3.11 NOISE

This section describes the existing environmental conditions related to the ambient noise within and near the project site. The general and site-specific profiles of air quality contained herein provide the environmental baseline by which environmental impacts are identified and measured. Environmental impacts are discussed in **Sections 4.0**.

3.11.1 REGULATORY SETTING

FEDERAL

Noise criteria used in this section include the Federal Interagency Committee on Noise (FICON), which assessed the annoyance effects of changes in ambient noise levels resulting from aircraft operations, and the Federal Highway Administration (FHWA) Noise Abatement Criteria for the assessment of noise consequences related to surface traffic.

The FHWA establishes Noise Abatement Criteria (NAC) for various land uses, which have been categorized based upon activity. Land uses are categorized on the basis of their sensitivity to noise.

STATE

The State Building Code (Part 2, Title 24, California Code of Regulations) provides that, consistent with local land use standards, residential structures located in noise critical areas, such as proximity to highways, county roads, city streets, railroads, rapid transit lines, airports, or industrial areas shall be designed to prevent the intrusion of exterior noises beyond the prescribed interior noise level of 45 decibel (dB) measured as Community Noise Exposure Level (CNEL) or day-night average levels (L_{dn}).

Residential structures to be located where the annual L_{dn} or CNEL exceeds 60 dB shall require an acoustical analysis showing that the proposed design will achieve the prescribed allowable interior noise level.

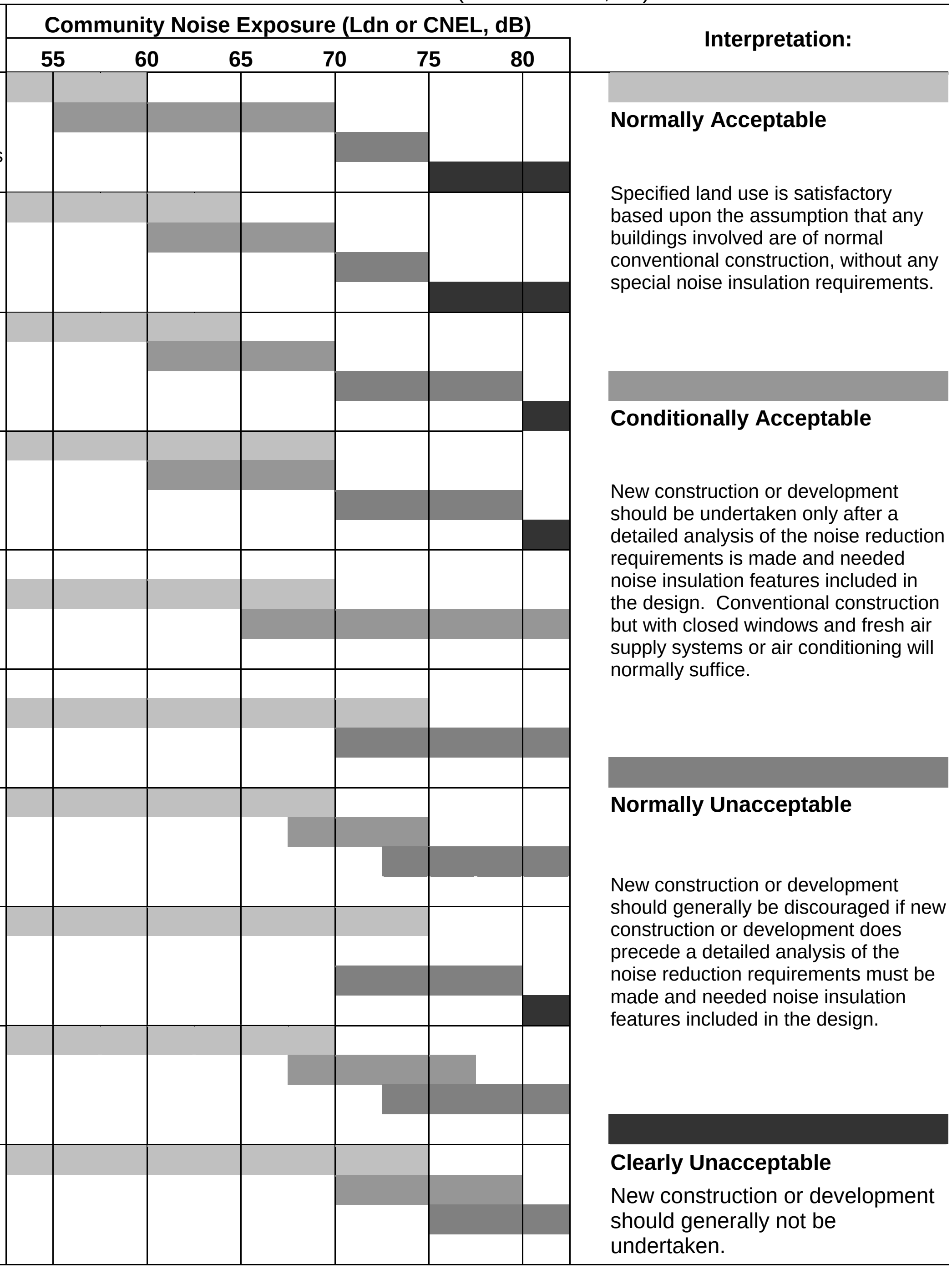
LOCAL

City of Richmond General Plan

Noise Element

The City of Richmond (City) has set forth goals and policies in the Noise Element of the City of Richmond General Plan, adopted in 1994 (as amended through 1998). The goal of the Noise Element with respect to community noise is to "control the level of noise pollution in the community by preventing the development of incompatible land uses, rather than relying entirely on acoustical techniques after the fact, such as sound walls, buffers, etc" (City of Richmond General Plan, 1994). The City has adopted the land use compatibility matrix presented in the State General Plan Guidelines, the current version of which is reproduced as **Table 3.11-1** below.

TABLE 3.11-1
COMMUNITY NOISE EXPOSURE (Ldn OR CNEL, dB)



Land Use Category

- Residential: Low density single family, duplex, mobile homes
- Residential: Multiply family
- Transient lodging, motels, hotels
- Schools, libraries, churches, hospitals, nursing homes
- Auditoriums, concert halls, amphitheaters
- Sorts arena, outdoor spectator sports
- Playgrounds, neighborhood parks
- Golf courses, riding stables, water recreation, cemeteries
- Office buildings, business, commercial, and professional
- Industrial, manufacturing, utilities, agriculture

Interpretation:

Normally Acceptable

Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

Conditionally Acceptable

New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Normally Unacceptable

New construction or development should generally be discouraged if new construction or development does precede a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

Clearly Unacceptable

New construction or development should generally not be undertaken.

Source: Brown-Buntin Associates, Inc., 2008

The most relevant City General Plan Noise Element policies are listed below:

NE-A.1 Discourage development, where such development will significantly increase existing noise levels, unless mitigation measures are designed as part of the project to limit noise emissions to an acceptable level compared to the existing sound level.

NE-A.2 Develop criteria establishing proper site planning and building orientation that will lessen noise intrusion and minimize noise elements.

NE-A.3 Utilize the building code to establish standards which would require sound insulation to control sound transmission within and from outside structures.

NE-A.4 Avoid land uses that place residential dwellings with “heavy” industrial and maritime uses.

NE-A.6 Require new commercial and industrial developments with potential noise and vibration producing activities to provide noise study reports prepared by a qualified professional with demonstrated experience in noise control engineering.

NE-A.7 Require new developments of proposed noise sensitive uses locating in noise impacted areas of Ldn 55 or greater to provide noise study reports prepared by a qualified professional with demonstrated experience in noise control engineering.

City of Richmond Municipal Code

The noise level performance standards of the Richmond Municipal Code (Chapter 9) are described below:

9.52.100 Exterior noise limits.

(a) No uses or activities shall create levels, which exceed the standards in **Table 3.11-2**.

(b) In determining whether any noise exceeds the maximum exterior noise limits set forth in this section, measurements shall be taken at the property line of the property from which the noise emanates, except that for noise emanating from property in an M-3 or M-4 zoning districts, measurement shall be taken at boundary of the zoning district in which the property is located.

(c) No person shall operate or cause to be operated within a dwelling unit, any source of sound that causes the sound level when measured inside a neighboring receiving dwelling unit to exceed the allowable noise level, for any period of time.

(d) In the event the noise, as judged by the enforcing authority, contains a steady, pure tone such as a whine, screech or hum, or is an impulsive sound such as hammering or riveting, or contains music or speech, the standard limits set forth above shall be reduced by 5 decibels.

(e) The exterior noise limits for any source of noise within any residential zone shall be reduced by 10 dBA between 10:00 p.m. and 7:00 a.m. The exterior noise limits for any source of noise in any zone other than a residential zone shall be reduced between 10:00 p.m. and 7:00 a.m. so that when measured at the property line of a "noise-sensitive use" the noise does not exceed 50 dBA.

TABLE 3.11-2
CITY OF RICHMOND COMMUNITY NOISE ORDINANCE EXTERIOR NOISE LIMITS

Zoning District	Maximum Noise Level in dBA (levels not to be exceeded more than 30 minutes in any hour)		Maximum Noise Level in dBA (level not to be exceeded more than 5 minutes in any hour)
	Measured at Property Line or District Boundary	Measured at Any Boundary of a Residential Zone	Between 10 PM and 7AM**, Measured at Any Boundary of a Residential Zone
Single-Family Residential	60	-	-
Multifamily Residential	65	-	-
Commercial	70	60	50 or ambient noise level
Lt. Industrial and Office Flex*	70	60	50 or ambient noise level
Heavy and Marine Industrial	75	65	50 or ambient noise level
Public Facilities and Community Use	65	60	50 or ambient noise level
Open Space and Recreational Districts	65	60	50 or ambient noise level

For: * M-1 and M-2 the measurement will be at property lines.
** Restricted hours may be modified through condition of an approved conditional use permit.
Source: Brown-Buntin Associates, Inc., 2008

The Municipal Code, Chapter 9, also establishes restrictions on construction activities to limit noise impacts. The following activities are prohibited:

"Construction Activities. Causing or permitting the operation of any tools or equipment used in construction, drilling, repair, alteration or demolition work at any time between the hours of 7 p.m. and 7 a.m. on weekdays or 6 p.m. and 8:30 a.m. on weekends and legal holidays in any residential or commercial zoning district or adjacent to any noise-sensitive uses or so as to create a noise disturbance or cause any violation of this chapter. Prior to commencing any construction project, the project sponsor may meet and confer with the City Public Works Department to establish an appropriate construction schedule which is designed to minimize construction noise impacts and which is in conformity with the requirements of this subsection. Where construction activities on a construction project which is adjacent to any noise-sensitive use(s) are anticipated to last for a year or more, temporary noise barriers shall be constructed that break the line of

sight between the noise-sensitive use(s) and the construction project, and that minimize noise impacts."

Factors, which will be considered in determining whether a violation of subsection (a) of this section has occurred, shall include, but not be limited to, the following:

(1) The intensity of the ambient noise;

(2) The proximity of the noise to residential and commercial areas;

(3) The zoning of the area within which the noise emanates (i.e., residential, commercial, open space, etc.);

(4) The number of persons affected by the noise source;

(5) The time of day or night the noise occurs;

(6) The duration of the noise (i.e., term, continuation, life, etc.); and

(7) The intensity of the noise (i.e., pitch, tone, content, etc.).

3.11.2 ENVIRONMENTAL SETTING

ACOUSTICAL BACKGROUND AND TERMINOLOGY

Noise is often defined as unwanted sound. Frequently occurring pressure variations (at least 20 times per second) detected by human ear is identified as sound. The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable. Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals of pressure) as a point of reference, defined as 0 dB. Other sound pressures are then compared to the reference pressure, and the logarithm is taken to keep the numbers in a practical range. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB. Another useful aspect of the decibel scale is that changes in levels (dB) correspond closely to human perception of relative loudness.

NOISE EXPOSURE AND COMMUNITY NOISE

Community noise is commonly described in terms of the "ambient" noise level, which is defined as the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}) over a given time period (usually one hour). The L_{eq} is the foundation of the L_{dn} noise descriptor, and shows very good correlation with community response to noise. **Table 3.11-3** contains definitions of acoustical terminology used in this section. **Table 3.11-4** shows examples of noise sources that correspond to various sound levels.

TABLE 3.11-3
ACOUSTICAL TERMINOLOGY

Term	Definition
A-weighted	The A-weighted sound level has been shown to correlate with subjective responses and two sounds judged to be of similar loudness would produce similar dB(A) values, although their unweighted dB values would vary considerably. The A-weighting compares well with other noise sources. It is, therefore, the most widely used.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
Attenuation	The reduction of noise.
Decibel or dB	Fundamental unit of sound. A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A decibel is one-tenth of a Bell.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 to 10 p.m.) weighted by a factor of 3 and nighttime hours weighted by a factor of 10 prior to averaging.
L_{dn}	The 24-hour day and night A-weighed noise exposure level that accounts for the greater sensitivity of most people to nighttime noise by weighting noise levels at night ("penalizing" nighttime noises). Noise between 10:00 p.m. and 7:00 a.m. is weighted (penalized) by adding 10 dBA to take into account the greater annoyance of nighttime noises.
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 highest root-mean-square (RMS) sound level measured over a given period of time.

Source: Beranek, 1998.

TABLE 3.11-4
TYPICAL A-WEIGHTED SOUND LEVELS OF COMMON NOISE SOURCES

Loudness Ratio	Decibels (dBA)	Description
128	130	Threshold of pain.
64	120	Jet aircraft take-off at 100 feet.
32	110	Riveting machine at operator's position.
16	100	Shotgun at 200 feet.
8	90	Bulldozer at 50 feet.
4	80	Diesel locomotive at 300 feet.
2	70	Commercial jet aircraft interior during flight.
1	60	Normal conversation speech at 5 to 10 feet.
1/2	50	Open office background level.
1/4	40	Background level within a residence.
1/8	30	Soft whisper at 2 feet.
1/16	20	Interior of recording studio.

Source: Beranek, 1998.

The L_{dn} is based upon the average noise level over a 24-hour day, with a +10 decibel weighting applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. Additional weight is placed on nighttime readings based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because L_{dn} represents a 24-hour average, it tends to disguise short-term variations in the noise environment. L_{dn}-based noise standards are commonly used to assess noise effects associated with traffic, railroad, and aircraft noise sources.

EFFECTS OF NOISE ON PEOPLE

The effects of noise on people fall into three categories:

- Subjective effects of annoyance, nuisance, and 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 can experience noise in the last category. There is no known way to measure the subjective effects of noise, or the corresponding reactions of annoyance and dissatisfaction. A wide variation in individual thresholds of annoyance exists, and different tolerances to noise tend to develop based on an individual's past experiences with noise. Human reaction to a new noise can be estimated through comparison of the new noise to the existing ambient noise level within a given environment. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will likely be judged by the recipients. With regard to increases in A-weighted noise levels, 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.
- A 10-dBA change is subjectively heard as approximately a doubling in loudness and can cause adverse response.

Noise effects on humans can be physical or behavioral in nature. The mechanism for chronic exposure to noise leading to hearing loss is well established. The elevated sound levels cause trauma to the cochlear structure in the inner ear, which gives rise to irreversible hearing loss. Though it pales in comparison to the health effects noted above, noise pollution also constitutes a significant factor of annoyance and distraction in modern artificial environments:

- The listeners attribute to the sound influences annoyance; if listeners dislike the noise content, they are annoyed.
- If the sound causes activity interference (for example, sleep disturbance), it is more likely to annoy.
- If listeners feel they can control the noise source, it less likely to be perceived as annoying.
- If listeners believe that the noise is subject to third party control, including police, but control has failed, they are more annoyed.
- The perceived unpleasantness of the sound causes annoyance. What is music to one is noise to another.

Stationary point sources of noise, including stationary mobile sources, such as idling vehicles, attenuates at a rate of 6 to 9 dBA per doubling of distance from the source, depending on environmental conditions (i.e., atmospheric conditions and noise barriers, either vegetative or manufactured, etc.). Widely distributed noises, such as a large industrial facility spread over many acres or a street with moving vehicles, would typically attenuate at a lower rate, approximately 4 to 6 dBA.

Roadway traffic noise generally attenuates at a rate of 3 to 4 dBA per doubling of distance; however, to increase the ambient noise level by 3 dBA (threshold which provides a noticeable increase in sound level) there would need to be a doubling of cars on a roadway (Road Traffic Noise, 2007).
Construction noise attenuates at a rate of 6 dBA per doubling of distant from the source, for example if a piece of construction equipment has a noise rating of 90 dBA at 50 feet then at 100 feet the noise level would be 84 dBA.

Noise that is measured in dBA cannot be added directly, because the equation that is used to calculate noise levels is a logarithmic function; therefore, when noise levels are added the resulting noise level is not the sum of the two values, i.e. 70 dBA plus 75 dBA is not 145 dBA. The resulting noise level of two noises is estimated by taking the absolute value of the two noises and adjusting the larger by the value shown in **Table 3.11-5**, i.e. 70 dBA plus 75 dBA has an absolute value of 5 dBA which according to the table gives a value of 1 dBA, thus, the resulting noise level is 76 dBA.

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. 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. 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 (FTA, 1995). Typically, gound-bourne vibration generated by man-made activities attenuates rapidly with distance from the source of the vibration.

TABLE 3.11-5
CRITERIA FOR ADDING TWO NOISES

When two decibel values differ by	Add the following amount to the higher value
0 or 1 dBA	3 dBA
2 or 3 dBA	2 dBA
4 to 9 dBA	1 dBA
10 dBA or more	0 dBA

Source: Noise Primer, 2001

EXISTING NOISE SOURCES

Ambient Noise and Vibration

Long-term ambient noise measurements were performed at a single location on the project site between June 28 and July 7, 2005, and at two locations on the project site between July 12 and July 20, 2007. These locations were selected from available, secure sites in two areas of the project site that were intended for noise-sensitive development. The sites describe the overall 24-hour noise environment, which is dominated by distant traffic on Interstate 580 (I-580). The long-term noise-monitoring locations are shown in **Figure 3.11-1** as site 1 and 2. Continuous noise measurements were conducted to describe the day/night distribution of ambient traffic noise levels, and to calculate hourly noise levels and day/night levels. **Table 3.11-6** summarizes the noise measurement results. **Appendix O** presents the noise measurement data in graphic format.

A short-term noise measurement was conducted on July 12, 2007, to verify that the long-term noise measurement sites reasonably represented noise exposures in other portions of the project site. This noise measurement was performed at Site 3, for a period of 15 minutes beginning at 11 a.m, the results of which are shown in **Table 3.11-7**. Noise measurements were conducted in terms of the L_{dn}. The noise level measurements were used to determine statistical trends in ambient noise levels throughout the day and nighttime periods. The dominant noise source at the site monitoring locations was distant traffic on I-580. In general, average daytime ambient noise levels are in the range of 50 dB at all locations, but may be elevated to between 50 and 55 dB at the site overlooking the San Francisco Bay under certain atmospheric conditions.

SOURCE: GlobeXplorer Aerial Photograph, 2/27/2004; Brown-Buntin Associates, Inc., 1/4/2008; AES, 2008

Figure 3.11-1
Ambient Noise Measurement Locations

TABLE 3.11-6
MEASURED AMBIENT NOISE LEVELS - SITES 1 AND 2

Date	Ldn, dB	
	Site 1	**Site 2**
June 29, 2005	50.7	--
June 30, 2005	52.2	--
July 1, 2005	52.4	--
July 2, 2005	56.0	--
July 3, 2005	53.7	--
July 4, 2005	58.7	--
July 5, 2005	62.3	--
July 6, 2005	59.7	--
July 13, 2007	52.1	52.4
July 14, 2007	53.1	52.1
July 15, 2007	53.1	51.9
July 16, 2007	52.4	52.1
July 17, 2007	51.8	52.9
July 18, 2007	52.0	52.3
July 19, 2007	50.3	52.3

Source: Brown-Buntin Associates, Inc., 2008

TABLE 3.11-7
SHORT-TERM NOISE MEASUREMENT RESULTS – SITE 3

Sound Level, dB						
Leq	**Lmax**	**L02**	**L08**	**L25**	**L50**	**L90**
49.2	56.5	53	50	49	48	47

Source: Brown-Buntin Associates, Inc., 2008

Other existing noise sources potentially significant include local traffic, adjacent industrial uses, and nighttime aircraft operations at Oakland International Airport, which is located approximately 12 miles from the project site.

Approximately 25 cars per day travel along Western Drive. Western Drive traffic does not significantly contribute to the local noise environment. The industrial uses adjacent to the project include oil wells, pumps, and storage tanks. The operation of these industrial facilities generates relatively little noise at the project site due largely to the topography of the site. The Oakland Airport flight patterns during the PM hours pass over the project site. Based upon the long-term noise measurement results, listed in **Table 3.11-6** there is little noise exposure attributed to the Oakland Airport.

Traffic Noise

Table 3.11-8 shows the predicted worst-case traffic noise levels for existing traffic volumes at a reference distance of 50 feet from the centerlines of the major roadways adjacent to and within the project site. The reference distance for I-580 was assumed to be 150 feet from the freeway centerline.

TABLE 3.11-8
EXISTING TRAFFIC NOISE LEVELS

Roadway Name	Segment Description: Between	Predicted Ldn, dB, at Reference Distance
Western Drive	Project Entrance and Marina	51.2
Richmond Parkway	Redwood Way/Hensley St.	74.0
Richmond Parkway	Hensley St./Gertrude St.	73.9
Richmond Parkway	Gertrude St./Parr Blvd.	75.9
Richmond Parkway	Parr Blvd/San Pablo Ave.	74.7
Richmond Parkway	San Pablo Ave./Blume Dr.	74.5
EB I-580 off ramps	Standard Ave./Castro St.	72.7
Garrard Boulevard	WB I-580 ramps/Ohio Ave.	71.2
Canal Boulevard	WB I-580 ramps/Cutting Blvd.	70.1
Garrard Boulevard	Macdonald Ave/Barrett Ave.	71.4
I-580	Canal and Western	74.3

Source: Brown-Buntin Associates, Inc., 2008

EXISTING VIBRATION SOURCES

Based upon 2005 and 2007 the field investigations conducted by Brown-Buntin Associates, Inc. (BBA), there are currently no sources of perceptible vibration in the areas of the project site.

SENSITIVE RECEPTORS

Some land uses are considered more sensitive to noise than others due to the amount of noise exposure (in terms of both exposure duration and insulation from noise) and the types of activities typically involved. Residences, motels and hotels, schools, libraries, churches, hospitals, nursing homes, auditoriums, and parks and other outdoor recreation areas generally are more sensitive to noise than are commercial and industrial land uses (U.S. DOT, 1995). A sensitive receptor is defined as any living entity or aggregate of entities whose comfort, health, or well being could be impaired or endangered by the existence of noise.

As stated previously the surrounding area is mostly industrial. The nearest school in the area is Washington Elementary School, which is 2.5 miles from the project site. The nearest residence is located 1.5 miles south east of the project site, while the nearest hospital is over 4.0 miles from the project site. There are several outdoor sporting venues in the area, Point San Pablo Yacht Harbor, baseball diamonds, and a swimming pool, all of which are approximately 0.75 miles from the project site. There are no other sensitive receptors in the vicinity of the project site.