# 3.11 Noise

This section discusses the noise impacts associated with the implementation of the proposed Specific Plan. It covers both construction impacts and long-term operational impacts of the Plan. The section also provides background information to help understand noise and its impacts, the regulation of noise by different agencies, and a description of the existing noise environment in the Planning Area.

## ENVIRONMENTAL SETTING

## PHYSICAL SETTING

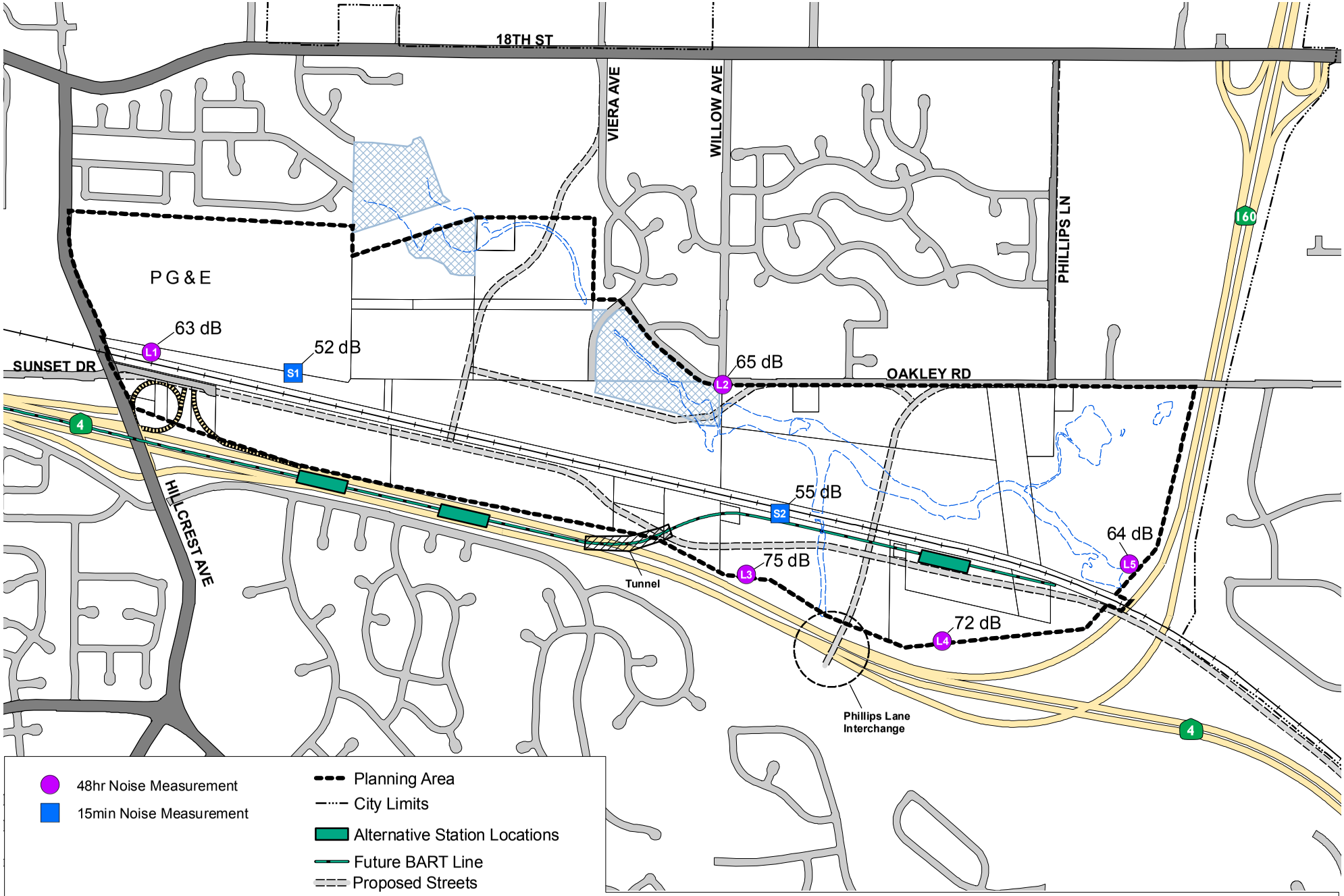
### Noise

As in most urban areas, vehicular traffic along major arterials is the principal noise source in the Planning Area. The dominant and consistent source of noise near the Planning Area is on-road vehicle traffic, particularly SR 4 and SR 160. Vehicular traffic along Hillcrest Avenue and Oakley Road contribute to the noise environment to a lesser degree. The Union Pacific Mococo Railroad right-of-way traverses the Planning Area on an east-west axis. At this time very few trains use this right-of-way, so railway noise is not a persistent factor. A transformer fan at the PG&E substation also contributes to the existing noise environment. Other potential human-caused sources of noise include planes flying overhead, construction, and landscaping equipment.

The level of highway traffic noise depends on three factors: (1) the volume of the traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Changes in traffic volume do not have a major influence on traffic noise levels. The primary source of noise from automobiles is high frequency tire noise, which increases with speed. In addition, trucks and older automobiles produce engine and exhaust noise, and trucks also generate wind noise. While tire noise from autos is generally located at ground level, truck noise sources can be located as high as ten to fifteen feet above the roadbed due to tall exhaust stacks and higher engines; sound walls are not effective for mitigating such noise unless they are very tall. Other factors that affect the perception of traffic noise include: distance from the highway, terrain, vegetation, and natural and structural obstacles.

### Noise Measurements

To quantify the existing noise environment at the project site, five continuous two-day (L1 through L5) noise measurements and two 15-minute short-term (S1 and S2) measurements were conducted from October 8 to 10, 2008. The short-term monitors measured noise levels simultaneously with synchronized long-term monitors and were used to estimate the Community Noise Equivalent Level (CNEL) at the short-term measurement locations. Table 3.11-1 and Figure 3.11-1 shows a summary of the measured data. CNEL describes a 24 hour average cumulative noise level measurement.




# Hillcrest Station Area Specific Plan
## Figure 3.11-1: Existing Noise Measurements

*Source: Salter, 2008; BART, 2008; Contra Costa County, 2004; City of Antioch, 2007; Dyett & Bhatia, 2008.*

**Table 3.11-1 Existing Noise Measurements**

| *Monitor* | *Location* | *Primary Noise Source(s)* | *Measured CNEL* |
|---|---|---|---|
| L1 | Approximately 385-feet east of the Hillcrest Avenue centerline, 215 feet north of the Sunset Drive centerline, six-feet above grade. | Hillcrest Avenue and bus stop directly to the south | **63 dB** |
| L2 | Approximately 40-feet south of the Oakley Road centerline at the Willow Avenue intersection, 12-feet above grade. | Distant SR 4 and Oakley Road | **65 dB** |
| L3 | Approximately 185-feet north of the SR 4 centerline on hill, 3150 feet west of the centerline of the SR 160 bridges over the rail line, 90-degree line-of-sight to SR 4, six-feet above grade. | SR 4 | **75 dB** |
| L4 | Approximately 300-feet north of SR 4 centerline at top of hill, 1730-feet west of the centerline of the SR 160 bridges over the rail line, 120-degree line-of-sight to SR 4, six-feet above grade. | SR 4 | **72 dB** |
| L5 | Approximately 330-feet west of SR 4 centerline, 195-feet north of freight line, 12-feet above grade | SR 160 | **64 dB** |
| S1 | Approximately 820-feet north of SR 4 centerline, 1450-east of Hillcrest Avenue, 5-feet above grade. | SR 4 | 52 dB [1] |
| S2 | Approximately 75-feet south of freight line, 550-feet east of Willow Avenue, 725-feet north of SR 4 centerline, behind hill, 5-feet above grade. | Distant SR 4 and Oakley Road | 55 dB [2] |

Note: Measurements exceeding the existing City standards for noise are in **bold**.

1. Calculated from a 15-minute $L_{eq}$ offset from monitor L1
2. Calculated from a 15-minute $L_{eq}$ offset from monitor L3

*Source: Charles M Salter Associates Inc, 2008*

## Vibration

Typically, indoor vibration levels near traffic corridors are below the threshold of human perception (below 65 VdB). In some instances, poorly maintained, rough roads with heavy-duty vehicles may generate perceptible vibrations; however, perceptible vibration levels would more likely be generated from construction equipment during project construction and transit vehicles after construction is complete. At this time, there are no major sources of vibrations in the Planning Area. Freight train activity is very infrequent, so no vibration velocity measurements were taken.

## Sensitive Receptors

Some land uses are considered more sensitive to ambient noise levels than others. People in residences, motels and hotels, schools, libraries, churches, hospitals, nursing homes, auditoriums, natural areas, parks, and outdoor recreation areas are generally more sensitive to noise than are people at commercial and industrial establishments. Consequently, the noise standards for sensitive land uses are more stringent than for those at less sensitive uses. At this time, there are no sensitive receptors within the Planning Area; however, much of the area is surrounded by

existing residential uses. Additionally, a church is located adjacent to the Planning Area at Oakley Road near the SR 160 overcrossing.

## TECHNICAL BACKGROUND

Noise is commonly defined as undesirable or unwanted sound. Noises vary widely in their scope, source, and volume, ranging from individual occurrences such as leaf blowers, to the intermittent disturbances of overhead aircraft, to the fairly constant noise generated by traffic on freeways. Noise can have real effects on human health, including hearing loss and the psychological effects or irritability from lack of sleep. Noise is primarily a concern with regard to noise-sensitive uses such as residences, schools, churches, and hospitals.

### Noise

#### *Measuring Sound*

Sound is generated by sound waves traveling outward from a source; the sound waves exert a sound pressure level (commonly called "sound level"), measured in decibels (dB). In general, people can perceive a two- to three-dB difference in noise levels; a difference of 10 dB is perceived as a doubling (or halving) of loudness. Environmental noise is usually measured in A-weighted decibels; a metric corrected for the variation in frequency response of the human ear. The A-weighted scale is used to describe all noise levels (dB) discussed in this section.

Three aspects of community noise are used in assessing the noise environment:

- **Level** (e.g., magnitude or loudness) of sound. Sound levels are measured and expressed in decibels (dB) with 10 dB roughly equal to the threshold of hearing.
- **Frequency** composition or spectrum of the sound. Frequency is a measure of the pressure fluctuations per second, measured in units of hertz (Hz). The characterization of sound level magnitude with respect to frequency is the sound spectrum, often described in octave bands, which divide the audible human frequency range (e.g., from 20 to 20,000 Hz) into ten segments.
- **Variation** in sound level with time, measured as noise exposure. Most community noise is produced by many distant noise sources that change gradually throughout the day and produce a relatively steady background noise having no identifiable source. Identifiable events of brief duration, such as aircraft flyovers, cause the community noise level to vary from instant to instant.

#### *Reporting Noise Levels*

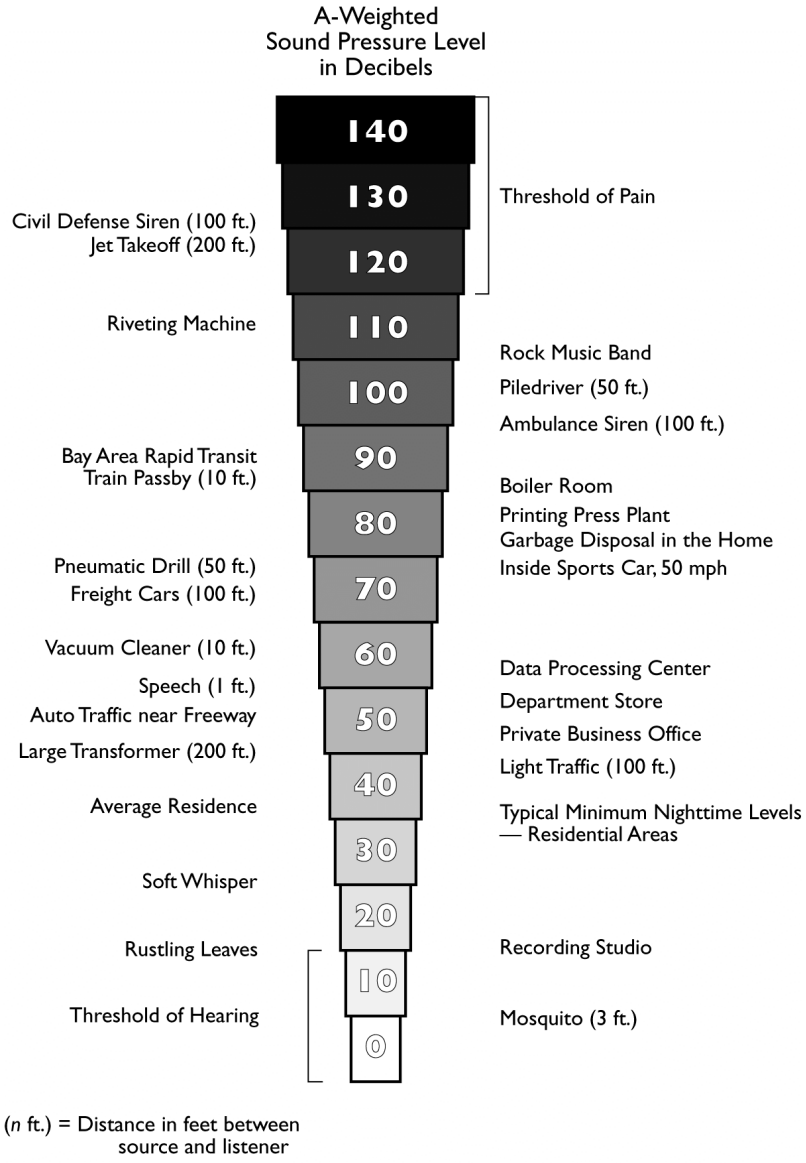
The noise levels presented in Figure 3.11-2 are representative of measured noise at a given instant in time. However, noise levels rarely persist consistently over a long period of time. Rather, noise levels vary with time, such that the noise experienced in any one place, or the community noise environment, varies continuously over time. Specifically, community noise is the result of many distant noise sources that constitute a relatively stable background noise exposure where the individual contributors are unidentifiable. The background noise level changes throughout a typical day, but does so gradually, corresponding with the addition and subtraction of distant noise sources such as traffic. At the same time, throughout the day, short duration single-event noise sources (e.g., aircraft flyovers, motor vehicles, sirens) that are readily identifiable to the individual

add to the existing background noise level. The combination of the slowly changing background noise and the single-event noise events give rise to a constantly changing community noise environment.

Given the variation of community noise levels from instant to instant, community noise levels must be measured over an extended period of time to legitimately characterize a community noise environment and evaluate cumulative noise impacts. This time-varying characteristic of environmental noise is described using statistical noise descriptors. The most frequently used noise descriptors are summarized below:

- $L_{eq}$: The equivalent sound level is used to describe noise over a specified period of time, typically one hour, in terms of a single numerical value. The $L_{eq}$ is the constant sound level which would contain the same acoustic energy as the varying sound level, during the same time period (i.e., the average noise exposure level for the given time period).
- $L_{max}$: The instantaneous maximum noise level measured during the measurement period of interest.
- $L_x$: The sound level that is equaled or exceeded x percent of a specified time period. The $L_{50}$ represents the median sound level (i.e., the noise level exceeded 50 percent of the time).
- DNL: The day-night average sound level (DNL) is the energy average of the A-weighted sound levels occurring during a 24-hour period, accounting for the greater sensitivity of most people to nighttime noise by weighting ("penalizing") nighttime noise levels by adding 10 dBA to noise between 10:00 p.m. and 7:00 a.m.
- CNEL: Similar to the DNL, the Community Noise Equivalent Level (CNEL) adds a 5-dBA "penalty" for the evening hours between 7:00 p.m. and 10:00 p.m., in addition to the 10-dBA penalty between the hours of 10:00 p.m. and 7:00 a.m.

**FIGURE 3.11-2: Typical Sound Levels**




### *Effects of Noise on People*

The effects of noise on people can be placed into three categories:

- subjective effects of annoyance, nuisance, dissatisfaction;
- interference with activities such as speech, sleep, and learning; and
- physiological effects such as hearing loss or sudden startling.

Environmental noise typically produces effects in the first two categories. Workers in industrial plants generally experience noise in the last category. There is no completely satisfactory way to

measure the subjective effects of noise or the corresponding reactions of annoyance and dissatisfaction. A wide variation exists in the individual thresholds of annoyance, and different tolerances to noise tend to develop based on an individual's past experiences with noise.

Therefore, an important way of predicting human reaction to a new or changed noise environment is the way the noise levels compare to the existing environment to which one has adapted: the so-called "ambient noise" level. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by those hearing it. With regard to increases in A-weighted noise level, the following relationships occur:

- except in carefully controlled laboratory experiments, a change of 1 dBA cannot be perceived;
- outside of the laboratory, a 3 dBA change is considered a just-perceivable difference;
- a change in level of at least 5 dBA is required before any noticeable change in human response would be expected; and
- a 10-dBA change is subjectively heard as an approximate doubling in loudness, and can cause an adverse response.

These relationships occur in part because of the logarithmic nature of sound and the decibel system. Because the decibel scale is based on logarithms, two noise sources do not combine in a simple additive fashion, but rather logarithmically. For example, if two identical noise sources produce noise levels of 50 dBA, the combined sound level would be 53 dBA, not 100 dBA.

### *Noise Attenuation*

Stationary "point" sources of noise, including stationary mobile sources such as idling vehicles, attenuate (decrease) at a rate of 6 dBA to 7.5 dBA per doubling of distance from the source, depending upon environmental conditions (i.e., atmospheric conditions and noise barriers). Widely distributed noises, such as a large industrial facility spread over many acres or a street with moving vehicles (a "line" source), would typically attenuate at a lower rate, approximately 3 to 4.5 dBA per doubling of the distance from the source, again, depending upon environmental conditions (Caltrans, 1998). Noise from large construction sites would have characteristics of both "point" and "line" sources, so attenuation would generally range between 4.5 and 7.5 dBA per doubling of distance.

Noise levels may also be reduced by intervening structures. For example, a single row of buildings between the receptor and the noise source reduces the noise level by about 5 dBA. Structures also act to insulate people inside these structures from exterior noise. Older home construction methods generally provide a reduction of exterior-to-interior noise levels of about 20 dBA with closed windows, while the reduction in newer homes is generally 30 dBA or more.

## Vibration

In contrast to airborne noise, ground-borne vibration is less common as an environmental problem. All structures can be made to vibrate with the application of an external force. An external force common to occupied buildings can either be continuously operating "steady-state" (e.g., rotating machinery), or a short duration occurrence "transient" (e.g., ground-borne motion due to traffic and rail operations, or structure-borne motion due to human activity inside the building such as footfalls). Typically, ground-borne vibration generated by man-made activities attenuates rapidly with distance from the source of the vibration. Sensitive receptors for vibration include structures (especially older masonry structures), people (especially residents, the elderly and sick), and vibration sensitive equipment.

There are several different methods that are used to quantify vibration. The peak particle velocity (PPV) is defined as the maximum instantaneous peak of the vibration signal in inches per second (in/sec). The PPV is most frequently used to describe vibration impacts to buildings. The root mean square (RMS) amplitude is most frequently used to describe the affect of vibration on the human body. The RMS amplitude is defined as the average of the squared amplitude of the signal. Decibel notation (VdB) is commonly used to measure RMS. The decibel notation acts to compress the range of numbers required to describe vibration.

The effects of ground-borne vibration include movement of the building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. In extreme cases, the vibration can cause damage to buildings. Building damage is not a factor for most projects, with the occasional exception of blasting and pile-driving during construction. Annoyance from vibration often occurs when the vibration exceeds the threshold of perception by only a small margin. A vibration level that causes annoyance will be well below the damage threshold for normal buildings. Examples of vibration inducing elements are jackhammers, pile drivers, and blasting. The FTA measure of the threshold of architectural damage for conventional sensitive structures is 0.2 in/sec PPV and the FTA threshold of human annoyance to ground-borne vibration is 80 VdB RMS. (Federal Transit Administration, 2006)

**Table 3.11-2 Typical Levels of Groundborne Vibrations**

| *Human/Structural Response* | *Velocity Level (VdB)* | *Typical Events (50 foot setback)* |
|---|---|---|
| Threshold, minor cosmetic damage | 100 | Blasting, pile driving, vibratory compaction equipment |
| | 95 | Heavy tracked vehicles (bulldozers, cranes, drill rigs) |
| Difficulty with tasks such as reading television subtitles or computer screen | 90 | |
| | 85 | Commuter rail, upper range |
| Residential annoyance, infrequent events | 80 | Rapid transit, upper range |
| Residential annoyance, frequent events | 75 | Commuter rail, typical |
| | | Bus or truck over bump on rough roads |
| | 70 | Rapid transit, typical |
| Approximate human threshold of perception to vibration | 65 | Buses, trucks, and heavy street traffic |
| | 60 | |
| | 55 | Background vibration in residential settings in the absence of activity |
| Lower limit for equipment ultra-sensitive to vibration | 50 | |

*Source: Federal Transit Administration, 2006*

If the external force is removed, the structure will still continue to vibrate freely until all vibratory energy is dissipated. Energy dissipation, sometimes referred to as damping, occurs because of friction in a material or at the interface between two materials. Energy loss at the interface between two materials is sometimes referred to as a "coupling loss." Vibratory energy is transferred from a material to its surrounding environment in the form of heat, sound, etc. Adding damping to a structure reduces vibration levels. However, it is generally not practical. Other more practical methods of reducing vibration levels in a structure have been successful in projects near extreme vibration sources, such as: reinforcing the building's resistance to vibrations by reducing beam, girder, and joist spans; using isolating systems likes springs or pads; or digging a deep trench between the project and the source.

## REGULATORY SETTING

Federal, state, and local agencies regulate different aspects of environmental noise. Federal and state agencies generally set noise standards for mobile sources such as aircraft and motor vehicles, while regulation of stationary sources associated with industrial, commercial and construction activities is left to local agencies. Local regulation of noise involves implementation of general plan policies and noise ordinance standards. Local general plans identify general principles intended to guide and influence development plans; local noise ordinances establish standards and procedures for addressing specific noise sources and activities.

## Definitions

### *Day-Night Average Sound Level (DNL)*

A descriptor established by the U.S. Environmental Protection Agency to represent a 24-hour average sound level with a 10 dB penalty applied to noise occurring during the night-time hours (10 p.m. – 7 a.m.) to account for the increased sensitivity of people during sleeping hours. A 10-dB increase in sound level is perceived by people to be twice as loud.

### *Community Noise Equivalent Level (CNEL)*

A descriptor for the 24-hour A-weighted average noise level. The CNEL concept accounts for the increased acoustical sensitivity of people to noise during the evening and night-time hours. Sound levels during the hours from 7 p.m. to 10 p.m. are penalized 5 dB; sound levels during the hours from 10 p.m. to 7 a.m. are penalized 10 dB. The CNEL value can be considered approximately equal to the DNL value, as the difference between the two is often less than 1 dB.

## Federal Regulations

**Code of Federal Regulations**. 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 passby noise standard is 80 dB at 15 meters from the vehicle pathway centerline. These controls are implemented through regulatory controls on truck manufacturers.

Federal regulations for railroad noise are contained in 40 CFR [Code of Federal Regulations], Part 201 and 49 CFR, Part 210. Noise limits for locomotives manufactured during or after 1980 are as follows: stationary locomotives (at idle throttle setting) are not to exceed 70 dB at 15 meters (approximately 50 feet) from the track pathway centerline. Stationary locomotives (at all other throttle settings) are not to exceed 87 dB at 15 meters; and moving locomotives are not to exceed 90 dB at 15 meters. These noise limits are implemented through regulatory controls on locomotive manufacturers.

**Federal Highway Administration.** In addition to noise standards for individual vehicles, under regulations established by the U.S. Department of Transportation's Federal Highway Administration, noise abatement must be considered for certain federal or federally-funded projects. Abatement is an issue for new highways or significant modification of an existing freeway. The agency must determine if the project would create a substantial increase in noise or if the predicted noise levels approach or exceed the Noise Abatement Criteria. Under the regulations, a substantial increase is defined as an increase in $L_{eq}$ 12 dB during the peak hour of traffic noise. The Noise Abatement Criteria differ among various activity categories. For sensitive uses, such as residences, schools, churches, parks, and playgrounds, the Noise Abatement Criteria is $L_{eq}$ 57 (interior) and 67 dB (exterior) during the peak hour of traffic noise.

**Swift Rail Development Act**. The sounding of locomotive horns or whistles in advance of highway rail grade crossings has been used as a safety precaution by railroads since the late 1880s. The manner in which horns have been sounded (two longs, one short and one long) was standardized in 1938. In response to a growing national trend towards restrictions on the use of locomotive horns under local ordinances and a related increase in collisions, Congress passed the Swift Rail Development Act, which directs the Federal Railroad Administration (FRA) to develop rules addressing this issue. In January 2000, the FRA published a proposed rule requiring use of the horns or whistles on approaches to every public road / rail grade crossing. An exception is

made in approved quiet zones, where supplementary safety measures have been installed or adopted by the state or locality. The proposed rule would also establish an upper limit for the loudness of train horns. Quiet zones are adopted by local governments, and approved by the FRA.

**National Environmental Policy Act**. The National Environmental Policy Act (NEPA), signed into law on January 1, 1970, directs federal agencies to carry out their regulations, policies and programs in accordance with NEPA's environmental protection policies. Although NEPA does not establish specific noise standards, the noise impacts of projects are routinely considered as one of the potential environmental consequences of federal actions subject to NEPA (such as certain federally funded highway or rail projects).

**Federal Transit Administration Vibration Guidelines.** Light and heavy rail are potential sources of substantial ground vibration depending on distance, the type and speed of trains, and the type of track. The Federal Transit Administration (FTA) of the U.S Department of Transportation has developed vibration impact assessment criteria for evaluating vibration impacts associated with rapid transit projects. The FTA vibration standards for residences and buildings where people normally sleep are listed in Table 3.11-3.

**Table 3.11-3 FTA Groundborne Vibration Criteria (VdB)**

| | *Groundborne Vibration Impact Limits* | | |
|---|---|---|---|
| *Receiving Land Use Category* | *Infrequent Events* [a] | *Occasional Events* [b] | *Frequent Events* [c] |
| Category 1 – Buildings where low ambient vibration is essential for interior operations | 65 [d] | 65 [d] | 65 [d] |
| Category 2 – Residences and buildings where people normally sleep | 80 | 75 | 72 |
| Category 3 – Institutional land uses with primary daytime use | 83 | 78 | 75 |

a. "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day.

b. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day.

c. "Frequent Events" is defined as more than 70 vibration events of the same source per day.

d. This limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research should always require detailed evaluation to define the acceptable vibration limits. Ensuring low vibration levels in a building requires special design of HVAC systems and stiffened floors.

*Source: Federal Transit Administration, May 2006.*

The FTA provides critical screening distances for vibration impacts on high-sensitivity, residential, and institutional land uses, as summarized in Table 3.11-4. The FTA methodology assumes that buildings beyond the screening distance would not be subject to vibration levels that exceed acceptable levels. Within the screening distance, vibration levels may be a potential impact that should be further analyzed and disclosure should be made to purchasers/lessees. However, these distances are guidelines, not standards.

**Table 3.11-4 Critical Screening Distances for Freight Rail Vibration**

| *Use* | *Feet* |
|---|---|
| High-Sensitivity Uses [1] | 600 |
| Residential | 200 |
| Institutional | 120 |

1. High-sensitivity uses include facilities such as vibration-sensitive research and manufacturing facilities, hospitals with vibration-sensitive equipment, and university research operations.

*Source: Federal Transit Administration, May 2006*

Vibration levels generated by railway operations are dependent on site specific conditions, such as rail condition, terrain, and soil strata. Vibration measurement data for similar projects in the Bay Area (e.g., Hercules, Livermore, Hayward) indicate that train vibration levels meet the FTA residential and institutional goals within approximately 80 feet to 120 feet of railways.

## State Regulations

**California Department of Transportation**. The State establishes noise limits for vehicles licensed to operate on public roads. For heavy trucks, the State passby standard is consistent with the federal limit of 80 dB. The State passby standard for light trucks and passenger cars (less than 4.5 tons, gross vehicle rating) is also 80 dB at 15 meters from the centerline. These standards are implemented through controls on vehicle manufacturers and by state and local laws enforced against vehicle operators. For new roadway projects, the California Department of Transportation (Caltrans) employs the Noise Abatement Criteria, discussed above in connection with the Federal Highway Administration.

**California Code of Regulations, California Building Code**. The State has established noise insulation standards for new multi-family residential units, hotels, and motels that would be subject to relatively high levels of transportation-related noise. These requirements are collectively known as the California Noise Insulation Standards. The noise insulation standards set forth an interior standard of DNL 45 dB for any habitable room. They also require an acoustical analysis demonstrating how dwelling units have been designed to meet this interior standard where such units are proposed in areas subject to noise levels greater than DNL 60 dB. If windows must be in the closed position to meet the interior noise level standard, the project design must include a ventilation or air-conditioning system to provide fresh air to the habitable interior environment. Title 24 standards are typically enforced by local jurisdictions through the building permit application process.

## Regional and Local Regulations

### *Antioch Municipal Code*

*5-17.04 Heavy Construction Equipment Noise*

(A) For the purpose of this chapter, the following definitions shall apply unless the context clearly indicates or requires a different meaning.

*Heavy Construction Equipment*. Equipment used in grading and earth moving, including diesel engine equipped machines used for that purpose, except pickup trucks of one ton or less.

*Operate.* Includes the starting, warming-up, and idling of heavy construction equipment engines or motors

(B) It shall be unlawful for any person to operate heavy construction equipment during the hours specified below:

(1) On weekdays prior to 7:00 a.m. and after 6:00 p.m.

(2) On weekdays within 300 feet of occupied dwelling space, prior to 8:00 a.m. and after 5:00 p.m.

(3) On weekends and holidays, prior to 9:00 a.m. and after 5:00 p.m., irrespective of the distance from the occupied dwelling.

*5-17.05 Construction Activity Noise*

(A) As used in this section, "***construction activity***" means the process or manner of constructing, building, refurbishing, remodeling or demolishing a structure, delivering supplies thereto and includes, but is not limited to, hammering, sawing, drilling, and other construction activities when the noise or sound there from can be heard beyond the perimeter of the parcel where such work is being performed. The term "construction activity" also includes the testing of any audible device such as a burglar or fire alarm or loudspeaker. "Construction activity" does not include floor covering installation or painting when done with non-powered equipment.

(B) It shall be unlawful for any person to be involved in construction activity during the hours specified below:

(1) On weekdays prior to 7:00 a.m. and after 6:00 p.m.

(2) On weekdays within 300 feet of occupied dwellings, prior to 8:00 a.m. and after 5:00 p.m.

(3) On weekends and holidays, prior to 9:00 a.m. and after 5:00 p.m., irrespective of the distance from the occupied dwellings.

(C) In addition to the penalties provided by this code, authorized employees may issue "Stop Work Orders" when a violation of this section or Section 5-17.04 has occurred. If such a Stop Work Order is issued, it shall not be released until the holder of the building permit provides assurance that future violations will not occur.

Section 9-5.19 contains the noise attenuation requirements for stationary and mobile noise sources.

*9-5.1901(A) Stationary noise sources.* Uses adjacent to outdoor living areas (e.g., backyards for single-family homes and patios for multi-family units) and parks shall not cause an increase in background ambient noise which will exceed 60 CNEL. *[Note: CNEL is approximately equivalent to DNL; typically there is less than 1 dB difference between the two.]*

*9-5.1901(B) Mobile noise sources.*

(1) Arterial and street traffic shall not cause an increase in background ambient noise which will exceed 60 CNEL.

(2) Proposed outdoor residential living areas adjacent to the future expressway (State Route 4 Bypass) or to State Route 4, including BART or eBART development, may be allowed up to a maximum of 65 CNEL as approved by the city.

(3) Existing outdoor residential living areas adjacent to the State Route 4 proposed widening, or to BART or eBART development, shall result in no significant increase (CNEL 5 dB or greater) in existing noise levels.

*9-5.1901(C) Noise analysis.* For new developments adjacent to the future bypass, applicants may be required to provide a noise and/or visual analysis conducted pursuant to the city's development and environmental review process as determined by staff during the project planning/entitlement phase.

*9-5.1901(D) Noise attenuation.* The city may require noise attenuation measures be incorporated into a project to obtain compliance with this section. Measures outlined in the noise policies of the General Plan should be utilized to mitigate noise to the maximum feasible extent.

*9-5.1901(E) Flexible application.* The city may allow up to 65 CNEL for residential projects adjacent to the future bypass or to State Route 4, BART or eBART if the applicant has demonstrated that noise attenuation down to 60 CNEL would result in significantly higher walls.

***Antioch General Plan***

*11.6.1 Noise Objective*

Achieve and maintain exterior noise levels appropriate to planned land uses throughout Antioch, as described below.

- Residential
  - Single Family: 60 dBA CNEL within rear yards
  - Multi-Family: 60 dBA CNEL within interior open space
- Schools
  - Classrooms: 65 dBA CNEL
  - Play and sports areas: 70 dBA CNEL
- Hospitals, Libraries: 60 dBA CNEL
- Commercial/Industrial: 70 dBA CNEL at the front setback.

*11.6.2 Noise Policies: Noise Compatible Land Use and Circulation Patterns*

a. Implementation of the noise objective contained in Section 11.6.1 and the policies contained in Section 11.6.2 of the Environmental Hazards Element shall be based on noise data contained in Section 4.9 of the General Plan EIR, unless a noise analysis conducted pursuant to the City's development and environmental review process provides more up-to-date and accurate noise projections, as determined by the City.

b. Maintain a pattern of land uses that separates noise-sensitive land uses from major noise sources to the extent possible, and guide noise-tolerant land uses into the noisier portions of the Planning Area.

c. Minimize motor vehicle noise in residential areas through proper route location and sensitive roadway design.

- Provide planned industrial areas with truck access routes separated from residential areas to the maximum feasible extent.
- Where needed, provide traffic calming devices to slow traffic speed within residential neighborhoods.

d. Where new development (including construction and improvement of roadways) is proposed in areas exceeding the noise levels identified in the General Plan Noise Objective, or where the development of proposed uses could result in a significant increase in noise, require a detailed noise attenuation study to be prepared by a qualified acoustical engineer to determine appropriate mitigation and ways to incorporate such mitigation into project design and implementation.

e. When new development incorporating a potentially significant noise generator is proposed, require noise analyses to be prepared by a qualified acoustical engineer. Require the implementation of appropriate noise mitigation when the proposed project will cause new exceedences of General Plan noise objectives, or an audible (3 dBA) increase in noise in areas where General Plan noise objectives are already exceeded as the result of existing development.

f. In reviewing noise impacts, utilize site design and architectural design features to the extent feasible to mitigate impacts on residential neighborhoods and other uses that are sensitive to noise. In addition to sound barriers, design techniques to mitigate noise impacts may include, but are not limited to:

- Increased building setbacks to increase the distance between the noise source and sensitive receptor.
- Orient buildings which are compatible with higher noise levels adjacent to noise generators or in clusters to shield more noise sensitive areas and uses.
- Orient delivery, loading docks, and outdoor work areas away from noise-sensitive uses.
- Place noise tolerant use, such as parking areas, and noise tolerant structures, such as garages, between the noise source and sensitive receptor.
- Cluster office, commercial, or multifamily residential structures to reduce noise levels within interior open space areas.
- Provide double glazed and double paned windows on the side of the structure facing a major noise source, and place entries away from the noise source to the extent possible.

g. Where feasible, require the use of noise barriers (walls, berms, or a combination thereof) to reduce significant noise impacts.

- Noise barriers must have sufficient mass to reduce noise transmission and high enough to shield the receptor from the noise source.
- To be effective, the barrier needs to be constructed without cracks or openings.
- The barrier must interrupt the line of sight between the noise source and noise receptor.

- The effects of noise "flanking" the noise barrier should be minimized by bending the end of the barrier back from the noise source.
- Require appropriate landscaping treatment to be provided in conjunction with noise barriers to mitigate their potential aesthetic impacts.

h. Continue enforcement of California Noise Insulation Standards (Title 25, Section 1092, California Administrative Code).

*Temporary Construction*

i. Ensure that construction activities are regulated as to hours of operation in order to avoid or mitigate noise impacts on adjacent noise-sensitive land uses.

j. Require proposed development adjacent to occupied noise sensitive land uses to implement a construction-related noise mitigation plan. This plan would depict the location of construction equipment storage and maintenance areas, and document methods to be employed to minimize noise impacts on adjacent noise sensitive land uses.

k. Require that all construction equipment utilize noise reduction features (e.g., mufflers and engine shrouds) that are no less effective than those originally installed by the manufacturer.

m. Prior to the issuance of any grading plans, the City shall condition approval of subdivisions and non-residential development adjacent to any developed/occupied noise-sensitive land uses by requiring applicants to submit a construction-related noise mitigation plan to the City for review and approval. The plan should depict the location of construction equipment and how the noise from this equipment will be mitigated during construction of the project through the use of such methods as:

- The construction contractor shall use temporary noise-attenuation fences, where feasible, to reduce construction noise impacts on adjacent noise sensitive land uses.
- During all project site excavation and grading on-site, the construction contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers, consistent with manufacturers' standards. The construction contractor shall place all stationary construction equipment so that emitted noise is directed away from sensitive receptors nearest the project site.
- The construction contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction.
- The construction contractor shall limit all construction-related activities that would result in high noise levels to between the hours of 7:00 a.m. and 7:00 p.m. Monday through Saturday. No construction shall be allowed on Sundays and public holidays.

n. The construction-related noise mitigation plan required shall also specify that haul truck deliveries be subject to the same hours specified for construction equipment. Additionally, the plan shall denote any construction traffic haul routes where heavy trucks would exceed 100 daily trips (counting those both to and from the construction site). To the extent feasible, the plan shall denote haul routes that do not pass sensitive land uses or residential dwellings. Lastly, the

construction-related noise mitigation plan shall incorporate any other restrictions imposed by the City.

### Local Standard

The adopted City standard is to achieve and maintain exterior noise levels appropriate to planned land uses throughout Antioch.

**Table 3.11-5 Maximum Noise by Land Use**

| *Land Use* | *Maximum Sound Levels* |
|---|---|
| Residential Single Family | 60 dBA CNEL in rear yards (up to 65 CNEL adjacent to SR 4 or eBART) |
| Residential Multi-Family | 60 dBA CNEL in interior open space<br>(up to 65 CNEL adjacent to SR 4 or eBART) |
| School Classrooms | 65 dBA CNEL |
| School Play areas | 70 dBA CNEL |
| Hospitals, Libraries | 60 dBA CNEL |
| Commercial/Industrial | 70 dBA CNEL at the front setback |

*Source: City of Antioch General Plan, November 24, 2003.*

## IMPACT ANALYSIS

## SIGNIFICANCE CRITERIA

Implementation of the proposed Plan would have a potentially significant adverse impact on noise if the Plan would:

- Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance;
- Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels;
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project; or
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

## METHODOLOGY AND ASSUMPTIONS

### Methodology

To quantify the existing noise environment at the project site, five continuous two-day (L1 through L5) noise measurements and two 15-minute short-term (S1 and S2) measurements were conducted from October 8 to 10, 2008. The short-term monitors measured noise levels simultaneously with synchronized long-term monitors and were used to estimate the CNEL at the short-term measurement locations.

This analysis evaluates the aggregate noise effects of the full implementation of the proposed Specific Plan. The future noise contours were created using the CadnaA noise prediction software. This software conforms to ISO Standard 9613, "Attenuation of sound during propagation outdoors." Future development projects may be required to perform additional noise analysis and any noise reduction measures identified in the studies shall be incorporated into the individual projects.

Construction noise impacts due to development pursuant to the Specific Plan have been assessed qualitatively.

### Assumptions

The contours for the future noise environment were based on the following assumptions:

- The future road network as described in Section 3.4 is assumed to be completed in 2035. The 2035 road network includes the potential Phillips Lane Interchange. Future traffic data was provided by Fehr & Peers. Vehicular noise propagation is per the Federal Highway Administration.
- The future topography is based on the Roadway Infrastructure Conceptual Grading Plan dated October 16, 2008 by BKF Engineers. This conceptual grading plan is a preliminary plan based on the future road network.
- The eBART project is assumed to be completed and in operation in 2015. The noise analysis includes two eBART stations, one in the SR 4 median and another adjacent to the railroad right of way near the future Phillips Lane interchange. Noise levels from the eBART project are summarized from the eBART Draft Environmental Impact Report dated September 2008. The worst-case scenario for noise includes the maintenance yard outside the SR 4 median, located between SR 4 and the railroad right of way near the center of the Planning Area.
- In absence of more information from Union Pacific, a worst-case scenario of 40 trains running on the Mococo Freight Line is evaluated. Trains are assumed to be evenly spread throughout the day and night. The noise levels are from the Federal Transit Administration methodology (FTA Office of Planning and Environment, May 2006).
- The future noise contours are based on an average temperature of 68°F with 50 percent relative humidity.

## SUMMARY OF IMPACTS

### Noise

The noise analysis is cumulative in nature. It includes the noise generated by increased regional traffic, train activity, and the eBART project, as well as the projected development within the Planning Area. By 2035, the projected noise environment for some residential and commercial projects planned along SR 4, SR 160, and the Union Pacific Mococo railroad will exceed City noise level standards. Sources of noise in the future include the eBART transit project, bus transit, increased traffic volumes and new roads, and a transformer fan at the PG&E substation. If Union Pacific resumes freight rail service on the Mococo line, increased noise levels will be significant. However, this impact is not a result of proposed Specific Plan projects. Policies proposed under the Specific Plan would reduce the impact of increased noise, but due to resumption of freight rail service will cause a significant and unavoidable impact on future development in the area proposed by the Specific Plan.

The current City standards state that outdoor living areas for residential projects near SR 4, the SR 4 Bypass, and the eBART project may be allowed up to a maximum of 65 CNEL. In 2035, approximately 138 acres of the Planning Area (38 percent) will be within areas with noises levels equal to or greater than 65 dB. The standard for commercial and industrial uses is that the CNEL must be 70 dB or less at the front setback of the building. There will be approximately 50 acres of the Planning Area (13 percent) that exceed this standard. As seen in Figure 3.11-3, these areas are concentrated along SR 4, SR 160, and the railroad. Approximately 616 Residential TOD units and 724 Town Center Mixed Use units will be in areas with noise levels above 65 dB; and approximately 444,000 square feet of community retail and 142,000 square feet of office TOD will be in areas with noise levels above 70 dB.

In residential areas where exterior noise levels would be exceeded, Specific Plan policies require noise mitigations that lower interior noise levels below the City and State minimum standard of 45 dB, to compensate for the high exterior noise levels which make outdoor activities uncomfortable.

Intermittent noise and vibration levels of construction projects within the Planning Area would be temporary but significant depending on the proximity of construction activities to sensitive receptors and the mitigation strategies in place. Compliance with City regulations and the proposed Specific Plan policy would ensure that construction noise and vibration impacts would be less than significant.

### Airport Noise

Because the Planning Area is not located in an airport land use plan or within two miles of a public airport or public use airport, there is no impact to consider in this environmental review.

### Vibrations

The resumption of freight rail travel on the Union Pacific Mococo Rail Line would cause vibrations which would impact existing and new development in the Hillcrest Station Area. There are no specific Building Code requirements for vibration levels in buildings. However, Specific Plan policies require project-level analysis to be completed to determine feasible vibration mitigation measures for development subject to these vibrations; and require implementation of feasible mitigations. Therefore, this impact is less than significant.

## IMPACTS AND MITIGATION MEASURES

### 3.11-1 *Development pursuant to the proposed Specific Plan could expose persons to or generate noise levels in excess of the City standards. (Significant and Unavoidable)*

Future development within the Planning Area will result in the development of new roads near existing neighborhoods and overall increased traffic volumes, thus increasing noise levels in some areas. In addition, development will occur near a potentially active freight rail line which is a major noise source, particularly within a quarter mile of where the horn sounds for at-grade road crossings like Hillcrest Avenue. Other sources of noise in the future will be the eBART transit project with a 24-hour maintenance yard, bus transit, and a transformer fan at the PG&E substation. The projected noise environment is summarized in Table 3.11-6. Projected future noise contours are illustrated in Figure 3.11-3.

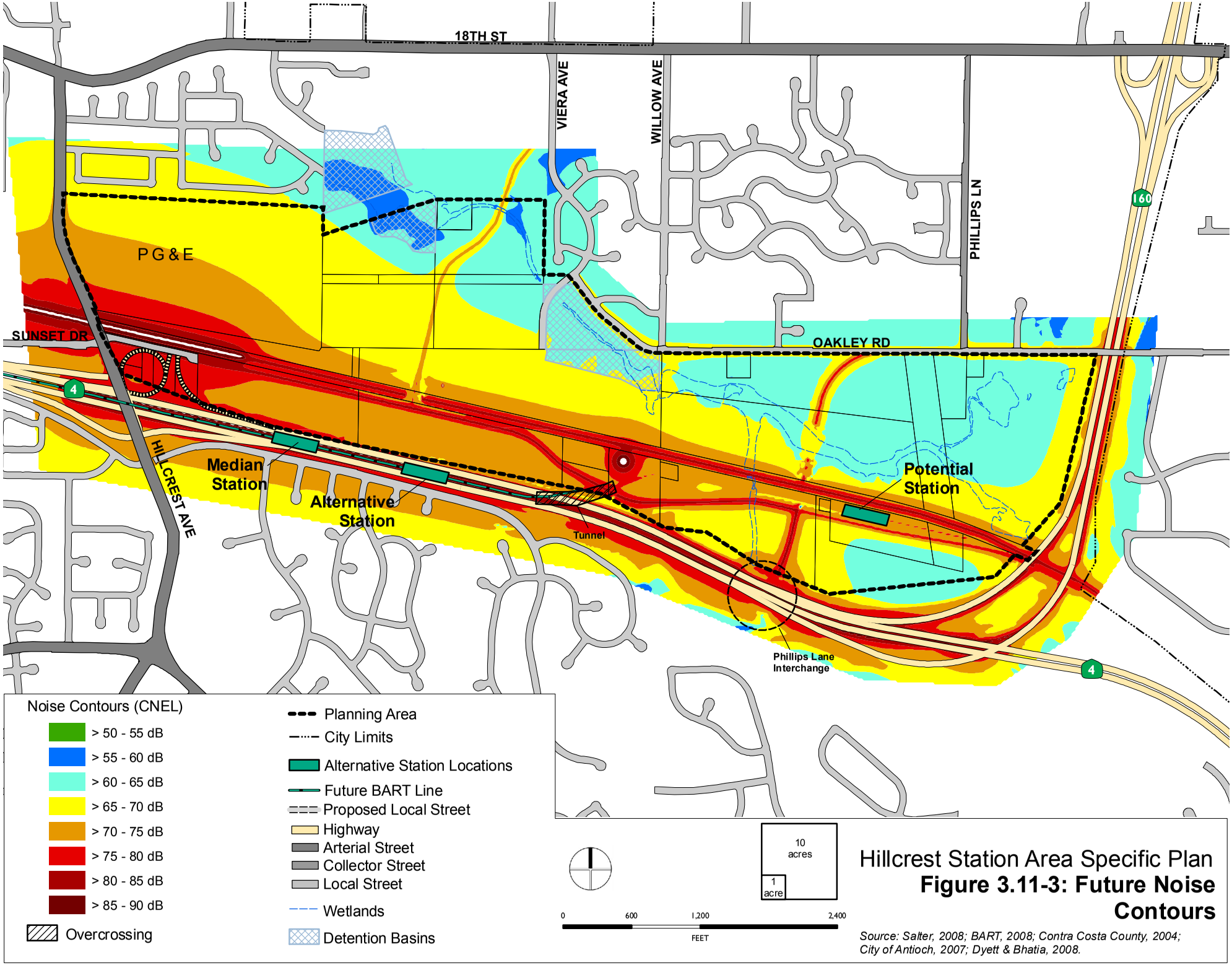
**Table 3.11-6 Noise Contour Acres**

| *Contour (dB)* | *Acres* | *Percent of Total Area* |
|---|---|---|
| <50 | 0 | 0% |
| 50 to 55 | 3 | 1% |
| 55 to 60 | 104 | 28% |
| 60 to 65 | 130 | 35% |
| 65 to 70 | 88 | 23% |
| 70 to 75 | 35 | 9% |
| 75 to 80 | 13 | 3% |
| 80 to 85 | 2 | 1% |

*Source: Charles M Salter Associates Inc., Dyett & Bhatia, 2008*

The current City standards state that outdoor living areas for residential projects near SR 4, the SR 4 Bypass, and the eBART project may be allowed up to a maximum of 65 CNEL. In 2035, approximately 138 acres of the Planning Area (38 percent) will be within areas with noises levels equal to or greater than 65 dB. The standard for commercial and industrial uses is that the CNEL must be 70 dB or less at the front setback of the building. There will be approximately 50 acres of the Planning Area (13 percent) that exceed this standard. As seen in Figure 3.11-3, these areas are concentrated along SR 4, SR 160, and the railroad. Table 3.11-7 summarizes the distances of the CNEL 70 and 65 dB noise contours from the centerline of major noise sources. These distances do not take into account the local topography or the additive effect resulting from noise sources being located close to each other. The contours illustrated on Figure 3.11-3 take topography and additive effects into account. Individual projects inside the applicable contour will require additional noise analysis to determine the appropriate mitigations to meet the City's standards.

Based on projections of future noise contours (Figure 3.11-3) and land use densities, it is estimated that some proposed development will be in areas that exceed maximum City standards for noise. Approximately 616 Residential TOD units and 724 Town Center Mixed Use units will be in areas with noise levels above 65 dB; and approximately 444,000 square feet of community retail and 142,000 square feet of office TOD will be in areas with noise levels above 70 dB.




# Hillcrest Station Area Specific Plan

## Figure 3.11-3: Future Noise Contours

*Source: Salter, 2008; BART, 2008; Contra Costa County, 2004; City of Antioch, 2007; Dyett & Bhatia, 2008.*

**Table 3.11-7 Distances to CNEL 70 and 65 dB Noise Contours from the Centerline of Major Noise Sources**

| *Source* | *Feet to CNEL 70 dB Contour (Office/Institutional Guideline)* | *Feet to CNEL 65 dB Contour (Residential Guideline)* |
|---|---|---|
| SR 4 | 340 | 730 |
| SR 160 | 150 | 310 |
| eBART | 30 | 60 |
| eBART at track crossovers | 60 | 125 |
| Freight Line | 80 | 170 |
| Freight Line within 0.25 mile of Hillcrest Ave. | 400 | 850 |

*Source: Charles M Salter Associates Inc., 2008*

The current City standards also state that development near SR 4, the SR 4 Bypass, and the eBART project may not result in increases greater than five CNEL above existing noise levels. As summarized in Table 3.11-8, four locations within the Planning Area exceed this standard. Each of these locations is adjacent to the Union Pacific Mococo railroad and freight rail will be the primary noise source. If Union Pacific resumes freight rail service on the Mococo line and if no grade separation is provided at Hillcrest Avenue, the noise impacts are significant. However this impact is due to the resumption of rail service, and is not an impact of the Specific Plan.

There are mitigation actions that could reduce the noise levels to a less than significant level. The grade separation at Hillcrest Avenue and the Union Pacific rail line, and a grade separation lowering the elevation of the rail line itself into a below-grade channel, would mitigate the noise impact. However since those projects are not within City control, and there is no identified funding source, these cannot be assumed as mitigations. Therefore the impacts of the railroad line noise on the proposed development under the Specific Plan are significant and unavoidable.

**Table 3.11-8 Existing (2008) and Future (2035) Noise Environment**

| *Monitor* | *Existing Primary Noise Source(s)* | *Future Primary Noise Source(s)* | *Existing (Msd.) CNEL* | *Future CNEL* |
|---|---|---|---|---|
| L1 | Hillcrest Avenue and bus stop directly to the south | Freight rail line (with horn) and Hillcrest Avenue | 63 dB | **79 dB** |
| L2 | Distant SR 4 and Oakley Road | Oakley Road and freight line | 65 dB | **67 dB** |
| L3 | SR 4 | SR 4 | 75 dB | **69 dB*** |
| L4 | SR 4 | SR 4 | 72 dB | **66 dB*** |
| L5 | SR 160 | Freight line and SR 160 | 64 dB | **70 dB** |
| S1 | SR 4 | Freight rail line (with horn) and SR 4 | 52 dB [1] | **73 dB** |
| S2 | Distant SR 4 and Oakley Road | Freight line and eBART | 55 dB [2] | **74 dB** |

Note: Measurements in **bold** exceed the current City standards.

* At these locations, the noise level is lower in the future due to the planned grading at the site. In the future, these measurement locations will no longer be at the top of the hill, but will be graded down so that there is no longer line-of-sight to SR 4.

1. Calculated from a 15-minute $L_{eq}$ offset from monitor L1
2. Calculated from a 15-minute $L_{eq}$ offset from monitor L3

*Source: Charles M Salter Associates, Inc., 2008*

Noise mitigation strategies to reduce exterior noise levels include, but are not limited to, the following: noise barriers (e.g., sound walls, fences, or berms), increased building setbacks, and site orientation/layout to shield sensitive outdoor spaces. Noise mitigation strategies to reduce interior noise levels include the incorporation of sound-rated windows/exterior doors and upgraded exterior wall and roof-ceiling assemblies.

Rooftop and other mechanical equipment at commercial uses need to be controlled to CNEL 70 dB at the property line (CNEL 65 dB if the adjacent property is zoned residential). This can typically be accomplished by proper location and orientation of equipment and the incorporation of duct silencers, acoustic louvers, building parapets, and/or mechanical penthouses or enclosed mechanical equipment rooms. Specific mitigation measures will be refined as the project progresses and equipment is selected.

### *Specific Plan Policies that Reduce Impact*

Implementation of the existing General Plan policies and the proposed Specific Plan policies would reduce the potential impact of increased noise but this impact remains significant and unavoidable.

EH-47 Require developers to comply with relevant noise insulation standards contained in Title 24 of the California Code of Regulations (Part 2, Appendix Chapter 12A).

EH-48 Require acoustical analysis performed by a licensed acoustical engineer to determine appropriate noise mitigations in order to meet the City's standards for projects as described below. Building permit applications shall demonstrate that noise mitigations are included in construction documents.

- Residential projects within:
  - 730 feet of the SR 4 centerline;
  - 310 feet of the SR 160 centerline;
  - 170 feet from the centerline of the Union Pacific Mococo Rail Line right-of-way; and,
  - 850 feet from the intersection of Hillcrest Avenue and the Union Pacific Mococo Rail Line (or the location(s) where freight trains sound horn).
- Institutional and Office projects within:
  - 340 feet of the SR 4 centerline;
  - 150 feet of the SR 160 centerline;
  - 80 feet from the centerline of the Union Pacific Mococo Rail Line right-of-way;
  - 400 feet from the intersection of Hillcrest Avenue and the Union Pacific Mococo Rail Line (or the location(s) where freight trains sound horn);
  - 30 feet of the eBART track centerline; and
  - 60 feet from the eBART at track crossovers ("frogs").

EH-49 Where projects in the Hillcrest Station Area incorporate noise mitigations and still cannot achieve City standards for exterior noise levels, as determined by acoustical analysis by a licensed acoustical engineer, project sponsors may apply for an exception to City exterior noise standards.

- Such exception requests will be considered through a discretionary development entitlement process.
- Projects requesting exceptions to exterior noise standards should demonstrate that:
  - (1) all feasible noise mitigations have been incorporated to lower exterior noise levels as close as possible to City standards; and
  - (2) noise mitigations that lower interior noise levels below the City and state standard of 45 dB have been incorporated, to compensate for the high exterior noise levels which make outdoor activities uncomfortable.

EH-50 In new residential projects, provide noise buffers other than sound walls, such as vegetation, storage areas, or parking, and site planning and locating bedrooms away from noise sources.

EH-51 Work with Union Pacific to minimize noise issues related to freight rail by implementing a grade separation at Hillcrest Avenue, and establishing a quiet zone through the Station Area.

LU-23 Locate residential units away from railroads and freeways, to minimize impacts from noise and air emissions. Units should be at least 300 feet away from rail and freeway rights-of-way, or incorporate construction measures that mitigate noise and air emission impacts.

***Mitigation Measures***

No mitigation measures required.

**3.11-2** ***New development under the Specific Plan may result in exposure of people and noise-sensitive uses to temporary noise and vibration impacts related to construction activities. (Less than Significant)***

Although the related noise and vibration impacts at any one location would be temporary, construction of individual projects within the Planning Area could cause adverse localized effects on the ambient noise environment. Construction activities would occur intermittently at different sites throughout the period of implementation of the proposed Specific Plan. Therefore, construction-related noise and vibration levels at and near the project site would fluctuate depending on the phase of construction, and the type, number, and duration of uses of various pieces of construction equipment. The potential construction-related noise and vibration impacts on depend on the proximity of construction activities to sensitive receptors, the presence of intervening barriers, the number, and the types and duration of construction equipment used. Construction noise levels could be substantially greater than existing noise levels at nearby sensitive receptor locations and could increase noise levels in close proximity to the construction site by more than five (5) CNEL.

***Specific Plan Policies that Reduce Impact***

The proposed Specific Plan recognizes that construction noise, although temporary, could lead to increased noise levels and could affect sensitive receptors. The Antioch Municipal Code defines regulations to control construction noise through restrictions on working hours. These restrictions would be applicable for all projects within the Planning Area. Compliance with these regulations and the following proposed Specific Plan policy would ensure that construction noise impacts would be less than significant.

EH-52 Require developers to mitigate noise exposure to sensitive receptors from construction activities. Mitigation may include a combination of techniques that reduce noise generated at the source, increase the noise insulation at the receptor, or increase the noise attenuation as noise travels from the source to the receptor (e.g., through the incorporation of barriers).

***Mitigation Measures***

No mitigation measures are required.

**3.11-3** ***Freight rail activity could expose existing and future development to groundborne vibration. (Less than Significant)***

Union Pacific has announced plans to increase the number of freight trains on the Mococo Line running through the Planning Area from as many as 10-15 trains per day starting in 2010 or later, and up to as many as 25-40 trains per day in the long term. As part of the worst case scenario, 40 trains are assumed to be evenly spread throughout the day and night in 2035. The FTA guidelines state that for occasional train activity (defined as 30 to 70 events per day), the ground vibration velocity at high-sensitivity uses (e.g., vibration-sensitive research and manufacturing facilities, hospitals with vibration-sensitive equipment, and university research operations) should not exceed 65 VdB (re: 1 microinch/second), residential land uses should not exceed 75 VdB, and institutional land uses should not exceed 78 VdB.

Based on the critical screening distances for freight rail vibrations provided by the FTA, a detailed vibration analysis should be conducted for high-sensitivity uses planned closer than 600 feet, residential buildings planned closer than 200 feet, and institutional buildings (e.g. schools, churches, and offices) planned closer than 120 feet from the railway. However, these are guidelines used to predict the level of vibration impact on land uses in the vicinity of a railway. There are no specific Building Code requirements for vibration levels in buildings.

***Specific Plan Policies that Reduce Impact***

EH-53 Require vibration velocity analysis to determine appropriate mitigations for proposed:

- Residential projects within 200 feet from the centerline of the Union Pacific Mococo Rail Line right-of-way;
- Institutional and Office projects within 120 feet from the centerline of the Union Pacific Mococo Rail Line right-of-way; and,
- High-sensitivity use projects (e.g. hospitals and medical labs) within 600 feet from the centerline of the Union Pacific Mococo Rail Line right-of-way.

***Mitigation Measures***

No mitigation measures are required.