Appendix 14

Noise Analysis

Noise and Vibration

14.1 Introduction

This document describes the potential noise effects that would be caused by implementation of the project. Information used to prepare this document came from the following resources:

- City of Seaside, *Seaside General Plan*, August 2004
- City of Seaside, *Municipal Code*, as amended
- City of Marina, *City of Marina General Plan*, amended August 4, 2010
- City of Marina, *Municipal Code*, as amended
- County of Monterey, *Monterey County Code of Ordinances*, as amended
- Federal Transit Administration
- California Department of Transportation

14.2 Environmental Setting

14.2.1 General Information on Noise

Acoustics is the science of sound. Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a medium (e.g., air) to human (or animal) ear. If the pressure variations occur frequently enough (at least 20 times per second), they can be heard and are called sound. The number of pressure variations per second is called the frequency of sound and is expressed as cycles per second, or hertz (Hz).

Noise is defined as loud, unexpected, or annoying sound. The fundamental acoustics model consists of a noise source, receptor, and the propagation path between the two. The loudness of the noise source, obstructions, or atmospheric factors affecting the propagation path, determine the perceived sound level and noise characteristics at the receptor. Acoustics deal primarily with the propagation and control of sound. A typical noise environment consists of ambient noise that is the sum of many distant and indistinguishable noise sources. Superimposed on this ambient noise is the sound from individual local sources. These sources can vary from an occasional aircraft or train passing by to continuous noise from traffic on a major highway. Perceptions of sound and noise are highly subjective from person to person.

Measuring sound directly in terms of pressure would require a large range of numbers. To avoid this, the decibel (dB) scale was devised. The dB scale uses the hearing threshold of 20 micropascals (μPa) as a point of reference, defined as 0 dB. Other sound pressures are then compared to this reference pressure, and the logarithm is taken to keep the numbers in a practical range. The dB scale allows a million-fold increase in pressure to be expressed as 120 dB, and changes in levels correspond closely to human perception of relative loudness. Table 14-1: Typical Noise Levels provides typical noise levels.

Table 14-1: Typical Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	– 110 –	Rock Band
Jet fly-over at 1,000 feet		
	– 100 –	

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Gas lawnmower at 3 feet		
	– 90 –	
Diesel truck at 50 feet at 50 miles per hour		Food blender at 3 feet
	– 80 –	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawnmower, 100 feet	**– 70 –**	Vacuum cleaner at 10 feet
Commercial area		Normal Speech at 3 feet
Heavy traffic at 300 feet	**– 60 –**	
		Large business office
Quiet urban daytime	**– 50 –**	Dishwasher in next room
	– 40 –	Theater, large conference room (background)
Quiet urban nighttime		
Quiet suburban nighttime		
	– 30 –	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	– 20 –	
		Broadcast/recording studio
	– 10 –	
Lowest threshold of human hearing	**– 0 –**	Lowest threshold of human hearing

Source: California Department of Transportation, *Technical Noise Supplement to the Traffic Noise Analysis Protocol*, September 2013.

Noise Descriptors

The dB 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 equivalent noise level (L_{eq}) represents the average[1] continuous sound pressure noise level over the measurement period, while the day-night noise level (DNL) and Community Equivalent Noise Level (CNEL) are measures of energy average during a 24-hour period, with dB weighted sound levels from 7:00 p.m. to 7:00 a.m. Most commonly, environmental sounds are described in terms of L_{eq} that has the same acoustical energy as the summation of all the time-varying events. Each is applicable to this analysis and defined Table 14-2: Definitions of Acoustical Terms.

[1] Note that this is not the arithmetic average. Leq is the constant noise level that would result in the same total sound energy being produced over a given period.

Table 14-2: Definitions of Acoustical Terms

Term	Definitions
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 µPa (or 20 micronewtons per square meter), where 1 pascals 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 dB 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 µPa). 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 dB 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 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.
Maximum Noise Level (L_{max}) Minimum Noise Level (L_{min})	The maximum and minimum dBA during the measurement period.
Exceeded Noise Levels (L_{01}, L_{10}, L_{50}, L_{90})	The dBA values that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day-Night Noise Level (DNL)	A 24-hour average L_{eq} 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 at nighttime. The logarithmic effect of these additions is that a 60 dBA 24-hour L_{eq} would result in a measurement of 66.4 dBA DNL.
Community Noise Equivalent Level (CNEL)	A 24-hour average L_{eq} with a 5 dBA weighting during the hours of 7:00 a.m. to 10:00 a.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 L_{eq} 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.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends on its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Compiled from Caltrans, *Technical Noise Supplement to the Caltrans Traffic Noise Analysis Protocol*, September 2013; Cyril M. Harris, *Handbook of Noise Control*, 1979; Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, September 2018.

The A-weighted decibel (dBA) 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 used. 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 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 on the distance between the receptor and the noise source.

A-Weighted Decibels

The perceived loudness of sounds is dependent on many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable and can be approximated by dBA values. There is a strong correlation between dBA and the way the human ear perceives sound. For this reason, the dBA has become the standard tool of environmental noise assessment. All noise levels reported in this document are in terms of dBA, but are expressed as dB, unless otherwise noted.

Addition of Decibels

The 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 dB is A-weighted, 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.[2] When two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dBA higher than one source under the same conditions.[3] Under the dB scale, three sources of equal loudness together would produce an increase of approximately 5 dBA.

Sound Propagation and Attenuation

Sound spreads (propagates uniformly outward in a spherical pattern, and the sound level decreases (attenuates) at a rate of approximately 6 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. Sound levels attenuate at a rate of approximately 3 dB for each doubling of distance from a line source, such as a roadway, depending on ground surface characteristics.[4] 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 3 dB per doubling of distance is assumed.

Noise levels may also be reduced by intervening structures; generally, a single row of buildings between the receptor and the noise source reduces the noise level by about 5 dBA, while a solid wall or berm reduces noise levels by 5 to 10 dBA.[5] The way 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. The exterior-to-interior reduction of newer residential units is generally 30 dBA or more.

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[2] FHWA, *Noise Fundamentals,* 2017. Available at: https://www.fhwa.dot.gov/environMent/noise/regulations_and_guidance/polguide/polguide02.cfm
[3] Ibid.
[4] California Department of Transportation, *Technical Noise Supplement to the Traffic Noise Analysis Protocol*, Page 2-29, September 2013.
[5] James P. Cowan, *Handbook of Environmental Acoustics*, 1994.

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.[6] 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 dBA, the following relationships should be noted[7]:

- Except in carefully controlled laboratory experiments, a 1-dBA change cannot be perceived by humans.
- Outside of the laboratory, a 3-dBA change is considered a just-perceivable difference.
- A minimum 5-dBA change is required before any noticeable change in community response would be expected. A 5-dBA increase 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.

Effects of Noise on People

<u>Hearing Loss</u>. 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 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 8 hours. If the noise is above 90 dBA, the allowable exposure time is correspondingly shorter.

<u>Annoyance</u>. 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 DNL as a measure of noise has been found to provide a valid correlation of

[6] Compiled from James P. Cowan, *Handbook of Environmental Acoustics,* 1994 and Cyril M. Harris, Handbook of Noise Control, 1979.
[7] Compiled from California Department of Transportation, *Technical Noise Supplement to the Traffic Noise Analysis Protocol*, September 2013, and FHWA, *Noise Fundamentals,* 2017.

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. A noise level of about 55 dBA DNL is the threshold at which a substantial percentage of people begin to report annoyance[8].

14.2.2 General Information on Vibration

Sources of groundborne vibrations include natural phenomena (earthquakes, volcanic eruptions, sea waves, landslides, etc.) or man-made 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, including vibration decibels (VdB), peak particle velocity (PPV), and 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.

Table 14-3: Human Response to Different Levels of Groundborne Vibration 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.

Table 14-3: Human Response to Different Levels of Groundborne Vibration

Peak Particle Velocity (in/sec)	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	Recommended upper level to which ruins and ancient monuments should be subjected
0.1	92	Level at which continuous vibrations may begin to annoy people, particularly those involved in vibration sensitive activities	Virtually no risk of architectural damage to normal buildings
0.2	94	Vibrations may begin to annoy people in buildings	Threshold at which there is a risk of architectural damage to normal dwellings
0.4-0.6	98-104	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Architectural damage and possibly minor structural damage

Source: California Department of Transportation, Transportation and Construction Vibration Guidance Manual, 2013.

[8] Federal Interagency Committee on Noise, Federal Agency Review of Selected Airport Noise Analysis Issues, August 1992.

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. 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. For the purposes of this analysis, a PPV descriptor with units of inches per second (in/sec) is used to evaluate construction-generated vibration for building damage and human complaints.

14.3 Existing Conditions

14.3.1 Project Setting

The MST SURF! Busway and Bus Rapid Transit Project (project) would be located between MST's Marina Transit Exchange at Reservation Road and De Forest Road (northern terminus), and Contra Costa Street and Orange Avenue in Sand City (ultimate southern terminus). The project consists of approximately 6 linear miles of roadway surface and related improvements to provide dedicated express busway service between these points.

The majority of the alignment of the busway would be within the Transportation Agency for Monterey County (TAMC) Monterey Branch Line rail corridor right-of-way, an approximately 100-foot wide corridor generally located between Beach Range Road and the Monterey Peninsula Recreation Trail on the ocean side of Highway 1. Given the length of the proposed busway and its physical location, the project would be located in and/or adjacent to the cities of Marina, Seaside, and Sand City, extending parallel to Highway 1 and Fort Ord Dunes State Park.

Surrounding land uses are also primarily residential, with some local serving neighborhood commercial.

14.3.2 Existing Noise Sources

The project is located in close proximity to Highway 1, and there is a high level of ambient roadway noise. The northern and southern ends of the busway alignment utilize public roadways within an existing urban environment. Mobile sources of noise, especially cars and trucks, are the most common and significant sources of noise in most communities. Other sources of noise are the various land uses (i.e., residential, commercial, institutional, and recreational and parks activities) throughout the surrounding project area that generate stationary-source noise. Highway 1 adjacent to the project area is the dominant source of noise.

Noise Measurements

To determine ambient noise levels in the project area, five short-term (1-hour) noise measurements and two long-term (24-hour) noise measurements were taken using a Larson Davis SoundExpert LxT Type I integrating sound level meter on January 5 and January 6, 2021; refer to **Attachment 14A** for existing noise measurement data and Figure 14-1A and 14-1B: Noise Measurement Locations.

Source: Kimley Horn, 2020; Nearmap, 2020

Figure 14-1A: Noise Measurement Locations

MST SURF! Busway and Bus Rapid Transit Project

Draft EIR

Not to scale

Kimley»Horn TAMC TRANSPORTATION AGENCY FOR MONTEREY COUNTY MST MONTEREY-SALINAS TRANSIT

Source: Kimley Horn, 2020; Nearmap, 2020

Figure 14-1B: Noise Measurement Locations

MST SURF! Busway and Bus Rapid Transit Project

Not to scale

Short-Term measurement 1 (ST-1) was taken to represent the ambient noise level at Seaside High School and adjacent residential uses; ST-2 was taken to represent existing noise levels at the proposed 5th Street Station; ST-3 was taken to represent existing noise levels near the future campground in the Ford Ord Dunes State Park; ST-4 was taken to represent the ambient noise level at Marina Del Mar Elementary School and adjacent residential uses; and ST-5 was taken to represent existing noise levels at the residential uses west of the project site in Sand City. Long-Term measurement 1 (LT-1) was taken to represent existing noise levels at the nearest residential uses to the project site in Sand City, and LT-2 was taken to represent ambient noise levels at residential uses to the east of the project site in Marina. The primary noise sources during the noise measurements was traffic on Del Monte Boulevard and Highway 1, traffic on local streets, and mobile and stationary noise at commercial and industrial operations nearby. Table 14-4: Noise Measurements, provides the ambient noise levels measured at these locations.

Table 14-4: Noise Measurements

Site No.	Location	L_{eq} (dBA)	L_{min} (dBA)	L_{max} (dBA)	L_{dn} (dBA)	Time	Date
ST-1	Along Ord Avenue adjacent to Seaside High School.	67.2	58.4	83.6	-	2:36 p.m. to 3:36 p.m.	1/5/2021
ST-2	Along 5th Street adjacent to Highway 1 and the proposed 5th Street Station.	62.2	52.8	73.7	-	11:03 a.m. to 12:03 p.m.	1/5/2021
ST-3	Along Beach Range Road adjacent to the future Ford Ord Dunes State Park campground.	62.8	53.5	77.4	-	1:04 p.m. to 2:04 p.m.	1/5/2021
ST-4	Along Marina Drive adjacent to Marina Del Mar Elementary School.	60.3	53.2	80.5	-	4:40 p.m. to 5:40 p.m.	1/5/2021
ST-5	Along Holly Street adjacent to industrial and residential uses	80.5	57.7	110.4	-	4:34 p.m. to 5:34 p.m.	1/6/2021
LT-1	Along California Avenue adjacent to industrial and residential uses, and a Costco.	63.2	46.9	94.0	66.9	2:40 p.m.	1/5/2021 - 1/6/2021
LT-2	Along Cypress Avenue adjacent to residential uses.	62.0	36.6	106.2	66.5	4:01 p.m.	1/5/2021 - 1/6/2021

Source: Noise Measurements taken by Kimley-Horn on January 5-6, 2021. .

Existing Stationary Noise

The primary sources of stationary noise in the project vicinity are those associated with the operations of nearby residential, commercial, and industrial uses to the east and west of the project site. The noise associated with these sources may represent a single-event noise occurrence, short-term noise, or long-term/continuous noise.

Existing Mobile Noise

Most of the project area's existing mobile noise is generated from vehicles along Highway 1 paralleling the project site to the east in a north-south direction. Other local roadways such as Del Monte Boulevard, Fremont Boulevard, Monterey Road, Beach Range Road (non-motorized), and other local residential streets also contribute to the vehicular noise environment. Traffic-related mobile source noise is a function of the roadways' traffic volumes and vehicle speeds.

14.3.3 Sensitive Receptors

Noise exposure standards and guidelines for various types of land uses reflect the varying noise sensitivities associated with each of these uses. Residences, hospitals, schools, guest lodging, libraries, and churches are treated as the most sensitive to noise intrusion and therefore have more stringent noise exposure targets than do other uses, such as manufacturing or agricultural uses that are not subject to impacts such as sleep disturbance.

The project site is located in an urban area at the edge of Highway 1 in the cities of Marina, Seaside, and Sand City. The surrounding land uses are predominantly residential, guest lodging, commercial, and recreational areas. Table 14-5: Sensitive Receptors lists the distances and locations of nearby sensitive receptors, which primarily includes residences.

Table 14-5: Sensitive Receptors

Receptor Description	Distance and Direction from the Project Site	Nearest Project Segment
City of Marina		
Marina Child Development Center	175 feet west	Segment 2
Single Family Residential Community	200 feet west	Segment 2
Single Family Residential Community	200 feet east	Segment 2
Multi-family Residential Uses	325 feet east	Segment 2
Church of Christ in Marina	460 feet east	Segment 2
City of Seaside		
Seaside High School	230 feet east	Segment 3
Single Family Residential Uses	280 feet east	Segment 3
Single Family Residential Uses	340 feet east	Segment 3
City of Sand City		
Single Family Residential Uses	120 feet west	Segment 4
Single-Family Residential Uses	170 feet east	Segment 4
Single Family Residential Community	260 feet west	Segment 4
Single-Family Residential Uses	300 feet west	Segment 4
Unincorporated Monterey County		
Fort Ord Dunes State Park	Adjacent to the west	Segments 2 and 3

14.4 Applicable Regulations, Plans, and Standards

14.4.1 Federal

Federal Transit Administration Noise and Vibration Guidance

The Federal Transit Administration (FTA) has published the Transit Noise and Vibration Impact Assessment Manual[9] (FTA Noise and Vibration Manual) to provide guidance on procedures for assessing impacts at different stages of transit project development. The report covers both construction and operational noise impacts and describes a range of measures for controlling excessive noise and vibration. In general, the primary concern regarding vibration relates to potential damage from

[9] Federal Transit Administration Office of Planning and Environment, *Transit Noise and Vibration Impact Assessment Manual,* September 2018.

construction. The guidance document establishes criteria for evaluating the potential for damage for various structural categories from vibration.

The FTA Noise and Vibration Manual provides three levels of criteria for assessment of noise impact from transit projects. No Impact, Moderate Impact, and Severe Impact. Noise sensitive land-uses are grouped into three categories: Category 1, Category 2, and Category 3. The categories are described in Table 14-6: Land Use Categories and Metrics for Transit Noise Impact Criteria.

Table 14-6: Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor $L_{eq(h)1}$	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq(h)1}$	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category. Places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included.

Notes:
1. L_{eq} for the noisiest hour of rail-related activity during hours of noise sensitivity.

Source: Federal Transit Administration*, Transit Noise and Vibration Impact Assessment Manual*, September 2018.

Construction Noise

The FTA guidelines for construction noise assessment are provided in FTA guidelines Section 7 and are applicable to transit projects. FTA general construction assessment criteria were used for this report and are consistent with Section 7.1 of the FTA guidelines. The values presented in Table 14-7: Federal Transit Administration Construction Noise Assessment Criteria represent a general impact assessment in the FTA guidelines, which is an appropriate method for this noise study due to the size and scope of construction activities for the project.

Table 14-7: FTA General Assessment Construction Noise Criteria

Land Use	$L_{eq\ equip(1hr)}$, dBA	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: Federal Transit *Administration, Transit Noise and Vibration Impact Assessment Manual*, September 2018.

Construction Vibration

Construction activities can result in varying degrees of ground vibration, depending on the equipment and method employed. The vibration associated with typical construction is not likely to damage building structures, but it could cause cosmetic building damage. Consequently, construction vibration impact on a building is generally assessed in terms of PPV (in inches per second), as defined in Section 14.3.2: General Information on Vibration. Table 14-8: Construction Vibration Building Damage Criteria summarizes the FTA guidelines' construction vibration criteria.

Table 14-8: Construction Vibration Building Damage Criteria

Building Category	PPV (inches per second)	Approximate L_v[1]
I. Reinforced-concrete, steel or timber (no plaster)	0.50	102 VdB
II. Engineered concrete and masonry (no plaster)	0.30	98 VdB
III. Non-engineered timber and masonry buildings	0.20	94 VdB
IV. Buildings extremely susceptible to vibration damage	0.12	90 VdB

L_v = velocity level, decibels; PPV = peak particle velocity; VdB = root mean square vibration
Notes:
1. VdB re 1 micro-inch per second

Source: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual,* 2018.

Operational Transit Noise

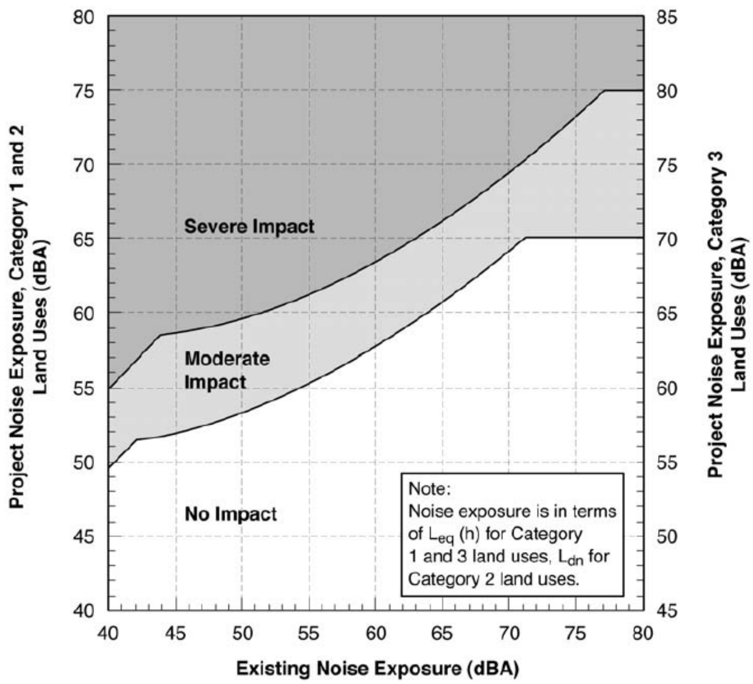
The FTA noise impact thresholds, as indicated in Figure 14-2: Noise Impact Criteria for Transit Projects, and Figure 14-3: Increase in Cumulative Noise Levels Allowed by Criteria (Land Use Categories 1 & 2), are based on the increase of existing ambient noise levels associated with project operations or in combination with other new planned projects (i.e., cumulative impact). The FTA guidelines specify a particular noise metric to be used depending on the specific land-use. L_{dn} is typically used for residential uses, whereas L_{eq} is typically used for schools.

As referenced in Figure 14-2, Moderate and Severe are used as criteria to assess transit-related noise impacts. The interpretations of these two levels of impact are summarized as follows:

- Moderate Impact: The change in the cumulative noise level is noticeable to most people, but it may not be sufficient to cause strong, adverse reactions from the community. In this transitional area, other project specific factors must be considered to determine the magnitude of the impact and the need for mitigation, such as the existing level, predicted level of increase over existing noise levels, and the types and numbers of noise-sensitive land uses affected.
- Severe Impact: Project noise above the upper curve is considered to cause a Severe Impact since a significant percentage of people would be highly annoyed by the new noise. This curve flattens out at 75 dB for Category 1 and 2 land uses, a level associated with an unacceptable living environment. Noise mitigation will normally be specified for Severe Impact areas unless there is no practical method of mitigating the noise.

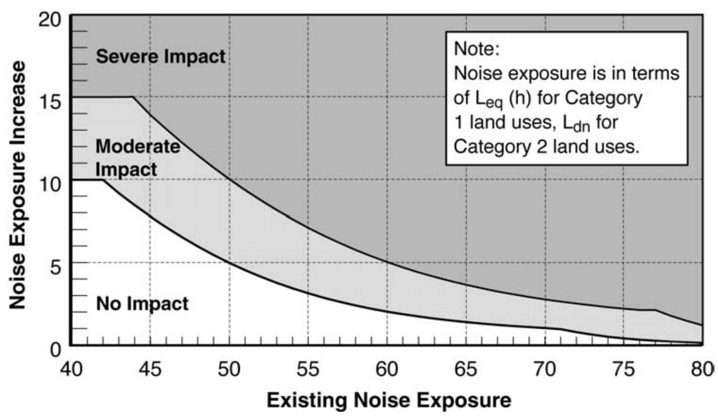
Although the curves in Figure 14-2 and Figure 14-3 are defined in terms of project noise exposure and existing noise exposure, it is important to emphasize that the increase in the cumulative noise (i.e., when the project noise is added to the existing noise) is the basis for the criteria.

Figure 14-2: Noise Impact Criteria for Transit Projects



Source: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, September 2018.

Figure 14-3: Increase in Cumulative Noise Levels Allowed by Criteria (Land Use Categories 1 & 2)



Source: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, September 2018.

Figure 14-2 shows that the criterion for impact allows a noise exposure increase of 10 dBA if the existing noise exposure is 42 dBA or less but only a 1 dBA increase when the existing noise exposure is 70 dBA. As the existing level of ambient noise increases, the allowable absolute level of project noise increases, but the total allowable increase in community noise exposure is reduced.

For residential land use, the noise criteria are to be applied outside the building locations at noise sensitive areas with frequent human use, including outdoor patios, decks, pools, and play areas. If there are none, the criteria should be applied near building doors and windows. For parks or other outdoor Category 3 land uses, the criteria are to be applied at the property line. However, for locations where land use activities are solely indoors, noise impact may be less significant if the outdoor-to-indoor reduction is greater than for typical buildings (approximately 25 dB with windows closed). Therefore, if it can be demonstrated that there will only be indoor activities, mitigation may not be needed.

Operational Vibration

The evaluation of vibration impacts can be divided into two categories, human annoyance and building damage. The FTA guidelines provide ground-borne noise and vibration criteria as listed in Table 14-9: Ground-Borne Vibration and Noise Impact for Affected Communities Land Use Category. These levels represent an event's maximum vibration level. In addition, the guidelines provide criteria for special buildings that are sensitive to ground-borne noise and vibration. The impact criteria for these special buildings are shown in Table 14-9. There are no special buildings within the project area.

Table 14-9: Ground-Borne Vibration and Noise Impact for Affected Communities Land Use Category

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re 1 micro inch/second)			Ground-Borne Noise Impact Levels (VdB re 20 µPa)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB[4]	65 VdB[4]	65 VdB[4]	N/A[4]	N/A[4]	N/A[4]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

µPa = micropascals; VdB = root mean square vibration velocity level; decibels dBA = A-weighted decibel; N/A = not applicable

Notes:
1. "Frequent events" are defined as more than 70 vibration events of the same kind per day.
2. "Occasional events" are defined as between 30 and 70 vibration events of the same kind per day.
3. "Infrequent events" are defined as fewer than 30 vibration events of the same kind per day.
4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research would require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the heating, ventilation, and air conditioning systems and stiffened floors.

Source: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual,* 2018.

Table 14-9 differentiates vibration impact thresholds depending on the frequency of daily vibration events, with fewer than 30 vibration events per day considered "infrequent," between 30 and 70 events considered "occasional," and more than 70 events considered "frequent." These dividing lines were originally selected so that most commuter rail or intercity rail projects would fall into the "infrequent" category and most urban transit projects (subway and light rail transit) would fall into the "frequent" category. Sensitive receivers (e.g., residential dwellings, churches) fall under Land Use Categories 2 or 3. Based on the criteria specified above, the FTA criteria for "frequent events" are used as the project involves 96 bus trips per day.

14.4.2 State

California Government Code

California Government Code Section 65302(f) mandates that the legislative body of each county and city adopt a noise element as part of its comprehensive general plan. The local noise element must recognize the land use compatibility guidelines established by the State Department of Health Services.

The guidelines rank noise land use compatibility in terms of "normally acceptable", "conditionally acceptable", "normally unacceptable", and "clearly unacceptable" noise levels for various land use types. Single-family homes are "normally acceptable" in exterior noise environments up to 60 CNEL and "conditionally acceptable" up to 70 CNEL. Multiple-family residential uses are "normally acceptable" up to 65 CNEL and "conditionally acceptable" up to 70 CNEL. Schools, libraries, and churches are "normally acceptable" up to 70 CNEL, as are office buildings and business, commercial, and professional uses.

Title 24 – Building Code

The State's noise insulation standards are codified in the California Code of Regulations, Title 24: Part 1, Building Standards Administrative Code, and Part 2, California Building Code. These noise standards are applied to new construction in California for interior noise compatibility from exterior noise sources. The regulations specify that acoustical studies must be prepared when noise-sensitive structures, such as residential buildings, schools, or hospitals, are located near major transportation noise sources, and where such noise sources create an exterior noise level of 65 dBA CNEL or higher. Acoustical studies that accompany building plans must demonstrate that the structure has been designed to limit interior noise in habitable rooms to acceptable noise levels. For new multi-family residential and non-residential buildings, the acceptable interior noise limit for new construction is 45 dBA CNEL.

14.4.3 Local

County of Monterey

City of Monterey General Plan

The *2010 Monterey County General Plan Safety Element* (October 2010) addresses policies and land use compatibility noise levels throughout unincorporated areas of the County. The Land Use Compatibility Table (Table S-2 in the General Plan) shows acceptable noise levels up to 60 dB CNEL for low density residential uses and 65 dB CNEL for multi-family residential. Playgrounds and neighborhood parks have a land use compatibility of up to 70 dB CNEL.

Seaside

City of Seaside General Plan

The *Seaside General Plan Noise Element* (August 2004) (Seaside Noise Element) addresses noise sources in the community and identifies ways to reduce the impacts of these noise sources. The Seaside Noise Element contains policies and programs to achieve and maintain noise levels compatible with various types of land uses. Table 14-10: City of Seaside Noise Standards shows the exterior and interior noise standards for a variety of land uses within the City of Seaside.

Table 14-10: City of Seaside Noise Standards

Land Use	Noise Standards (dBA CNEL)	
	Exterior	Interior
Residential	65	45
Mixed Use Residential	70	45
Commercial	70	-
Office	70	50
Industrial	75	55
Public Facilities	70	50
Schools	50	50

Source: Seaside General Plan Noise Element, August 2004.

In addition, the following noise standards, goals, policies, and implementation plans would be applicable to the proposed project:

Goal N-2: Minimize transportation-related noise impacts.

Policy N-2.1: Reduce noise impacts associated with motorized vehicles, aircraft, and trains.

Implementation Plan N-2.1.1 Noise Control. Reduce noise impacts from transportation activity to enhance the quality of the community. Incorporate noise control measures, such as sound walls and berms, into roadway improvement projects to mitigate impacts to adjacent development. Request Cal-trans and the Monterey County Transportation Agencies to provide noise control for roadway projects within the community. Particularly advocate reducing noise impacts from the list major noise sources.

Implementation Plan N-2.1.2 Enforcement of Transportation Noise Standards. Coordinate with the Police Department, Monterey County Sheriff's Department and the California Highway Patrol to enforce the California Vehicle Code pertaining to noise standards for cars, trucks and motorcycles. Periodically review truck and bus routes in the community for noise impacts to residential and other sensitive land uses. Where noise impacts are identified from truck traffic, modify the designated truck routes to avoid impacts. Where impacts are identified from bus traffic, recommend alternative routes to the Monterey County Transportation Authority.

City of Seaside Municipal Code

Chapter 9.12 (Noise Regulations) of the Seaside Municipal Code seeks to protect the citizens of the City from unnecessary, excessive, and annoying noise; to maintain quiet in areas where noise levels are low; and to implement programs to reduce unacceptable noise. Section 9.12.030 states that excessive, unnecessary or unusually loud operation or use of any of the following is prohibited before seven a.m. or after seven p.m. daily (except Saturday, Sunday and holidays when the prohibited time shall be before nine a.m. and after seven p.m.):

1. Hammers, hand-powered saws or similar implements; impact wrenches or similar equipment powered by compressed air; tools or pieces of equipment powered by an internal combustion engine such as, but not limited to, chain saws, blowers and lawn mowers; electrically powered tools or equipment such as, but not limited to, saws, drills, lathes or routers; heavy equipment such as, but not limited to, bulldozers, steam shovels, road graders, back hoes; ground drilling

and boring equipment; hydraulic crane and boom equipment; portable power generators or pumps; pavement or pile driving equipment,

2. Any construction, demolition, excavation, erection, alteration or repair activity, unless authorized in writing by the building official. Written authorization may be issued in the case of an emergency, or where the building official determines that the peace, comfort and tranquility of the occupants of residential property will not be impaired because of the location or nature of the construction activity.

Marina

City of Marina General Plan

The *City of Marina General Plan* (amended August 4, 2010) (Marina General Plan) contains policies and standards to address noise impacts in the City. Table 14-11: City of Marina Noise Standards shows the maximum exterior and interior noise standards for a variety of land uses within the City of Marina.

Table 14-11: City of Marina Noise Standards

Land Use Category	Maximum Exterior		Maximum Interior
	Acceptable	Conditionally Acceptable	
Residential	60	70	45
Live/Work	65	75	50
Hotel/Motel	65	75	50
Office	67	77	55
Other Commercial	70	80	60
Industrial/Agriculture	70	80	60
Schools, Libraries, Theaters, Churches, Nursing Homes	60	70	45
Parks and Playfields	65	70	NA
Golf Courses, Riding Stables, Cemeteries	70	75	NA

Source: City of Marina, *City of Marina General Plan*, August 2010.

The following noise standards and policies would be applicable to the proposed project:

Policy 3.3-6: Protect existing and future residential areas from through-traffic that creates safety, noise, and pollution problems.

Policy 3.7: Existing and future residential neighborhoods shall be protected from intrusion by heavy through-traffic and from safety, noise and pollution problems created by such traffic.

Policy 4.108: These measures must reduce interior noise to the maximum allowable limits shown in Table 4.1 (Table 14-11)*, and, within the Airport Planning Area, to CNEL 45 dB for all uses which are conditionally permitted as indicated by Table 4-1 of the Airport CLUP. In such instances, the developer of a new building shall provide the City with proof from a professional acoustical consultant that exterior noise levels have been mitigated such that building occupants will not be subject to interior noise levels greater than those in Table 4.1* (Table 14-11)*, and, within the Airport Planning Area, in Table 4-1 of the CLUP. Except in the Airport Planning Area, if the City finds the project to be in the public interest, the City* *may approve a project where the exterior noise level exceeds the conditionally acceptable level. Such approval shall be contingent upon a detailed analysis by a qualified acoustical engineer showing that specific measures included in the project will reduce interior noise to the maximum interior levels shown in Table 4.1* (Table 14-11).

Policy 4.109: The construction of new or the improvement of existing arterials and collectors as identified in this plan shall require discretionary approval. A cumulative noise impact analysis shall be undertaken prior to approval of all new major new roads or improvements of existing arterials and collectors which would result in significant increases in traffic volumes. If projected cumulative traffic increases in traffic volumes would result in a substantial increase in ambient noise levels which would adversely affect existing noise-sensitive uses or subject future receptors to exterior noise levels in excess of the "acceptable" exterior noise standards of Table 4.1 (Table 14-11)*, appropriate noise abatement measures shall be identified and implemented, including increased setbacks for any new sensitive receptors, appropriate architectural design and construction techniques and the use of landscaped earth berms.*

City of Marina Municipal Code

Chapter 9.24, Noise Regulations, contains the primary set of statutes through which Marina regulates noise. Section 9.24.040 that the following are declared to be a violation of the Municipal Code and public nuisances:

- Operation or use of any of the following, before seven a.m. or after seven p.m. daily, except Sundays and holidays when the prohibited time shall be before ten a.m. and after seven p.m. and when daylight savings time is in effect the hours of permitted operation shall be extended one hour to eight p.m. in such a manner as to create excessive, unnecessary or unusually loud noise: hammers, hand-powered saws, or similar implements; impact wrenches or similar equipment powered by compressed air; tools or pieces of equipment powered by an internal combustion engine such as, but not limited to, chain saws, blowers, and lawn mowers; electrically powered tools or equipment such as, but not limited to, saws, drills, lathes or routers; portable power generators or pumps; or similar noise-producing implements. The above prohibitions are in addition to any similar prohibitions which are found in Section 15.04.070 relating to construction hours and noise related to activities requiring a building, grading, demolition or similar permit;
- Excessive, unnecessary or unusually loud noise due to construction, demolition, excavation, erection, alteration or repair activity that disturbs the peace, comfort and tranquility of the occupants of residential property unless it is due to an emergency or properly authorized by the Marina department of public safety or public works department.

Monterey County Code of Ordinances

The County of Monterey (County) Noise Control Ordinance is included in Chapter 10.60 of the County's Code of Ordinances. The County's noise ordinance establishes a maximum noise-level standard of 85 dB at 50 feet for non-transportation noise sources. he County's noise ordinance was recently updated in 2014 to also include nighttime noise limitations for non-transportation noise sources. During the nighttime hours between 10:00 p.m. and 7:00 a.m., noise levels shall not exceed 45 dBA L_{eq} or 65 dBA L_{max}, measured at the property line of the noise source. Noise generated by some activities, including but not limited to, devices associated with religious services, emergency vehicles, commercial agricultural operations, and outdoor gatherings, are exempt. The ordinance applies in coastal and non-coastal unincorporated areas of the County.

14.5 Environmental Impacts and Mitigation Measures

14.5.1 Significance Criteria

According to the adopted Appendix G of the *State CEQA Guidelines*, impacts related to noise from a proposed project would be significant if the project would:

- Generate 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;
- Generate excessive groundborne vibration or groundborne noise levels; and
- 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, expose people residing or working in the project area to excessive noise levels.

14.5.2 Study Methodology

Construction

Construction Noise

Construction noise estimates are based on typical noise levels published by the Federal Transit Administration (FTA) and FHWA. Construction noise is assessed in dBA L_{eq}. This unit is appropriate because L_{eq} can be used to describe noise level from operation of each piece of equipment separately, and levels can be combined to represent the noise level from all equipment operating during a given period.

Reference noise levels are used to estimate noise levels at nearby sensitive receptors based on a standard noise attenuation rate of 6 dB per doubling of distance (line-of-sight method of sound attenuation for point sources of noise). Construction noise level estimates do not account for the presence of intervening structures or topography, which may reduce noise levels at receptor locations. Therefore, the noise levels presented herein represent a conservative, reasonable worst-case estimate of actual temporary construction noise.

Construction Vibration

The proposed project would result in significant impacts if it were to generate vibration levels substantial enough to damage nearby structures or buildings, or result in vibration levels that are commonly accepted as an annoyance to sensitive land uses.

The Caltrans Transportation and Construction Vibration Guidance Manual (September 2013) characterizes the annoyance potential of vibration as follows: 0.01 in/sec PPV is “barely perceptible,” 0.04 in/sec PPV is “distinctly perceptible,” 0.1 in/sec PPV is “strongly perceptible, and 0.4 in/sec PPV is “severe.” The analysis uses the “strongly perceptible” threshold of 0.1 in/sec PPV from the *Caltrans Transportation and Construction Vibration Guidance Manual* to determine human annoyance impacts during construction.

For structural damage, the analysis uses FTA guidelines. The FTA has published standard vibration velocities for construction equipment operations. For example, for a building that is constructed with reinforced concrete with no plaster, the FTA guidelines show that a vibration level of up to 0.20 in/sec is considered safe and would not result in any construction vibration damage.

Operations

Transit Noise

For the analysis of long-term operational impacts on the existing ambient noise environment, impacts are considered significant if project operation would result in a substantial increase in noise levels in the project area. This evaluation uses the FTA's moderate or severe noise impact criteria shown in Figure 14-2 and Figure 14-3 to evaluate mobile transit noise impacts from the project. As the existing ambient noise level increases, the allowable noise level increases, but the total amount that community noise exposure is allowed to increase is reduced. This accounts for the unexpected result that a project noise exposure that is less than the existing noise exposure can still cause an impact. As noted above, residential uses (Category 2 land use) are the closest sensitive receptors to the project. In addition, there are two schools (Seaside High School and Marina Del Mar Elementary School, Category 3 land uses) within 500 feet of the project site.

Transit Vibration

A General Vibration Assessment was prepared for the proposed project in accordance with FTA guidelines (Section 6.4 of the FTA guidelines). The General Vibration Assessment is used to examine potential impacts on vibration-sensitive land use areas identified in the screening step more closely. It uses generalized information likely to be available at an early stage in the development process and during the development of most environmental documents. Vibration levels at sensitive receivers are determined by estimating the overall vibration velocity level and A-weighted ground-borne noise levels as a function of distance from the track and applying adjustments to account for factors such as track support systems, vehicle speed, type of building, and track and wheel conditions. If an impact is identified through the General Vibration Assessment procedures and not mitigated, a Detailed Vibration Assessment of the selected alternative must be completed. Based on the FTA guidelines, the project would be below the impact thresholds under a General Vibration Assessment; therefore, a Detailed Vibration Assessment is not warranted (see Section 7.5).

Acoustical Analysis Parameters

The methodology used in assessing operational impacts from project implementation is based on the FTA Noise and Vibration Manual (2018). Mobile transit noise was modeled using the FTA Noise Impact Assessment Spreadsheet. The following assumptions were used in the analysis of the proposed busway operations:

- Model results are calculated for the closest receivers north and south of the project alignment.
- Highway/transit source type.
- 96 bus trips per day (assumed 12 per hour, for 8 hours per day).
- Assumed 100 percent electric bus fleet.
- Buses were assumed to travel at a maximum speed of 65 miles per hour (mph).

- The 5th Street Station was modeled as a "Bus Storage Yard" in the FTA Noise Impact Assessment Spreadsheet.

14.5.3 Summary of No and/or Beneficial Impacts

Proximity to a Public or Private Airport

The Monterey Regional Airport is located approximately 1.30 miles south of the project site and the Marina Municipal Airport is located approximately 1.90 miles east of the project site; there are no private airstrips in the project area. The project site lies outside the 65 dBA CNEL noise contour specified in the Monterey Regional Airport Land Use Compatibility Plan Update (May 2018). Additionally, the project would not exacerbate noise levels from the airport and would be no impact.

14.5.4 Impacts of the Proposed Project

Impact N-1: **The project would not generate 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. This is a less-than-significant impact.**

Construction

Construction noise typically occurs intermittently and varies depending on the nature or phase of construction (e.g. land clearing, grading, excavation, paving). Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. During construction, exterior noise levels could affect the residential neighborhoods and adjacent commercial and industrial uses surrounding the construction site. Project construction would occur approximately 65 feet from existing commercial and industrial uses, and approximately 90 feet from the nearest residential uses to the north of the project site.[10] These sensitive uses may be exposed to elevated noise levels during project construction. However, it is noted that construction activities would occur throughout the project site and would not be concentrated at a single point near sensitive receptors for an extended period of time. In addition, construction noise levels are not constant, and in fact, construction activities and associated noise levels would fluctuate and generally be brief and sporadic, depending on the type, intensity, and location of construction activities. Noise levels typically attenuate (or drop off) at a rate of 6 dB per doubling of distance from point sources, such as industrial machinery.

Primary construction activities associated with development of the project would include site preparation, grading, retaining wall installation and paving. The grading phase of project construction tends to be the shortest in duration and create the highest construction noise levels due to the operation of heavy equipment required to complete this activity. It should be noted that only a limited amount of equipment can operate near a given location at a particular time. Equipment typically used during this stage includes heavy-duty trucks, backhoes, bulldozers, excavators, front-end loaders, and

[10] For the purposes of the construction noise analysis, the construction area is defined as the center of the project site. Although some construction activities may occur at distances closer than 50 or 75 feet from the nearest receptors, construction equipment would be dispersed throughout the project site during various construction activities. Therefore, the center of the project site represents the most appropriate distance based on the sporadic nature of construction activities.

scrapers. 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 noise would be shorter-duration incidents, such as dropping large pieces of equipment or the hydraulic movement of machinery lifts, which would last less than one minute. No pile-driving would be required during construction.

Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. Typical noise levels associated with individual construction equipment are listed in Table 14-12: Typical Construction Equipment Noise Levels.

Table 14-5: Typical Construction Equipment Noise Levels

Equipment	Typical Level (dBA) 25 Feet from the Source1
Air Compressor	86
Backhoe	86
Compactor	88
Concrete Pump	88
Concrete Vibrator	82
Crane, Derrick	94
Dozer	91
Generator	88
Grader	91
Impact Wrench	91
Jack Hammer	94
Loader	86
Paver	91
Pneumatic Tool	91
Pump	83
Roller	91
Street Sweeper	82
Saw	91
Scraper	88
Shovel	90
Truck	86

Source: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual,* 2018.

The noise levels calculated in Table 14-13: Project Construction Noise Levels, show estimated exterior construction noise for the project without accounting for attenuation from existing physical barriers. All construction equipment was assumed to operate simultaneously at a construction area nearest to the sensitive receptor. These assumptions represent a worst-case noise scenario as construction activities would routinely be spread throughout the construction site further away from noise sensitive receptors.

As shown in Table 14-13: Project Construction Noise Levels, unobstructed construction noise levels could reach 79.5 dBA at the nearest residential receptors, and 82.3 dBA at the nearest commercial and industrial uses. The cities of Seaside, Marina, and Sand City do not have construction noise standards. The FTA has established a daytime threshold of 90 dBA L_{eq} (1-hour) for residential uses and 100 dBA L_{eq} (1 hour) for commercial and industrial uses to evaluate construction noise impacts.[11] As shown in Table 14-13, noise levels at the nearest receptors would not exceed the FTA's applicable construction noise thresholds. In addition, the maximum noise level of 82.3 dBA shown in Table 14-13 would not exceed the County of Monterey's maximum noise-level standard of 85 dB at 50 feet for non-transportation noise sources (see Chapter 10.60 of the County's Code of Ordinances).

Table 14-13: Project Construction Noise Levels

Construction Phase	Receptor/Land Use	Receptor Distance (feet)	Modeled Exterior Construction Level (1-hour L_{eq})	Exceed FTA Threshold?[1]
Site Preparation	Commercial	65	82.1	No
	Industrial	65	82.1	No
	Residential	90	79.3	No
Grading	Commercial	65	82.3	No
	Industrial	65	82.3	No
	Residential	90	79.5	No
Paving	Commercial	65	76.6	No
	Industrial	65	76.6	No
	Residential	90	73.7	No

Notes:
1. 90 dBA (L_{eq} 1-hour) for residential uses and 100 dBA (L_{eq} 1-hour) for commercial and industrial uses.
Source: Refer to **Attachment 14A** for construction noise modeling assumptions and results.

Project construction would comply with the allowable construction hours set forth in Seaside Municipal Code Section 9.12.030, Marina Municipal Code Section 9.24.040, and Chapter 10.60 of the County County's Code of Ordinances. In addition, all construction equipment would be equipped with properly operating and maintained mufflers and other state required noise attenuation devices, helping to reduce noise at the source. Therefore, construction noise impacts to nearby receptors would be **less than significant.**

Construction Traffic Noise

Construction noise may be generated by large trucks moving materials to and from the project site. Large trucks would be necessary to deliver building materials as well as remove dump materials. Excavation and cut and fill would be required. Based on the California Emissions Estimator Model (CalEEMod) default assumptions for this project, as analyzed in Section 6, Air Quality, the project would generate the highest number of daily trips during the site preparation phase. The model estimates that the project would generate up to 153 soil hauling trips and 18 worker trips per day. Because of the

[11] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, Table 7-2, Page 179, September 2018.

logarithmic nature of noise levels, a doubling of the traffic volume (assuming that the speed and vehicle mix do not also change) would result in a noise level increase of 3 dBA. Due to the low quantity of daily trips during project construction, traffic volumes on adjacent roadways would not be doubled on these roadways. Therefore, construction related traffic noise would not be noticeable and would have a **less-than-significant impact**.

Operational Transit Noise

As noted in Section 14.6.2, Study Methodology, noise modeling was calculated for the nearest receivers east and west of the project alignment for the proposed busway for Existing Plus Project conditions. A total of 22 residential (FTA Category 2 land use) receivers, two schools (Seaside High School and Marina Del Mar Elementary School, FTA Category 3 land uses), and a park (Fort Ord State Park, FTA Category 3 land use), were modeled in compliance with the tools and methods in the FTA Noise and Vibration Manual. The modeling results are identified in Table 14-14: Busway Transit Noise Levels.

The results in Table 14-14 indicate that transit noise levels would not exceed the FTA's Moderate or Severe impact thresholds at Receivers 2-1 through 2-16, 2-19, 2-20 through 2-22, and 3-1 through 3-3. Moderate impacts would occur at Receivers 2-17, 2-18, and 2-20. As described above, a moderate noise impact is a noticeable change that may not be sufficient to cause strong adverse reactions from the community. Several nearby residential receivers are already exposed to noise levels exceeding the FTA's Moderate impact thresholds under existing conditions. In addition, as shown in Table 14-14, noise levels would increase by a maximum of 4 dBA compared to existing conditions at Receivers 2-17, 2-18, and 2-20. According to the Caltrans *Traffic Noise Analysis Protocol* (April 2020), "In California a substantial noise increase is considered to occur when the project's predicted worst-hour design-year noise level exceeds the existing worst-hour noise level by 12 dBA or more." Thus, the project would not result in a substantial increase (12 dBA or more) in transit noise levels.

It is also noted the highest project noise level for residential receivers in the City of Seaside (i.e., 46 dBA at Receiver 2-11) would not exceed the City of Seaside's maximum exterior noise level standard of 65 dBA for residential uses. In addition, noise levels at Seaside High School (i.e., 47 dBA at Receiver 3-1) would not exceed the City of Seaside's maximum exterior noise level standard of 50 dBA for schools. The highest project noise level for residential receivers in the City of Marina (i.e., 62 dBA at Receiver 2-17) would exceed the City of Marina's normally acceptable exterior noise level standard of 60 dBA for residential uses, but would be below the conditionally acceptable noise standard of 70 dBA. Per Marina General Plan Policy 4.108, "the City may approve a project where the exterior noise level exceeds the conditionally acceptable level. Such approval shall be contingent upon a detailed analysis by a qualified acoustical engineer showing that specific measures included in the project will reduce interior noise to the maximum interior levels shown in Table 4.1." Based on a standard exterior-to-interior noise level reduction of 25 dBA with windows closed,[12] maximum interior noise levels from the project would be approximately 37 dBA and would be below the City of Marina's interior noise standard of 45 dBA for residential uses.

[12] HUD, *Noise Guidebook*, 2009. Available at: https://www.hudexchange.info/resource/313/hud-noise-guidebook/

As discuss above, the project would not result in a Severe noise impact per FTA standards, would not result in a substantial increase in transit noise levels, and would comply with all local noise standards. Therefore, impacts in this regard would be **less than significant**.

Table 14-4: Busway Transit Noise Levels

Receiver[1]	Land Use	Distance from Proposed Busway (feet)	Distance from Proposed 5th Street Station (feet)	Bus Pass-By Total (per hour)	Measured Existing Noise Level (dBA)[2]	Modeled Noise Level (dBA L_{dn})[1]	FTA Moderate Impact Threshold	FTA Severe Impact Threshold	Impact Type[3]	Combined Noise Level (dBA L_{dn})[1]	Noise Level Increase (dBA L_{dn})
2-1	Residential	370	20,000	12	67	52	62	67	None	67	0
2-2	Residential	175	19,865	12	67	52	62	67	None	67	0
2-3	Residential	185	19,630	12	67	56	62	67	None	67	0
2-4	Residential	500	19,175	12	67	45	62	67	None	67	0
2-5	Residential	310	18,680	12	67	48	62	67	None	67	0
2-6	Residential	335	18,380	12	67	48	62	67	None	67	0
2-7	Residential	185	18,380	12	67	52	62	67	None	67	0
2-8	Residential	350	18,000	12	67	48	62	67	None	67	0
2-9	Residential	100	17,100	12	67	60	62	67	None	68	1
2-10	Residential	200	16,930	12	67	51	62	67	None	67	0
2-11	Residential	475	14,350	12	67	46	62	67	None	67	0
2-12	Residential	385	10,340	12	67	51	62	67	None	67	0
2-13	Residential	590	9,620	12	67	49	62	67	None	67	0
2-14	Residential	415	9,050	12	67	51	62	67	None	67	0
2-15	Residential	515	8,345	12	67	50	62	67	None	67	0
2-16	Residential	500	8,375	12	60	50	63	68	None	61	1
2-17	Residential	75	8,835	12	60	62	63	68	Moderate	64	4
2-18	Residential	85	9,125	12	60	61	63	68	Moderate	64	4
2-19	Residential	190	9,180	12	60	52	63	68	None	61	1
2-20	Residential	100	9,860	12	60	60	63	68	Moderate	63	3
2-21	Residential	390	9,875	12	67	51	62	67	None	67	0
2-22	Residential	470	9,775	12	67	50	62	67	None	67	0
3-1	Institutional (Seaside High School)	290	12,600	12	67	47	62	67	None	67	0
3-2	Institutional (Marina Del Mar Elementary School)	75	9,350	12	60	56	63	68	None	61	1
3-3	Recreational (State Park)	520	4,500	12	43	63	64	70	None	63	0

Notes:
1. All receivers within 500 feet of the proposed busway were modeled. Receiver locations can be found in **Attachment 14A**.
2. Existing noise levels obtained from noise measurement data obtained by Kimley-Horn on January 5-6, 2021. See Table 14-4 and **Attachment 14A** for noise measurement data.
3. Moderate Impact: The change in the cumulative noise level is noticeable to most people, but it may not be sufficient to cause strong, adverse reactions from the community. In this transitional area, other project specific factors must be considered to determine the impact's magnitude and the need for mitigation, such as the existing level, predicted level of increase over existing noise levels, and the types and numbers of noise-sensitive land uses affected.
4. Severe Impact: Project noise above the upper curve is considered to cause a Severe Impact since a significant percentage of people would be highly annoyed by the new noise. This curve flattens out at 75 dB for Category 1 and 2 land uses, a level associated with an unacceptable living environment. Noise mitigation will normally be specified for Severe Impact areas unless there is no practical method of mitigating the noise.

Impact N-2: The project would not generate excessive groundborne vibration or groundbourne noise levels. This is a less-than-significant impact.

Construction

Increases in groundborne vibration levels attributable to the project would be primarily associated with 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. The effect on buildings located in the vicinity of the construction site often varies depending on soil type, ground strata, and construction characteristics of the receiver building(s). The results from vibration can range from no perceptible effects at the lowest vibration levels, to low rumbling sounds and perceptible vibration at moderate levels, to slight damage at the highest levels. Groundborne vibrations from construction activities rarely reach levels that damage structures.

The FTA has published standard vibration velocities for construction equipment operations. In general, depending on the building category of the nearest buildings adjacent to the potential pile driving area, the potential construction vibration damage criteria vary. For example, for a building constructed with reinforced concrete with no plaster, the FTA guidelines show that a vibration level of up to 0.50 inch per second (in/sec) peak particle velocity (PPV) is considered safe and would not result in any construction vibration damage. In general, the FTA architectural damage criterion for continuous vibrations (i.e. 0.2 in/sec) appears to be conservative. The types of construction vibration impacts include human annoyance and building damage. Human annoyance occurs when construction vibration rises significantly above the threshold of human perception for extended periods of time. According to the Caltrans *Transportation and Construction Vibration Guidance Manual* (September 2013), human annoyance from groundborne vibration occurs when levels exceed 0.1 in/sec PPV. Building damage can be cosmetic or structural. Ordinary buildings that are not particularly fragile would not experience cosmetic damage (e.g. plaster cracks) at distances beyond 30 feet. This distance can vary substantially depending on soil composition and underground geological layer between vibration source and receiver.

Table 14-15: Typical Construction Equipment Vibration Levels, lists vibration levels at 25, 50 and 100 feet for typical construction equipment. Groundborne vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increases in distance. As indicated in Table 14-15, based on FTA data, vibration velocities from typical heavy construction equipment operations that would be used during project construction range from 0.0004 to 0.089 in/sec PPV from 25-100 feet from the source of activity.

As shown in Table 14-15, the highest vibration levels are achieved with the large bulldozer operations. This construction activity is expected to take place during grading. The nearest off-site structures are commercial buildings located approximately 25 feet from the active construction zone for the proposed project. At this distance, construction vibration levels would be approximately 0.089 in/sec PPV. Therefore, construction equipment vibration velocities would not exceed the FTA's 0.20 PPV threshold or Caltrans' human annoyance threshold of 0.1 in/sec PPV. In general, other construction activities would occur throughout the project site and would not be concentrated at the point closest to the nearest off-site structures. Therefore, vibration impacts associated with the project would be **less than significant**.

Table 14-6: Typical Construction Equipment Vibration Levels

Equipment	Typical Level (dBA) 25 Feet from the Source[1]	Typical Level (dBA) 50 Feet from the Source[1]	Typical Level (dBA) 100 Feet from the Source[1]
Large Bulldozer	0.089	0.0315	0.0111
Loaded Trucks	0.076	0.0269	0.0095
Rock Breaker	0.059	0.0209	0.0074
Jackhammer	0.035	0.0124	0.0044
Small Bulldozer/Tractors	0.003	0.0011	0.0004

Notes:

1. Calculated using the inverse square law formula for sound attenuation: $dBA_2 = dBA_1 + 20Log(d_1/d_2)$. Where: dBA_2 = estimated noise level at receptor; dBA_1 = reference noise level; d_1 = reference distance; d_2 = receptor location distance.

Source: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, September 2018.

Operations

A General Vibration Assessment was prepared for project operational bus pass-bys, in accordance with the FTA Noise and Vibration Manual. The nearest off-site structure (a commercial building), and residence are located approximately 40 feet and 75 feet, respectively, from the proposed busway driving lane. At this distance and a maximum speed of 65 mph, vibration levels would be approximately 72 VdB at the at the nearest commercial building and 66 VdB at the nearest residence, which would be below the FTA's 75 VdB ground-borne vibration impact level for Land Use Category 3 uses (commercial) and Land Use Category 2 (residential) uses for frequent events (refer to Table 14-9). As a result, vibration levels from bus pass-bys associated with the proposed project would not cause structural damage at off-site structures or create human annoyance. As a result, impacts from vibration associated with project operation would be **less than significant.**

14.5.5 Cumulative Impacts

Noise by definition is a localized phenomenon, and drastically reduces as distance from the source increases. Cumulative noise impacts involve development of the project in combination with ambient growth and other related development projects. As noise levels decrease as distance from the source increases, only projects in the nearby area could combine with the project to potentially result in cumulative noise impacts.

Impact N-3: The project will not contribute to cumulatively considerable noise impacts. This is a less-than-significant impact.

Cumulative Construction Noise

As discussed above, the project's construction noise levels would not exceed the FTA noise standards and would comply with the allowable construction hours and maximum noise limits set forth by the cities of Seaside, Marina, Sand City, and County of Monterey. There would be periodic, temporary, noise level increases that would cease upon completion of construction activities. The project would contribute to other proximate construction noise impacts if construction activities were conducted concurrently. However, based on the noise analysis above, the project's construction-related noise impacts would be less than significant.

Construction activities at other planned and approved projects would be required to take place during daytime hours, and the local cities and project applicants would be required to evaluate construction noise impacts and implement mitigation, if necessary, to minimize noise impacts. Each project would be required to comply with the applicable municipal code limitations on allowable hours of construction and maximum noise limits. Therefore, project construction would not contribute to cumulative impacts and impacts in this regard are not cumulatively considerable.

Cumulative Operational Noise

Cumulative noise impacts describe how much noise levels are projected to increase over existing conditions with the development of the project and other foreseeable projects. Cumulative noise impacts would occur primarily as a result of increased traffic on local roadways due to buildout of the project and other projects in the vicinity.

Operational Transit Noise

As discussed above, the project would not result in any long-term operational transit noise impacts. As this time, there are no known highway, transit, or other large developments in the project vicinity that would contribute to an increase in the cumulative noise environment. Therefore, the project's long-term noise contribution would not be cumulatively considerable and impacts would be **less than significant.**

14.6 References

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