Appendix C

Noise Report

LAKE COUNTY INTEREGIONAL TRANSIT CENTER PROJECT NOISE AND VIBRATION ASSESSMENT

Lake County, California

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INTRODUCTION

The Lake County Transit Authority (Lake Transit) is considering construction of a new transit center, relocation of route services from the existing transit hub to the new transit center, acquisition of four (4) hydrogen buses, improvements to the existing Lake Transit maintenance and operations (M&O) facility to support the use of the new hydrogen buses, and expansion of interregional transit service.

The Interregional Transit Center would be located on approximately 2 acres of land on the southwest corner of S. Center Drive and Dam Road Extension in Clearlake, California. Additionally, construction staging would occur on approximately 0.76 acre-portion of the property immediately west and adjacent to the proposed transit center. The M&O improvements would be located within the 3.2-acre Lake Transit M&O facility at 9240 Hwy 53, in Lake County, California.

This report evaluates the Project's potential to result in significant noise and vibration impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. The report is divided into two sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise and vibration, summarizes applicable regulatory criteria, and discusses the results of the ambient noise monitoring survey completed to document existing conditions; and, 2) the Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts, provides a discussion of each project impact, and presents mitigation measures, where necessary, to reduce the identified impacts to a less-than-significant level.

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (*frequency*) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A *decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA).* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. 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. This *energy-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the *sound level meter*. Sound level meters can accurately measure environmental noise levels to within about plus or minus 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 upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level* (*CNEL*) is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 p.m. - 10:00 p.m.) and a 10 dB addition to nocturnal (10:00 p.m. - 7:00 a.m.) noise levels. The *Day/Night Average Sound Level* (L_{dn}) is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn} and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57-62 dBA L_{dn} with open windows and 65-70 dBA L_{dn} if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed, those facing major roadways and freeways typically need special glass windows.

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 the 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. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA L_{dn}. At a L_{dn} of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn} of 60-70 dBA. Between a L_{dn} of 70-80 dBA, each decibel increase increases by about 3 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the L_{dn} is 60 dBA, approximately 30-35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

Fundamentals of Groundborne Vibration

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 method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous or frequent intermittent vibration levels produce. The guidelines in Table 3 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess groundborne vibration and almost exclusively to assess the potential of vibration to cause damage and the degree of annoyance for humans.

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table 3 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from "Historic and some old buildings" to "Modern industrial/commercial buildings". Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at lower levels than those shown, 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.

TABLE 1 Definition of Acoustical Terms Used in this Report

Term	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 micro Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons 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 micro Pascals). 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 A-weighted noise level during the measurement period.
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	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 p.m. and 7:00 a.m.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 p.m.to 10:00 p.m. and after addition of 10 decibels to sound levels measured in the night between 10:00 p.m. and 7:00 a.m.
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.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

TABLE 2 Typical Noise Levels in the Environment

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

Source: Technical Noise Supplement (TeNS), California Department of Transportation, September 2013.

TABLE 3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, April 2020.

Regulatory Background

This section describes the relevant guidelines, policies, and standards established by State Agencies, Lake County, and the City of Clearlake. The State CEQA Guidelines, Appendix G, are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. A summary of the applicable regulatory criteria is provided below.

State CEQA Guidelines. CEQA contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise impacts would be considered significant if the project would result in:

(a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

(b) Generation of excessive groundborne vibration or groundborne noise levels;

(c) 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, if the project would expose people residing or working in the project area to excessive noise levels (not applicable).

Lake County General Plan. The goal of the Lake County General Plan Noise Element is to, "protect County residents from the harmful exposure of excessive noise and prevent incompatible land uses from encroaching upon existing and planned land uses." To achieve this goal, the Noise Element sets forth the following policies relevant to the project:

Policy N-1.1 Noise Compatibility Guidelines

The County shall consider the compatibility of proposed land uses, utilizing the standards in Table 8-1, with the noise environment when preparing or revising community and/or specific plans and when reviewing development proposals. Where proposed land uses are likely to produce noise levels exceeding the "normally acceptable" criteria (e.g. "conditionally acceptable", "normally unacceptable"), the County shall require an acoustical analysis prior to development approval to ensure noise mitigation measures are included. Land uses should be prohibited from locating in areas with a noise environment within the "unacceptable" range.

Policy N-1.2 Sensitive Receptors

The County shall prohibit the development of new commercial, industrial, or other noise generating land uses adjacent to existing residential uses, and other sensitive noise receptors such as schools, health care facilities, and libraries if noise levels are expected to exceed 55 dBA during daytime (7AM to 10PM) or 45 dBA during nighttime (10PM to 7AM), measured at the property line of the noise sensitive land use, unless effective mitigation measures are incorporated into the project design.

Policy N-1.5 Transportation Noise Abatement

The County shall consider the compatibility of existing and proposed land uses located near highways and major roads. Noise abatement measures should be implemented in these circumstances to reduce noise impacts. These measures could include:

- Erection of walls or landscaped berms;
- Restriction of building multistory dwellings within fixed distances of major roads unless setbacks are increased and additional insulation used;
- Use of open space as a buffer; and,
- Incorporation of site planning or architectural treatments, and alternative technologies (e.g., muffle geothermal-related noise emission).

Where possible, less intrusive noise mitigation (e.g., landscaped berms, open space buffers) should be encouraged rather than sound walls to preserve view corridors.

Policy N-1.7 Noise Control During Construction

The County shall require contractors to implement noise-reducing mitigation measures during construction when residential uses or other sensitive receptors are located within 500 feet.

Policy N-1.12 County Vehicles

The County shall ensure that new equipment and vehicles purchased by the County are equipped with the best available noise reduction technology, when feasible, and kept in working order to reduce noise impacts.

Lake County Municipal Code. The Lake County Municipal Code, Chapter 21, Article 41, Section 21-41.11 sets forth noise performance standards to promote compatibility among various land uses within the County as follows:

41.11 Noise:

Maximum sound emissions for any use shall not exceed equivalent sound pressure levels in decibels, A-Weighted Scale, for any one (1) hour as stipulated in Table 11.1. These maximums are applicable beyond any property lines of the property containing the noise. (Note: Equivalent sound pressure level (Leq) is a measure of the sound level for any one (1) hour. It is the energy average of all the various sounds emitted from the source during the hour. A-Weighted Scale is used to adjust sound measurements to simulate the sensitivity of the human ear.)

Table 11.1 Maximum one-hour equivalent sound pressure levels (A-Weighted - dBA)

Time of Day	Receiving Property Zoning District		
	Residential*	Commercial	Industrial
7 am - 10 pm	55	60	65
10 pm - 7 am	45	55	60

*Note: The Residential category also includes all agricultural and resource zoning districts.

(a) In the event the receiving property or receptor is a dwelling, hospital, school, library or nursing home, even though it may be otherwise zoned for commercial or industrial and related uses, maximum one-hour equivalent sound pressure received shall be as indicated in Table 11.2.

Table 11.2 Maximum one-hour equivalent sound pressure levels (A-Weighted - dBA)

Time of Day	Level
7 am - 10 pm	57
10 pm - 7 am	50

(b) Noises of short duration: For noises of short duration or impulsive character, such as hammering, maximum one-hour sound pressure levels permitted beyond the property of origin shall be seven decibels less than those listed in Table 11.2 above.

(c) Noises of unusual periodic character: For noises of unusual periodic character, such as humming, screeching, and pure tones, the median octave band sound pressure levels as indicated in Table 11.3 shall not be exceeded beyond the property of origin when the receiving property is zoned residential or is occupied by a dwelling, hospital, school, library, or nursing home.

Table 11.3 Median octave band sound pressure levels

Octave Band Center Frequency, Hz	7 am - 10 pm	10 pm - 7 am
31.5	68	65
63	65	62
25	61	56
250	55	50
500	52	46
1,000	49	43
2,000	46	40
4,000	43	37
8,000	40	34

(d) Additional allowance: When the receiving property is zoned commercial or industrial and is not a dwelling, hospital, school, library, or nursing home, an additional sound decibel emission above the pressure levels specified in Table 11.3 above shall be permitted as indicated in Table 11.4.

Table 11.4 Additional allowance

Receiving Property Zone	Additional Decibels Allowed
Commercial	5
Industrial	10

(e) Exemptions: Local noise standards set forth in this Section do not apply to the following situations and sources of noise provided standard, reasonable practices are being followed:

1. Emergency equipment operated on an irregular or unscheduled basis.
2. Warning devices operated continuously for no more than five (5) minutes.
3. Bells, chimes, or carillons.
4. Non-electronically amplified sounds at sporting, amusement, and entertainment events.
5. Construction site sounds between 7:00 am and 7:00 pm[1].
6. Lawn and plant care machinery fitted with correctly functioning sound suppression equipment and operated between 7:00 am and 8:00 pm.
7. Aircraft when subject to federal or state regulations.
8. Agricultural equipment when operated on property zoned for agricultural activities.

(f) Exceptions: Upon written application from the owner or operator of an industrial or commercial noise source, the Zoning Administrator or Planning Commission, as part of a use permit approval, may conditionally authorize exceptions to local noise emission standards in the following situations:

1. Infrequent noise.
2. Noise levels at or anywhere beyond the property lines of the property of origin when exceeded by an exempt noise, as listed in Section (e) above, in the same

[1] By exempting daytime (7am to 7 pm) construction noise from the one-hour equivalent sound pressure levels listed in Tables 11.1 and 11.2 and section 41.11c, the allowable CNEL level for construction noise is effectively increased to the hourly daytime level minus 3 dB, thus making a CNEL in excess of 60 dBA allowable.

location.

3. If after applying Best Available Control Technology (BACT), a use existing prior to the effective date of this ordinance is unable to conform to the standards established by this section.

Clearlake General Plan. The goal of the Clearlake General Plan Noise Element is, "A community with minimal exposure to excessive noise and/or vibration." To achieve this goal, the Noise Element sets forth the following policies relevant to the project:

Policy NO 1.1.1
The City shall avoid placing noise and vibration generators next to sensitive land uses such as residences, churches, schools, parks and hospitals.

Policy NO 1.2.1
The City shall adopt regulations that encourage the enforcement of state vehicle code regulations limiting public exposure to noise from automobiles, trucks and motorcycles.

Policy NO 1.5.1
Regulate long-term increases in ambient noise levels during review of development proposals. For projects that are required by the California Environmental Quality Act (CEQA) to analyze noise impacts, the following criteria shall be used to determine the significance of those impacts:

Stationary and Non-Transportation Noise Sources

- A significant impact may occur if the project results in an exceedance of the noise level standards contained in this element, or the project will result in an increase in ambient noise levels by more than 3 dB, whichever is greater. This does not apply to construction activities which are conducted according to City regulations for construction activities. Compliance with the City's construction requirements shall be sufficient to reduce construction-related noise impacts to a less than significant level.

Transportation Noise Sources

- Where existing traffic noise levels are less than 60 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +5 dB L_{dn} increase in roadway noise levels will be considered significant; and
- Where existing traffic noise levels range between 60 and 65 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +3 dB L_{dn} increase in roadway noise levels will be considered significant; and
- Where existing traffic noise levels are greater than 65 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a + 1.5 dB L_{dn} increase in roadway noise levels will be considered significant.

Clearlake Municipal Code. The Clearlake Municipal Code, Chapter V, Article 5-4, Section 5-4.4 sets forth the following noise performance standards:

5-4.4 Noise Restrictions; Exceptions.
a. No person shall produce any noise by any means between the hours of 10:00 p.m. and 7:00 a.m. which when measured within fifty (50') feet of any dwelling or transient accommodation exceeds 55 decibels. "Dwelling" includes apartments, duplexes, mobile homes, and conventional single-family residences. "Transient accommodation" includes hotels, motels, hospitals, travel trailer parks and campgrounds.

b. No person shall produce any noise by any means which measures in excess of 65 decibels at a distance within fifty (50') feet of any dwelling or transient accommodation between the hours of 7:00 a.m. and 10:00 p.m. with the following exceptions:

> 1. Pursuant to permission granted by the Building Official in any case where a building permit has been obtained, or by the City Engineer in any case where public work not requiring a building permit is being performed, construction equipment may be operated during daylight hours which produces noise up to a level of 80 decibels when measured at a distance of one hundred (100') feet from the source. The Building Official and City Engineer may impose a lesser maximum permissible level in any situation where local complaints demonstrate the existence of a problem and where, in the opinion of the official involved, the lesser limit would not impose an unreasonable burden on the work of construction. The preceding noise limit shall not apply to impact tools and equipment if the official is satisfied that the contractor or other builder has taken reasonable steps to control and reduce noise, such as mufflers and acoustically attenuating shields.

5-4.6 Noise Restricted Near Schools and Churches.
It shall be unlawful for any person to exceed the noise limits established in subsection 5-4.4 above within one hundred fifty (150') feet of any school or church during the regular hours of instruction or worship, respectively. (Ord. #25, A4, S6; Ord. #50)

Existing Noise Environment

The project site is located at the southwest corner of the intersection of Dam Road Extension and South Center Drive, just east of State Route 53 (SR 53) in the City of Clearlake, California. The Clearlake Masonic Lodge is located to the west, and the Lake County Superior Court building and Lake County Behavioral Services building are located to the northwest, and north, respectively. The Konocti Education Center is located to the east on the opposite side of Dam Road Extension. Commercial uses exist adjacent to the site along the southern property line. The nearest residential land uses are approximately 1,000 feet to the north.

The noise environment at the site and in the surrounding area results primarily from local vehicular traffic along SR 53, Dam Road Extension, and South Center Drive. A noise monitoring survey consisting of two long-term (LT-1 and LT-2) and three short-term (ST-1 through ST-3) noise measurements was conducted in the vicinity of the site between Wednesday, June 22, 2022, and

Friday, June 24, 2022 to quantify existing noise levels. All measurement locations are shown in Figure 1.

Long-term noise measurement LT-1 was made along College Access Road, approximately 55 feet east of the centerline of Dam Road Extension, to represent typical noise levels at the nearby college and along Dam Road Extension. Hourly average noise levels at LT-1 typically ranged from 58 to 66 dBA L_{eq} during daytime hours (7:00 a.m. and 10:00 p.m.) and from 46 to 63 dBA L_{eq} during nighttime hours (10:00 p.m. and 7:00 a.m.). The day-night average noise level was 63 dBA on Thursday, June 23, 2022. Figure 2 summarizes the data collected at LT-1.

Long-term noise measurement LT-2 was made along South Center Drive, approximately 230 feet east of the centerline of SR 53 to represent typical noise levels at the nearby Clearlake Masonic Lodge and at the Lake County Superior Court building. Hourly average noise levels at LT-1 typically ranged from 57 to 65 dBA L_{eq} during daytime hours (7:00 a.m. and 10:00 p.m.) and from 50 to 61 dBA L_{eq} during nighttime hours (10:00 p.m. and 7:00 a.m.). The day-night average noise level was 65 dBA on Thursday, June 23, 2022. Figure 3 summarizes the data collected at LT-2.

Short-term noise measurement ST-1 was made on Wednesday, June 22, 2022, between 10:40 a.m. and 10:50 a.m. ST-1 was made at the proposed site, approximately 35 feet south of the South Center Road centerline to represent typical noise levels at the western property line and nearby office building. During the measurement, eighteen vehicles passed the site on Dam Road Extension, while three vehicles passed the site along South Center Drive. Typical local traffic noise levels from SR 53 ranged from 50 to 62 dBA, while intermittent traffic noise levels from Dam Road Extension ranged from 50 to 64 dBA, and infrequent traffic noise levels from South Center Drive were 62 to 63 dBA. The 10-minute L_{eq} measured at ST-1 was 54 dBA.

Short-term noise measurement ST-2 was made on Wednesday, June 22, 2022, between 11:00 a.m. and 11:10 a.m. ST-2 was made at center of the site, approximately 135 feet west of the Dam Road Extension centerline to represent typical noise levels in the vicinity. During the measurement, twenty-five vehicles passed the site on Dam Road Extension, while two vehicles passed the site along South Center Drive. Typical local traffic noise levels from SR 53 ranged from 47 to 56 dBA, while intermittent traffic noise levels from Dam Road Extension ranged from 52 to 68 dBA, and infrequent traffic noise levels from South Center Drive were around 53 dBA. The 10-minute L_{eq} measured at ST-1 was 54 dBA.

Short-term noise measurement ST-3 was made on Friday, June 24, 2022, between 10:40 a.m. and 10:50 a.m. ST-2 was made approximately 160 feet east of the Dam Road Extension centerline to document the typical noise environment at the nearby college. During the measurement, seventeen vehicles passed the site on Dam Road Extension. Typical local traffic noise levels from Dam Road Extension ranged from 50 to 63 dBA, while distant SR 53 traffic noise levels from ranged from 43 to 51 dBA. The 10-minute L_{eq} measured at ST-1 was 51 dBA. Results of the short-term measurements are summarized in Table 4.

TABLE 4 Summary of Short-Term Noise Measurements (dBA)

Noise Measurement Location	Date, Time	Measured Noise Level, dBA					
		L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	L_{eq}
ST-1: ~35 feet south of the centerline of South Center Drive	6/22/2022, 10:40-10:50	68	63	57	52	46	54
ST-2: ~135 feet west of the centerline of Dam Road Extension	6/22/2022, 11:00-11:20	68	65	57	50	45	54
ST-3: ~165 feet east of the centerline of Dam Road Extension	6/24/2022, 10:40-10:50	66	60	54	47	44	51

FIGURE 1 Aerial Image Showing the Project Site and Noise Measurement Locations

Source: Google Earth, 2022.

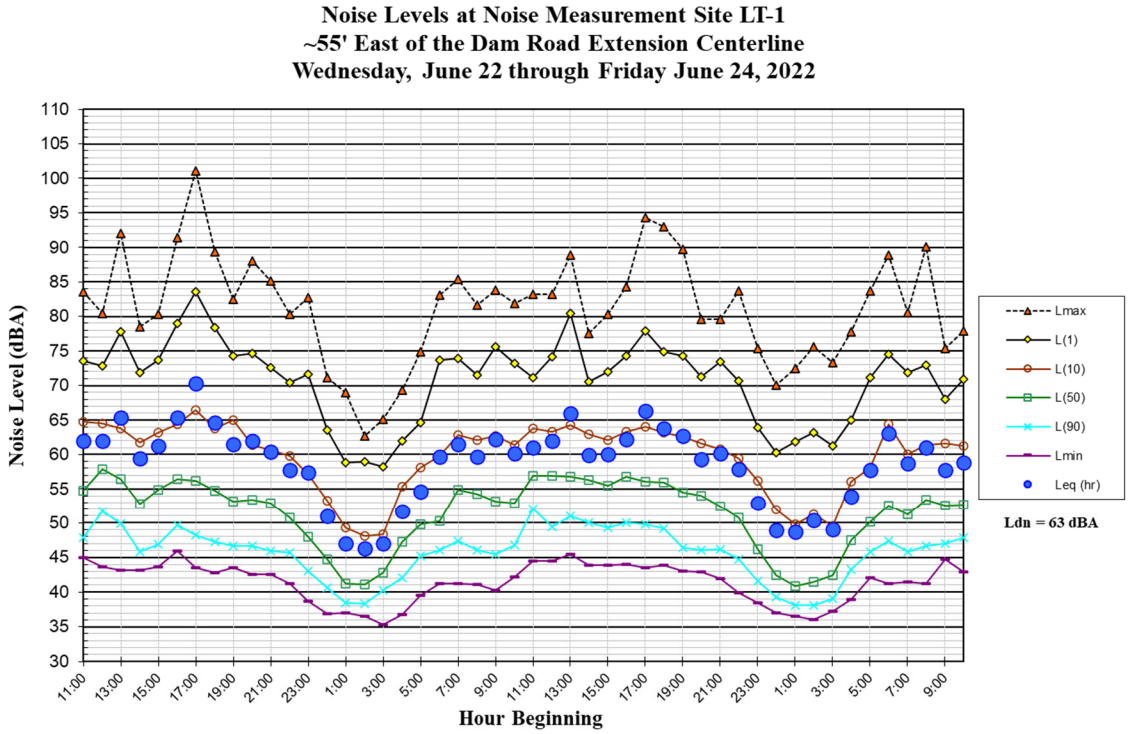

Figure 2

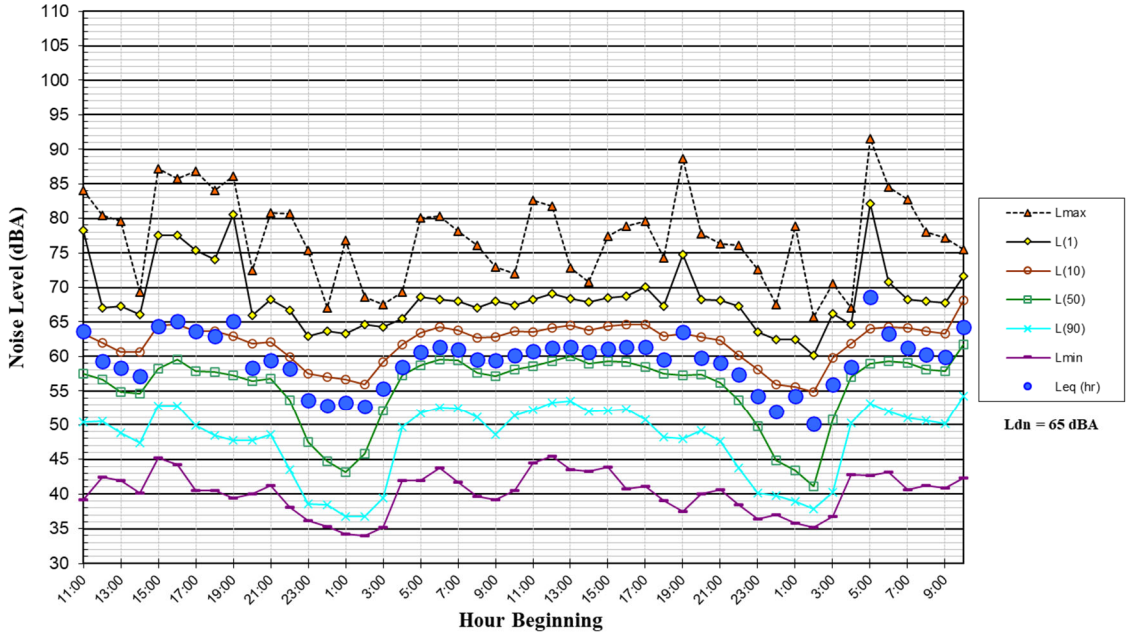

Figure 3

NOISE IMPACTS AND MITIGATION MEASURES

This section describes the significance criteria used to evaluate project impacts under CEQA, provides a discussion of each project impact, and presents mitigation measures, where necessary, to provide a compatible project in relation to adjacent land uses.

Significance Criteria

The following criteria were used to evaluate the significance of environmental noise resulting from the project:

- A significant noise impact would be identified if the project would generate a substantial temporary or permanent noise level increase over ambient noise levels at existing noise-sensitive receptors surrounding the project site and that would exceed applicable noise standards presented in the General Plan or Municipal Code at existing noise-sensitive receptors surrounding the project site.

    - A significant temporary noise impact would be identified if construction of the project would occur outside of the allowable hours specified by Lake County (7:00 a.m. to 7:00 p.m.). In the City of Clearlake, construction activities producing noise levels exceeding 80 dBA at 100 feet would be considered significant.

    - For permanent transportation noise sources, a +3 dB L_{dn} increase in roadway noise levels will be considered significant where existing traffic noise levels range between 60 and 65 dB L_{dn} at the outdoor activity areas of noise-sensitive uses

    - A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the General Plan or Municipal Code.

- A significant impact would be identified if the construction of the project would generate excessive vibration levels surrounding receptors. Groundborne vibration levels exceeding 0.25 in/sec PPV would have the potential to result in cosmetic damage to normal buildings.

Impact 1a: **Temporary Construction Noise.** Existing noise-sensitive land uses would be exposed to a temporary increase in ambient noise levels due to project construction activities, but the temporary increase would not be considered substantial. This is a **less-than-significant** noise impact.

Noise impacts resulting from construction depend upon the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, and the distance between construction noise sources and noise-sensitive areas. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (e.g., early morning, evening, or nighttime hours), the construction occurs in areas near noise-sensitive land uses, or when construction lasts over extended periods of time.

Typically, construction activities would be carried out in stages. During each stage of construction, there would be a different mix of equipment operating, and noise levels would vary by stage and vary within stages, based on the amount of equipment in operation and the location at which the equipment is operating. Typical construction noise levels at a distance of 50 feet are shown in Tables 5 and 6. Table 5 shows the average noise level ranges, by construction phase, and Table 6 shows the maximum noise level ranges for different construction equipment. Most demolition and construction noise falls in the range of 80 to 90 dBA at 50 feet from the source. Construction-generated noise levels drop off/increase at a rate of about 6 dBA per doubling/halving of the distance between the source and receptor. Shielding by buildings or terrain can provide an additional 5 to 10 dBA noise reduction at distant receptors.

TABLE 5 Typical Ranges of Construction Noise Levels at 50 Feet, L_{eq} (dBA)

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	II	I	II	I	II	I	II
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

I – All pertinent equipment present at site.
II – Minimum required equipment present at site.

Source: U.S.E.P.A., Legal Compilation on Noise, Vol. 1, p. 2-104, 1973.

TABLE 6 Construction Equipment 50-foot Noise Emission Limits

Equipment Category	L_{max} Level (dBA)1,2	Impact/Continuous
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Ballast Equalizer[3]	82	Continuous
Ballast Tamper[3]	83	Continuous
Bar Bender	80	Continuous
Chain Saw	85	Continuous
Compressor (air)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rail Saw[3]	90	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tie Cutter[3]	84	Continuous
Tie Handler[3]	80	Continuous
Tie Inserter[3]	85	Continuous
Tractor	84	Continuous
Truck	84	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes: [1] Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant. [2]Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.[3] Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, FTA Report No. 0123, September 2018., [4] Mitigation of Nighttime Construction Noise, Vibrations and Other Nuisances, National Cooperative Highway Research Program, 1999.

Construction of the transit center is anticipated to begin in spring 2023, and last approximately 10 months. Construction phases would include site preparation, grading, building construction, paving, and architectural coating. Equipment expected to be used in each construction phase are summarized in Table 7, along with the estimated noise levels at 100 feet. Federal Highway Administration's (FHWA's) Roadway Construction Noise Model (RCNM) was used to calculate the hourly average noise levels for each phase of construction, assuming the simultaneous operation of all proposed equipment. This construction noise model includes representative sound levels for the most common types of construction equipment and the approximate usage factors of such equipment that were developed based on an extensive database of information gathered during the construction of the Central Artery/Tunnel Project in Boston, Massachusetts (CA/T Project or "Big Dig"). The usage factors represent the percentage of time that the equipment would be operating at full power.

TABLE 7 Construction Noise Levels - Transit Center

Phase (Work Days)	Construction Equipment (Quantity)	Noise Level (dBA) at 100 feet	
		L_{max}	L_{eq}
Site Preparation (2 days)	Grader (1) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1)	79	79
Grading (6 days)	Grader (1) Rubber Tired Dozer (1) Tractor/Loader/Backhoe (2)	79	79
Building Construction (280 days)	Crane (1) Forklift (1) Generator Set (1) Tractor/Loader/Backhoe (1) Welders (3)	78	77
Paving (14 days)	Cement and Mortar Mixer (1) Tractor/Loader/Backhoe (1) Paver (1) Paving Equipment (1) Roller (1)	78	78
Architectural Coating (14 days)	Air Compressor (1)	78	74

Based on the modeling results summarized in Table 7, construction activities would not produce noise levels exceeding 80 decibels when measured at a distance of one hundred feet from the source. Compliance with the City's construction requirements is sufficient to reduce construction-related noise impacts to a less than significant level.

Construction phases for the hydrogen facility on the M&O Yard would consist of demolition and site preparation, excavation/foundations/trenching, facility installation, and repaving. The overall construction schedule for the hydrogen facility on the M&O Yard is approximately 2 months

beginning in summer 2023. Similar construction noise levels to those described for the transit center would be expected at the M&O Yard.

The Lake County Municipal Code exempts construction site sounds between 7:00 am and 7:00 pm. However, Lake County General Plan Policy N-1.7 require contractors to implement noise-reducing mitigation measures during construction when residential uses or other sensitive receptors are located within 500 feet. Therefore, the following best management practices would be implemented as part of the project to ensure consistency with the Lake County General Plan, reduce construction noise levels emanating from the site, and minimize disruption and annoyance:

- Construction activities shall be limited to the hours between 7:00 am and 7:00 pm, Monday through Friday in accordance with the Lake County General Plan, unless permission is granted with a development permit or other planning approval.

- Equip all internal combustion engine-driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.

- Prohibit unnecessary idling of internal combustion engines.

- Locate stationary noise-generating equipment such as air compressors or portable power generators as far as possible from sensitive receptors. Construct temporary noise barriers to screen stationary noise-generating equipment when located near adjoining sensitive land uses.

- Utilize "quiet" air compressors and other stationary noise sources where technology exists.

- Control noise from construction workers' radios to a point where they are not audible at existing residences bordering the project site.

- Notify all adjacent businesses, residences, and other noise-sensitive land uses of the construction schedule in writing.

- Designate a "disturbance coordinator" who would be responsible for responding to any complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., bad muffler, etc.) and will require that reasonable measures be implemented to current the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include it in the notice sent to neighbors regarding the construction schedule.

With the implementation of these measures, construction operations would comply with the requirements of the City of Clearlake and Lake County. Noise generated by construction activities would occur over a temporary period of less than one year, and the impact would be considered **less-than-significant**.

Impact 1b: **Permanent Operational Noise.** Noise generated by the project would not substantially increase existing noise levels at outdoor activity areas of noise-sensitive uses or violate the standards established in the Clearlake Municipal Code. This is a **less-than-significant** noise impact.

Transit Center

The predominant noise source attributable to the project operations would be bus operations. Noise measurements were made on Friday, June 24, 2022, between 10:55 a.m. and 11:30 a.m. at the existing Lake County Transit Authority station located approximately 1,100 feet southeast of the proposed site. The purpose of these measurements was to document existing noise levels produced by Lake County Transit Authority buses. Between 10:55 a.m. and 11:00 a.m. three buses were parked in a row idling at the bus stop. Sustained noise levels of 62 to 64 dBA were recorded at a distance of approximately 130 feet. When these buses passed by the monitoring location, noise levels of 69 to 77 dBA were recorded at approximately 20 feet, and noise levels of 55 dBA were noted at 150 feet. An additional bus was observed to produce noise levels of 55 dBA at approximately 100 feet away. The average noise level at 85 feet from the acoustic center of the activity was 61 dBA L_{eq}, and assuming a similar level of activity throughout the day (between the hours of 6:00 a.m. to 8:00 p.m., consistent with existing schedules), the L_{dn} attributable to these activities would also be 61 dBA at 85 feet.

The City of Clearlake identifies transportation-related noise increases to be 3 dB L_{dn} or greater as significant where existing traffic noise levels range between 60 and 65 dB L_{dn} at the outdoor activity areas of noise-sensitive uses. Where existing traffic noise levels are less than 60 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +5 dB L_{dn} increase in roadway noise levels is considered significant. No formalized outdoor activity areas exist at the Lake County Superior Court building to the northwest, at the Lake County Behavioral Services building to the north, or at the commercial buildings to the south (Freedom Heating and Air Conditioning, Sears Appliance Store, and Walmart), and operational noise levels at these land uses are not discussed further.

The outdoor activity area at the Clearlake Masonic Lodge, located west of the project site, includes a covered barbeque near the southeast corner of the building. The barbecue area is located approximately 150 feet from the primary noise sources at the transit center and would be exposed to operational noise levels of 56 dBA L_{dn}. With the operation of the project, the existing noise level at the barbeque area (63 dBA L_{dn}) would increase by approximately 1 dBA L_{dn} and reach 64 dBA L_{dn}. The operation of the project would not increase noise levels by 3 dB L_{dn} or more at the at the Clearlake Masonic Lodge barbeque area.

The nearest outdoor activity areas at the Konocti Education Center are located approximately 200 feet from the primary noise sources at the transit center and would be exposed to operational noise levels of 51 dBA L_{dn}. With the operation of the project, the existing noise level at the outdoor activity areas at the Konocti Education Center (55 dBA L_{dn}) would increase by 1 to 2 dBA L_{dn} and reach 56 to 57 dBA L_{dn}. The operation of the project would not increase noise levels by 5 dB L_{dn} or more at the nearest outdoor activity areas at the Konocti Education Center.

The nearest dwellings are approximately1,000 feet north of the project site. At 1,000 feet, and assuming no intervening acoustical shielding, operational noise levels would be 40 dBA or less. As noted above, the nearest sensitive school building is approximately 200 feet east. At 200 feet, and assuming no intervening acoustical shielding, operational noise levels would be 54 dBA or less. No transient accommodations exist in the project vicinity. Based on the above, predicted noise levels would not exceed 55 dBA between the hours of 10:00 p.m. and 7:00 a.m. or 65 dBA between the hours of 7:00 a.m. and 10:00 p.m. and would comply with the Clearlake Municipal Code. This is a less-than-significant impact.

M&O Facility

Lake Transit proposes to purchase four (4) hydrogen buses to supplement the existing fleet. Buses would be stored at the M&O facility, consistent with existing practices. Improvements to the M&O facility are proposed to support hydrogen buses. Improvements would consist of hydrogen fueling infrastructure and retrofits to the existing maintenance facility to allow for the proper air flow and ventilation needed to safely work on the hydrogen buses. In addition to the retrofitting the building, solar panels will be installed on the south-facing pitched roofs. No new substantial operational noise sources are proposed at the M&O Facility. This is a less-than-significant impact.

Mitigation Measure 1b: None required.

Impact 2: Exposure to Excessive Groundborne Vibration. Construction-related vibration levels are not expected to exceed applicable vibration thresholds. **This is a less-than-significant impact.**

The construction of the project may generate perceptible vibration when heavy equipment or impact tools are used close to sensitive receptors. Transit center construction phases would include site preparation, grading, building construction, paving, and architectural coating. utilizing such equipment or tools would include demolition, site preparation, grading, trenching, building construction, and paving. Such activities could occur as close as 25 feet from the nearest building. Construction phases for the hydrogen facility on the M&O Yard would consist of demolition and site preparation, excavation/foundations/trenching, facility installation, and repaving. Such activities could occur as close as 75 feet from the nearest building. Foundation construction techniques involving impact or vibratory pile driving equipment, which can cause excessive vibration, are not expected with the proposed project.

Neither Lake County nor the City of Clearlake specify a construction vibration limit to apply to project construction activities. The California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a conservative limit of 0.25 in/sec PPV for historic and some old buildings (see Table 3). For the purposes of this study, groundborne vibration levels exceeding the conservative 0.25 in/sec PPV limit at the existing adjacent buildings would have the potential to result in a significant vibration impact.

Vibration levels are highest close to the source, and then attenuate with increasing distance at the rate $(D_{ref}/D)^{1.1}$, where D is the distance from the source in feet and D_{ref} is the reference distance of 25 feet. Vibration levels also vary depending on soil conditions, construction methods, and equipment used.

Table 8 presents typical vibration levels from construction equipment at 25 feet. This distance represents the nearest building south of the transit center. Jackhammers typically generate vibration levels of 0.035 in/sec PPV and drilling typically generates vibration levels of 0.089 in/sec PPV at 25 feet. Vibratory rollers generate vibration levels reaching 0.210 in/sec PPV at 25 feet. Table 8 also presents construction vibration levels calculated at the location of the nearest building about 50 feet east of transit center and 75 feet from the hydrogen facility on the M&O Yard. As indicated in Table 8, construction-related vibration levels would not exceed 0.25 in/sec PPV at the nearest structures. All other buildings and receptors in the vicinity are located further from areas of the project site where construction vibration would be produced. This is a less-than-significant impact.

TABLE 8 Vibration Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	PPV at 50 ft. (in/sec)	PPV at 75 ft. (in/sec)
Clam shovel drop		0.202	0.094	0.060
Hydromill (slurry wall)	in soil	0.008	0.004	0.002
	in rock	0.017	0.008	0.005
Vibratory Roller		0.210	0.098	0.063
Hoe Ram		0.089	0.042	0.027
Large bulldozer		0.089	0.042	0.027
Caisson drilling		0.089	0.042	0.027
Loaded trucks		0.076	0.035	0.023
Jackhammer		0.035	0.016	0.010
Small bulldozer		0.003	0.001	0.001

Source: Transit Noise and Vibration Impact Assessment Manual, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, September 2018, as modified by Illingworth & Rodkin, Inc., June 2022.

Mitigation Measure 2: None required.