APPENDIX F

Noise Impact Assessment

Noise Impact Assessment

North Bench Recycled Water System Project

Yucaipa, California

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LIST OF ACRONYMS AND ABBREVIATIONS

Term	**Description**
ANSI	The American National Standards Institute
City	City of Yucaipa
CNEL	Community Noise Equivalent Level
County	San Bernardino County
dB	Decibel
dBA	Decibel is A-weighted
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
ITE	Institute of Transportation Engineers
L_{eq}	Measure of ambient noise
OPR	Office of Planning and Research

LIST OF ACRONYMS AND ABBREVIATIONS

Term	**Description**
OSHA	Federal Occupational Safety and Health Administration
PPV	Peak particle velocity
Project	North Bench Recycled Water System Project
RMS	Root mean square
WEAL	Western Electro-Acoustic Laboratory, Inc.
YVWDRWFF	Yucaipa Valley Water District Regional Water Filtration Facility

1.0 INTRODUCTION

This report documents the results of a Noise Impact Assessment completed for the Yucaipa Valley Water District North Bench Recycled Water System Project (Project), which proposes the expansion of a recycled water system in the North Bench area (zones 16 through 20) of the City of Yucaipa, San Bernardino County, California. This Project would extend the easternmost segment of the system from the 14 zone to the future 16 zone to make recycled water service available for current and future customers and developments in the area. This assessment was prepared as a comparison of predicted Project noise levels to noise standards promulgated by the City of Yucaipa General Plan Noise Element, the City of Yucaipa Municipal Code, the San Bernardino County General Plan, and San Bernardino County Municipal Code. The purpose of this report is to estimate Project-generated noise levels and to determine the level of impact the Project would have on the environment.

1.1 Project Location and Description

The Project Site is primarily located in the City of Yucaipa (City). A small section of the eastern portion of the Project Area is located within the Oak Glen community of unincorporated San Bernardino County. The City of Yucaipa covers approximately 28 square miles within San Bernardino County, California. The City is bordered by the City of Calimesa to the south and the City of Crafton to the west. The Project is located in Township 1 South, Range 1 West of the Yucaipa and Forest Falls, California USGS 7.5-minute topographic quadrangle maps (see Figure 1-1).

The Project includes the construction of four recycled water reservoirs, four booster stations, and approximately 3.4 miles of pipeline. The westernmost of the booster stations would be located at the Yucaipa Valley Water District Regional Water Filtration Facility (YVRWFF). The first booster station and reservoir would be located north of Oak Glen Road approximately one mile east of the YVRWFF adjacent to an existing reservoir. The second reservoir and booster station would be located at the eastern end of Lan Franc Road, south of Oak Glen Road. The third reservoir and booster station would be located south of Oak Glen Road within undisturbed land. The fourth reservoir would be constructed south of Oak Glen Road adjacent to an existing reservoir approximately two miles east of the first reservoir. The construction of the four recycled water reservoirs and booster pumps would disturb approximately 1.6 acres of land. The 3.4-mile pipeline would disturb a total of 4.0 acres of land and would be constructed in the existing roadway along Glen Oak Road. Therefore, the whole of the Project would disturb 5.6 acres of land total. It is anticipated that construction would take 12 months and would begin in early 2023.

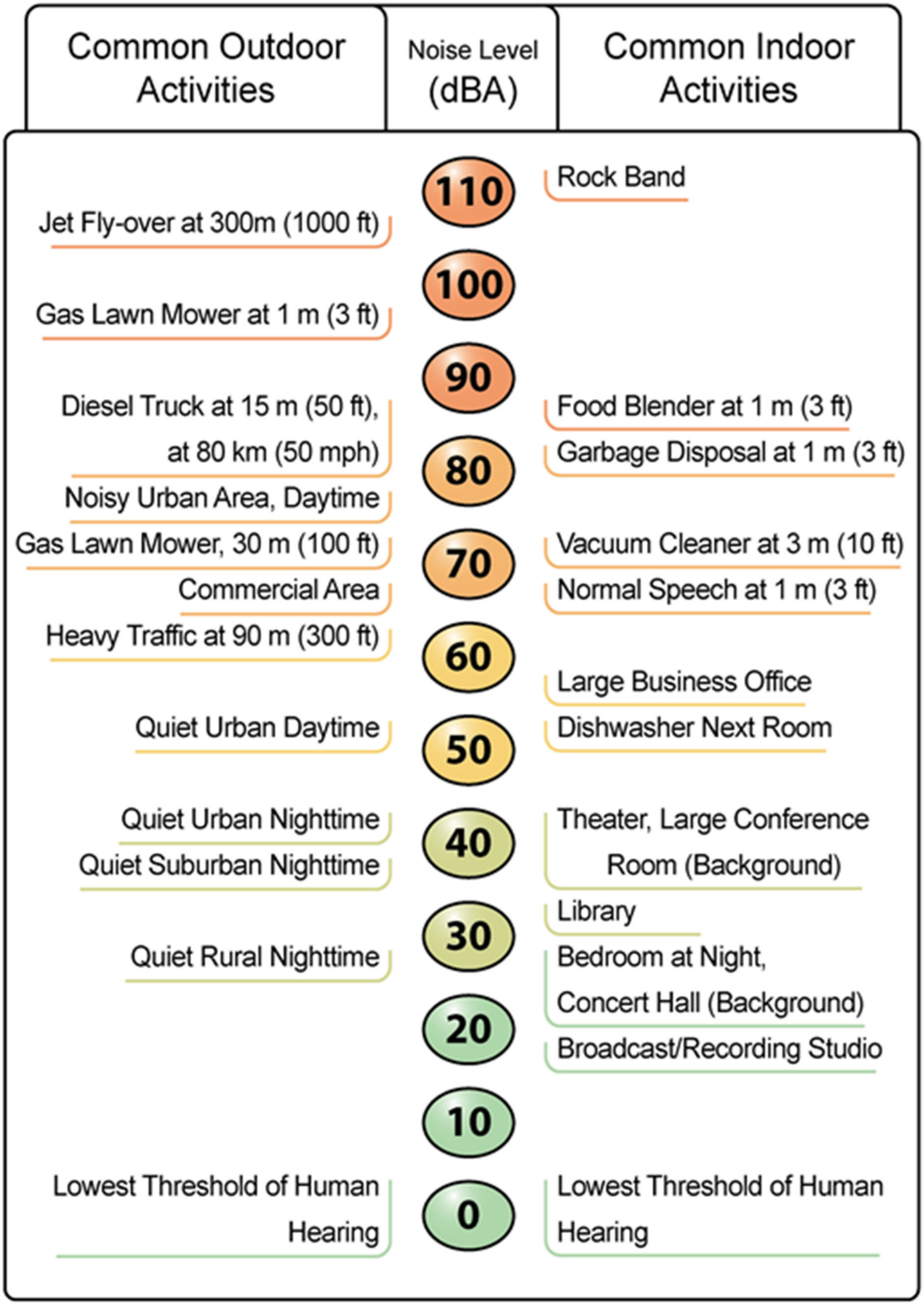
2.0 ENVIRONMENTAL NOISE AND GROUNDBORNE VIBRATION ANALYSIS

2.1 Fundamentals of Noise and Environmental Sound

2.1.1 Addition of Decibels

The decibel (dB) scale is logarithmic, not linear, and therefore sound levels cannot be added or subtracted through ordinary arithmetic. Two sound levels 10 dB apart differ in acoustic energy by a factor of 10. When the standard logarithmic decibel is A-weighted (dBA), an increase of 10 dBA is generally perceived as a doubling in loudness. For example, a 70-dBA sound is half as loud as an 80-dBA sound and twice as loud as a 60-dBA sound. When two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be three dB higher than one source under the same conditions (Federal Transit Administration [FTA] 2018). 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 three dB). Under the decibel scale, three sources of equal loudness together would produce an increase of five dB.

Typical noise levels associated with common noise sources are depicted in Figure 2-1.



Source: California Department of Transportation (Caltrans) 2020a

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Figure 2-1. Common Noise Levels

2018-057.009 North Bench Recycled Water System Project

2.1.2 Sound Propagation and Attenuation

Noise can be generated by a number of sources, including mobile sources such as automobiles, trucks and airplanes, and stationary sources such as construction sites, machinery, and industrial operations. Sound spreads (propagates) uniformly outward in a spherical pattern, and the sound level decreases (attenuates) at a rate of approximately six dB for each doubling of distance from a stationary or point source. Sound from a line source, such as a highway, propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of approximately three dB for each doubling of distance from a line source, such as a roadway, depending on ground surface characteristics (Federal Highway Administration [FHWA] 2011). No excess attenuation is assumed for hard surfaces like a parking lot or a body of water. Soft surfaces, such as soft dirt or grass, can absorb sound, so an excess ground-attenuation value of 1.5 dB per doubling of distance is normally assumed. For line sources, an overall attenuation rate of three dB per doubling of distance is assumed (FHWA 2011).

Noise levels may also be reduced by intervening structures; generally, a single row of detached buildings between the receptor and the noise source reduces the noise level by about five dBA (FHWA 2006), while a solid wall or berm generally reduces noise levels by 10 to 20 dBA (FHWA 2011). However, noise barriers or enclosures specifically designed to reduce site-specific construction noise can provide a sound reduction 35 dBA or greater (Western Electro-Acoustic Laboratory, Inc. [WEAL] 2000). To achieve the most potent noise-reducing effect, a noise enclosure/barrier must physically fit in the available space, must completely break the “line of sight” between the noise source and the receptors, must be free of degrading holes or gaps, and must not be flanked by nearby reflective surfaces. Noise barriers must be sizable enough to cover the entire noise source and extend lengthwise and vertically as far as feasibly possible to be most effective. The limiting factor for a noise barrier is not the component of noise transmitted through the material, but rather the amount of noise flanking around and over the barrier. In general, barriers contribute to decreasing noise levels only when the structure breaks the "line of sight" between the source and the receiver.

The manner in which older homes in California were constructed generally provides a reduction of exterior-to-interior noise levels of about 20 to 25 dBA with closed windows (Caltrans 2002). The exterior-to-interior reduction of newer residential units is generally 30 dBA or more (Harris Miller, Miller & Hanson Inc. [HMMH] 2006). Generally, in exterior noise environments ranging from 60 dBA Community Noise Equivalent Level (CNEL) to 65 dBA CNEL, interior noise levels can typically be maintained below 45 dBA, a typically residential interior noise standard, with the incorporation of an adequate forced air mechanical ventilation system in each residential building, and standard thermal-pane residential windows/doors with a minimum rating of Sound Transmission Class (STC) 28. (STC is an integer rating of how well a building partition attenuates airborne sound. In the U.S., it is widely used to rate interior partitions, ceilings, floors, doors, windows, and exterior wall configurations.) In exterior noise environments of 65 dBA CNEL or greater, a combination of forced-air mechanical ventilation and sound-rated construction methods is often required to meet the interior noise level limit. Attaining the necessary noise reduction from exterior to interior spaces is readily achievable in noise environments less than 75 dBA CNEL with proper wall construction techniques following California Building Code methods, the selections of proper windows and doors, and the incorporation of forced-air mechanical ventilation systems.

2.1.3 Noise Descriptors

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Several rating scales have been developed to analyze the adverse effect of community noise on people. Because environmental noise fluctuates over time, these scales consider that the effect of noise on people is largely dependent on the total acoustical energy content of the noise, as well as the time of day when the noise occurs. The L_{eq} is a measure of ambient noise, while the L_{dn} and CNEL (Community Noise Equivalent Level) are measures of community noise. Each is applicable to this analysis and defined in Table 2-1.

Table 2-1. Common Acoustical Descriptors

Descriptor	Definition
Decibel, dB	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micropascals (or 20 micronewtons per square meter), where 1 pascal is the pressure resulting from a force of 1 newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micropascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average acoustic energy content of noise for a stated period of time. Thus, the Leq of a time-varying noise and that of a steady noise are the same if they deliver the same acoustic energy to the ear during exposure. For evaluating community impacts, this rating scale does not vary, regardless of whether the noise occurs during the day or the night.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	A 24-hour average Leq with a 10 dBA "weighting" added to noise during the hours of 10:00 p.m. to 7:00 a.m. to account for noise sensitivity in the nighttime. The logarithmic effect of these additions is that a 60 dBA 24-hour Leq would result in a measurement of 66.4 dBA Ldn.
Community Noise Equivalent Level, CNEL	A 24-hour average Leq with a 5 dBA "weighting" during the hours of 7:00 p.m. to 10:00 p.m. and a 10 dBA "weighting" added to noise during the hours of 10:00 p.m. to 7:00 a.m. to account for noise sensitivity in the evening and nighttime, respectively. The logarithmic effect of these additions is that a 60 dBA 24-hour Leq would result in a measurement of 66.7 dBA CNEL.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Decibel, dB	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20.

The A weighted decibel sound level scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about ±1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends on the distance between the receptor and the noise source. Close to the noise source, the models are accurate to within about ±1 to 2 dBA.

2.1.4 Human Response to Noise

The human response to environmental noise is subjective and varies considerably from individual to individual. Noise in the community has often been cited as a health problem, not in terms of actual physiological damage, such as hearing impairment, but in terms of inhibiting general well-being and contributing to undue stress and annoyance. The health effects of noise in the community arise from interference with human activities, including sleep, speech, recreation, and tasks that demand concentration or coordination. Hearing loss can occur at the highest noise intensity levels.

Noise environments and consequences of human activities are usually well represented by median noise levels during the day or night or over a 24-hour period. Environmental noise levels are generally considered low when the CNEL is below 60 dBA, moderate in the 60 to 70 dBA range, and high above 70 dBA. Examples of low daytime levels are isolated, natural settings with noise levels as low as 20 dBA and quiet, suburban, residential streets with noise levels around 40 dBA. Noise levels above 45 dBA at night can disrupt sleep. Examples of moderate-level noise environments are urban residential or semi-commercial areas (typically 55 to 60 dBA) and commercial locations (typically 60 dBA). People may consider louder environments adverse, but most will accept the higher levels associated with noisier urban residential or residential-commercial areas (60 to 75 dBA) or dense urban or industrial areas (65 to 80 dBA). Regarding increases in A-weighted noise levels (dBA), the following relationships should be noted in understanding this analysis:

- Except in carefully controlled laboratory experiments, a change of 1 dBA cannot be perceived by humans.
- Outside of the laboratory, a 3-dBA change is considered a just-perceivable difference.
- A change in level of at least 5 dBA is required before any noticeable change in community response would be expected. An increase of 5 dBA is typically considered substantial.
- A 10-dBA change is subjectively heard as an approximate doubling in loudness and would almost certainly cause an adverse change in community response.

2.1.5 Effects of Noise on People

2.1.5.1 Hearing Loss

While physical damage to the ear from an intense noise impulse is rare, a degradation of auditory acuity can occur even within a community noise environment. Hearing loss occurs mainly due to chronic exposure to excessive noise but may be due to a single event such as an explosion. Natural hearing loss associated with aging may also be accelerated from chronic exposure to loud noise.

The Occupational Safety and Health Administration (OSHA) has a noise exposure standard that is set at the noise threshold where hearing loss may occur from long-term exposures. The maximum allowable level is 90 dBA averaged over eight hours. If the noise is above 90 dBA, the allowable exposure time is correspondingly shorter.

2.1.5.2 Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources.

2.2 Fundamentals of Environmental Groundborne Vibration

2.2.1 Vibration Sources and Characteristics

Sources of earthborne vibrations include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, landslides) or manmade causes (explosions, machinery, traffic, trains, construction equipment, etc.). Vibration sources may be continuous (e.g., factory machinery) or transient (e.g., explosions).

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One is the peak particle velocity (PPV); another is the root mean square (RMS) velocity. The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. The RMS velocity is defined as the average of the squared amplitude of the signal. The PPV and RMS vibration velocity amplitudes are used to evaluate human response to vibration.

PPV is generally accepted as the most appropriate descriptor for evaluating the potential for building damage. For human response, however, an average vibration amplitude is more appropriate because it takes time for the human body to respond to the excitation (the human body responds to an average vibration amplitude, not a peak amplitude). Because the average particle velocity over time is zero, the RMS amplitude is typically used to assess human response. The RMS value is the average of the amplitude squared over time, typically a 1- sec. period (FTA 2018).

Table 2-2 displays the reactions of people and the effects on buildings produced by continuous vibration levels. The annoyance levels shown in the table should be interpreted with care since vibration may be found to be annoying at much lower levels than those listed, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage. In high-noise environments, which are more prevalent where groundborne vibration approaches perceptible levels, this rattling phenomenon may also be produced by loud airborne environmental noise causing induced vibration in exterior doors and windows.

Ground vibration can be a concern in instances where buildings shake, and substantial rumblings occur. However, it is unusual for vibration from typical urban sources such as buses and heavy trucks to be perceptible. For instance, heavy-duty trucks generally generate groundborne vibration velocity levels of 0.006 PPV at 50 feet under typical circumstances, which as identified in Table 2-2 is considered very unlikely to cause damage to buildings of any type. Common sources for groundborne vibration are planes, trains, and construction activities such as earth-moving which requires the use of heavy-duty earth moving equipment.

Table 2-2. Human Reaction and Damage to Buildings for Continuous or Frequent Intermittent Vibration Levels			
Peak Particle Velocity (inches/second)	**Approximate Vibration Velocity Level (VdB)**	**Human Reaction**	**Effect on Buildings**
0.006–0.019	64–74	Range of threshold of perception	Vibrations unlikely to cause damage of any type
0.08	87	Vibrations readily perceptible	Threshold at which there is a risk of architectural damage to extremely fragile historic buildings, ruins, ancient monuments
0.1	92	Level at which continuous vibrations may begin to annoy people, particularly those involved in vibration sensitive activities	Threshold at which there is a risk of architectural damage to fragile buildings. Virtually no risk of architectural damage to normal buildings
0.25	94	Vibrations may begin to annoy people in buildings	Threshold at which there is a risk of architectural damage to historic and some old buildings
0.3	96	Vibrations may begin to feel severe to people in buildings	Threshold at which there is a risk of architectural damage to older residential structures
0.5	103	Vibrations considered unpleasant by people subjected to continuous vibrations	Threshold at which there is a risk of architectural damage to new residential structures and Modern industrial/commercial buildings

Source: Caltrans 2020b

3.0 EXISTING ENVIRONMENTAL NOISE SETTING

3.1 Noise Sensitive Land Uses

Noise-sensitive land uses are generally considered to include those uses where noise exposure could result in health-related risks to individuals, as well as places where quiet is an essential element of their intended purpose. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels. Additional land uses such as hospitals, historic sites, cemeteries, and certain recreation areas are considered sensitive to increases in exterior noise levels. Schools, churches, hotels, libraries, and other places where low interior noise levels are essential are also considered noise-sensitive land uses.

The nearest existing noise-sensitive land uses to the Project Site are residential properties adjacent to the northern, southwestern, and northwestern Project Site boundary with the closest being approximately 86 feet distant.

3.2 Existing Ambient Noise Environment

The most common and significant source of noise in the City of Yucaipa is mobile noise generated by transportation-related sources. Other sources of noise are the various land uses (i.e., industrial facilities, agricultural uses, residential and commercial) that generate stationary-source noise.

3.2.1 Existing Ambient Noise Measurements

The American National Standards Institute (ANSI) Standard 12.9-2013/Part 3 "Quantities and Procedures for Description and Measurement of Environmental Sound – Part 3: Short-Term Measurements with an Observer Present" provides a table of approximate background sound levels in L_{dn}, daytime L_{eq}, and nighttime L_{eq}, based on land use and population density. The ANSI standard estimation divides land uses into six distinct categories. Descriptions of these land use categories, along with the typical daytime and nighttime levels, are provided in Table 3-1. At times, one could reasonably expect the occurrence of periods that are both louder and quieter than the levels listed in the table. ANSI notes, "95% prediction interval [confidence interval] is on the order of +/- 10 dB." The majority of the Project Area would be considered ambient noise Category 5 or 6.

Table 3-1. ANSI Standard 12.9-2013/Part 3 A-weighted Sound Levels Corresponding to Land Use and Population Density

Category	Land Use	Description	People per Square Mile	Typical L_{dn}	Daytime L_{eq}	Nighttime L_{eq}
1	Noisy Commercial & Industrial Areas and Very Noisy Residential Areas	Very heavy traffic conditions, such as in busy, downtown commercial areas; at intersections for mass transportation or other vehicles, including elevated trains, heavy motor trucks, and other heavy traffic; and at street corners where many motor buses and heavy trucks accelerate.	63,840	67 dBA	66 dBA	58 dBA
2	Moderate Commercial & Industrial Areas and Noisy Residential Areas	Heavy traffic areas with conditions similar to Category 1, but with somewhat less traffic; routes of relatively heavy or fast automobile traffic, but where heavy truck traffic is not extremely dense.	20,000	62 dBA	61 dBA	54 dBA
3	Quiet Commercial, Industrial Areas and Normal Urban & Noisy Suburban Residential Areas	Light traffic conditions where no mass-transportation vehicles and relatively few automobiles and trucks pass, and where these vehicles generally travel at moderate speeds; residential areas and commercial streets, and intersections, with little traffic, compose this category.	6,384	57 dBA	55 dBA	49 dBA
4	Quiet Urban & Normal Suburban Residential Areas	These areas are similar to Category 3, but for this group, the background is either distant traffic or is unidentifiable; typically, the population density is one-third the density of Category 3.	2,000	52 dBA	50 dBA	44 dBA
5	Quiet Residential Areas	These areas are isolated, far from significant sources of sound, and may be situated in shielded areas, such as a small wooded valley.	638	47 dBA	45 dBA	39 dBA
6	Very Quiet Sparse Suburban or rural Residential Areas	These areas are similar to Category 4 but are usually in sparse suburban or rural areas; and, for this group, there are few if any nearby sources of sound.	200	42 dBA	40 dBA	34 dBA

Source: The American National Standards Institute (ANSI) 2013

4.0 REGULATORY FRAMEWORK

4.1 Federal

4.1.1 Occupational Safety and Health Act of 1970

OSHA regulates onsite noise levels and protects workers from occupational noise exposure. To protect hearing, worker noise exposure is limited to 90 decibels with A-weighting (dBA) over an eight-hour work shift (29 Code of Regulations 1910.95). Employers are required to develop a hearing conservation program when employees are exposed to noise levels exceeding 85 dBA. These programs include provision of hearing protection devices and testing employees for hearing loss on a periodic basis.

4.1.2 U.S. Environmental Protection Agency Office of Noise Abatement and Control

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

4.1.3 National Institute of Occupational Safety and Health

A division of the US Department of Health and Human Services, the National Institute for Occupational Safety and Health (NIOSH) has established a construction-related noise level threshold as identified in the Criteria for a Recommended Standard: Occupational Noise Exposure prepared in 1998. NIOSH identifies a noise level threshold based on the duration of exposure to the source. The NIOSH construction-related noise level threshold starts at 85 dBA for more than 8 hours per day; for every 3-dBA increase, the exposure time is cut in half. This reduction results in noise level thresholds of 88 dBA for more than 4 hours per day, 92 dBA for more than 1 hour per day, 96 dBA for more than 30 minutes per day, and up to 100 dBA for more than 15 minutes per day. The intention of these thresholds is to protect people from hearing losses resulting from occupational noise exposure.

4.2 State

4.2.1 State of California General Plan Guidelines

The State of California regulates vehicular and freeway noise affecting classrooms, sets standards for sound transmission and occupational noise control, and identifies noise insulation standards and airport noise/land-use compatibility criteria. The State of California General Plan Guidelines (State of California 2003), published by the Governor's Office of Planning and Research (OPR), also provides guidance for the acceptability of projects within specific CNEL/L_{dn} contours. The guidelines also present adjustment factors that may be used in order to arrive at noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution.

4.2.2 State Office of Planning and Research Noise Element Guidelines

The State OPR Noise Element Guidelines include recommended exterior and interior noise level standards for local jurisdictions to identify and prevent the creation of incompatible land uses due to noise. The Noise Element Guidelines contain a land use compatibility table that describes the compatibility of various land uses with a range of environmental noise levels in terms of the CNEL.

4.2.3 California Department of Transportation

In 2020, the California Department of Transportation (Caltrans) published the Transportation and Construction Vibration Manual (Caltrans 2020b). The manual provides general guidance on vibration issues associated with the construction and operation of projects concerning human perception and structural damage. Table 2 presents recommendations for levels of vibration that could result in damage to structures exposed to continuous vibration.

4.3 Local

4.3.1 City of Yucaipa General Plan and Municipal Code

The Noise Section of City of Yucaipa General Plan addresses noise-related issues within the community. Programs include protection of noise sensitive uses from excessive noise levels, as well as measures to protect noise generators from encroachment by noise sensitive uses. The following policies are applicable to the Proposed Project:

Goal S-6: Appropriate community noise and vibration levels that balance the need for peaceful environments for sensitive land uses with the needs of local businesses and regional land uses

Policy S-6.6: Require mitigation of exterior and interior noise to the levels in [Table 4-1]. Encourage the use of building design, site planning, landscaping, and other features to reduce noise levels.

The City regulates construction noise in its municipal code. Chapter 87.0905 of the City of Yucaipa's Municipal Code exempts temporary construction, repair, or demolition noise between 7:00 a.m. and 7:00 p.m., except Sundays and Federal holidays.

Table 4-1. Noise Standards for New Uses Affected by Traffic and Railroad Noise			
New Land Use	Land Uses	L_{dN} (or CNEL), dB	
		Interior	Exterior
Residential	Single and Multi-family Duplex	45	60*
	Mobile Home	45	60*
	Hotel, Motel, Lodging	45	60*
Commercial	Commercial Retail, Bank, Restaurant	50	---
	Office Building, R&D, Offices	45	65
	Amphitheater, Auditorium, Theater	45	---
Institutional	Hospital, School, Church, Library	45	65
Open Space	Park and Recreational Area	---	65

Source: City of Yucaipa 2016
Notes: *An exterior noise level up to 65 dBA will be allowed, provided exterior noise levels are substantially mitigated through the reasonable use of best available noise reduction technology and interior noise does not exceed 45 dBA with windows and doors closed.

4.3.2 San Bernardino County General Plan and County Code

While the Project Site is located largely within the City of Yucaipa, a portion of the Project extends into the unincorporated community of Oak Glen. Therefore, the Project would affect land uses in the unincorporated County of San Bernardino. The San Bernardino County General Plan Public Safety Element contains policy provisions intended to protect County residents from the harmful and annoying effects of exposure to excessive noise. For instance, noise standards for adjacent mobile noise sources are limited to propagating exterior noise levels of 60 dBA L_{dn}/CNEL at unincorporated County residences and all new stationary sources of noise are limited to producing daytime noise levels of 55 dBA L_{eq} at any noise sensitive receptor. The County regulates construction noise in its County Code. Chapter 83.01.080 of the County Code exempts temporary construction, maintenance, repair, and demolition noise from all noise standards provided that construction is limited between the hours of 7:00 a.m. and 7:00 p.m., except on Sundays or Federal holidays.

5.0 IMPACT ASSESSMENT

5.1 Thresholds of Significance

The impact analysis provided below is based on the following California Environmental Quality Act Guidelines Appendix G thresholds of significance. The Project would result in a significant noise-related impact if it would produce:

1) 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.

2) Generation of excessive groundborne vibration or groundborne noise levels.

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

For purposes of this analysis, the City and County noise standards were used, where applicable, for evaluation of Project-related noise impacts and are discussed further below.

5.2 Methodology

This analysis of the existing and future noise environments is based on noise-prediction modeling and empirical observations. In order to estimate the worst-case construction noise levels that may occur at the nearest noise-sensitive receptors in the Project vicinity, predicted construction noise levels were calculated utilizing the FHWA's Roadway Construction Model (2006). Groundborne vibration levels associated with construction-related activities for the Project were evaluated utilizing typical groundborne vibration levels associated with construction equipment. Potential groundborne vibration impacts related to structural damage and human annoyance were evaluated, taking into account the distance from construction activities to nearby structures and typically applied criteria for structural damage and human annoyance.

Transportation-source noise is addressed qualitatively.

5.3 Impact Analysis

5.3.1 Project Noise

5.3.1.1 Would the Project Result in Short-Term Construction-Generated Noise in Excess of Standards?

Construction noise associated with the Proposed Project would be temporary and would vary depending on the nature of the activities being performed. Noise generated would primarily be associated with the operation of off-road equipment for onsite construction activities as well as construction vehicle traffic on area roadways. Construction noise typically occurs intermittently and varies depending on the nature or phase of construction (e.g., land clearing, grading, excavation, building construction, paving). Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. Typical operating cycles for these types of construction equipment may involve one or two minutes of full power operation followed by three to four minutes at lower power settings. Other primary sources of acoustical disturbance would be random incidents, which would last less than one minute (such as dropping large pieces of equipment or the hydraulic movement of machinery lifts). During construction, exterior noise levels could negatively affect sensitive land uses in the vicinity of the construction site.

Nearby noise-sensitive land uses consist of residences at 86 feet from the pipeline construction component of the Project. The residences located north of the Project Site boundary are located within the City limits while the remaining nearby noise-sensitive land uses are located within the unincorporated County. The City and County both limit the time that construction can take place but do not promulgate numeric thresholds pertaining to the noise associated with construction. Specifically, Chapter 87.0905 of the City's Municipal Code and Chapter 83.01.080 of the County's Municipal Code state that temporary construction, repair, or demolition noise between 7:00 a.m. and 7:00 p.m. are exempted from noise standards, except on Sundays and Federal holidays. Additionally, construction would occur throughout the linear Project Site and would not be concentrated at one point.

Onsite Construction Noise

To estimate the worst-case onsite construction noise levels that may occur at the nearest noise-sensitive receptor in the Project vicinity in order to evaluate the potential health-related effects (physical damage to the ear) from construction noise, the construction equipment noise levels were calculated using the Roadway Noise Construction Model and compared against the construction-related noise level threshold established in the Criteria for a Recommended Standard: Occupational Noise Exposure prepared in 1998 by NIOSH. A division of the US Department of Health and Human Services, NIOSH identifies a noise level threshold based on the duration of exposure to the source. The NIOSH construction-related noise level threshold starts at 85 dBA for more than 8 hours per day; for every 3-dBA increase, the exposure time is cut in half. This reduction results in noise level thresholds of 88 dBA for more than 4 hours per day, 92 dBA for more than 1 hour per day, 96 dBA for more than 30 minutes per day, and up to 100 dBA for more than 15 minutes per day. For the purposes of this analysis, the lowest, more conservative threshold of 85 dBA L_{eq} is used as an acceptable threshold for construction noise at the nearby sensitive receptors.

The anticipated short-term construction noise levels generated for the necessary equipment were calculated using the Roadway Noise Construction Model for the excavation, site preparation, grading, building construction, pipeline installation, and paving anticipated for the Proposed Project. It is acknowledged that the majority of construction equipment is not situated at any one location during construction activities, but rather spread throughout the Project Site and at various distances from sensitive receptors. The anticipated short-term construction noise levels generated for the necessary equipment is presented in Table 5-1.

Table 5-1. Construction Average (dBA) Noise Levels at Nearest Receptor- Project Site			
Equipment	**Estimated Exterior Construction Noise Level at Nearest Residences**	**Construction Noise Standards (dBA L_{eq})**	**Exceeds Standards?**
Excavation			
Concrete Saw	77.9	*85*	**No**
Dozer	73.0	*85*	**No**
Tractors/Loaders/Backhoes (3)	75.3 (each)	*85*	**No**
Combined Excavation Equipment	**82.6**	*85*	**No**
Site Preparation			
Grader	76.3	*85*	**No**
Dozer	77.0	*85*	**No**
Tractors/Loaders/Backhoes	75.3	*85*	**No**
Combined Site Preparation Equipment	**79.8**	*85*	**No**
Grading			
Graders	76.3	*85*	**No**
Dozer	73.0	*85*	**No**
Tractors/Loaders/Backhoes	75.3	*85*	**No**
Combined Grading Equipment	**81.2**	*85*	**No**
Building Construction			
Crane	67.9	*85*	**No**
Forklift	74.7	*85*	**No**
Generator	72.9	*85*	**No**
Tractors/Loaders/Backhoes	75.3	*85*	**No**
Welder/Torch (3)	65.3 (each)	*85*	**No**
Combined Building Construction Equipment	**80.0**	*85*	**No**
Pipeline Installation			
Boring Jack Power Unit	75.3	*85*	**No**
Concrete Saw (2)	77.9 (each)	*85*	**No**
Tractors/Loaders/Backhoes (2)	75.3 (each)	*85*	**No**
Excavator	72.0	*85*	**No**

Table 5-1. Construction Average (dBA) Noise Levels at Nearest Receptor- Project Site			
Equipment	**Estimated Exterior Construction Noise Level at Nearest Residences**	**Construction Noise Standards (dBA L_{eq})**	**Exceeds Standards?**
Forklift	74.7	*85*	**No**
Generator	72.9	*85*	**No**
Flat Bed Truck	65.6	*85*	**No**
Slurry Trenching Machine (2)	72.6 (each)	*85*	**No**
Crane	67.9	*85*	**No**
All Other Equipment > 5 HP	77.3	*85*	**No**
Paver (2)	69.5 (each)	*85*	**No**
Pavement Scarafier (2)	77.8 (each)	*85*	**No**
Roller (2)	68.3 (each)	*85*	**No**
Combined Pipeline Installation Equipment	**87.3**	*85*	**Yes**
Paving			
Vibratory Concrete Mixer	68.3	*85*	**No**
Paver	69.5	*85*	**No**
Pavement Scarafier	77.8	*85*	**No**
Roller	68.3	*85*	**No**
Tractors/Loaders/Backhoes	75.3	*85*	**No**
Combined Paving Equipment	**80.7**	*85*	**No**

Source: Construction noise levels were calculated by ECORP Consulting using the FHWA Roadway Noise Construction Model (FHWA 2006). Refer to Attachment A for Model Data Outputs.

Notes: Construction equipment used during construction derived from the Roadway Construction Emissions Model and California Emissions Estimator Model. These models are designed to calculate air pollutant emissions from construction activity and contains default construction equipment and usage parameters for typical construction projects based on several construction surveys conducted in order to identify such parameters. L_{eq} = The equivalent energy noise level, is the average acoustic energy content of noise for a stated period of time. Thus, the L_{eq} of a time-varying noise and that of a steady noise are the same if they deliver the same acoustic energy to the ear during exposure. For evaluating community impacts, this rating scale does not vary, regardless of whether the noise occurs during the day or the night.

As shown in Table 5-1, the NIOSH threshold of 85 dBA L_{eq} would be exceeded at the nearest potential receptors to onsite construction during pipeline installation. It is noted that construction noise was modeled on a worst-case basis. It is very unlikely that all pieces of construction equipment would be operating at the same time for the various phases of Project construction as well as at the point closest to residences. The following best management practices are recommended.

Measure NOI-1: The following measures shall be applied to Project pipeline installation activities:

1. All construction equipment, fixed or mobile, will be equipped with properly operating and maintained mufflers, consistent with manufacturer standards.
2. All stationary construction equipment will be placed so that emitted noise is directed away from the noise sensitive receptors nearest the Project Site.
3. As applicable, shut off all equipment when not in use.
4. Equipment staging shall be located in areas that create the greatest distance between construction-related noise/vibration sources and sensitive receptors surrounding the Project Site.
5. Jackhammers, pneumatic equipment, and all other portable stationary noise sources will be directed away from sensitive receptors to the extent possible. Either one-inch plywood or sound blankets can be utilized for this purpose. They shall reach up from the ground and block the line of sight between equipment and the nearest off-site residences. The shielding shall be without holes and cracks.
6. No amplified music and/or voice will be allowed on the construction site.

Timing/Implementation: *During Pipeline Installation*

Monitoring/Enforcement: *Yucaipa Valley Water District*

Implementation of these best management practices will reduce construction noise associated with pipeline installation below the NIOSH threshold of 85 dBA L_{eq}. As previously described, noise barriers or enclosures such as that recommended in mitigation measure NOI-1 can provide a sound reduction 35 dBA or greater (WEAL 2000), which would be a reduction robust enough to maintain construction noise levels less than 85 dBA at the nearest residences during pipeline installation. Temporary noise barriers can consist of a solid plywood fence and/or flexible sound curtains, such as an 18-ounce tarp or a 2-inch-thick fiberglass blanket attached to chain link fencing. Therefore, Project construction activities would not expose persons to and generate noise levels in excess of the NIOSH health-based threshold, and therefore would not result in noise-related health effects. (physical damage to the ear).

Offsite Construction Worker Traffic Noise

Project construction would result in minimal additional traffic on adjacent roadways over the time period that construction occurs. According to the Roadway Construction Emissions Model and California Emissions Estimator Model, which are used to predict the number of construction related automobile trips, the maximum number of construction-related trips traveling to and from the Project Site during a single construction phase would not be expected to exceed 218 daily trips in total (200 construction worker trips and 18 haul truck trips). The worker trips would largely occur within two distinct segments of the day, the morning and afternoon, while the haul trips would occur intermittently throughout the workday. According to the Caltrans *Technical Noise Supplement to the Traffic Noise Analysis Protocol* (2013), doubling of traffic on a roadway is required to result in an increase of 3 dB (outside of the laboratory, a 3-dBA change is considered a just-perceivable difference). The majority of this construction-related traffic trips would access the Project Site via Oak Glen Road. According to the City of Yucaipa General Plan Environmental Impact Report (2015), the segment of Oak Glen Road east of Bryant Street (the section that traverses the Project Site) accommodates 4,176 average daily trips. Thus, the Project construction would not result in a doubling of traffic on the primary roadway used to access the Project Site, and therefore its contribution to existing traffic noise would not be perceptible. Additionally, it is noted that construction is temporary, and the trips generated from construction would cease upon completion of the Project.

5.3.1.2 Would the Project Result in a Substantial Permanent Increase in Ambient Noise Levels in Excess of County or City Standards During Operations?

As previously described, noise-sensitive land uses are locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Residences, schools, hospitals, guest lodging, libraries, and some passive recreation areas would each be considered noise-sensitive and may warrant unique measures for protection from intruding noise. The nearest existing noise-sensitive land uses to the Project Site are residential properties adjacent to the north of the Project Site boundary with the closest being approximately 86 feet distant.

Operational noise sources associated with the Proposed Project include mobile and stationary sources from the permit testing of back-up diesel generators.

Operational Offsite Traffic Noise

Project operations would result in minimal additional traffic on adjacent roadways. The only visitors to the site would be for permit testing of back-up diesel generators and repair or maintenance workers, whose presence at the site would be required infrequently and inconsistently. According to the California Department of Transportation (Caltrans) *Technical Noise Supplement to the Traffic Noise Analysis Protocol* (2013), doubling of traffic on a roadway is required to result in an increase of 3 dB (outside of the laboratory, a 3-dBA change is considered a just-perceivable difference). The Proposed Project would not result in a doubling of traffic on vicinity roadways, and therefore its contribution to existing traffic noise would not be perceptible.

Operational Onsite Stationary Noise

Operational noise sources associated with the Proposed Project include mobile and stationary sources from the permit testing of back-up diesel generators. The diesel-powered backup generators would operate at no more than 10 hours per year, with a maximum operating time of 2 hours per day for routine testing. Upon the conclusion of the infrequent permit testing, operational noise associated with the Project would return to baseline noise levels.

5.3.2 Project Groundborne Vibration

5.3.2.1 Would the Project Expose Structures to Substantial Groundborne Vibration During Construction?

Excessive groundborne vibration impacts result from continuously occurring vibration levels. Increases in groundborne vibration levels attributable to the Project would be primarily associated with short-term construction-related activities. Construction on the Project Site would have the potential to result in varying degrees of temporary groundborne vibration, depending on the specific construction equipment used and the operations involved. Ground vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increases in distance.

Construction-related ground vibration is normally associated with impact equipment such as pile drivers, jackhammers, and the operation of some heavy-duty construction equipment, such as dozers and trucks. It is noted that pile drivers would not be necessary during Project construction. Vibration decreases rapidly with distance and it is acknowledged that construction activities would occur throughout the Project Site and would not be concentrated at the point closest to sensitive receptors. Groundborne vibration levels associated with construction equipment at 25 feet distant are summarized in Table 5-2.

Table 5-2. Representative Vibration Source Levels for Construction Equipment

Equipment Type	Peak Particle Velocity at 25 Feet (inches per second)
Large Bulldozer	0.089
Caisson Drilling	0.089
Loaded Trucks	0.076
Hoe Ram	0.089
Jackhammer	0.035
Small Bulldozer/Tractor	0.003
Vibratory Roller	0.210

Source: FTA 2018; Caltrans 2020b

City of Yucaipa Municipal Code Section 87.0910 states that no ground vibration shall be allowed which can be felt without the aid of instruments at or beyond the lot line, nor will any vibration be permitted which produces a particle velocity greater than or equal to two-tenths (0.2) inches per second measured at or beyond the lot line. The nearest structure of concern to the construction site are residences located approximately 86 feet north of the Project Site center.

Based on the representative vibration levels presented for various construction equipment types in Table 5-2 and the construction vibration assessment methodology published by the FTA (2018), it is possible to estimate the potential Project construction vibration levels. The FTA provides the following equation:

$$[PPVequip = PPVref \times (25/D)^{1.5}].$$

Table 5-3 presents the expected Project related vibration levels at a distance of 86 feet.

Table 5-3. Onsite Construction Vibration Levels at 86 Feet

Receiver PPV Levels (in/sec)[1]					Peak Vibration	Threshold	Exceed Threshold
Large Bulldozer, Caisson Drilling, & Hoe Ram	Loaded Trucks	Jackhammer	Small Bulldozer	Vibratory Roller			
0.01395	0.01191	0.00548	0.00047	0.03291	**0.01395**	0.2	**No**

Notes: [1]Based on the Vibration Source Levels of Construction Equipment included on Table 5-2 (FTA 2018). Distance to the nearest structure of concern is approximately 86 feet.

As shown in Table 5-3, vibration as a result of onsite construction activities on the Project Site would not exceed 0.2 PPV at the nearest structures. Thus, onsite Project construction would not exceed the threshold.

5.3.2.2 Would the Project Expose Structures to Substantial Groundborne Vibration During Operations?

Operational sources of groundborne vibration during operations associated with the Proposed Project include mobile and stationary sources from the permit testing of back-up diesel generators. The diesel-powered backup generators would operate at no more than 10 hours per year, with a maximum operating time of 2 hours per day for routine testing. The permit testing associated with the backup generators would not result in measurable amounts of vibration. Therefore, the Project would result in negligible groundborne vibration impacts during operations.

5.3.3 Excess Airport Noise

5.3.3.1 Would the Project Expose People Residing or Working in the Project area to Excessive Airport Noise?

The Project Site is located approximately six miles east of the Redlands Municipal Airport. According to Figure 3B, *Aircraft Noise Concerns*, of the Redlands Municipal Airport Land Use Compatibility Plan, the Project Site is located outside of noise contours. Thus, the Proposed Project would not expose people working on the Project Site to excess airport noise levels.

6.0 REFERENCES

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LIST OF ATTACHMENTS

ATTACHMENT A

Federal Highway Administration Roadway Construction Noise Model Outputs – Project Construction

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 10/14/2022
Case Description: North Bench Recycled Water System Project

Description	**Land Use**
Excavation	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**
Concrete Saw	No	20		89.6	86
Dozer	No	40		81.7	86
Tractor	No	40	84		86
Tractor	No	40	84		86
Tractor	No	40	84		86

Results

	Calculated (dBA)	
Equipment	***Lmax**	**Leq**
Concrete Saw	84.9	77.9
Dozer	77	73
Tractor	79.3	75.3
Tractor	79.3	75.3
Tractor	79.3	75.3
Total	**84.9**	**82.6**

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 10/14/2022
Case Description: North Bench Recycled Water System Project

Description	**Land Use**
Site Preparation	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**
Grader	No	40	85		86
Dozer	No	40		81.7	86
Tractor	No	40	84		86

Results

Equipment		**Calculated (dBA)** *Lmax	**Leq**
Grader		80.3	76.3
Dozer		77	73
Tractor		79.3	75.3
	Total	**80.3**	**79.8**

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 10/14/2022
Case Description: North Bench Recycled Water System Project

Description	**Land Use**
Grading	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**
Grader	No	40	85		86
Dozer	No	40		81.7	86
Tractor	No	40	84		86
Tractor	No	40	84		86

Results

Equipment		**Calculated (dBA)** *Lmax	Leq
Grader		80.3	76.3
Dozer		77	73
Tractor		79.3	75.3
Tractor		79.3	75.3
	Total	**80.3**	**81.2**

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 10/14/2022
Case Description: North Bench Recycled Water System Project

Description	Land Use
Building Construction	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**
Crane	No	16		80.6	86
Gradall	No	40		83.4	86
Generator	No	50		80.6	86
Tractor	No	40	84		86
Welder / Torch	No	40		74	86
Welder / Torch	No	40		74	86
Welder / Torch	No	40		74	86

Results

		Calculated (dBA)		**Noise Limits (dBA)**
Equipment		***Lmax**	**Leq**	
Crane		75.8	67.9	
Gradall		78.7	74.7	
Generator		75.9	72.9	
Tractor		79.3	75.3	
Welder / Torch		69.3	65.3	
Welder / Torch		69.3	65.3	
Welder / Torch		69.3	65.3	
	Total	**79.3**	**80**	

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 10/14/2022

Case Description: North Bench Recycled Water System Project

Description	**Land Use**
Pipeline Construction Phase	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**
Boring Jack Power Unit	No	50		83	86
Concrete Saw	No	20		89.6	86
Concrete Saw	No	20		89.6	86
Tractor	No	40	84		86
Tractor	No	40	84		86
Excavator	No	40		80.7	86
Gradall	No	40		83.4	86
Generator	No	50		80.6	86
Flat Bed Truck	No	40		74.3	86
Slurry Trenching Machine	No	50		80.4	86
Slurry Trenching Machine	No	50		80.4	86
Crane	No	16		80.6	86
All Other Equipment > 5 HP	No	50	85		86
Paver	No	50		77.2	86
Paver	No	50		77.2	86
Pavement Scarafier	No	20		89.5	86
Pavement Scarafier	No	20		89.5	86
Roller	No	20		80	86
Roller	No	20		80	86

Results

Equipment	**Calculated (dBA) *Lmax**	**Leq**
Boring Jack Power Unit	78.3	75.3
Concrete Saw	84.9	77.9
Concrete Saw	84.9	77.9
Tractor	79.3	75.3
Tractor	79.3	75.3
Excavator	76	72
Gradall	78.7	74.7
Generator	75.9	72.9
Flat Bed Truck	69.5	65.6
Slurry Trenching Machine	75.6	72.6
Slurry Trenching Machine	75.6	72.6
Crane	75.8	67.9
All Other Equipment > 5 HP	80.3	77.3
Paver	72.5	69.5
Paver	72.5	69.5
Pavement Scarafier	84.8	77.8
Pavement Scarafier	84.8	77.8
Roller	75.3	68.3
Roller	75.3	68.3

Total	**84.9**	**87.3**

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 10/14/2022

Case Description: North Bench Recycled Water System Project

Description	**Land Use**
Paving	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**	**Estimated Shielding (dBA)**
Vibratory Concrete Mixer	No	20		80	86	0
Paver	No	50		77.2	86	0
Pavement Scarafier	No	20		89.5	86	0
Roller	No	20		80	86	0
Tractor	No	40	84		86	0

Results

Equipment	**Calculated (dBA) *Lmax**	**Leq**
Vibratory Concrete Mixer	75.3	68.3
Paver	72.5	69.5
Pavement Scarafier	84.8	77.8
Roller	75.3	68.3
Tractor	79.3	75.3
Total	**84.8**	**80.7**

*Calculated Lmax is the Loudest value.