3.10 Noise

3.10.1 Introduction

This section includes an evaluation of the potential for the project to result in adverse impacts related to noise. This section describes the existing noise environment and identifies nearby sensitive receptors, presents relevant local noise ordinances and standards, and discusses potential project impacts and appropriate mitigation measures, as necessary.

3.10.2 Scoping Comments

Comments related to noise impacts were received during the public scoping process. These comments and the location where they are addressed in the noise analysis are provided in Table 3.10-1.

Table 3.10-1 Noise Scoping Comments

Agency/Entity	Comment	Location in Noise Section that Comment is Addressed
Edi Alvarez and Neil Dukas	What noise, if any, may be associated with the ongoing operation of a pump station located at the foot of Laurel Avenue and adjacent to the creek?	Section 3.10.6, Impact 3.10-1
Garril Page	No one in Ross welcomes the noise of Sir Francis Drake Blvd. The FAP Riparian Corridor results in permanent, increased noise intrusion from SFD throughout a large portion of Ross. The longer construction period of FAP Riparian Corridor means extended, expanded exposure to all aspects of construction noise.	Section 3.10.6, Impact 3.10-1

3.10.3 Fundamentals of Noise

Sound, Noise, and Acoustics

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air). Noise is generally defined as unwanted sound (i.e., loud, unexpected, or annoying sound). Acoustics is defined as the physics of sound. In acoustics, the fundamental scientific model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receiver determine the sound level and characteristics of the noise perceived by the receiver. Acoustics addresses primarily the propagation and control of sound.

Frequency

The number of sound pressure peaks travelling past a given point in a single second is referred to as the frequency, expressed in cycles per second or Hertz (Hz). A given sound may consist of energy at a single frequency (pure tone) or in many frequencies over a broad frequency range (or band). Human hearing is generally affected by sound frequencies between 20 Hz and 20,000 Hz.

Amplitude

The amplitude of pressure waves generated by a sound source determines the perceived loudness of that source. Sound pressure amplitude is measured in micro-Pascals (μPa). One μPa is approximately one-hundred billionths of normal atmospheric pressure. Sound pressure amplitudes for different kinds of noise environments can range from less than 100 μPa to 100,000,000 μPa. Because of this huge range of values, sound is rarely expressed in terms of pressure. Instead, a logarithmic scale is used to describe sound pressure level (SPL) in terms of decibels (dB). The threshold of human hearing (near total silence) is approximately 0 dB, which corresponds to 20 μPa.

Addition of Decibels

Because dBs are logarithmic units, SPL cannot be added or subtracted through ordinary arithmetic means. Under the dB scale, a doubling of sound energy corresponds to a 3 dB increase. In other words, when two sources are each producing sound of the same magnitude, the resulting sound level at a given distance would be approximately 3 dB higher than one of the sources under the same conditions. For example, if one automobile produces an SPL of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB – rather they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level of approximately 5 dB louder than one source, and ten sources of equal loudness together produce a sound level of approximately 10 dB louder than the single source.

A-Weighted Decibels

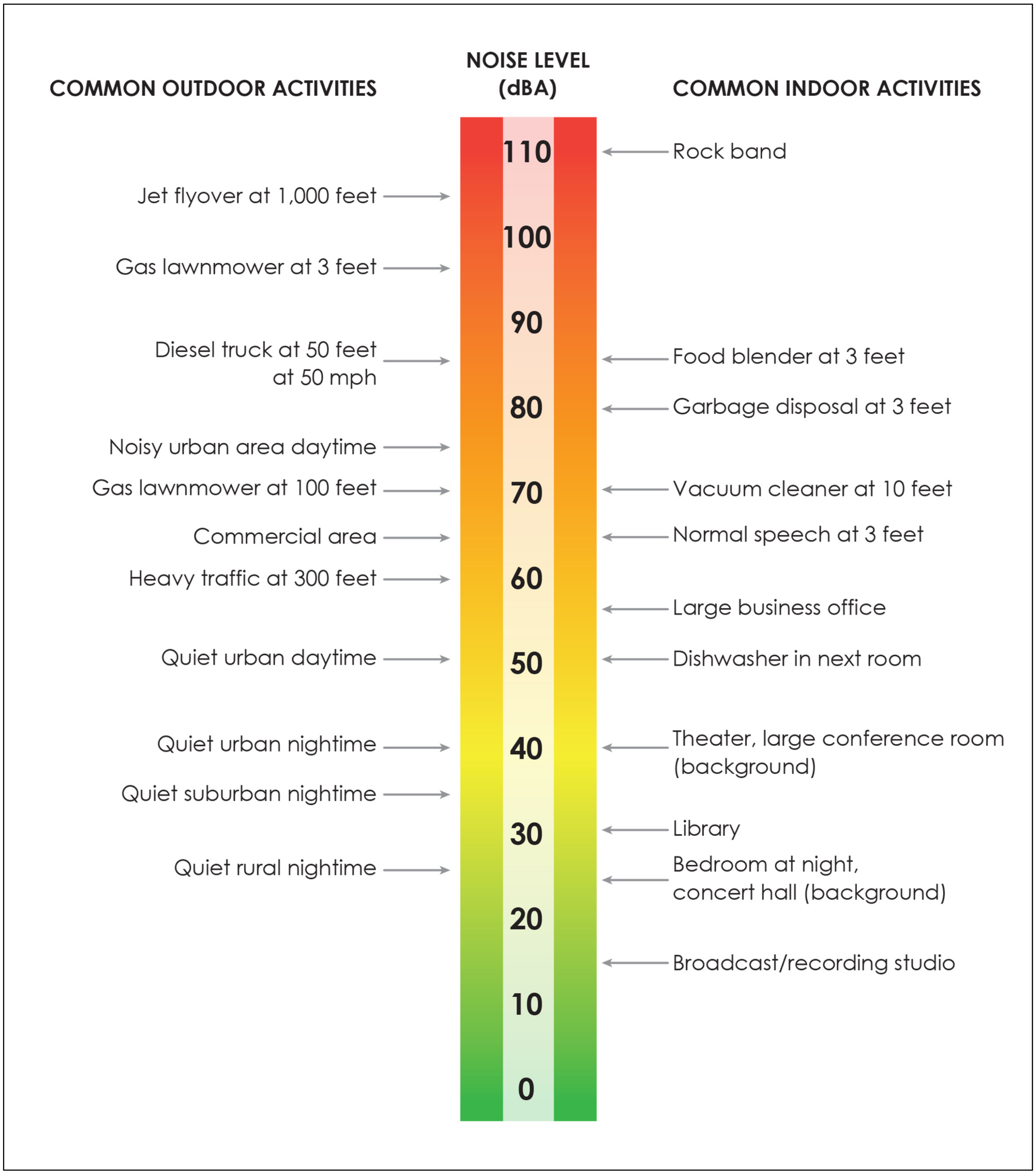
Figure 3.10-1 illustrates sound levels associated with common sound sources. The perceived loudness of sound is dependent on many factors, including magnitude and frequency. However, within the usual range of environmental sound levels, perception of loudness is relatively predictable and can be approximated by frequency filtering using the standardized A-weighting network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. For this reason, the dBA sound level has become the standard descriptor for environmental noise assessment. All noise levels reported in this section are expressed as A-weighted levels.

Human Response to Changes in Noise Levels

As discussed above, doubling sound energy results in a 3-dB increase in sound. However, for a given sound-level change measured with precise instrumentation, the subjective human perception of a doubling of loudness will usually be different from what is measured.

Under controlled conditions in a laboratory setting, the trained, healthy human ear is able to discern 1-dBA changes in sound levels when exposed to steady, single-frequency (“pure-tone”) signals in the mid-frequency range (1,000 Hz to 8,000 Hz). In typical noisy environments, changes in noise of 1 to 2 dB are generally not perceptible. However, it is widely accepted that people are able to begin to detect sound level increases of 3 dB in typical noisy environments.

Figure 3.10-1 Typical Noise Levels



Source: (Caltrans, 2013a)

Further, a 6-dB increase is generally perceived as a distinctly noticeable increase, and a 10-dB increase is generally perceived as a doubling of loudness. Therefore, a doubling of sound energy that would result in a 3-dB increase in SPL would generally be perceived as barely detectable. Refer to Table 3.10-2 for the approximate relationship between increases in environmental noise level and human perception.

Table 3.10-2 Approximate Relationship Between Increases in Environmental Noise Level and Human Perception

Noise Level Increase, dBA	Human Perception (Typical)
Up to about 3	Generally not perceptible
About 3	Barely perceptible
About 6	Distinctly noticeable
About 10	Twice as loud
About 20	Four times as loud

Source: (Cavanaugh, Tocci, & Wilkes, 2009)

Noise Descriptors

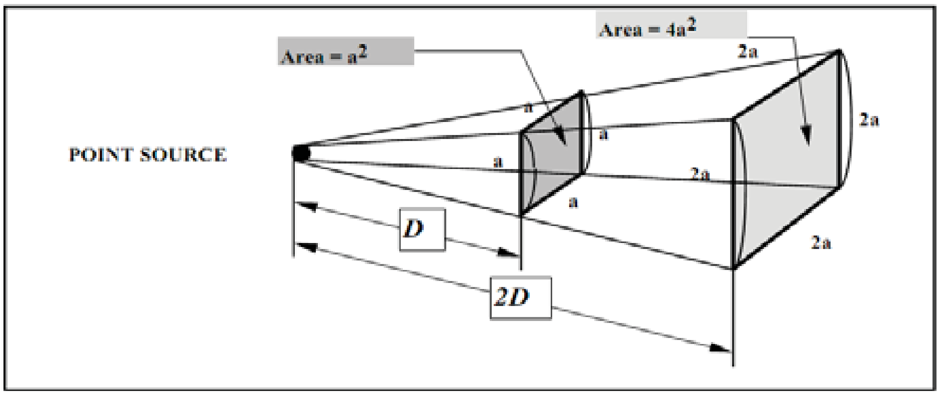
Noise in our daily environment fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, but others are random. Some noise levels fluctuate rapidly, but others slowly. Some noise levels vary widely, but others are relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors most commonly used in environmental noise analysis and are applicable to this study:

1. **Equivalent Sound Level (L_{eq}):** The L_{eq} represents an average of the sound energy occurring over a specified time period. In effect, the L_{eq} is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same period. The one-hour A-weighted L_{eq} level is the energy average of dBAs occurring during a one-hour period.
2. **Maximum Sound Level (L_{max}):** The L_{max} is the highest instantaneous sound level measured during a specified period.
3. **Minimum Sound Level (L_{min}):** The L_{min} is the lowest instantaneous sound level measured during a specified period.
4. **Day–Night Average Level (L_{dn}):** The L_{dn} is the energy average of dBAs occurring over a 24-hour period, with a 10-dB "penalty" applied to dBAs occurring during nighttime hours (10:00 p.m. to 7:00 a.m.).
5. **Community Noise Equivalent Level (CNEL)**: Similar to the Ldn, the CNEL is the energy average of A-weighted sound levels over a 24-hour period, with a 5-dB penalty added for the evening hours between 7:00 p.m. and 10:00 p.m. in addition to a 10-dB penalty between the hours of 10:00 p.m. and 7:00 a.m.

Sound Propagation

Sound from a localized source (i.e., point source) propagates uniformly outward in a spherical pattern; therefore, this type of propagation is called spherical spreading. The sound level attenuates (or decreases) at a rate of 6 dB for each doubling of distance from a point source as its energy is continuously spread out over a spherical surface (see Figure 3.10-2 for an illustration of spherical spreading of noise from a point source). Point sources of noise, such as stationary equipment or on-site construction equipment, attenuate (lessen) at a rate of 6.0 dB per doubling of distance from the source. Noise attenuation from a point source increases by 1.5 dB from 6 dB to 7.5 dB for each doubling of distance due to ground absorption and reflective wave canceling. These factors are collectively referred to as *excess ground attenuation*. The basic geometric-spreading loss rate is used where the ground surface between a noise source and a receiver is reflective, such as parking lots or a smooth body of water. The excess ground attenuation rate (7.5 dB per doubling of distance) is used where the ground surface is absorptive, such as soft dirt, grass, or scattered bushes and trees.

Figure 3.10-2 Point Source Spreading with Distance



Source: (Caltrans, 2013a)

Widely distributed noises, such as a street with moving vehicles (a "line" source), would typically attenuate at a lower rate of approximately 3 dB for each doubling of distance between the source and the receiver. If the ground surface between source and receiver is absorptive rather than reflective, the nominal rate increases to 4.5 dB for each doubling of distance. Atmospheric effects, such as wind and temperature gradients, can also influence noise -attenuation rates from both line and point sources of noise. However, unlike ground attenuation, atmospheric effects are constantly changing and difficult to predict.

Trees and vegetation, buildings, and/or barriers between a source and receiver reduce the noise level that would otherwise occur at a given receptor. However, for a vegetative strip to have a noticeable effect on noise levels, it must be dense and wide. For example, a stand of trees must be at least 100 feet wide and dense enough to completely obstruct a visual path to the roadway to attenuate traffic noise by 5 dB (Caltrans, 2013a). A row of structures can shield more distant receivers depending upon the size and spacing of the intervening structures and site geometry. Similar to vegetative strips discussed above, noise barriers, which include natural topography and soundwalls, reduce noise by blocking the line of sight between the source and receiver. Generally, a noise barrier that breaks the line of sight between source and receiver will provide at least a 5-dB reduction in noise.

Vibration

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Several descriptors are typically used to quantify the amplitude of vibration including peak particle velocity (PPV) and root mean square velocity. PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave and is typically expressed in units of inches per second (in/sec). The PPV is most frequently used to describe vibration impacts on buildings. Root mean square velocity is defined as the average of the squared amplitude of the signal, usually measured in decibels referenced to one microinch per second, and is reported as vibration decibels (VdB). The decibel notation acts to compress the range of numbers required to describe vibration (FTA, 2006). VdB vibration velocity amplitudes are used to evaluate human response to vibration. 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. In suburban environments, such as the project area, sources of groundborne vibration include construction activities and heavy trucks and buses. Typically, groundborne vibration generated by human-made activities attenuates rapidly with distance from the source of the vibration.

Groundborne vibration can be an annoyance. The primary effect of perceptible vibration is often a concern. However, secondary effects, such as the rattling of a china cabinet, can also occur even when vibration levels are well below perception. Any effect (primary perceptible vibration, secondary effects, or a combination of the two) can lead to annoyance. The degree to which a person is annoyed depends on the activity in which they are participating at the time of the disturbance. For example, someone sleeping or reading will be more sensitive than someone who is running on a treadmill. Reoccurring primary and secondary vibration effects often lead people to believe that the vibration is damaging their home although those vibration levels may be well below minimum thresholds for damage potential. Vibration generated by construction activity has the potential to damage structures. This damage could be structural damage, such as cracking of floor slabs, foundations, columns, beams, or wells or cosmetic architectural damage, such as cracked plaster, stucco, or tile.

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 induce structural 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. Studies have shown that the threshold of perception for average persons is in the range of 0.008 to 0.012 in/sec PPV. 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 minor cracking of building elements, or may threaten the integrity of the building. Construction-induced vibration that can be detrimental to a building is very rare and has only been observed in instances where the structure is in a high state of disrepair and the construction activity (e.g., impact pile driving) occurs immediately adjacent to the structure.

Table 3.10-3 displays the human reactions and effects on buildings that can be caused by various continuous vibration levels. As discussed previously, annoyance is a subjective measure, and vibrations may be found to be annoying at much lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations at the threshold of perception can be annoying.

Table 3.10-3 Approximate Reaction of People and Damage to Buildings from Construction 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 to strongly perceptible	Recommended upper limit of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Virtually no risk of damage to normal buildings
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential dwellings such as plastered walls or ceilings
0.5	Severe – vibrations considered unpleasant	Threshold at which there is a risk of damage to newer residential structures

Source: (Caltrans, 2013a)

3.10.4 Environmental Setting

Existing Ambient Noise Environment

The project is located in a low density, suburban residential area with no close exposure to heavily traveled roadways except traffic along Sir Francis Drake Boulevard, which is readily noticeable along Corte Madera Creek. Noise sources in the project vicinity include vehicle traffic on Sir Francis Drake Boulevard and Lagunitas Road (approximately 120 feet east of upper Unit 3 and crossing Unit 4, respectively), traffic along adjacent roadways, and passing walkers, runners, and bicyclists along Bike Route 20. The majority of ambient noise in the project area is associated with transportation-related sources, especially in areas where the creek approaches or is crossed by roadways. There are no known sources of substantial permanent stationary source noise in the project area. Within the project area, the majority of perceivable groundborne vibration is associated with vehicular traffic and is limited to large, loaded vehicles such as haul trucks on local roadways.

Noise measurements were collected at three locations along Corte Madera Creek and in the vicinity of the creek to characterize existing daytime noise conditions caused by various noise sources. Ambient noise levels were monitored at general locations where noise levels are considered representative of typical uses in the area. The noise monitoring locations are shown in Figure 3.10-3.

Noise levels were monitored using an Extech SDL600, Type 2 meter, which meets the standards of the American National Standards Institute (ANSI) for general environmental noise measurement instrumentation. The average noise levels and sources of noise measured at each location are identified in Table 3.10-4. The recorded daytime noise levels are characteristic of a low -density, suburban residential area with no close exposure to heavily traveled roadways. Noise measurements were taken on Wednesday, September 16, 2020, at mid-day to sample average ambient noise levels likely to occur during construction of the project.

Sensitive Receptors

Human response to noise varies considerably from one individual to another. Effects of noise at various levels can include interference with sleep, concentration, and communication and can cause physiological and psychological stress and hearing loss. Given these effects, some land uses are considered more sensitive to noise levels than others due to the duration and nature of time people spend at these uses. In general, residences are considered most sensitive to noise as people spend extended periods of time in them including the nighttime hours. Therefore, noise impacts to rest and relaxation, sleep, and communication are highest at residential uses. Schools, hotels, hospitals, nursing homes, and recreational uses are also considered to be more sensitive to noise as activities at these land uses involve rest and recovery, relaxation, and concentration and increased noise levels tend to disrupt such activities. Places such as churches, libraries, and cemeteries, where people tend to pray, study, and/or contemplate, are also sensitive to noise, but due to the limited time people spend at these uses, impacts are usually tolerable. Commercial and industrial uses are considered the least noise sensitive.

Sensitive land uses within 1,000 feet of the project area include single family residences along the left and right banks of Corte Madera Creek, Ross Common Park, Frederick Allen Park, Ross Elementary School, Kentfield Hospital, Adaline E. Kent Middle School, and the College of Marin. Residences are generally located within 50 feet of the channel in Units 4 and 3. Ross Elementary School and Adaline E. Kent Middle School are approximately 485 feet and 543 feet from the nearest project elements, respectively. College of Marin borders Corte Madera Creek, within 50 feet of the project area. Kentfield Hospital is located approximately 61 feet from the project area. The sensitive land uses and associated receptors within 1,000 feet of the project area are shown in Figure 3.10-3 and summarized in Table 3.10-5.

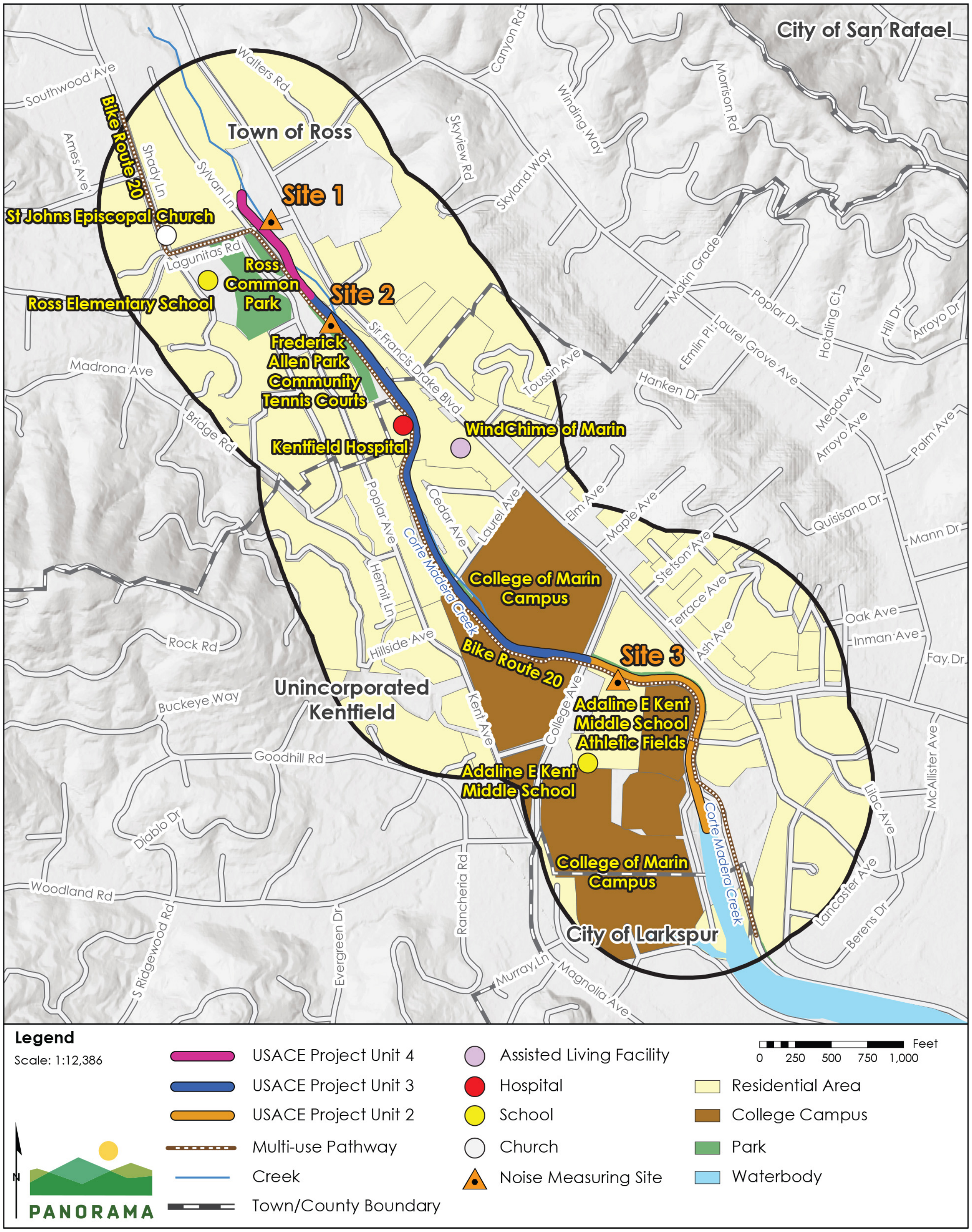
Table 3.10-4 Ambient Noise Levels at Noise Monitoring Locations

Measurement Location	L_{min}, dBA	L_{90}, dBA	L_{eq}, dBA	L_{10}, dBA	L_{max}, dBA	Noise Sources
Site 1: Near Ross Town Hall, adjacent to Lagunitas Road	45.9	53.5	62.9	66.7	76.6	Traffic passing on Lagunitas Road (adjacent to and south of the monitor), especially when queuing for left turn onto Sir Francis Drake Boulevard, is most influential; Sir Francis Drake traffic
Site 2: Frederick Allen Park; Creekside bicycle path	42.2	46.6	51.8	53.9	59.8	Traffic passing on Sir Francis Drake Boulevard (about 150 feet north) is most influential; passing walkers, runners, and bicyclists
Site 3: Creekside bicycle path, north of athletic fields at middle school	40.2	42.4	46.3	48.5	57.4	Distant traffic passing on Sir Francis Drake Boulevard (about 400 feet north) is most influential; passing walkers, runners, and bicyclists

Note:

[a] L_{eq} is a constant sound level that carries the same sound energy as the actual time-varying sound over the measurement period. L_{min}, L_{90}, L_{10}, and L_{max} are the minimum sound level, the sound level exceeded 90% of the time, the sound level exceeded 10% of the time, and the maximum sound level, respectively, all as recorded during measurement periods of 10-minute duration.

Figure 3.10-3 Noise Measuring Sites and Sensitive Receptors within 1,000 Feet of the Project Area



Sources: (Tele Atlas North America, Inc. 2019, GHD 2020, USGS 2019, US Geological Survey 2013, Esri, United States Geological Survey, U.S. Geographic Names Information System 2020)

Table 3.10-5 Sensitive Receptors within 1,000 Feet of the Project Area

Project Unit	Sensitive Land Use	Nearest Sensitive Receptor Location
Unit 4	Church, school, residences	• Residential properties directly abut the construction area and are above the creek. • Ross Elementary School is approximately 485 feet west of the proposed Grading Transition Area in Unit 4. • St. John's Episcopal Church is approximately 560 feet west of the proposed Grading Transition Area in Unit 4. • Ross Common Park is approximately 80 feet west of the proposed Grading Transition Area in Unit 4.
Unit 3	Hospital, assisted living facility, school, college campus, residences	• Residences directly abut the proposed grading area and floodwall on the east side of Fredrick Allen Park. • Residential properties directly abut the proposed floodwalls in lower Unit 3 • There are residences located approximate 35 feet west of the channel where the new fish pools and floodwall will be located in Lower Unit 3. • Kentfield Hospital is approximately 61 feet west of the channel where the new fish pools and floodwall will be located in Unit 3. • College of Marin campus is adjacent to the proposed floodwall and stormwater pump station in Unit 3 from Laurel Avenue to College. • Wind Chime of Marin (assisted living facility) is approximately 306 feet east of the channel where the new fish pools and floodwall will be located in Unit 3.
Unit 2	School, college campus, residences	• There is a college campus building located approximately 46 feet northwest of the proposed Unit 2 floodwall. • The proposed Unit 2 floodwall abuts residential properties. • Adaline E. Kent Middle School is located approximately 543 feet west of the proposed Unit 2 floodwall.

3.10.5 Regulatory Setting

The following laws, statutes, regulations, codes, and policies would apply to the project.

Federal Regulations

Truck Operations

Federal regulations establish noise limits for medium and heavy trucks (more than 4.5 tons, gross vehicle weight rating) under 40 CFR, Part 205, Subpart B. The federal truck pass-by noise standard is 80 dBA at 15 meters (approximately 50 feet) from the vehicle pathway centerline. These limits are implemented through regulatory controls on truck manufacturers.

Occupational Safety and Health Administration

The Occupational Safety and Health Administration aims to ensure worker safety and health in the United States by working with employers and employees to create better working environments. With regard to noise exposure and workers, Occupational Safety and Health Administration regulations set forth accepted criteria to protect the hearing of workers exposed to occupational noise. Noise exposure regulations are listed in 29 CFR Section 1910.95. Most applicable to the project, 1910.95(c)(1) states that an employer shall administer a hearing conservation program whenever noise exposure levels equal or exceed an eight-hour time-weighted average sound level of 85 dBA.

State Regulations

California Government Code Section 65302 encourages each local government entity to implement a noise element as part of its general plan. In addition, the California Governor's Office of Planning and Research has developed guidelines for preparing noise elements, which include recommendations for evaluating the compatibility of various land uses as a function of community noise exposure. According to the guidelines, exterior noise exposures generally fall into three categories: normally acceptable, conditionally acceptable, and unacceptable. Each land use has a particular dBA range within each exterior noise exposure category. For residential uses, an exterior noise environment of less than 62.5 dBA L_{dn} or CNEL is considered "normally acceptable" while a noise environment of 62.5 to 77.5 dBA L_{dn} or CNEL is considered "conditionally acceptable." For neighborhood parks, the General Plan guidelines indicate that an exterior noise environment of less than 65 dBA L_{dn} or CNEL is considered "normally acceptable," between 65 dBA and 80 dBA L_{dn} or CNEL is considered "conditionally acceptable," and 80 dBA or greater is considered "unacceptable."

Regional and Local Regulations

Marin County Municipal Code

The Marin County Code stipulates the following regulation for construction-related noise:

Section 6.70.030 – Enumerated Noises.

(5) Construction Activities and Related Noise.

a. Hours for construction activities and other work undertaken in connection with building, plumbing, electrical, and other permits issued by the community development agency shall be limited to the following:
   i. Monday through Friday: seven a.m. to six p.m.
   ii. Saturday: 9 am to 5 pm
   iii. Prohibited on Sundays and Holidays (New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.)
b. Loud noise-generating construction-related equipment (e.g., backhoes, generators, jackhammers) can be maintained, operated, or serviced at a construction site for permits administered by the community development agency from eight a.m. to five p.m. Monday through Friday only.
c. Special exceptions to these limitations may occur for:

i. Emergency work as defined in Section 22.130.030 of this code provided written notice is given to the community development director within forty-eight hours of commencing work;
ii. Construction projects of city, county, state, other public agency, or other public utility;
iii. When written permission of the community development director has been obtained, for showing of sufficient cause;
iv. Minor jobs (e.g., painting, hand sanding, sweeping) with minimal/no noise impacts on surrounding properties; or
v. Modifications required by the review authority as a discretionary permit condition of approval.

Marin Countywide Plan

The Built Environment Element of the Marin Countywide Plan contains the following goal, policy, and implementing program that relates to noise and is applicable to the project (Marin County , 2007).

Goal NO-1: Protection from Excessive Noise. Ensure that new land uses, transportation activities, and construction do not create noise levels that impair human health or quality of life.

> ***Policy NO-1.3: Regulate Noise Generating Activities***. Require measures to minimize noise exposure to neighboring properties, open space, and wildlife habitat from construction-related activities, yard maintenance equipment, and other noise sources, such as amplified music.
>
> > *Implementing Program NO-1.i: Regulate Noise Sources* - Sections 6.70.030(5) and 6.70.040 of the Marin County Code establish allowable hours of operation for construction-related activities. As a condition of permit approval for projects generating significant construction noise impacts during the construction phase, construction management for any project shall develop a construction noise reduction plan and designate a disturbance coordinator at the construction site to implement the provisions of the plan.

Town of Ross Municipal Code

The following code of the Town of Ross Municipal Code related to noise is applicable to the project (Town of Ross, 2020).

Chapter 9.20 Unnecessary Noise

> **9.20.035 Construction.** (a) It is unlawful for any person or construction company within the town limits to perform any construction operation before eight a.m. or after five p.m., Monday through Friday of each week and not at any time on Saturday, Sunday, or the other holidays listed in Section 9.20.060.

Town of Ross General Plan

The following goal and policy of the Ross General Plan related to noise is applicable to the project.

Goal 5. Protecting Community Health and Safety, and Preparing for Emergencies.

> **5.10 Traffic and Construction Noise**. Require mitigation of construction and traffic noise impacts on the ambient noise level in the Town.

3.10.6 Impact Assessment Methodology

Significance Criteria

Consistent with State CEQA Guidelines Appendix G (Environmental Checklist) and Marin County Environmental Review Guidelines, the project would have a significant impact if it would result in one or more of the following:

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, the project would expose people residing or working in the project area to excessive noise levels.

Approach to Impact Analysis

The following analysis discusses the significant impacts of the project related to noise and vibration. This section includes an analysis of potential short-term (construction) and long-term (operation) impacts of the project. Impact evaluations are assessed based on the existing conditions described earlier in this section. Mitigation measures are identified, as necessary, to reduce significant impacts.

3.10.7 Impact Discussion

Impacts Avoided

Due to the nature of the project, there would be no impacts related to the following criteria; therefore, no impact discussion is provided for the reasons described below:

1. **Criterion (c).** The project is not located within an airport land use plan, and the nearest public airport, the Gnoss Field Airport in Novato, is located approximately 12 miles from the project. The nearest private airport, the San Rafael Airport in San Rafael, is located approximately 4 miles from the project. Therefore, the project would not result in any airport-operations-related safety hazard for people residing or working in the project area.

Impacts Analyzed

Impact	Significance Determination
Impact 3.10-1: The project could result in generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.	**Construction: Less than Significant with Mitigation**
	Operation and Maintenance: Less than Significant

Construction

The project is located in a suburban residential area. Noise sources in the project vicinity include vehicle traffic on Sir Francis Drake Boulevard, Lagunitas Road, and College Avenue (approximately 120 feet east of upper Unit 3, crossing Unit 4, and crossing where Units 2 and 3 meets, respectively); traffic along adjacent roadways; and passing walkers, runners, and bicyclists along Bike Route 20. Construction of the project would temporarily generate noise during the seven months of active construction. Construction activities would occur on weekdays between the hours of 8:00 a.m. and 5:00 p.m. No nighttime or weekend construction activities would occur as part of the project.

Construction noise is regulated by the Town of Ross and Marin County Municipal Codes. Town of Ross Municipal Code Section 9.20.035 and Marin County Municipal Code Section 6.70.030(c) outline the allowable construction hours within each jurisdiction. Table 3.10-6 below lists the hours and times when construction is allowed in each jurisdiction.

Table 3.10-6 Town of Ross and Marin County Municipal Code Construction Requirements

Jurisdiction	Weekdays	Saturdays	Sundays	Federal Holidays
Marin County	8:00 a.m. to 5:00 p.m.	Construction not allowed	Construction not allowed	Construction not allowed
Town of Ross	8:00 a.m. to 5:00 p.m.	Construction not allowed	Construction not allowed	Construction not allowed

Project construction would require heavy equipment, including graders, excavators, cranes, dump trucks, and smaller equipment to transport materials, clear vegetation, grade new work areas, and remove and install floodwalls.

Table 3.10-7 lists the equipment that would be used during construction and the associated noise levels at a reference distance of 50 feet from the noise source.

Construction phase noise levels are modeled using a national model and construction equipment database in the Roadway Construction Noise Model (RCNM) from the Federal Highway Administration (FHWA). A list of construction equipment anticipated to be used during each construction phase is provided in Table 3.10-7. Construction noise is calculated for each phase of construction using noise-generating equipment that could be operating simultaneously within the work sites. The results are the sum of noise levels that would be experienced by typical receptors at a given distance. Construction noise levels are estimated at 50 feet, 100 feet, and 200 feet from the construction work area. Table 3.10-8 shows the equipment required for work during each construction phase and the estimated L_{eq} and L_{max} at 50, 100, and 200 feet.

Compliance with Noise Standards and Ordinances by Project Element

Unit 4 and Frederick Allen park Construction

The ambient noise levels in Unit 4 and at residences adjacent to Frederick Allen Park on Sir Francis Drake Boulevard is approximately 62.9 dBA L_{eq} (Table 3.10-4). Both Unit 4 and Frederick Allen Park are located within the Town of Ross where the Town of Ross Municipal Code and General Plan construction noise standards would apply. Construction noise would be generated during daytime hours (8 a.m. to 5 p.m.) when construction noise is exempt under the Town of Ross Municipal Code 9.20.035. The project would not conflict with Town of Ross Municipal Code due to the daytime construction period.

Project construction activities would generate noise that would result in a temporary increase in the ambient noise level to a maximum of 84.9 dBA L_{eq} at 50 feet for a period of a few days during concrete removal and 81.1 dBA to 81.4 dBA L_{eq} during other construction activities (Table 3.10-8). The Town of Ross General Plan requires mitigation for construction noise impacts when construction noise substantially exceeds the ambient noise level. The temporary increase in noise levels during construction in Unit 4 and at Frederick Allen park would be substantial (greater than 10 dBA) and therefore significant and require mitigation in accordance with the Town of Ross General Plan.

Table 3.10-7 Maximum Noise Levels Generated by Construction Equipment

Equipment	L_{max} (dBA) at 50 feet
Boom truck/cherry picker[a]	85
Concrete truck and boom pump[b]	82
Concrete saw	90
Crane	85
Drill[c]	85
Dump trucks	84
Excavator (small and medium)	85
Flatbed trucks	84
Generators	82
Air compressors	80
Grader	85
Jackhammer	85
Hoe Ram	90
Loader[d]	80

Equipment	L_{max} (dBA) at 50 feet
Pickup trucks (small and large)	55
Pump	77
Roller/Compactor	85
Paver	85
Silent piler[e]	Less than 62

Notes:

[a] Crane is used to represent noise from a boom truck/cherry picker.

[b] Concrete pump truck is used to represent noise from a concrete truck and boom pump.

[c] Auger drill rig is used to represent noise from a drill.

[d] Front-end loader is used to represent noise from a loader.

[e] Noise level is estimated to be 61.5 dBA at 16 meters (52 feet) with eco mode on.

Source: (FHA, 2017; Giken, n.d.)

Table 3.10-8 Estimated Noise from Equipment Required for Construction Phases

Construction Phase	Equipment	Distance from Construction Work Area	L_{eq} (dBA)	L_{max} (dBA)
Concrete channel removal	Excavator, loader, hoe ram[a], dump truck	50	84.9	90.3
		100	78.9	84.3
		200	72.9	78.2
Bank stabilization Floodwall installation	Excavator, concrete pump, cement truck, compressor	50	81.1	81.4
		100	75.1	75.4
		200	69.0	69.4
Habitat enhancement Fish ladder removal Fish pools construction	Excavator, loader, concrete pump, cement truck	50	81.4	81.4
		100	75.4	75.4
		200	69.3	69.4
Pump station construction	Crane, drill, concrete pump, cement truck, compressor	50	81.9	84.4
		100	75.9	78.3
		200	69.8	72.3

[a] It is assumed that a hoe ram could be used to remove concrete instead of a jackhammer. A hoe ram has a noise level of 90 dBA at 50 feet, which is higher than a jackhammer (85 dBA at 50 feet). Therefore, a hoe ram is used to conservatively estimate noise from concrete channel removal activity.

Source: (FHWA, 2017).

The District would implement **Mitigation Measure 3.10-1: Construction Noise Reduction Plan** to reduce noise levels and impacts. Mitigation Measure 3.10-1 specifies the requirements of the noise-reduction plan, including notification of nearby residents and use of noise barriers to reduce noise levels at adjacent sensitive receptors. Barriers that are correctly placed and well-designed would be expected to reduce construction equipment noise levels by 9 to 10 dBA. The maximally affected receptors are residents living adjacent to Frederick Allen Park, where concrete removal would occur for a few days and grading and heavy equipment use would last up to seven months. Residents adjacent to Frederick Allen Park and Unit 4 are located on Sir Francis Drake Boulevard. Ambient noise levels on Sir Francis Drake Boulevard are similar to, and likely higher than, the noise levels on Lagunitas Road due to the higher volume of traffic on Sir Francis Drake Boulevard. With implementation of Mitigation Measure 3.10-1, construction noise levels would be reduced approximately 9 to 10 dBA. Because Mitigation Measure 3.10-1 includes noise reduction measures that would reduce the noise impact on ambient noise levels in the Town of Ross, the construction noise would be consistent with the Town of Ross General Plan requirements and the impact would, therefore, be less than significant with mitigation.

Lower Unit 3 and Unit 2 Construction Floodwalls and Fish Pools

Lower Unit 3 and Unit 2 construction areas are located within Marin County where the Marin County Municipal Code and Countywide Plan noise standards would apply. The Marin County Municipal Code allows for construction noise during the hours of 8 a.m. to 5 p.m. Monday through Friday. All construction would occur during these hours and would not conflict with the noise standards in the municipal code. The Marin Countywide Plan requires preparation of a noise reduction plan for projects generating significant construction noise. Installation of floodwalls and construction of eleven larger fish pools in lower Unit 3 and Unit 2 would proceed along the channel in a linear fashion. While the overall duration for installation of the three segments of floodwall and construction of fish pools would last several weeks, construction in each area would last a few days. The impacts from floodwall installation and fish-pool construction noise would be less than significant due to the very short duration of construction near each sensitive receptor.

Stormwater Pump Station

The proposed stormwater pump station would be located approximately 100 feet from the nearest residential structure or College of Marin buildings. Construction of the stormwater pump station would occur between 8 a.m. and 5 p.m. Monday through Friday and would not conflict with the noise requirements in the Marin County Municipal Code. Noise levels from stormwater pump station construction would be approximately 75.9 dBA L_{eq} at a distance of 100 feet during daytime construction hours (8 a.m. to 5 p.m.). Ambient noise levels at the stormwater pump station are likely slightly less than at Lagunitas Road (62.9 dBA L_{eq}) because the stormwater pump station is removed form Frederick Allen Park but is subject to traffic, including traffic to the adjacent College of Marin. Construction of the stormwater pump station would result in a substantial increase in ambient noise levels (greater than 10 dBA) at nearby sensitive receptors during daytime hours for up to six weeks. The increase in noise would be significant. Because the Countywide Plan requires implementation of a noise reduction plan for projects that generate significant construction noise, and the project would generate significant construction noise, the impact would be significant. The District would implement **Mitigation Measure 3.10-1: Construction Noise Reduction Plan** to reduce noise levels and impacts. Mitigation Measure 3.10-1 requires preparation of a noise reduction plan that includes notification of nearby residents and use of noise barriers to reduce noise levels at adjacent sensitive receptors. Preparation of the noise reduction plan consistent with Mitigation Measure 3.10-1, would reduce significant construction noise and would comply with the Countywide Plan. The impact from temporary construction noise generation at the stormwater pump station would, therefore, be less than significant with mitigation.

Lower College of Marin Corte Madera Creek Concrete Channel Removal
The concrete channel removal in Unit 2 would require construction for up to six weeks. Dewatering would require installation of sheet piles. The sheet piles would be installed with a silent piler that would generate noise levels up to 62 dBA. The nearest sensitive receptors are located approximately 500 feet from the construction area. Construction activities in the area could generate noise up to 63 dBA L_{eq} at the nearest receptors on Sir Francis Drake Boulevard. The temporary noise at sensitive receptors would be similar to ambient noise levels from traffic on Sir Francis Drake Boulevard, and the project would not cause a substantial increase in noise levels; therefore, the impact would be less than significant.

Construction Traffic Noise
In addition to on-site construction noise, off-site hauling and material deliveries associated with construction activities would occur along designated truck routes within the project vicinity. This increase in truck traffic compared to existing conditions would contribute incrementally to traffic noise along local streets. Truck noise levels depend on vehicle speed, load, terrain, and other factors. The effects of off-site truck noise would depend on the existing level of background noise at a particular sensitive receptor. It is anticipated that a maximum day of truck traffic from the project area would result in 93 one-way trips per day during fish-pool construction and activities at Frederick Allen Park. Several phases have overlapping construction time periods that could result in a higher number of peak daily truck trips of up to approximately 413 one-way trips accessing the project area. Worker travel to and from the construction site would account for a maximum of 20 one-way trips per day. Accounting for the overlap of construction phases, peak one-way worker trips could be up to 112 per day.

Haul truck routes would likely occur along U.S. Highway 101, Sir Francis Drake Boulevard, and other local roadways in the immediate vicinity of the project area. Noise associated with a single truck pass-by can be approximately 80 dBA at 50 feet (FHWA, 2006). However, it takes a doubling of traffic to increase average noise levels by only 3 dB, which is considered barely perceptible to the average person (Caltrans, 2013a). Since U.S. Highway 101 and the majority of Sir Francis Drake Boulevard experience elevated traffic levels, the worst-case worker and haul truck traffic of 525 one-way trips per day would not double traffic volume along these roadways and would therefore not result in a perceptible increase in traffic noise at existing sensitive receptor locations. The impact associated with traffic noise would be less than significant.

Operation and Maintenance

Operation and maintenance activities would generally be similar to existing conditions except for operation of the proposed stormwater pump station and testing of the new backup generator. Typical activities include sediment and debris removal, vegetation management, and regular inspection and as-needed repair of floodwalls or other structures. These activities may include the use of offroad equipment such as lawn mowers, backhoes, and loaders. The pumps for the stormwater pump station would be installed underground and are not anticipated to create perceptible noise at the nearest receptor. The pumps would only be operational during and immediately following storm events when creek levels exceed the height of the outfall pipe and the stormwater pump station is needed to avoid flooding. Power for the stormwater pump station will primarily be provided by a connection to the grid. A generator would also provide emergency backup power in the case of power failure when the stormwater pump station needs to operate. Operation of the backup generator would only occur during emergencies and during testing of the generator. Operation and maintenance activities for the project would be temporary and occur infrequently throughout the year and would not result in a permanent increase in noise; therefore, impacts would be less than significant.

Mitigation: Implement Mitigation Measure 3.10-1.

Mitigation Measure 3.10-1: Construction Noise Reduction Plan. The District would adhere to this requirement and develop a construction noise reduction plan in compliance with local regulations to include measures to reduce construction noise impacts. These measures shall include, but not be limited to, the following:

1. Distribute to the potentially affected residences and other sensitive receptors within 200 feet of project construction boundary a "hotline" telephone number, which shall be attended during active construction working hours, for use by the public to register complaints. The distribution shall identify a noise-disturbance coordinator who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator would determine the cause of the noise complaints and institute feasible actions warranted to correct the problem. All complaints shall be logged noting date, time, complainant's name, nature of complaint, and any corrective action taken. The distribution shall also notify residents adjacent to the project area of the construction schedule.
2. All construction equipment shall have intake and exhaust mufflers recommended by the manufacturers thereof. Further, pavement breakers and jackhammers shall also be equipped with acoustically attenuating shields or shrouds recommended by the manufacturers thereof. In lieu of or in the absence of manufacturers' recommendations, the Director of Public Works shall have the authority to prescribe such means of accomplishing maximum noise attenuation as he deems to be in the public interest, considering the available technology and economic feasibility.

3. Maintain maximum physical separation between noise sources (construction equipment) and sensitive noise receptors. Separation may be achieved by locating stationary equipment to minimize noise impacts on the community.
4. Impact tools (e.g., jack hammers) used during construction activities will be hydraulically or electrically powered where feasible to avoid noise associated with compressed air exhaust from pneumatically powered tools. Where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used.
5. Use construction noise barriers such as paneled noise shields, barriers, or enclosures adjacent to noisy stationary equipment such as generators, air compressors, jackhammers, etc. Noise control shields shall be made featuring a solid panel and a weather-protected, sound-absorptive material on the construction-activity side of the noise shield.

Significance after Mitigation: Implementing Mitigation Measure 3.10-1 would comply with the Town of Ross General Plan and Countywide Plan. The mitigation would reduce construction noise levels by requiring use of equipment that would reduce noise generation and use of sound barriers to reduce noise at sensitive receptors. The impact would be less than significant after mitigation.

	Significance Determination
	Construction: Less than Significant with Mitigation
Impact 3.10-2: The project would not result in generation of excessive groundborne vibration or groundborne noise levels.	**Operation and Maintenance: Less than Significant**

Overview

The Marin Countywide Plan and Town of Ross General Plan and relevant municipal codes do not address vibration or provide numerical thresholds for identifying groundborne vibration impacts. In the absence of local standards for construction equipment vibration, the evaluation presented below uses the vibration thresholds presented in Table 3.10-9 to assess the significance of groundborne vibration and noise impacts. For risk of architectural damage to historic buildings and structures, this analysis applies a threshold of 0.12 in/sec PPV (Caltrans, 2013b). The only historic structures located in proximity to the project include Lagunitas Bridge and Ross Town Hall, north of the Unit 4 construction area and beyond the limits of vibration effects from the project. A threshold of 0.3 in/sec PPV is used for all other buildings. The FTA provides an equation that may be used to estimate vibration at different distances based on a reference PPV of 25 feet (Table 3.10-10) for various construction equipment. Using the FTA equation, the distances at which vibration-generating construction equipment would be lower than the damage thresholds were calculated and compared to potential distances to receiving buildings.

Table 3.10-9 Vibration Thresholds

	Maximum Peak Particle Velocity (PPV), inches per section (in/sec)
Historic buildings and structures	0.12
All other structures	0.3

Note:

The vibration criteria are based on continuous or frequent intermittent sources, including impact pile drivers, compactors, crack and seat equipment, vibratory pile drivers, and vibratory compaction equipment.

Source: (Caltrans, 2013b).

Table 3.10-10 Vibration Velocities for Construction Equipment

Equipment	Reference PPV at 25 feet (in/sec)	PPV at 5 feet (in/sec)	PPV at 30 feet (in/sec)
Large bulldozer[a]	0.089	0.523	0.073
Small bulldozer[b]	0.003	0.018	0.002
Jackhammer	0.035	0.206	0.029
Hoe ram	0.24	1.41	0.196
Loaded Trucks	0.076	0.446	0.062
Caisson Drilling	0.089	0.523	0.073
Silent piler[c]	0.05	0.294	0.041

Notes:

[a] Large bulldozer is used to represent vibration velocity for a medium excavator.

[b] Small bulldozer is used to represent vibration velocity for a small excavator.

[c] No vibration data are available for silent piler. Vibration data from the Fundex Tubex piling system were used to model vibration level as a "worst-case scenario" of pile installation vibration.

Source: (FTA, 2006).

Construction

Temporary sources of groundborne vibration during construction would result from operation of conventional heavy construction equipment such as an excavator, loaded haul trucks, and a jackhammer or hoe ram.

The nearest structures to the project are located approximately 30 to 60 feet from the project elements, with the exception of buildings located directly west of Frederick Allen Park. The nearest structure at Frederick Allen Park is located approximately three feet to the west of proposed floodwall. Table 3.10-10 summarizes typical vibration levels generated by heavy equipment applicable to the project at five feet and 30 feet distances. Assuming that a large bulldozer[1] would be used during project construction, structures would be exposed to a vibration level of 0.029 in/sec at 30 feet from construction area. Structures in all project elements, except adjacent to Frederick Allen Park, would not be exposed to vibration levels that would exceed the established building damage threshold (0.3 in/sec) since the nearest structures are located at least 30 feet away from the construction area.

Grading activities and construction of the short floodwall in Frederick Allen Park could occur at as close as three feet from buildings. A large bulldozer would produce a PPV of 0.523 at five feet, and a loaded truck would produce a PPV of 0.446 at five feet (Table 3.10-10); these vibration levels exceed the threshold of 0.3 PPV, and the vibration impact is therefore significant. **Mitigation Measure 3.10-2 Vibration Reduction Measures** would reduce potentially significant impacts by requiring vibration monitoring during construction activities in Frederick Allen Park adjacent to buildings and requiring notification to residents and property owners of vibration-generating activity and potential consequences. Because the mitigation requires monitoring and specifies procedures to avoid exceeding the vibration threshold, groundborne vibration impacts would be less than significant with mitigation.

Operation and Maintenance

Operation and maintenance activities would generally be similar to existing conditions except for operation of the proposed pump station and testing of the new backup generator, including sediment and debris removal, vegetation management, and regular inspection and as-needed repair of floodwalls or other structures. These activities would be temporary and may include the use of off-road equipment such as lawn mowers, backhoes, and loaders. These activities would occur at a greater distance from the nearest sensitive receptors than the construction. It is anticipated the vibration levels that occur during operation and maintenance activities would not exceed the established adverse human reaction threshold or the building damage threshold; therefore, this would result in a less-than-significant impact.

Mitigation: Implement Mitigation Measure 3.10-2.

Mitigation Measure 3.10-2: Vibration Reduction Measures. The District shall design the project to avoid intense vibration activities within five feet of the structures at Frederick Allen Park (e.g., avoid use of large bulldozer, jackhammer, hoe ram, or loaded trucks). If intense vibration generating activities cannot be avoided in proximity to structures, vibration monitoring shall be conducted during grading and floodwall construction activities in Frederick Allen Park to confirm vibration levels do not exceed vibration thresholds at the nearest receptors. If vibration levels approach the threshold of 0.3 PPV at the nearest structure, then construction practices shall be modified (i.e., use

[1] Vibration data are not available for excavator. Vibration data from bulldozer were used to model vibration level for excavator.

smaller types of construction equipment, operate the equipment in a manner to reduce vibration, or use alternate construction methods) so that the threshold is not exceeded.

Significance after Mitigation: Implementing Mitigation Measure 3.10-2 would reduce significant vibration impacts to a less-than-significant level by requiring the District implementation to avoid intense vibration in proximity to structures.

3.10.8 References

Caltrans. (2013a, September). Technical Noise Supplement to the Traffic Noise Analysis Protocol.

Caltrans. (2013b, September). Transportation and Construction Vibration Guidance Manual.

Cavanaugh, W. J., Tocci, G. C., & Wilkes, J. A. (2009, November 2009). Architectural Acoustics: Principles and Practice . John Wiley & Sons.

FHA. (2017, August 24). *Construction Noise Handbook - Table 9.1 RCNM Default Noise Emission Reference Levels and Usage Factors*. Retrieved September 25, 2020, from https://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm

FHWA. (2006, January). Roadway Construction Noise Model User's Guide.

FHWA. (2017, June 28). *Roadway Construction Noise Model - RCNM*. Retrieved from https://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/

FTA. (2006, May). Transit Noise and Vibration Impact Assessment .

FTA. (2006, May). Transit Noise and Vibration Impact Assessment .

Giken. (n.d.). *Silent Piler F101 for U Sheet Piles 400mm wide*. Retrieved October 15, 2020, from https://www.giken.com/en/wp-content/uploads/silentpiler_f101.pdf

Marin County . (2007, November 6). Marin Countywide Plan.

Marin County . (2019). Marin County Initial Study Checklist . Marin County Community Development Agency Planning Division.

Town of Ross. (2007, June). Town of Ross General Plan.

USACE. (2010, December). Corte Madera Creek Flood Control Study Baseline Report .