountain Monsters Daycare is approximately 0.1 mile east of the proposed alignment. San Lorenzo Valley Elementary School, San Lorenzo Valley Middle School, and San Lorenzo Valley High School are approximately 0.2 mile west of the proposed pipeline alignment in Felton. The Santa Cruz County Juvenile Hall and Community School is immediately east of the pipeline route along Graham Hill Road, southeast of Felton, and Brook Knoll Elementary School is approximately 0.2 mile east of the pipeline route along the southern portion of Graham Hill Road.

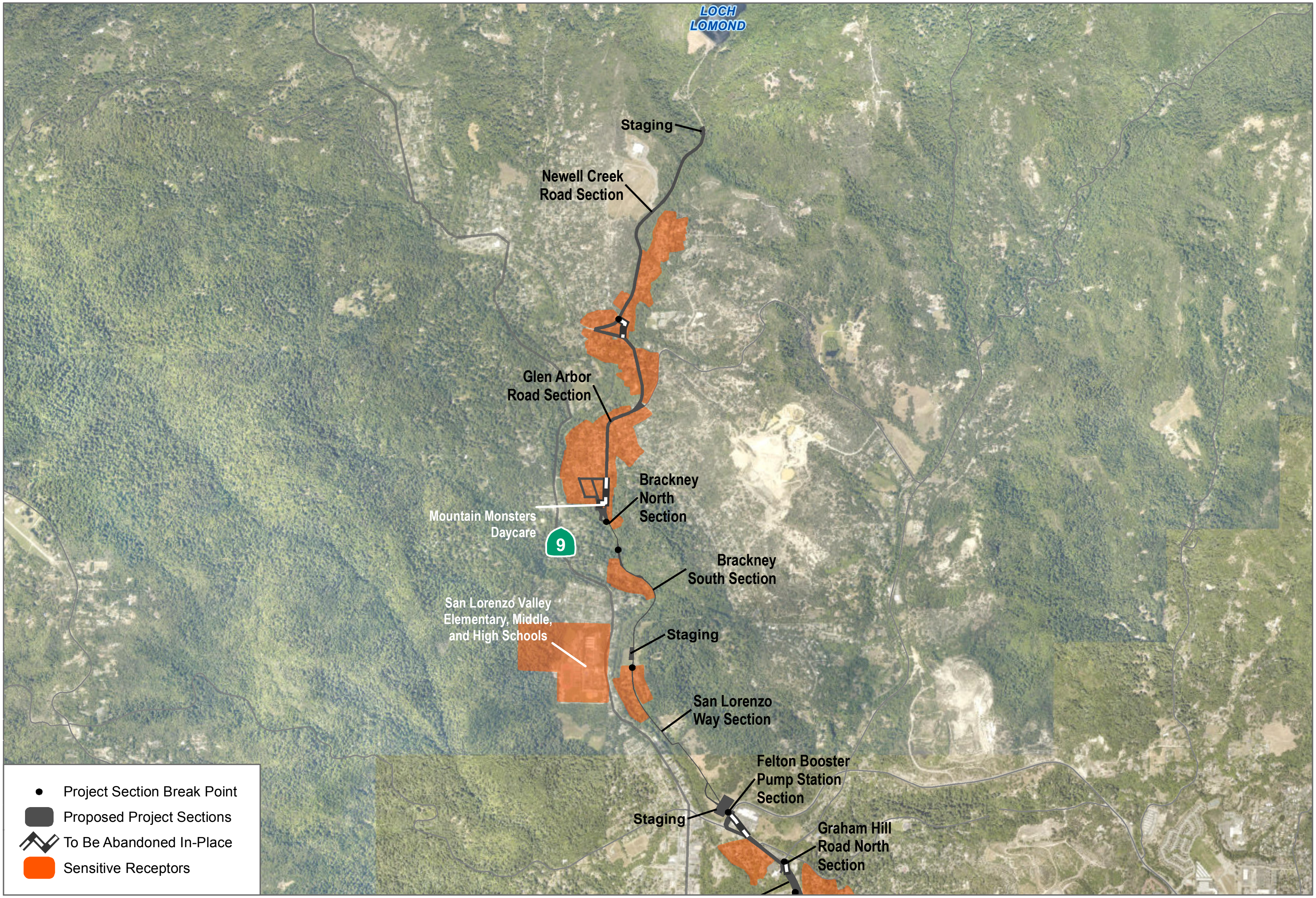
4.10.2.2 Existing Ambient Noise Measurements

Dudek staff visited the length of the Proposed Project on May 7 and 11, 2021 to measure ambient sound levels in the vicinity of the Project segments and at measurement locations representative of existing noise-sensitive receptors. Sound level measurements were performed at eleven (11) locations adjacent to the Proposed Project. Short-term sound level measurements were conducted with a Rion NL–62 precision integrating sound level meter, placed on a tripod with the microphone positioned approximately 5 feet above the ground. The short-term measurements were 10 minutes in duration at all locations, with the sound level meter configured to use A-weighting and a "slow" response time setting. Figure 4.10-2 shows the measurement locations. Table 4.10-3 presents the results of the short-term sound level measurements.

Table 4.10-3. Short-Term Sound Level Measurements

Site	Description	Time	L_{eq} (dBA)	L_{max} (dBA)	L_{90} (dBA)
ST1	Newell Creek Rd., north of Glen Arbor Rd.	5/11/2021 3:04 PM	43.7	60.3	33.2
ST2	Caledonium Ave., south of Glen Arbor Rd.	5/11/2021 2:39 PM	58.0	74.4	36.6
ST3	East of the eastern end of Brackney Rd.	5/7/2021 4:59 PM	42.5	55.7	38.5
ST4	Graham Hill Rd. northwest of the Zayante Creek crossing	5/7/2021 4:30 PM	44.5	57.3	37.0
ST5	Graham Hill Rd. traffic, at Roaring Camp Rd.	5/7/2021 4:06 PM	64.6	79.5	50.8
ST6	Grandview Ave., north of Graham Hill Rd.	5/7/2021 3:37 PM	56.7	70.0	45.1
ST7	Graham Hill Rd. traffic north of Lockwood Ln.	5/7/2021 3:13 PM	66.7	78.7	48.1
ST8	Bobs Ln. at Worth Ln.	5/11/2021 4:32 PM	41.7	50.7	38.3
ST9	Western end of Geneva Ct.	5/11/2021 4:56 PM	48.3	59.2	39.7
ST10	Graham Hill Rd. traffic north of Treetop Dr.	5/7/2021 2:40 PM	67.7	77.8	42.6
ST11	Graham Hill Rd. traffic, at GHWTP driveway	5/7/2021 2:03 PM	69.5	81.7	44.8

Notes: ST = short-term; dBA = A-weighted decibel; L_{eq} = equivalent noise level (time-averaged sound level); L_{max} = maximum sound level; L_{90} = the sound level exceeded 90% of the time, approximates the background ambient sound level.



SOURCE: ESRI Imagery 2021, County of Santa Cruz 2020, City of Santa Cruz Water Department 2020, USGS 2020

DUDEK

0 1,500 3,000 Feet

FIGURE 4.10-1A

Sensitive Receptors - Northern Segment

Newell Creek Pipeline Improvement Project

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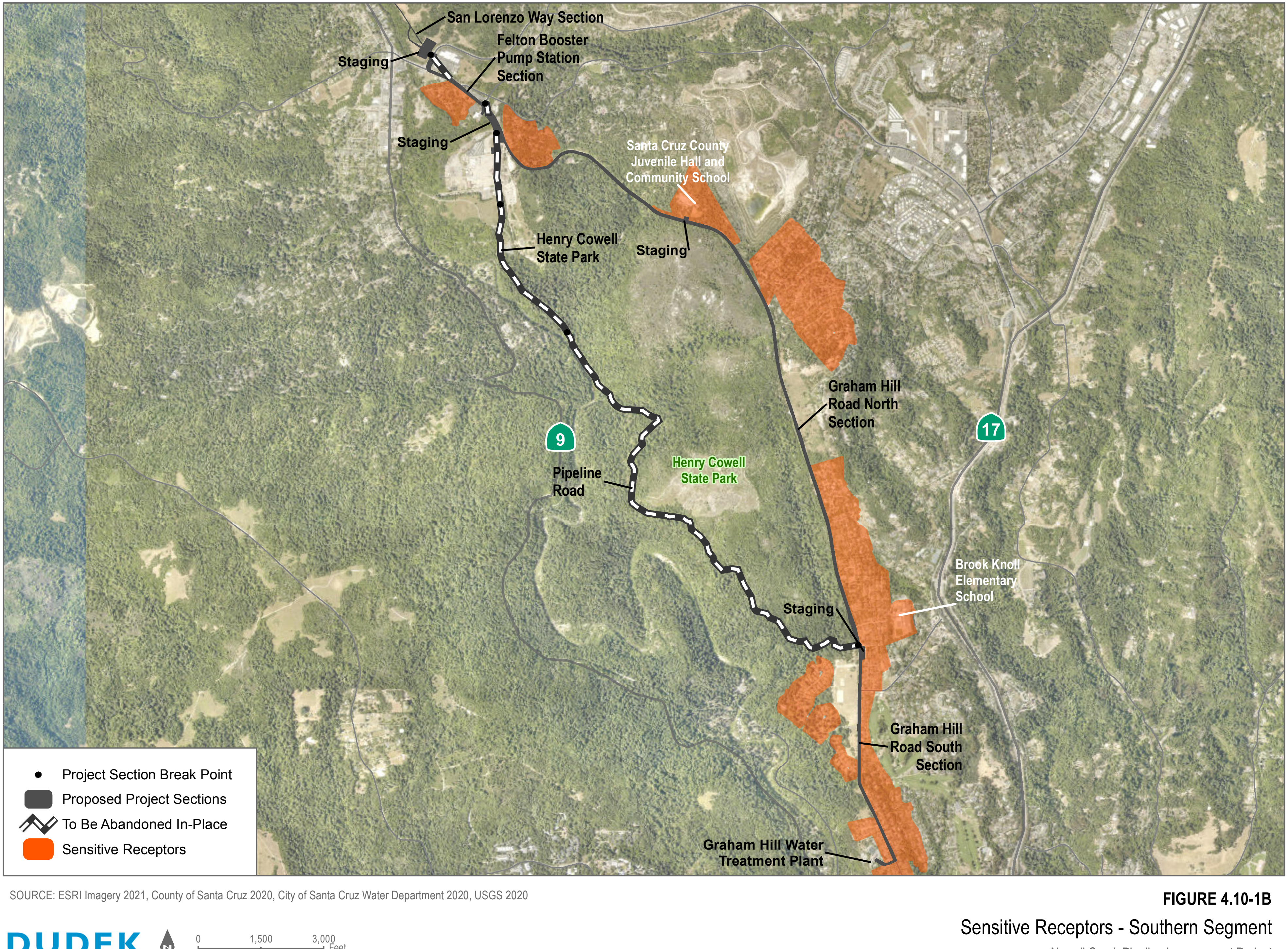

SOURCE: ESRI Imagery 2021, County of Santa Cruz 2020, City of Santa Cruz Water Department 2020, USGS 2020

DUDEK

FIGURE 4.10-1B

Sensitive Receptors - Southern Segment

Newell Creek Pipeline Improvement Project

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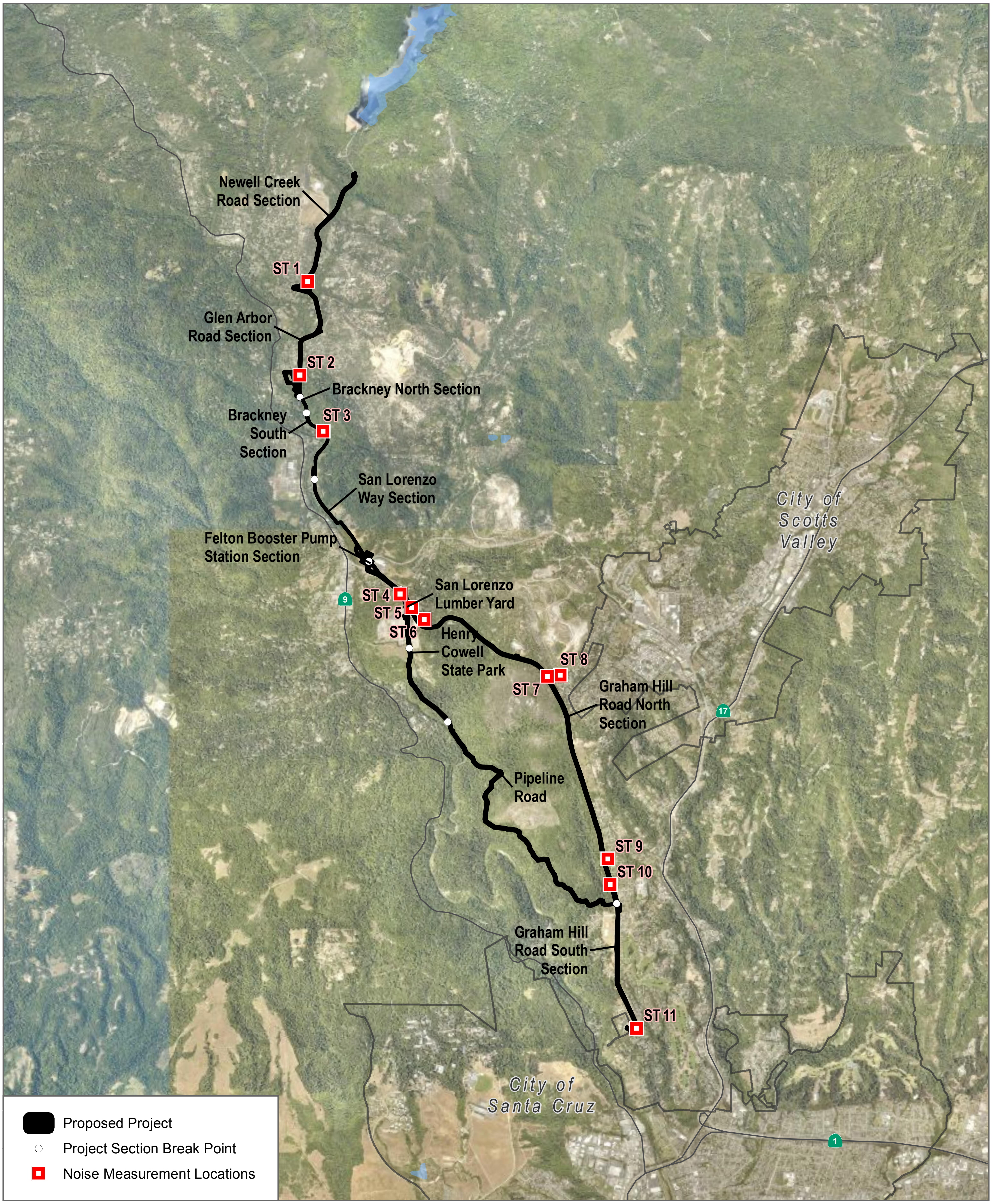

SOURCE: ESRI Imagry 2021, CAL FIRE 2020, Santa Cruz County 2021

DUDEK

FIGURE 4.10-2

Noise Measurement Locations

Newell Creek Pipeline Improvement Project

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Short-term measurement location ST-1 documented existing traffic noise level at the edge of the Newell Creek Rd. right-of-way, an approximate setback distance of 25 feet from the Newell Creek Rd. centerline, with an approximate noise level exposure of 44 dBA L_{eq}. Short-term measurement location ST-2 documented existing traffic noise level south of the intersection of Caledonium Ave and Glen Arbor Rd, an approximate distance of 105 feet from the Glenn Arbor Rd. centerline, with an approximate noise level exposure of 58 dBA L_{eq}.

Short-term measurement locations ST4, ST5, ST7, ST10 and ST11 documented existing traffic noise levels along Graham Hill Road, at similar distances from the centerline of the roadway to the façade of nearby receptors exposed to the traffic noise. Existing traffic noise levels were recorded to range from approximately 65 to 70 dBA L_{eq} with setback distances of 50 to 70 feet to the Graham Hill Rd. centerline. As the majority of the proposed project construction activities would take place within the roadway easement, the existing traffic noise level exposure at noise-sensitive receptors adjacent to the roadways are considered representative of these short-term measurement locations.

Short-term noise level measurement locations ST3, ST6, ST8 and ST9 are representative of the noise-sensitive receptors located further within the residential neighborhoods adjacent to the Proposed Project alignment. Ambient noise levels cataloged at the measurement locations representing the noise-sensitive residential neighborhoods ranged from approximately 42 to 57 dBA L_{eq}, with maximum noise levels ranging from approximately 51 to 70 dBA L_{max}. Existing ambient noise levels at the measurement locations were primarily affected by traffic on Graham Hill Rd, with the noise level exposure being proportional to the distance of the noise-sensitive receptors to the roadway and any noise level reductions provided by natural and man-made intervening elements (buildings, topography, dense foliage, etc.).

4.10.2.3 Existing Sources of Noise

The Proposed Project is located in suburban and rural foothills areas of the County. The character of the ambient noise environment varies from quiet rural areas to small in-town areas with neighborhood commercial and minor industrial areas. Common sound sources in the project vicinity include traffic, general community sounds, mechanical noise, and the natural environment. The primary noise sources affecting the Proposed Project are described below.

Aircraft Noise

During the noise monitoring survey, no aircraft were observed. The Proposed Project is not located within any adopted 60 or 65 dB CNEL/L_{dn} airport noise contours. The nearest airport to the Proposed Project is the Bonny Doon Village Airpark, which is a privately owned airstrip approximately 2.5 miles west of the Brackney North and South pipe sections. As such, noise associated with existing and future aircraft operations in the area is not a substantial contributor to the ambient noise environment.

Roadway Traffic Noise

Existing traffic noise levels were modeled for roadway segments in the study area based on the Federal Highway Administration (FHWA) Highway Traffic Noise Model (TNM) prediction methodologies (FHWA 1998), traffic volume data from Santa Cruz County (County of Santa Cruz 2016) and the California Department of Transportation (Caltrans 2019). The FHWA TNM incorporates sound emissions and sound propagation algorithms based on well-established theory and accepted international standards. The acoustical algorithms contained within the FHWA TNM 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 as vehicle volume, speed, vehicle type, roadway configuration, distance to the receiver, and propagation over different types of ground (acoustically soft and hard ground).

Modeled existing traffic noise levels are summarized in Table 4.10-4, at a representative distance of 100 feet from the centerline of each major roadway in the study area and distances from roadway centerlines to the 60-dBA, 65--dBA, and 70-dBA L_{dn} traffic noise level contours. The location of the 60-dBA L_{dn} traffic noise contour along the local roadway network ranges from within the right-of-way to approximately 230 feet from the centerline of the modeled roadways. The extent to which existing land uses in the study area are affected by existing traffic noise depends on their respective proximity to the roadways and their individual sensitivity to noise. Refer to Appendix D of this report for complete modeling inputs and results.

Table 4.10-4. Summary of Modeled Existing Traffic Noise Levels

Roadway	Segment		ADT	L_{dn} at 100 feet	Distance to L_{dn} Contour from Centerline of Roadway (feet)		
	From	*To*			*70 dBA*	*65 dBA*	*60 dBA*
Graham Hill Rd	Hwy 9	Mt Hermon Rd	27,896	65.4	49	107	230
Graham Hill Rd	Mt Hermon Rd	Lockwood Ln	6,749	59.3	19	41	89
Glen Arbor Rd	Hwy 9	Glen Arbor Rd	4,337	54.5	9	20	43
State Highway 9			21,727	61.9	42	90	194

Notes: ADT = average daily traffic; dBA = A-weighted decibels; L_{dn} = average day-night noise level.
Not accounting for shielding provided by natural or man-made intervening objects. Actual distance to real-world noise level contours will be dependent upon shielding effects in the environment under consideration.

Vibration

Transportation-related vibration from roadways in the study area 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 (Caltrans 2020).

4.10.3 Regulatory Framework

4.10.3.1 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 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.

4.10.3.2 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 4.10-5 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.

Table 4.10-5. 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.

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 Threshold

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 2020b).

4.10.3.3 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 applicable policies and standards are considered 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.

<u>Policies</u>

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 4.10-6 in this EIR).

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.

9.2.6 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 4.10-6. 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 2020a, Table 9-2.
Note: Outdoor noise exposure measured at the property line of receiving land use.

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 AM and 10:00 PM 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 PM and 8:00 AM 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.

City of Santa Cruz General Plan

Applicable noise standards in the City of Santa Cruz General Plan are contained within Chapter 8 of the General Plan (Hazards, Safety, and Noise) (City of Santa Cruz 2012). The Hazards, Safety, and Noise chapter contains specific goals, policies, and standards for use in planning and land compatibility determinations within the City of Santa Cruz. In particular, the Hazards, Safety, and Noise chapter establishes noise/land-use compatibility standards which are applicable to all new residential, commercial, and mixed-use projects (Figure 2 of the Hazards, Safety, and Noise chapter and Goal HZ3.2.1), and the General Plan seeks to ensure that noise standards are met in the siting of noise-sensitive uses (Goal HZ3.2).

The Hazards, Safety, and Noise chapter policies establish a maximum interior noise level threshold of 45 dBA L_{dn} for all residential uses, consistent with California noise insulation standards. Figure 2 of the Hazards, Safety, and Noise chapter indicates that exterior noise levels up to 60 dBA L_{dn} are normally acceptable for residential development and exterior noise levels up to 65 dBA L_{dn} are normally acceptable for multi-family residential and transient residential development; with noise levels up to 70 dBA L_{dn} considered conditionally acceptable. Hazards, Safety, and Noise chapter Policy HZ3.2.3 reiterates the “noise level target” of 65 dBA L_{dn} for outdoor activity areas associated with new multi-family residential developments. Policies HZ3.1.3 and HZ3.1.5 qualitatively discuss the management and monitoring of construction noise levels to minimize noise impacts on surrounding land uses.

City of Santa Cruz Municipal Code

Chapters 9.36 and 24.14 of the City of Santa Cruz Municipal Code (City of Santa Cruz 2020) include provisions for noise regulations. The former prohibits excessive noise during nighttime hours (10:00 PM through 8:00 a.m.) (Section 9.36.010, Subsection(a)), but without any quantitative (numerical) limits. For the purposes of construction activities performed in support of public works, the nighttime noise restriction shall not apply during the hours of 7:00 AM to 8:00 AM

Subsection (d) of Chapter 9.36 states that “Subsection (a) shall not apply to any person engaged in performance of a contract for public works awarded by the City of Santa Cruz, in the event of an emergency and if the city manager of the City of Santa Cruz so authorizes work.”

Subsection (e) of Chapter 9.36 allows for specific construction activities to occur between the hours of 10:00 PM and 8:00 AM where either the chief building inspector, public works director, planning and community development director or water department director have provided written determination and consent that said task is required commence or be completed between said hours.

Section 9.36.025 states “This chapter shall not apply to refuse collection, recyclable collection or street sweeping activities undertaken by, or pursuant to contract with, the city of Santa Cruz. Similarly, this chapter shall not apply to any other activity undertaken by the city, another governmental agency, or city contractor, for public health and safety purposes when, in the judgment of the city or governmental agency, such activity cannot be undertaken effectively or efficiently in compliance with the regulations set forth in this chapter.

In addition to the Chapter 9.36 regulations, Section 24.14 describes performance standards which limit noise production with respect to noise production from residential and commercial/industrial land uses: up to a 5 dB or 6 dB increase, respectively, above existing outdoor ambient sound levels.

4.10.4 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 thresholds 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. Mitigation measures are presented for identified significant or potentially significant impacts, and the level of significance with mitigation also is identified.

4.10.4.1 Thresholds of Significance

The thresholds of significance used to evaluate the impacts of the Proposed Project related to noise are based on past and current versions of Appendix G of the CEQA Guidelines and the City of Santa Cruz CEQA Guidelines. A significant impact would occur if the Proposed Project would:

A. Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
B. 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.
C. Result in excessive groundborne vibration or groundborne noise levels.
D. 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 Section 4.10.3.3, Local, for the County of Santa Cruz and the City of Santa Cruz have been considered and utilized, in part, to develop the following quantified significance criteria (presented in Table 4.10-7) for Significance Thresholds A and B above related to permanent increases in ambient noise levels.

Table 4.10-7. Significant Change in Permanent Ambient Noise Levels

Existing Ambient Noise Level, L_{dn}/CNEL	Significant Increase
<60 dBA	+ 5 dB or Greater
>60 dBA	+ 3 dB or Greater

Source: Adapted from FICON 1992 and Caltrans 2020.
Notes: dBA = Decibel A-weighted; CNEL = Community Noise Equivalent Level; L_{dn} = day-night average noise level.

It is important to consider significance thresholds based on the degradation of the existing ambient noise environment. Using a single absolute value to evaluate an impact relating to a noise level increase would not account for the preexisting ambient noise environment to which a person has become accustomed. The County of Santa Cruz and the City of Santa Cruz have established varying standards to address increases in the ambient noise environment that occur due to the development of a project, or the addition of a new noise source. These relative noise level thresholds allow for an increase above the existing ambient noise levels ranging from 3 to 6 dBA L_{dn}, depending on the ambient noise level without the project element or the land uses involved.

For community noise assessments Caltrans considers that it is "generally not significant" if no noise-sensitive uses are located within the project area, or if increases in community noise levels associated with implementation of the project would not exceed +3 dB at noise-sensitive locations in the project vicinity (Caltrans 2020a). Research assessing the percentage of people who are highly annoyed by changes in ambient noise levels indicate that when ambient noise levels are low, a greater change is needed to cause a response. As ambient noise levels increase, a lesser change in noise levels is required to elicit significant annoyance. Based on this premise, the significance thresholds outlined in Table 4.10- for permanent increases in ambient noise levels are considered to correlate well with human response to changes in such noise levels and assess degradation of ambient community noise environment. These significance thresholds are consistent with those outlined by the County of Santa Cruz and would provide compliance with the City of Santa Cruz relative increase standards.

Given the above, the quantified significance thresholds for Significance Thresholds A, B, and C are as follows:

- **Significance Threshold A.** The Proposed Project would result in the generation of a substantial permanent increase in ambient noise levels resulting in a significant impact in the vicinity of the Project if they would cause an increase of +5 dBA L_{dn} in the ambient noise level exposure, where existing ambient noise levels are below 60 dBA L_{dn} or a +3 dBA L_{dn} increase in the ambient noise level exposure, where existing ambient noise levels are above 60 dBA L_{dn}, based on Table 4.10-7. (These thresholds are consistent with those outlined by the County of Santa Cruz and would provide compliance with the City of Santa Cruz relative increase standards.)
- **Significance Threshold B.** The Proposed Project would result in the generation of a substantial temporary or permanent noise levels in the vicinity of the Project if the following standards would be exceeded:
    - Construction Noise. For temporary construction activities, a significant impact would occur if construction noise exceeds 60 dBA between 10:00 PM and 8:00 AM or 75 dBA between 5:00 PM and 10:00 PM. Between the hours of 8:00 AM to 5:00 PM on weekdays, construction noise is not limited, based on Santa Cruz County Code Section 8.30.10. Other factors considered in the determination of significance are pitch, duration of sound, time of day or night, necessity of the noise, and proximity to buildings used for sleeping.
    - Operational Noise. For operational noise in any location the same quantified significance thresholds as identified for Significance Threshold A would apply.
- **Significance Threshold C.** The Proposed Project would result in the generation of substantial temporary ground borne noise or vibration levels if it would result in groundborne noise or vibration levels that exceed the Caltrans guidance (i.e., 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) (Caltrans 2020).

4.10.4.2 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 construction assumptions developed for the analyses in this EIR and data obtained during on-site noise measurements. 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 Proposed Project.

Construction

The principal source of project-generated noise would be associated with construction activities; 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 (percentage of the time that the equipment is operational). 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 4.10-8.

Table 4.10-8. 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 2018.
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 effects of construction noise depend largely on the types and specific locations of construction activities occurring on any given day, noise levels generated by those activities, distances to noise-sensitive receptors,[1] and the existing ambient noise environment in the vicinity of the receiver. Construction generally occurs in

1 Distances of construction activities to noise-sensitive receptors can vary throughout a given day and over the course of construction as construction equipment and activities move along the linear pipeline construction site.

several discrete stages, with each stage varying the equipment mix, and the associated noise. These stages alter the characteristics of the sound levels generated from the construction activity and in the surrounding community.

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.

The decommissioning of the existing pipeline segment along Pipeline Road would include the use of minimal heavy construction equipment and would complete approximately 1,000 linear feet per day. Nearest receptors are located generally west of the alignment and the San Lorenzo River, at the northern portion of Henry Cowell State Park (i.e., Beth Drive, River Lane, and Old Big Trees Drive). Based on the small area of nearby sensitive receptors, the distance between the alignment and the receptors, the limited use of heavy equipment and the rate of the decommissioning operations, the Proposed Project would not exceed the daytime thresholds of significance during such operations.

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 in the Transportation and Construction Vibration Guidance Manual (Caltrans 2020) and the relative distance to sensitive receptors from a given vibration source. Representative groundborne vibration levels for various types of construction equipment, developed by FTA, are summarized below in Table 4.10-9. Based on the reference vibration levels presented in Table 4.10-9, the distance at which the equipment would exceed the applicable Caltrans thresholds was calculated for the Proposed Project.

Table 4.10-9. Representative Vibration Levels for Construction Equipment

Equipment	PPV at 25 feet (in/sec)[1,2]	Approximate Lv (VdB) at 25 feet[3]
Vibratory Roller	0.210	94
Hoe Ram	0.089	87
Heavy-duty Trucks (Loaded)	0.076	86
Jackhammer	0.035	79
Small Bulldozer	0.003	58

Source: FTA 2018.
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: $PPV_{equip} = PPV_{ref} (25/D)^{1.5}$ (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.

Operation

The Proposed Project's operation and maintenance activities for existing infrastructure (i.e., pipelines, valves, blowoffs, and FBPS) would generally remain similar to existing activities. The Proposed Project does not include pump stations or other appurtenant facilities that would generate noise. Once Proposed Project construction is complete, operations would be similar to existing conditions and would not require an increase in on-road vehicle trips associated with routine inspection and maintenance by City staff. The Proposed Project components are discussed qualitatively based on existing and similar facilities, existing ambient noise levels and nearby noise-sensitive receptors.

Application of Relevant Standard Practices

The City has adopted standard construction practices (see Section 3.6.6, Standard Construction Practices) that the City or its contractors would implement to avoid or minimize effects related to noise and vibration. One Standard Construction Practice would be applicable to the noise and vibration impacts of the Project; its effectiveness in avoiding and minimizing effects is described below.

Standard Construction Practice #26 requires the City to designate a Construction Noise Coordinator and notify adjacent property owners regarding planned nighttime construction activities and specifies the protocol for responding to any local complaints that are received about construction noise. When a noise complaint is received, the Construction Noise Coordinator shall notify the City within 48 hours, determine the cause of the complaint, and implement as possible reasonable measures to resolve the complaint as deemed acceptable by the City. This measure provides an avenue for adjacent property owners to communicate with the City to express noise complaints but does not include enforceable, objective measures or standards that the Proposed Project must achieve related to construction noise.

Impacts have been evaluated with respect to the thresholds of significance, as described above. In the event adverse environmental impacts would occur even with consideration of applicable policies and regulations and Proposed Project Standard Construction Practices described in Chapter 3, Project Description, if applicable, impacts would be potentially significant, and mitigation measures are provided to reduce impacts to less-than-significant levels.

4.10.4.3 Project Impact Analysis

Areas of No Impact

The Proposed Project would not have impacts with respect to the following thresholds of significance as described below.

- **Exposure to Aircraft Noise (Significance Threshold D).** The Proposed Project would not expose people to excessive aircraft noise. The nearest airstrip to the Proposed Project is the Bonny Doon Village Airpark, which is a privately owned, private-use airport located approximately 2.5 miles west of the Brackney North and Brackney South sections. The nearest public or public-use airport is Watsonville Municipal Airport, which is located approximately 14 miles southeast of the GHWTP facility. Watsonville Municipal Airport is not part of an adopted airport land use plan, and the study area 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 threshold is not further evaluated.

Project Impacts

Impact NOI-1: Substantial Permanent Increase in Ambient Noise Levels (Significance Threshold A). Operation of the Proposed Project would not result in generation of a substantial permanent increase in ambient noise levels during long-term operation in the vicinity the Project components. ***(Less than Significant)***

The Proposed Project would not include any new noise generating sources that would result in long-term operational noise levels. The FBPS has been improved over the past decade, and no new pump stations would be required for the Proposed Project. Minor operational and maintenance components would include the replacement of existing air valves, new air/vacuum valves in some new pipeline sections and blowoff valves. Air/vacuum valves would typically be installed along the pipeline at 1/4 to 1/2- mile intervals to aid in the releasing of air when filling the pipeline, dewatering the pipeline, isolating pipeline sections or other maintenance activities. Noise generated in association with the use of these valves would be minimal, consistent with existing operations, and are not operated for a significant duration of time to affect the ambient day/night noise levels (L_{dn}).

Long-term operation of the Proposed Project would result in a negligible increase in traffic on the roadway network, as it is expected to remain consistent with current operation and maintenance activities. Routine maintenance is expected but would be similar to existing conditions. Therefore, long-term operation and maintenance of the Proposed Project would result in a less-than-significant impact.

Mitigation Measures

As described above, the Proposed Project would not result in significant impacts related to permanent increases in noise, and therefore, no mitigation measures are required.

Impact NOI-2: Substantial Increase in Ambient Noise Levels in Excess of Standards (Significance Threshold B). Construction of the Proposed Project would result in generation of a substantial temporary increase in ambient noise levels in the vicinity of some Proposed Project pipe sections in excess of applicable standards established in local general plans or noise ordinances. ***(Significant and Unavoidable)*** Operation of the Proposed Project would not result in the generation of a substantial permanent increase in ambient noise levels in the vicinity of the Proposed Project in excess of applicable standards. (***Less than Significant***)

Construction

The majority of the Proposed Project includes conventional open cut trenching and construction methods. Trenchless methods would be used in the Brackney North and potentially Brackney South sections and for the existing railroad crossing in the Graham Hill Road North section. The Proposed Project construction methods would have the potential to impact the ambient noise environment in the immediate vicinity of construction activities. The Proposed Project is scheduled to be constructed in phases over multiple years from late 2022/early 2023 to 2032. The Brackney North, Graham Hill Road North, and Graham Hill Road South pipe sections would be constructed first, with an estimated construction schedule of about 24 months for the

Graham Hill Road sections and approximately 9 months for the Brackney North section, including pipeline installation, road repaving, and abandonment of the existing NCP.

Construction generally would occur during normal weekday work hours, between 8 AM and 5 PM and in accordance with County of Santa Cruz encroachment permit requirements. However, construction along Graham Hill Road would be limited to the hours of 8 AM to 4 PM with temporary lane closures restricted to 9 AM to 3 PM. The trenchless installation method that will be used for the pipeline in the Brackney North section would primarily occur during weekday work hours, between 8 AM and 5 PM; however, the HDD construction method would require approximately one day of continuous 24-hour construction activity.

The Proposed Project also includes the implementation of Standard Construction Practice #26 that requires that adjacent property owners be notified of nighttime construction schedules and that a Construction Noise Coordinator be identified that will be responsible for responding to local complaints about construction noise. See Section 4.10.4.2, Analytical Methods, for additional information about this measure and its effectiveness.

Conventional Trenching and Construction Methods

Conventional open cut trenching methods consist of excavation of the trench, removal of soil, installation of pipe bedding, and backfilling with engineered fill. Conventional construction methods would be utilized throughout the Proposed Project alignment in all pipe sections, except for the Brackney North section, potentially the Brackney South section, and a portion of the Graham Hill Road North section at a railroad crossing. The open cut trench would typically be 4 to 5 feet wide, with construction support activities occurring within a 10- to 15-foot-wide construction corridor. Approximately 60 to 100 linear feet of pipeline can be installed on a typical workday using conventional trenching.

The conventional trenching and construction methods would generate noise levels associated with the operation of heavy construction equipment and construction related activities (see Table 4.10- for typical construction equipment noise levels).

Noise levels for the phases using conventional trenching and construction methods were calculated using the FHWA and FTA reference noise levels presented in Table 4.10-. The loudest mix of equipment associated with conventional trenching and pipeline construction would occur during the "Pipeline – Road Removal/Pipe Installation/Appurtenances" phase. The Pipeline phase would incorporate the use of excavators, backhoes, loaders, dump trucks, and rollers; with a resulting noise level of 85.2 dBA L_{eq} at a distance of 50 feet. Accounting for an attenuation rate of 6 dB per doubling of distance, construction of the Proposed Project would exceed the daytime noise level threshold of 75 dBA at a distance of 124 feet and the 60 dBA nighttime threshold at a distance of 472 feet, although no nighttime construction is proposed for segments with conventional construction methods. While some residents would be subject to intermittent noise levels that may exceed 75 dBA during the day, given the linear nature of conventional open cut trenching and construction methods, the Proposed Project would not expose an individual noise-sensitive receptor to construction noise for extended periods of time. However, noise-sensitive receptors located less than 124 feet from the conventional trenching and construction methods could be exposed to noise levels exceeding the daytime construction noise thresholds. As such, the construction of the Proposed Project would result in a potentially significant impact.

Implementation of MM NOI-1 would reduce the temporary increase in ambient noise levels during construction in excess of applicable standards in the vicinity of the Proposed Project by requiring the location of noise generating equipment as far as possible from noise-sensitive receptors, within an acoustically rated enclosure, shroud or temporary barrier when necessary; requiring the use of mufflers and noise suppressors on equipment; and limiting equipment idling. For the conventional trenching construction methods, these measures would result in the minimization of construction noise that would typically be considered unreasonably disturbing, such as noise having excessive intensity, duration, or pitch as defined in the County Code and reduce construction noise levels below the daytime noise level threshold of 75 dBA.

Trenchless Construction Methods

Brackney North and Brackney South Sections. Construction of the Proposed Project pipeline segment in the Brackney North section would be installed using the trenchless Horizontal Directional Drilling (HDD) method. Construction activities associated with the HDD drilling operations would be located in a typical work area of 15,000 sf. at the northern HDD entry point. The HDD drilling would be conducted from a work area located near the gravel turnout near the intersection of Brackney Road and the City's existing pipeline easement, which would locate the acoustical center of the work area approximately 150 feet from the nearest noise-sensitive receptor's outdoor activity area. The northern HDD entry point would be located within a temporary construction easement between Caledonium Avenue and Fremont Avenue, which would locate the acoustical center of the work area approximately 75 feet from the nearest noise-sensitive receptor's outdoor activity area. As indicated in Chapter 3, Project Construction, HDD operations would generally occur between 8 AM and 5 PM; however, the pipeline pullback portion of the HDD process would require continuous 24-hour operation for approximately one (1) day.

The HDD construction process generally consists of three stages; drilling of a pilot hole, enlarging the pilot hole using a larger cutting tool known as a back reamer, and pulling of the pipe through the enlarged hole. Equipment used for the HDD process on the primary entry site generally includes a drill rig, mud (lubrication fluid) pumping and processing systems, heavy equipment (e.g. crane, boom truck, loader, backhoe, etc.), and frac tanks (water and mud storage). The HDD exit side can employ an additional HDD entry side rig/equipment or use a smaller compliment of heavy equipment and support equipment (Burge and Kiteck 2009). For the Proposed Project it is assumed that a full complement of equipment may be employed at both HDD entry sites. Empirical sound level data, based on HDD drilling operations of varying sizes, indicates that the sound power levels (Lw) generated by a typical equipment complement for an HDD entry side would be 115 dBA Lw. At a distance of 75 feet, sound pressure levels generated by the HDD entry side equipment under "peak" power are calculated to be approximately 75 dBA L_{eq} at the nearest noise-sensitive receptor's outdoor activity area. As previously discussed, throughout the construction operations the equipment would have periods of peak operation and periods of time with lower noise level emissions; this is accounted for through application of the acoustical usage factors presented in Table 4.10-8. Application of any acoustical usage factor less than 100% peak operation would reduce the HDD entry site noise level exposure at the nearest receptor to levels less than the predicted peak of 75 dBA Leq. Therefore, HDD drilling operations would comply with the County of Santa Cruz 75 dBA Leq construction threshold during the daytime period of 8 AM to 5 PM, but would exceed the 60 dBA Leq noise level threshold when operating outside of the daytime hours. As such, the construction of the Proposed Project would result in a potentially significant impact.

During the construction period requiring continuous HDD pipeline pullback operations at the Brackney North section, the implementation of MM NOI-1, limiting operations to less sensitive daytime hours, would not be possible. Implementation of MM NOI-1 would reduce the HDD construction noise levels between 5 and 13 dBA (Wu & Keller 2007), resulting in noise levels calculated to range from 62 to 70 dBA at nearby noise-sensitive receptors. Therefore, temporary noise from these operations could still exceed the noise level thresholds noted above, after incorporation of MM NOI-1. As a result, construction of the Brackney North pipe section would have a significant and unavoidable impact related to construction noise.

Similar noise impacts could result during construction of the Brackney South section if the HDD method is used for in all or part of this area. Depending on the location of the pipe entry sites, the nearest noise sensitive receptor may be within 75 to 100+ feet of the entry. Temporary construction operations could also exceed noise level thresholds as noted above. As a result, construction of the Brackney South pipe section could have a significant and unavoidable impact related to construction noise.

Graham Hill Road North Section. A trenchless construction also would be used to extend the proposed pipe under the existing Big Trees and Union Pacific Railway crossing across Graham Hill Road in the Graham Hill North pipe section. Two alternatives are under consideration. The first, pipe ramming, is a trenchless, non-steerable installation method for driving an open-ended steel casing using a percussive hammer. The hammer transmits the ramming force to the pipe via a tapered adaptor cone which is welded to the rear of the pipe. After a section of casing has been installed, the hammer and adaptor cones are removed, and a new casing section is welded into place. The hammer assembly is reattached, and ramming operations continue. The soil may be removed from the casing using augers, jetting, or compressed air after completion of ramming, or at intervals during the drive (Mott MacDonald 2021).

The loudest noise generator associated with pipe ramming is caused by the anvil (within the hammer) striking the casing and transferring the hammer energy into the pipe. During the pipe ramming process there are hammer strike periods and longer periods of lower noise levels generated by secondary support equipment (e.g., excavators, spoil clearing, cranes or lift-trucks, air compressors/hydraulic power units). Depending on the type of power unit (i.e., pneumatic or hydraulic), the pneumatic air compressor has been found to be the loudest consistent noise source of the necessary support equipment (Atalah 1998). Based on typical operations of the secondary support equipment, an air compressor or hydraulic power unit, excavator, crane or lift-truck could be used at the same time to complete the designated task. These operations would result in combined loudest noise levels of 82.2 dBA Leq at a distance of 50 feet. As a result, noise-sensitive receptors within approximately 115 feet of the center of construction activity would be exposed to noise levels exceeding the County of Santa Cruz construction noise threshold of 75 dBA and be potentially significant. After the incorporation of MM NOI-1 construction of the Graham Hill Road North section, utilizing the pipe ramming construction methods would be reduced to a less than significant impact.

The second alternative construction method, auger-boring, is a pipe jacking method for installing a casing pipe between two shafts by means of a rotating cutting head. This process requires an auger boring machine to be placed in a launch pit on grade at the beginning of the pipeline segment as well as a reception pit at the end of the drive. The auger boring machine is equipped with a jacking frame, forces from the jacking frame need to be transferred to the back of the jacking shaft with a thrust block or into the soil below with anchors. The auger-boring head can produce elevated noise levels in the immediate vicinity of the drilling face; however, the drilling face would be located in an entrance or exit pit, which would provide shielding of the noise generated by the auger-boring drill face. Secondary support equipment, located at ground level, would include a similar complement of equipment as used in the HDD and pipe ramming trenchless methods, such as an air compressor, excavator, hydraulic power unit, a welder and either a lift truck or crane for placing/positioning of pipe sections. With that, noise-sensitive receptors within approximately 115 feet of the center of construction activity would be exposed to noise levels exceeding the County of Santa Cruz construction noise threshold of 75 dBA and be potentially significant. After the incorporation of MM NOI-1 construction of the Graham Hill Road North section, utilizing the pipe ramming construction methods would be reduced to a less than significant impact.

Operation

As indicated in Impact NOI-1, the Proposed Project would not directly result in operational activities or include new substantial noise sources. Given that, the Proposed Project would not result in a substantial permanent increase in ambient noise levels and long-term operation of the Proposed Project would have no operational noise impact.

Mitigation Measures

Implementation of MM NOI1 described below would reduce potentially significant construction noise to a less-than-significant level for construction of pipeline sections using conventional trenching methods. However, as indicated above, the Brackney North pipeline installation would have significant and unavoidable construction noise impacts due to 24-hour pipeline pullback operations during construction.

MM NOI-1: **Construction Noise (Applies to all segments).** 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 AM and 5:00 PM, unless specifically identified work outside these hours is authorized by the City's Water Director as necessary to allow for safe access to a construction site, safe construction operations or efficient construction progress, such as required by the HDD pullback operations for the Brackney North segment.
- Construction activities requiring operations continuing outside of the standard work hours of 8:00 AM and 5:00 PM (e.g., HDD operations for the Brackney North and Brackney South sections) shall locate noise generating equipment as far as possible from noise-sensitive receptors, and/or within an acoustically rated enclosure (meeting or exceeding Sound Transmission Class [STC] 27), shroud or temporary barrier as needed to limit the propagation of sound into the surrounding areas in excess of the 60 dBA nighttime (10:00 PM to 8:00 AM) criteria at the nearest sensitive receptor. Noisy construction equipment, such as aboveground conveyor systems, and impact tools will likely require location within such an acoustically rated enclosure, shroud or barrier to meet the above criteria. Impact tools, in particular, shall have the working area/impact area shrouded or shielded whenever possible, with intake and exhaust ports on power equipment muffled or suppressed.
- Use of temporary or portable, application-specific noise shrouds, barriers or enclosures shall be required to shield nearby noise-sensitive receptors from equipment and operations that have the potential to generate noise levels in excess of the 75 dBA daytime (8:00 a.m. to 10:00 p.m.) criteria, as measured at nearby

sensitive receptors. This generally corresponds with a distance of 125 feet from construction activities to the nearest sensitive receptor, however site-specific factors will need to be taken into consideration, such as the specific construction equipment mix, and intervening structures or topography that may result in associated noise reductions below the acceptable daytime noise threshold.

- Portable and stationary site support equipment (e.g., generators, compressors, and cement mixers) shall be located as far as possible from nearby noise-sensitive receptors.
- 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.
- Construction equipment shall not be idled for extended periods of time (i.e., 5 minutes or longer) in the immediate vicinity of noise-sensitive receptors.

Impact NOI-3:	**Groundborne Vibration (Significance Threshold C).** Construction of the Proposed Project would result in the potential generation of excessive groundborne vibration or groundborne noise levels. ***(Less than Significant)***

Construction activities may result in varying degrees of temporary groundborne vibration or noise, depending on the specific construction equipment used and operations involved. Pile driving and blasting are not currently expected to be utilized in the construction of the Proposed Project. The construction phases and equipment mixes used in this analysis are consistent with those used in Impact NOI-2. The Proposed Project is not anticipated to incorporate equipment or processes that would generate substantial groundborne noise or vibration during operations; as such, groundborne noise and vibration sources would be limited to construction activities.

Groundborne noise and vibration sources are anticipated to include typical heavy equipment (e.g., excavator, tractors, vibratory roller, etc.) associated with conventional open cut trenching and pipeline construction, as well as equipment associated with the HDD pipeline installation process (e.g., drill rig, hydraulic power units, mud pump and process equipment, and tanks). Use of a vibratory roller during the paving portions of pipeline installations would produce vibration levels exceeding the Caltrans threshold of 0.3 in/sec PPV at distances of 15 feet or less from the vibratory roller. Vibration generating activities associated with the conventional open cut trenching and construction methods would be performed within the roadway right-of-way and easements. When accounting for typical property line setback distances for structures, structures susceptible to vibration damage would be located at distances greater than 15 feet and would not exceed the Caltrans 0.3 in/sec PPV threshold. Therefore, generation of groundborne noise and vibration levels associated with conventional open cut trenching and construction methods would result in a less-than-significant impact.

The closest sensitive receptors to the HDD entry points for the Brackney North segment are more than 50 feet from the proposed construction activities. The drill rig and heavy equipment associated with the HDD pipeline installation and construction process would produce vibration levels less than 0.03 in/sec PPV; which would be substantially below the Caltrans threshold of 0.3 in/sec PPV. The closest sensitive receptors for the Graham

Hill Road North trenchless construction activities are approximately 40 feet from the proposed activities. Vibration levels present during trenchless methods such as pipe ramming will be dependent on the power applied through the hammer. Empirical data indicates that trenchless methods such as pipe ramming would attenuate to the Caltrans threshold of 0.3 in/sec PPV at an approximate distance of 30 feet (Atalah 1998) and would be approximately 0.18 in/sec PPV at a distance of 40 feet. Therefore, generation of groundborne noise and vibration levels associated with trenchless HDD construction methods would result in a less-than-significant impact.

Mitigation Measures

As described above, the Proposed Project would not result in significant impacts related to vibration, and therefore, no mitigation measures are required.

4.10.4.4 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 4.0-1 in Section 4.0, Introduction to Analyses, and as relevant to this topic. The geographic area of potential cumulative noise and vibration impacts is limited to the immediate vicinity of the project pipeline alignment, areas immediately adjacent to the routes designated for access, hauling or linear construction and areas within approximately 650 feet of the Proposed Project construction activities.

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

Impact NOI-4:	**Cumulative Noise Impacts (Significance Thresholds A, B and C).** Construction and operation of 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 elevated noise and vibration levels from multiple cumulative projects simultaneously and in close proximity. Construction of the project would occur over several phases, beginning in 2022 and ending in 2031. As shown in Table 4.0-1, which displays the estimated construction schedule for cumulative projects, where known, there are two cumulative projects that are located at or near the Project sites that could be under construction during this same period of time as the Proposed Project. The only cumulative projects with an overlap of construction schedules are two improvement projects at the GHWTP (Concrete Tanks Project and Facility Improvement Project). Other cumulative projects in the vicinity of Project sites would be completed before Proposed Project construction begins (Newell Creek Dam Inlet/Outlet Improvement Project and San Lorenzo Way Bridge Replacement) or would occur after completion of the Graham Hill Road pipe sections (intertie pipeline with Scotts Valley, for which no project timeline has been established).

Construction of the Proposed Project would have the potential to generate noise and vibration levels in excess of the applicable standards, as described in Impact NOI-2. Specifically, construction of the Brackney North pipe section would require continuous 24-hour operation for pipeline pullback, which would be a significant contribution to the immediate noise environment when the pullback operations are underway. As indicated in Impact NOI-2, this impact would be significant and unavoidable specifically related to the HDD activities due to the continuous nature of the noise and its operation in the more sensitive nighttime period. However, the HDD pipeline installation operations would not occur in close enough proximity to allow for construction noise levels to combine with cumulative projects and therefore would not result in a significant cumulative noise impact. The HDD pipeline pullback operations would also cease after approximately one day. Conventional open cut trenching and construction operations associated with the Proposed Project would not generate noise levels that would contribute to a significant cumulative noise impact. Therefore, the Proposed Project's cumulative construction noise impact would be less than significant, despite the significant and unavoidable project-specific noise impacts of the trenchless HDD pipeline construction methods.

Based on the distance of all of the Proposed Project construction operations from other cumulative noise-generating projects, cumulative projects would not result in a significant cumulative impact related to noise and vibration.

4.10.5 References

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