SECTION III.I NOISE AND VIBRATION

III.I.1 Introduction

This section of the EIR discusses existing and future sources of noise and vibration on and around the Project site and examines the potential for (1) exposure of persons to or generation of noise levels in excess of standards established in the Environmental Protection Element of the *San Francisco General Plan* or San Francisco Noise Ordinance (Article 29, *San Francisco Police Code*); (2) exposure of persons to or generation of excessive groundborne vibration levels; (3) a substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project; (4) a substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project; (5) exposure of persons to excessive aircraft noise levels; or (6) substantial impacts from existing noise sources. The impact analysis identifies both Project-level and cumulative environmental impacts, as well as feasible mitigation measures that could reduce or avoid the identified impacts.

Data used to prepare this analysis were obtained from the *San Francisco General Plan* (General Plan) *Environmental Protection Element*; the *Bayview DEIR San Francisco 49ers Stadium Operational Noise Study*, prepared by Wilson, Ihrig & Associates (included as Appendix I1); the Federal Transit Administration's *Transit Noise and Vibration and Impact Assessment* methodology; and by measuring and modeling existing and future noise levels within the Project site and at surrounding land uses. Traffic information contained in the *Traffic Impact Analysis*, prepared by the LCW Consulting, Fehr & Peers Associates, and CHS Consulting Group, was used to prepare the noise modeling for vehicular sources. All construction activity estimates were based on the September 2009 MACTEC Engineering Construction Phasing Plan.

Acoustic Terminology and Definitions

Sound is created when vibrating objects produce pressure variations that move rapidly outward into the surrounding air. The main characteristics of these air pressure waves are amplitude, which we experience as a sound's loudness, and frequency, which we experience as a sound's pitch. The standard unit of sound amplitude is the decibel (dB); it is a measure of the physical magnitude of the pressure variations relative to the human threshold of perception. The human ear's sensitivity to sound amplitude is frequency-dependent; it is more sensitive to sounds in the mid-frequency range than to sounds with much lower or higher frequencies.

Most "real world" sounds (e.g., a dog barking, a car passing, etc.) are complex mixtures of many different frequency components each having different amplitudes. When the average amplitude of such sounds is measured with a sound level meter, it is common for the instrument to apply adjustment factors to each of the measured sound's frequency components. These factors account for the differences in perceived loudness of each of the sound's frequency components relative to those to which the human ear is most sensitive. Because the human ear is not equally sensitive to a given sound level at all frequencies, a special frequency-dependent rating scale has been devised to relate noise to human sensitivity. The A-weighted decibel scale (dBA) provides this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. The unit of A-weighted sound amplitude is also the decibel. In reporting measurements to which A-weighting has been applied, an "A" is appended to dB

(dBA) to make this clear. In some cases, however, it is useful to know the actual average sound amplitude without application of the A-weighting factors; this type of averaging is called C-weighting and its result is reported in C-weighted decibels (dBC). Finally, since environmental sound levels usually vary greatly over time, it is often useful to know the degree of variability at a particular location over any measurement period. This variability is specified in terms of statistical sound levels (L_n), where n is the percentage of time these levels are exceeded during the measurement period. For example, L_{10}, L_{50}, and L_{90} are descriptors that represent the sound level exceeded 10 percent of the time, 50 percent of the time, and 90 percent of the time, respectively, during a measurement, while L_{min} and L_{max} represent the minimum and maximum sound levels during the measurement period.

Noise is the term generally given to the intrusive, "unwanted" aspects of sound. Many factors influence how a sound is perceived and whether it is considered harmful or disruptive to an individual or a community. These factors include the primary physical characteristics of a sound (e.g., amplitude, frequency, duration, etc.), but also secondary acoustic and non-acoustic factors (that can influence judgment regarding the degree to which it is intrusive and disruptive. Table III.I-1 (Representative Environmental Noise Levels) lists representative noise levels for the environment.

All quantitative descriptors used to measure environmental noise exposure recognize the strong correlation between the high acoustical energy content of a sound (i.e., its loudness and duration) and the disruptive effect it is likely to have as noise. Because environmental noise fluctuates over time, most such descriptors average the sound level over the time of exposure, and some add "penalties" during the times of day when intrusive sounds would be more disruptive to listeners. The rating scales of L_{eq}, L_{min}, and L_{max} are measures of ambient noise, while the L_{dn} and Community Noise Equivalent Level (CNEL) are measures of community noise. L_{eq} is the average A-weighted sound level measured over a given time interval. L_{eq} can be measured over any time period, but is typically measured for 1-minute, 15-minute, 1-hour, or 24-hour periods. L_{dn} is another average A-weighted sound level measured over a 24-hour time period. However, this noise scale is adjusted to account for some individuals' increased sensitivity to noise levels during the evening and nighttime hours. L_{eq}, L_{min}, and L_{max}, as well as L_{dn} and CNEL are all applicable to this analysis and defined as follows:

The most commonly used noise descriptors for environmental exposures are:

- **L_{eq}**, the equivalent-energy noise level, is the average acoustic energy[207] content of noise over any chosen exposure time. The L_{eq} is the constant noise level that would deliver the same acoustic energy to the ear as the actual time-varying noise over the same exposure time. L_{eq} does not depend on the time of day during which the noise occurs.
- **L_{dn}**, the day-night average noise level, is a 24-hour average L_{eq} with a 10 dBA "penalty" added to noise during the hours of 10:00 P.M. to 7:00 A.M. to account for increased nighttime noise sensitivity. Because of this penalty, the L_{dn} would always be higher than its corresponding 24-hour L_{eq} (e.g., a constant 60 dBA noise over 24 hours would have a 60 dB L_{eq}, but a 66.4 dBA L_{dn}).

[207] Averaging sound levels in decibels is not done by standard arithmetic averaging, but according to the following rule:
$L_{eq} = 10 \times \log((1/n) \times (10^{L1/10} + 10^{L2/10} + \ldots + 10^{Ln/10})$; where L_1, L_2, L_n are n individual sound levels.
For example, the L_{eq} of the sound levels $L_1 = 60$ dBA and $L_2 = 70$ dBA is 67.4 dBA, not 65 dBA as it would if standard arithmetic averaging were used. The larger individual sound levels contribute much more substantially to the L_{eq} than they would to an average done in the standard way.

Table III.I-1 Representative Environmental Noise Levels

Common Outdoor Activities	*Noise Level (dBA)*	*Common Indoor Activities*
	—110—	Rock Band
Jet Fly-over at 100 feet	—105—	
	—100—	
Gas Lawnmower at 3 feet	—95—	
	—90—	
	—85—	Food Blender at 3 feet
Diesel Truck going 50 mph at 50 feet	—80—	Garbage Disposal at 3 feet
Noisy Urban Area during Daytime	—75—	
Gas Lawnmower at 100 feet	—70—	Vacuum Cleaner at 10 feet
Commercial Area	—65—	Normal Speech at 3 feet
Heavy Traffic at 300 feet	—60—	
	—55—	Large Business Office
Quiet Urban Area during Daytime	—50—	Dishwasher in Next Room
	—45—	
Quiet Urban Area during Nighttime	—40—	Theater, Large Conference Room (background)
Quiet Suburban Area during Nighttime	—35—	
	—30—	Library
Quiet Rural Area during Nighttime	—25—	Bedroom at Night, Concert Hall (background)
	—20—	
	—15—	Broadcast/Recording Studio
	—10—	
	—5—	
Lowest Threshold of Human Hearing	—0—	Lowest Threshold of Human Hearing

SOURCE: California Department of Transportation 1998

- **CNEL**, the Community Noise Equivalent Level, is a 24-hour average L_{eq} with a 5 dBA "weighting" during the hours of 7:00 P.M. to 10:00 P.M. and a 10 dBA "weighting" added to noise during the hours of 10:00 P.M. to 7:00 A.M. to account for noise sensitivity in the evening and nighttime, respectively. The logarithmic effect of these additions is that a 60 dBA-24 hour L_{eq} would result in a measurement of 66.7 dBA CNEL.
- **SEL**, the sound exposure level (also known as the single noise event level), is the constant noise level that would deliver the same acoustic energy to the ear of a listener during a one-second exposure as the actual time-varying noise would deliver over its entire time of occurrence.[208] SEL is typically used to characterize the effects of short-duration noise events (e.g., aircraft fly-overs or train pass-bys)

[208] For a sound lasting longer than one second, its SEL would be higher than that of the largest of the shorter-duration component sounds that make up the total. For example, if a sound with a ten-second-long duration made up of 10 one-second-long component sounds, each of 60 dBA amplitude, its SEL would be 70 dBA.

Noise levels from a particular source decline as distance to the receptor increases. Other factors, such as the weather and other reflecting or shielding factors, also help intensify or reduce the noise level at any given location. A commonly used rule of thumb for roadway noise is that for every doubling of distance from the source, the noise level is reduced by about 3 dBA at acoustically "hard" locations (i.e., where the area between the noise source and the receptor is nearly complete asphalt, concrete, hard-packed soil, or other solid materials) and 4.5 dBA at acoustically "soft" locations (i.e., where the area between the source and receptor is unpacked earth or has vegetation, including grass). Noise from stationary or point sources (such as commercial heating and ventilation units [HVAC] or construction equipment) is reduced by about 6 to 7.5 dBA for every doubling of distance at acoustically hard and soft locations, respectively. Generally, if a noise source is completely enclosed or completely shielded with a solid barrier located close to the source, an 8 dBA noise reduction can be expected; if the enclosure and/or barrier it is interrupted, noise would be reduced by only 5 dBA. The exterior-to-interior reduction of newer residential units and office buildings is generally 30 dBA or more.

Fundamentals of Environmental Ground-borne Vibration

Vibrating objects in contact with the ground radiate energy through the ground. If the object is massive enough and/or close enough to an observer, the ground vibrations are perceptible. Vibration magnitude is measured in vibration decibels (VdB) relative to a 1 micro-inch-per-second reference level. Background vibration levels in most inhabited areas are usually 50 VdB or lower, well below the threshold of perception (i.e., typically about 65 VdB). In most cases, when vibration is perceptible to people in their homes or workplaces, the source is within the same building (i.e., operation of HVAC equipment, movement of other occupants, slamming of doors, etc.). The outdoor sources most commonly responsible for producing perceptible vibration are heavy construction equipment, steel-wheeled trains, and motor vehicle traffic on rough roads (if the roadway is smooth, the vibration from traffic is rarely perceptible). At about 100 VdB, vibration levels are strong enough to begin to cause structural damage in fragile buildings.

Health and Welfare Effects of Environmental Noise

World Health Organization Noise Exposure Recommendations

The World Health Organization (WHO) is perhaps the best source of current knowledge regarding health impacts of noise. According to WHO, sleep disturbance can occur when continuous indoor noise levels exceed 30 dBA or when intermittent interior noise levels reach 45 dBA, particularly if background noise is low. With a bedroom window slightly open (a reduction from outside to inside of 15 dB), the WHO criteria would suggest exterior continuous (ambient) nighttime noise levels should be 45 dBA or below, and short-term events should not generate noise in excess of 60 dBA. WHO also notes that maintaining noise levels within the recommended levels during the first part of the night is believed to be effective for the ability to fall asleep.[209]

Other potential health effects of noise identified by WHO include decreased performance on complex cognitive tasks, such as reading, attention, problem solving, and memorization; physiological effects such

[209] World Health Organization, *Guidelines for Community Noise*. Geneva, 1999. http://www.who.int/docstore/peh/noise/guidelines2.html.

as hypertension and heart disease (after many years of constant exposure, often by workers, to high noise levels); and hearing impairment (again, generally after long-term occupational exposure, although shorter-term exposure to very high noise levels, for example, exposure several times a year to concert noise at 100 dBA). Noise can also disrupt speech intelligibility at relatively low levels; for example, in a classroom setting, a noise level as low as 35 dBA can disrupt clear understanding. Finally, noise can cause annoyance, and can trigger emotional reactions like anger, depression, and anxiety. WHO reports that, during daytime hours, few people are seriously annoyed by activities with noise levels below 55 dBA, or moderately annoyed with noise levels below 50 dBA.

According to WHO, an adverse effect of noise is defined as:

> … a change in the morphology and physiology of an organism that results in impairment of functional capacity, or an impairment of capacity to compensate for additional stress, or increases the susceptibility of an organism to the harmful effects of other environmental influences … [including] any temporary or long-term lowering of the physical, psychological or social functioning of humans or human organs.

WHO exposure recommendations to avoid the adverse effects described below is summarized in Table III.I-2 (WHO Guideline Values for Community Noise in Specific Environments).

Table III.I-2 WHO Guideline Values for Community Noise in Specific Environments

Specific Environment	*Critical Health Effect(s)*	*L_{eq} (dBA)*	*Exposure Time (hours)*	*L_{max} (dB)*
Outdoor residential area	Serious annoyance, daytime and evening	55	16	—
	Moderate annoyance, daytime and evening	50	16	—
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime and evening	35	16	
Inside bedrooms	Sleep disturbance, nighttime	30	8	45
School class rooms, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	—
School playground outdoor	Annoyance (external source)	55	during play	—
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Outdoors in parks and nature preserves[a]	Disruption of tranquility	*		

SOURCE: WHO Guidelines for Community Noise - A complete, authoritative guide on the effects of noise pollution on health, Table 4.1.

a. Existing quiet outdoor areas should be preserved, and the ratio of intruding noise to natural background sound should be kept low.

The San Francisco Noise Ordinance (Section 2900) makes the following declaration with regard to community noise levels and the WHO Guidelines (additional provisions of the San Francisco Noise Ordinance that pertain to the Project are given below in Regulatory Framework):

> It shall be the policy of San Francisco to maintain noise levels in areas with existing healthful and acceptable levels of noise and to reduce noise levels, through all practicable means, in those areas of San Francisco where noise levels are above acceptable levels as defined by the World Health Organization's Guidelines on Community Noise.

III.I.2 Setting

Existing Noise Levels and Noise-Sensitive Uses in the Project Vicinity

The Project site consists of two distinct geographic areas: Candlestick Point, which primarily contains the existing San Francisco 49ers stadium, the Candlestick Point State Recreation Area (CPSRA), a recreational vehicle park, and the Alice Griffith Public Housing; and HPS Phase II, which contains many structures associated with ship repair, storage, and former Navy uses, most of which are vacant, as well as 300 artists located in studios on Parcels A and B.

The Project site is located in the southeastern area of San Francisco and extends east to San Francisco Bay (refer to Figure II-1 [Project Location]). This promontory is bounded on the south and west by the Bayview Hunters Point neighborhood and on the north and east by San Francisco Bay. The ground surface across the entire Project site is relatively flat with elevations ranging from approximately 0 feet to +20 feet (San Francisco City Datum [SFCD]).[210] Maximum ground surface elevation near the Project site is on Bayview Hill (west of Candlestick Point), which reaches an elevation of approximately 400 feet SFCD. To the north of HPS Phase II, there is a bluff that forms the end of a ridge (Hunters Point Hill) extending to the northwest almost to Third Street. The bluff is currently being developed with residential uses by Lennar Urban (HPS Phase I). The ridge serves to shield a portion of an existing residential neighborhood further north from any existing or future noise sources on HPS Phase II. To the northwest of HPS Phase II, the land is generally flat and largely residential, while west of Candlestick Point, an existing residential neighborhood is elevated above that site's flat terrain.

There are also existing light industry and warehouse land uses to the west and northwest of the Project site (in the vicinity of and north of Carroll Avenue), but these uses are not generally considered to be noise sensitive.

Noise-Sensitive Uses

The City and County of San Francisco has defined noise-sensitive uses as land uses and/or receptors of residences of all types, schools, hospitals, convalescent facilities, rest homes, hotels, motels, and places of worship. Sensitive uses from a noise perspective include places where there is a reasonable expectation that individuals could be sleeping, learning, worshipping, or recuperating. Existing noise-sensitive uses in the vicinity of the Project site include residential areas of Bayview Hunters Point, and Hunters Point Phase I residential uses. Schools in the vicinity of the Project site include Bret Harte Elementary School, Bret Harte Nursery and School-Age Children's Center, Kipp Bayview Academy, S.R. Martin College Preparatory School, Muhammad University of Islam, Malcom X Academy Elementary School, and Dr. George Washington Carver Elementary School. Additionally, residential uses developed within the Project site that would be occupied during subsequent construction phases would be considered noise-sensitive uses for the purposes of this EIR.

[210] San Francisco City Datum (SFCD) is a local vertical geodetic reference system specific to the City and County of San Francisco and formally established in 1964 as 8.616 feet above the National Geodetic Vertical Datum of 1929 (NGVD29), making it about 8.13 feet above mean sea level. The North American Vertical Datum was established in 1988 (NAVD88) and generally has replaced NGVD29 as a standard reference. Elevations expressed in NGVD29 may be converted to NAVD88 by adding 2.69 feet.

Community Ambient Noise Levels

Long-term 24-hour ambient noise measurements were taken at six locations in the residential neighborhoods north and west of the Project site for a total of six days in 2009. The long-term ambient noise measurements were conducted over the course of three days in January 2009 first by recording A-weighted community noise levels. In July 2009, the C-weighted community noise levels were measured at the same locations over the course of three days. Both the A-weighted and C-weighted measurements were for three consecutive 24-hour periods at each location during the respective measurement times and were recorded using Larson Davis digital sound level meters that satisfy the American National Standards Institute (ANSI) for general environmental noise measurement instrumentation. The Saturday-Sunday-Monday period was chosen for the three-day measurements because those are the days when a football game would most likely to be played at the proposed Stadium and concerts are also most likely to occur there during a weekend. To obtain the measurements, the microphone was positioned at a height of 12 ft feet above the ground. The locations of these measurements are indicated as N1 through N6 on the aerial photo in Figure III.I-1 (Long-Term Ambient Noise Measurement Locations).

Table III.I-3 (Existing Day-Night Noise Levels [L_{dn}]) contains a summary of the L_{dn} measurements by location for each 24-hour period of the survey. Hourly data were recorded for L_{eq} and Ln descriptors (the latter being the levels exceeded n% of the time, where n=90, 50, 10, and 1). The existing ambient noise measurement data indicate variable conditions, with some areas quieter than others. From Table III.I-3 it can be seen that the measured L_{dn} ranges from 58 dBA to 67 dBA, with the highest level measured at N1 (likely due to a higher level of truck traffic there than at the other locations). Weekend noise levels were lower (by 1 to 4 dBA) on Sunday than on Saturday, while Monday noise levels were generally similar to those on Saturday. With most L_{dn} values (i.e., except those at N3 and N6) near or greater than 65 dBA L_{dn}, the ambient noise levels in the study area are generally higher than in San Francisco's western residential neighborhoods (i.e., Richmond or Sunset Districts), but lower than those in Downtown or South of Market Areas.[211] It was observed that N3 and N6 had less traffic than the other locations measured, which would explain why these locations are quieter than the others.

Table III.I-4 (Existing A-Weighted Background Noise Levels [L_{90}]) contains a summary of the range of existing A-weighted ambient background (L_{90}) levels, at times when a football game would usually occur (i.e., weekend afternoons, 3:00 P.M. to 6:00 P.M., and Monday evenings, 6:00 P.M. to 9:00 P.M.).

Table III.I-5 (Existing C-Weighted Background Noise Levels [L_{90}] at Night) contains a similar summary of the C-weighted background levels at night, the time a concert at the proposed stadium would likely occur (7:00 P.M. to midnight).

[211] *Spatial distribution of traffic induced noise exposures in a US city: an analytic tool for assessing the health impacts of urban planning decisions*, WYW Seto et al, International Journal of Health Geographics, 2007, 6:24.

SOURCE: PBS&J, 2009.

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FIGURE III.I-1

Candlestick Point — Hunters Point Shipyard Phase II EIR

LONG-TERM AMBIENT NOISE MEASUREMENT LOCATIONS

Table III.I-3 Existing Day-Night Noise Levels (L_{dn})

Location ID	Measurement Location Description	Saturday 10 Jan 2009	Sunday 11 Jan 2009	Monday 12 Jan 2009
N1	Residential area along Carroll Avenue north of Arelious Walker Drive	67	63	67
N2	Residential area along Revere Avenue between Ingalls Street and Jennings Street	64	63	65
N3	Residential area along Donahue Street between Kirkwood Avenue and Jerrold Avenue	62	58	59
N4	Residential area along Kiska Road between Reardon Road and Ingalls Street	65	65	66
N5	Residential area along Hawes Street near Hunters Point Boulevard	65	62	64
N6	Residential area along Jamestown Avenue at Hawes Street	60	59	60

SOURCE: Wilson, Ihrig & Associates, 2009

Measurements include the effects of all noise sources influential at or near each location during each designated measurement period; traffic noise is likely the dominant influence at all locations and during all periods, but other sources (e.g., aircraft, trash pickup, etc.) also contribute to the totals.

Table III.I-4 Existing A-Weighted Background Noise Levels (L_{90})

Location ID	Measurement Location Description	Saturday 10 Jan 2009	Sunday 11 Jan 2009	Monday 12 Jan 2009
N1	Residential area along Carroll Avenue north of Arelious Walker Drive	45 to 46	45 to 49	43 to 47
N2	Residential area along Revere Avenue between Ingalls Street and Jennings Street	48 to 49	47 to 50	45 to 49
N3	Residential area along Donahue Street between Kirkwood Avenue and Jerrold Avenue	42 to 45	43 to 45	41 to 43
N4	Residential area along Kiska Road between Reardon Road and Ingalls Street	45 to 48	42 to 43	44 to 45
N5	Residential area along Hawes Street near Hunters Point Boulevard	47 to 50	44 to 46	43 to 48
N6	Residential area along Jamestown Avenue at Hawes Street	47 to 50	49 to 50	46 to 48

SOURCE: Wilson, Ihrig & Associates, 2009

Measurements include the effects of all noise sources influential at or near each location during each designated measurement period; traffic noise is likely the dominant influence at all locations and during all periods, but other sources (e.g., aircraft, trash pickup, etc.) also contribute to the totals.

Table III.I-5 Existing C-Weighted Background Noise Levels (L_{90}) at Night

Location ID	Description	Range	Median
N1	Residential area along Carroll Avenue north of Arelious Walker Drive	58 to 63	60
N2	Residential area along Revere Avenue between Ingalls Street and Jennings Street	55 to 62	58
N3	Residential area along Donahue Street between Kirkwood Avenue and Jerrold Avenue	53 to 60	56
N4	Residential area along Kiska Road between Reardon Road and Ingalls Street	55 to 64	59
N5	Residential area along Hawes Street near Hunters Point Boulevard	56 to 64	60
N6	Residential area along Jamestown Avenue at Hawes Street	—	—

SOURCE: Wilson, Ihrig & Associates, 2009

Measurements include the effects of all noise sources influential at or near each location during each designated measurement period; traffic noise is likely the dominant influence at all locations and during all periods, but other sources (e.g., aircraft, trash pickup, etc.) also contribute to the totals.

Traffic Noise Levels along Major Project Site Access Routes

Short-term traffic noise measurements (i.e., 15 minutes each) were taken at five near-curbside locations along the main Project site access routes during the weekday PM peak commute period, as shown in Table III.I-6 (Existing Peak-Hour Traffic Noise Measurements). The locations of these measurements are indicated as T1 through T5 on the aerial photo in Figure III.I-2 (Short-Term Ambient Noise Measurement Locations).

Table III.I-6 Existing Peak-Hour Traffic Noise Measurements (L_{eq})

Noise Receptor	*Land Use Description*	*Noise Level* L_{eq}	L_{min}	L_{max}	*Primary Noise Source*
T1	Candlestick Condos	66.8	60.5	87.3	Traffic along Candlestick, and US-101
T2	Residences along Hunters Point Boulevard	67.8	47.1	86.3	Traffic along Hunters Point Boulevard
T3	Residences along Palou Avenue between Jennings and Ingalls	65.8	51.6	86.4	Traffic along Palou Avenue
T4	Vacant lot along Carroll Avenue across from Alice Griffith Neighborhood Park residences.	64.8	46.9	88.0	Traffic along Carroll Avenue
T5	Residences along Gilman Avenue, across from Bret Hart Elementary School	61.4	52.4	78.9	Traffic along Gilman Avenue

SOURCE: PBS&J, 2009.
Noise measurements taken on May 20, 2009, between the hours of 3:00 P.M. and 6:00 P.M. for 15 minutes each.
Noise measurement data sheets are available in Appendix I2 (Short-Term Noise Measurements).

In addition to short-term measurements, traffic noise L_{eq} (peak hour) and L_{dn} at the setbacks of the residential uses adjacent to the major access routes (and other streets likely to carry substantial Project traffic volumes) were calculated using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM). The model calculates the average noise level at specific locations based on traffic volumes, average speeds, roadway geometry, truck mix, distance from roadway to receptor and site environmental conditions. The average vehicle noise rates (energy rates) utilized in TNM replicate the latest measurements of average vehicle noise rates for all vehicle classes. Traffic volumes utilized as data inputs in the noise prediction model were provided through the traffic analysis prepared for this EIR.[212] The *San Francisco General Plan* regards noise levels less than or equal to 60 dBA L_{dn} as "satisfactory, with no special noise insulation requirements" for residential uses (refer to Section III.I.3 [Regulatory Framework]). The average daily noise levels along these roadway segments are presented in Table III.I-7. As shown, all roadways modeled were below the 60 dBA L_{dn} noise level, except for 3rd Street and Bayshore Boulevard.

[212] United States Department of Transportation. Federal Highway Administration. FHWA Traffic Noise Model® User's Guide (Version 2.5 Addendum) April 2005.

SOURCE: PBS&J, 2009.

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FIGURE III.I-2 Candlestick Point — Hunters Point Shipyard Phase II EIR

SHORT-TERM AMBIENT NOISE MEASUREMENT LOCATIONS

Table III.I-7 Modeled Existing Traffic Noise Levels at Residential Setbacks

Roadway	*Land Use*	*Setback Distance (feet from centerline)*	L_{dn}
Innes north of Carroll Avenue	Residential	30	53.3
3rd south of Carroll Avenue	Residential	40	**62.8**
Caesar west of 3rd Street	Residential	60	59.
Palou Avenue east of 3rd Street	Residential	40	56.8
Ingalls north of Carroll Avenue	Residential	30	56.7
Carroll Avenue east of 3rd Street	Residential	60	52.6
Gilman Avenue east of 3rd Street	Commercial	40	57.7
Jamestown Avenue north of Harney Way	Residential	60	51.4
Harney Way west of Jamestown Avenue	Residential	80	52.6
Bayshore Boulevard north of Visitacion	Residential	40	**65.1**

SOURCE: PBS&J 2009
Noise model data sheets are available in Appendix I3 (Traffic Noise Model Output).

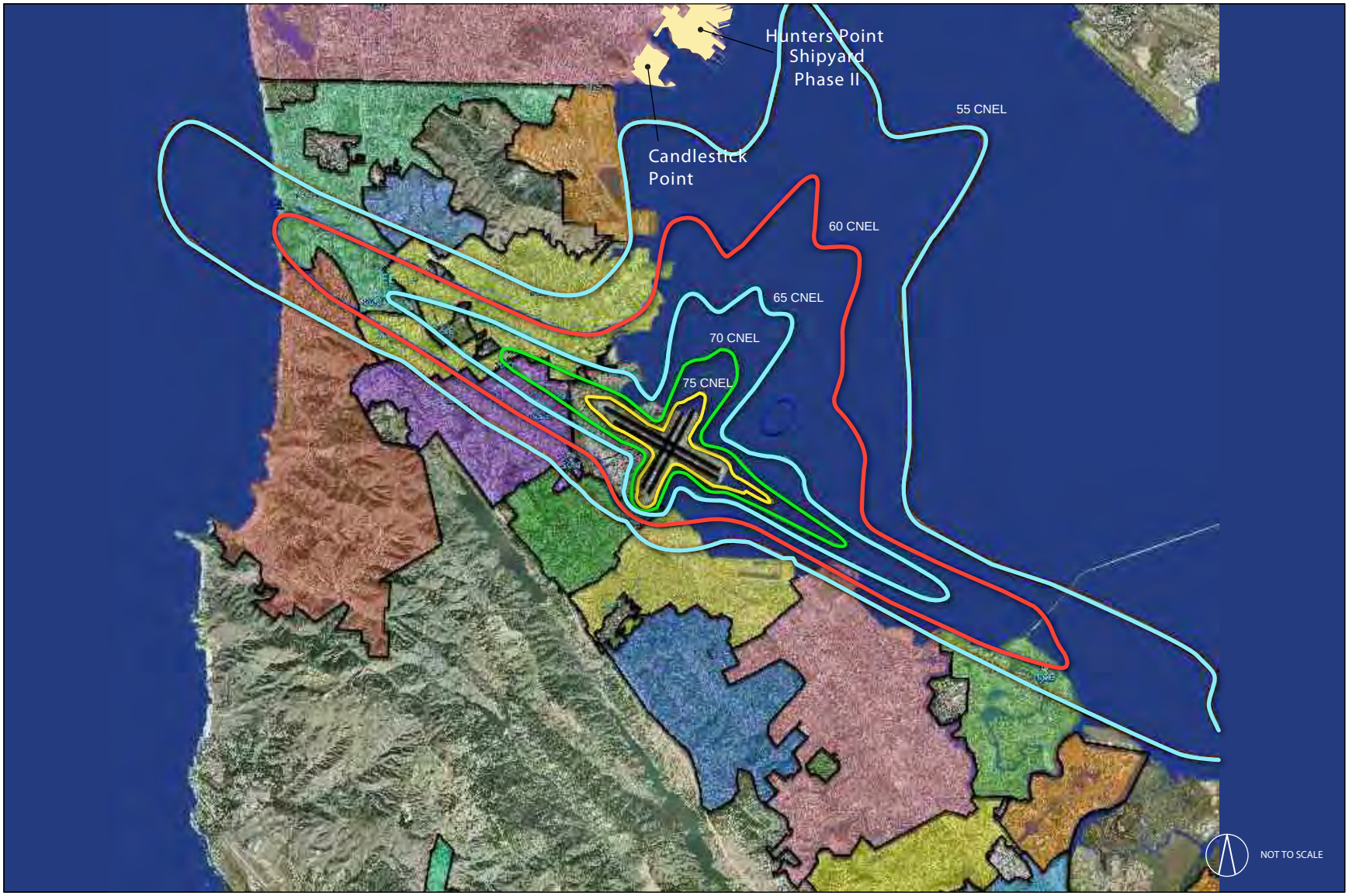
Existing Aircraft Noise Levels on the Project Site

San Francisco International Airport (SFO) is located approximately 10 miles to the south of the Project site. Commercial aircraft associated with SFO operations regularly fly-over the Project site. However, as shown in Figure III.I-3 (SFO Noise Contour Map), the Project site is well outside SFO's 65 dBA CNEL noise contour (and is even outside the 55 dBA CNEL contour). Additionally, SFO issues monthly July 2009 *Airport Director's Reports*, which document the frequency of aircraft noise standard violations and the number/locations of noise complaints received. A review of *Airport Director's Reports* from the past 6 months indicates that no complaints were received from BVHP neighborhood residents regarding aircraft noise.[213]

Football Game Noise Levels Measured Near the Existing 49er Stadium

Noise measurements were taken near the existing Candlestick Park stadium (outside the Jamestown Condominiums on the west side of Jamestown Avenue) during a football game (49ers vs. Tampa Bay, Sunday December 23, 2007). As shown in Figure III.I-4 (Monster Park Sound Levels [49ers vs. Tampa Bay on December 23, 2007] at Jamestown Condominiums), the noise level in the vicinity of a stadium with a football game in progress is highly variable. Most of the peak noise events were associated with game activities (e.g., pre-game ceremonies, crowd cheering, music, and announcements on the public address system, etc.). The highest game-related peak noise (L_{max}) was in the upper 60s to mid 70s dBA, but more often lower; audible game-related noise events were fairly frequent but of short duration. The average noise level (L_{eq}) during the portion of the game monitored was in the mid 60s dBA, while the

[213] SFO Aircraft Noise Abatement Office, *July 2009 Airport Directors Report.* http://www.flyquietsfo.com/reports/monthlyDirectors/0907%20report%20with%20cover.pdf. Accessed September 24, 2009.



SOURCE: 65 CNEL noise contour, http://tx-sfo.airportnetwork.com/#.

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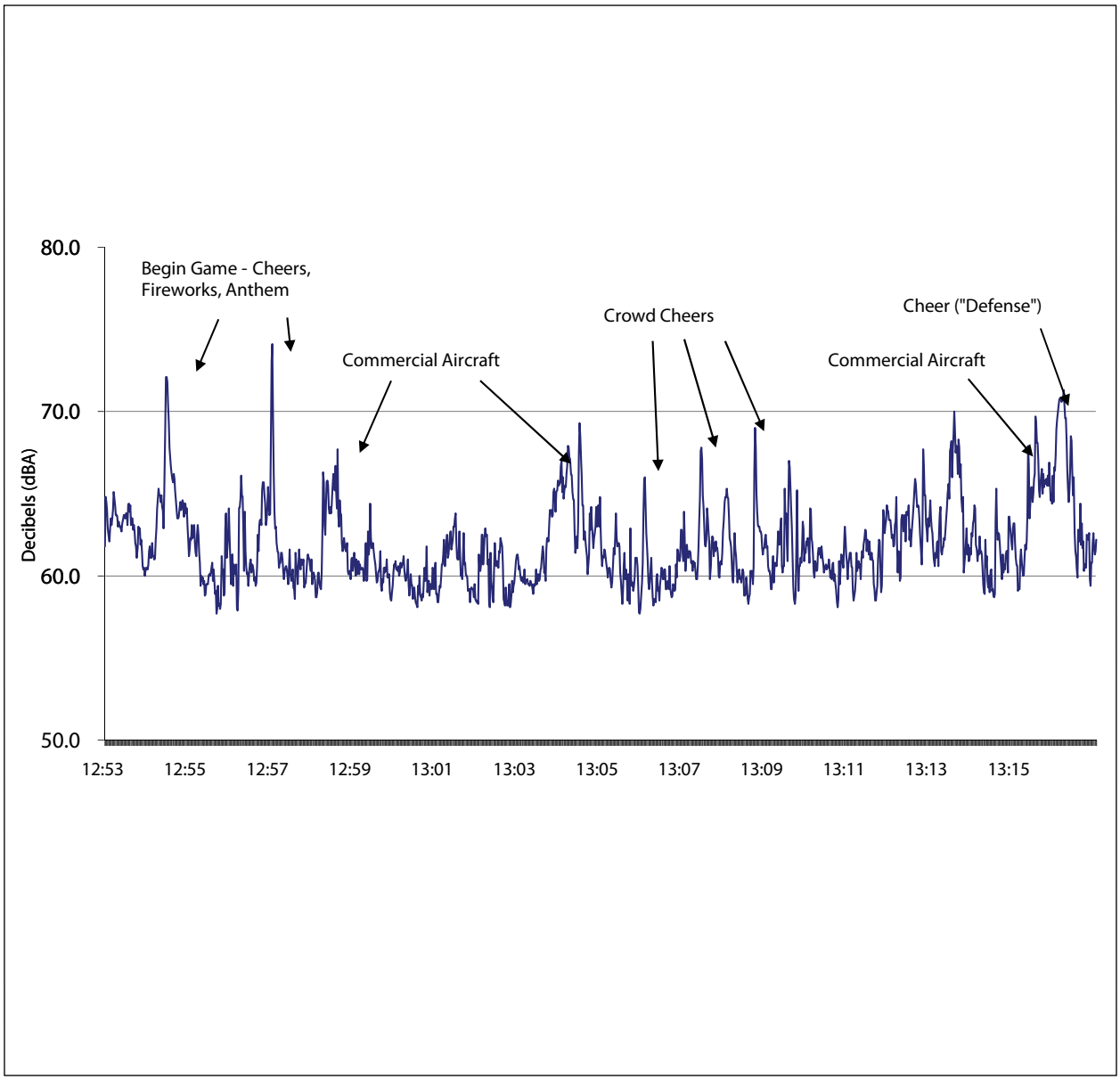
FIGURE III.I-3

Candlestick Point — Hunters Point Shipyard Phase II EIR

SFO NOISE CONTOUR MAP



SOURCE: PBS&J, 2009.

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Candlestick Point — Hunters Point Shipyard Phase II EIR

MONSTER PARK SOUND LEVELS (49ers vs Tampa Bay Dec. 23, 2007) AT JAMESTOWN CONDOMINIUMS

FIGURE III.I-4

background level (L_{90}) was in the upper 50s dBA. Also, game activity was not the only source of peak noise events. Candlestick Park is under major approach/departure routes to/from SFO. Aircraft overflights happened a few times during the monitoring period and though their L_{max} were not as large as that of the highest game noise events, their audible duration was longer, pushing their SEL level into the low to mid 70s dBA.

III.I.3 Regulatory Framework

Federal

US Environmental Protection Agency

The federal *Noise Control Act of 1972* addressed the issue of noise as a threat to human health and welfare, particularly in urban areas. In response to the Act, the US Environmental Protection Agency (US EPA) published *Information of Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (US EPA Levels). Table III.I-8 (Summary of Noise Levels Identified as Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety) summarizes EPA recommendations for noise-sensitive areas. Ideally, the yearly average L_{eq} should not exceed 70 dBA to prevent measurable hearing loss over a lifetime, and the L_{dn} should not exceed 55 dBA outdoors and 45 dBA indoors to prevent significant activity interference and annoyance in noise-sensitive areas. In addition to the identified noise levels to protect public health, the US EPA Levels identifies an increase of 5 dBA as an adequate margin of safety relative to a baseline noise exposure level of 55 dBA L_{dn} before a noticeable increase in adverse community reaction would be expected.

Table III.I-8 Summary of Noise Levels Identified as Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety

Effect	*Level*	*Area*
Hearing Loss	L_{eq}(24 hr) < 70 dBA[a]	All areas.
Outdoor activity interference and annoyance	L_{dn} < 55 dBA	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
Outdoor activity interference and annoyance	L_{eq}(24 hr) < 55 dBA	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	L_{dn} < 45 dBA	Indoor residential areas.
Indoor activity interference and annoyance	L_{eq}(24 hr) < 45 dBA	Other indoor areas with human activities such as schools, etc.

SOURCE: US Environmental Protection Agency, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, March 1974.

a. Yearly average equivalent sound levels in decibels; the exposure period that results in hearing loss at the identified level is a period of forty years.

The EPA does not promote these findings as universal standards or regulatory goals with mandatory applicability to all communities, but rather as advisory exposure levels below which there would be no reason to suspect that there would be risk from any of the identified health or welfare effects of noise.

Federal Transit Administration

The Federal Transit Administration (FTA) developed a methodology and significance criteria to evaluate noise impacts from surface transportation modes (i.e., passenger cars, trucks, buses, and rail) in *Transit Noise Impact and Vibration Assessment* (FTA Guidelines) (May 2006). The incremental noise impact criteria included the FTA Guidelines, as presented in Table III.I-9 (Federal Transit Administration Impact Criteria for Noise-Sensitive Uses), are based on US EPA Levels and subsequent studies of annoyance in communities affected by transportation noise and contained in the FTA Guidelines. The scientific rationale for the choice of these criteria is also explained in the FTA Guidelines. Starting from the EPA's definition of minimal noise impact as a 5 dBA change from an established protective ambient level, the FTA extended the EPA's incremental impact criteria to higher baseline ambient levels. As baseline ambient levels increase, smaller and smaller increments are allowed to limit increases in community annoyance (e. g., in residential areas with a baseline ambient noise level of 50 dBA L_{dn}, a 5 dBA increase in noise levels would be acceptable, while at 70 dBA L_{dn}, only a 1 dBA increase would be allowed).

Table III.I-9 Federal Transit Administration Impact Criteria for Noise-Sensitive Uses

Residences and Buildings Where People Normally Sleep[a]		*Institutional Land Uses with Primarily Daytime and Evening Uses*[b]	
Existing L_{dn} (dBA)	*Allowable Noise Increment (dBA)*	*Existing Peak Hour L_{eq} (dBA)*	*Allowable Noise Increment (dBA)*
45	8	45	12
50	5	50	9
55	3	55	6
60	2	60	5
65	1	65	3
70	1	70	3
75	0	75	1
80	0	80	0

SOURCE: Federal Transit Administration, Transit Noise Impact and Vibration Assessment, May 2006.

a. This category includes homes, hospitals, and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.

b. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material.

The FTA has also developed criteria for judging the significance of vibration produced by transportation sources and construction activity, as shown in Table III.I-10 (Groundborne Vibration Impact Criteria for General Assessment).

Under Federal Highway Administration (FHWA) regulations, noise abatement must be considered for new highway construction and highway reconstruction projects when the noise levels approach or exceed the noise-abatement criteria. For residential, school and other noise sensitive sites, these criteria indicate that the equivalent noise level (L_{eq}) during the noisiest 1-hour period of the day should not exceed 67 A-weighted decibels (dBA) at the exterior or 52 dBA within the interior. For commercial purposes, the exterior L_{eq} should not exceed 72 dBA.

Table III.I-10 Groundborne Vibration Impact Criteria for General Assessment

Land Use Category	Impact Levels (VdB; relative to 1 micro-inch/second)		
	Frequent Events[a]	Occasional Events[b]	Infrequent Events[c]
Category 1: Buildings where vibration would interfere with interior operations	65[d]	65[d]	65[d]
Category 2: Residences and buildings where people normally sleep	72	75	80
Category 3: Institutional land uses with primarily daytime uses	75	78	83

SOURCE: Federal Transit Administration, Transit Noise Impact and Vibration Assessment, May 2006.

a. "Frequent Events" is defined as more than 70 vibration events of the same source per day.
b. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day.
c. "Infrequent Events" is defined as fewer than 30 vibration events of the same source per day.
d. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research would require detailed evaluation to define the acceptable vibration levels.

Federal Aviation Administration

Federal Aviation Administration (FAA) regulations (i.e., Part 150, Airport Noise Compatibility Planning) prescribe the methodology governing the development, submission, and review of airport noise exposure maps and noise compatibility programs. The noise exposure maps use average annual L_{dn} or CNEL contours around the airport as the primary noise descriptor. To the FAA, all land uses are considered compatible when aircraft noise effects are less than 65 dB L_{dn} or CNEL. At higher noise exposures, increasing restrictions are applied to development within the aircraft noise contours depending upon the noise-sensitivity of the land use and the degree of noise attenuation required in the structures' interior spaces. As shown in Figure III.I-3, the Project site is well outside SFO's 65 dBA CNEL noise contour.

State

Governor's Office of Planning and Research

The Governor's Office of Planning and Research (OPR) *General Plan Guidelines 2003* (GP Guidelines) promotes use of L_{dn} or CNEL for evaluating the compatibility of various land uses with respect to their noise exposure. The designation of a level of noise exposure as "normally acceptable" for a given land use category implies that the interior noise levels would be acceptable to the occupants without the need for any special structural acoustic treatment. The GP Guidelines identify the suitability of various types of construction relative to a range of outdoor noise levels. The GP Guidelines provide each local community some flexibility in setting local noise standards that allow for the variability in community preferences. Findings presented in the US EPA Levels influenced the recommendations of the GP Guidelines, most importantly in the choice of noise exposure metrics (i.e., L_{dn} or CNEL) and in the upper limits for the "normally acceptable" outdoor exposure of noise-sensitive uses (i.e., no higher than 60 dBA L_{dn}/CNEL for residential, which is obtained when the EPA's 5 dBA margin of safety is added to the baseline noise exposure level of 55 dBA level that the US EPA believes is completely adequate to protect public health and welfare).

Title 25 (California Noise Insulation Standards)

The California Noise Insulation Standards (*California Code of Regulations*, Title 25, Section 1092) establishes uniform minimum noise insulation performance standards for new hotels, motels, dormitories, apartment houses, and dwellings other than detached single-family dwellings. Specifically, Title 25 states that interior noise levels attributable to exterior sources shall not exceed 45 dBA L_{dn} or CNEL (the same levels that the EPA recommends for residential interiors) in any habitable room of new dwellings. Acoustical studies must be prepared for proposed multiple unit residential and hotel/motel structures where outdoor L_{dn} or CNEL is 60 dBA or greater. The studies must demonstrate that the design of the building would reduce interior noise to 45 dBA L_{dn} or CNEL, or lower. Dwellings are to be designed so that interior noise levels would meet this standard for at least ten years from the time of building permit application. Interior noise levels can be reduced through the use of noise insulating windows, and by using sound isolation materials when constructing walls and ceilings. The primary means to achieve this standard is through the use of noise insulating windows, and/or sound isolation materials when constructing walls and ceilings.

Local

San Francisco General Plan

The *San Francisco General Plan* provides long-term guidance and policies for maintaining and improving the quality of life and the man-made and natural resources of the community. The Environmental Protection Element of the *San Francisco General Plan* is concerned primarily with avoiding or mitigating the adverse effects of transportation noise. However, many of the Objectives and related Policies of the *Transportation Noise* section could be applicable to noise from other sources (including noise from crowds, public address systems, and concert noise from a stadium):

Objective 10 Minimize the impact of noise on affected areas.

Policy 10.1 Promote site planning, building orientation and design, and interior layout that will lessen noise intrusion.

Policy 10.2 Promote the incorporation of noise insulation materials in new construction.

Objective 11 Promote land uses that are compatible with various transportation noise levels.

Policy 11.1 Discourage new uses in areas in which the noise level exceeds the noise compatibility guidelines for that use.

The "Land Use Compatibility Chart for Community Noise" included in Policy 11.1 specifies the compatibility of different land use types within a range of ambient noise levels.

For residential uses:

- Noise exposure is considered "satisfactory, with no special noise insulation requirements" where the L_{dn} is 60 dBA or less.

- "New construction or development should be undertaken only after a detailed analysis of noise reduction requirements is made and needed noise insulation features included in the design" where the L_{dn} is between 60 dBA and 70 dBA.
- "New construction or development should generally be discouraged" where L_{dn} is over 65 dBA.

For other noise-sensitive uses (i.e., schools, libraries, churches, hospitals, nursing homes):

- Noise exposure is considered "satisfactory, with no special noise insulation requirements" where the L_{dn} is 65 dBA or less.
- "New construction or development should be undertaken only after a detailed analysis of noise reduction requirements is made and needed noise insulation features included in the design" where the L_{dn} is between 62 dBA and 70 dBA.
- "New construction or development should generally not be undertaken" where L_{dn} is over 65 dBA.

Policy 11.3 Locate new noise-generating development so that the noise impact is reduced.

San Francisco Noise Ordinance (Article 29, San Francisco Police Code)

The Noise Ordinance specifically recognizes that adverse effects on a community can arise from noise sources such as transportation, construction, mechanical equipment, entertainment, and human and animal behavior. The San Francisco Noise Ordinance (Article 29, *San Francisco Police Code*, Section 2900) makes the following declaration:

> It shall be the policy of San Francisco to maintain noise levels in areas with existing healthful and acceptable levels of noise and to reduce noise levels, through all practicable means, in those areas of San Francisco where noise levels are above acceptable levels as defined by the World Health Organization's Guidelines on Community Noise.

The following policies are included to address and limit disruptive noise intrusions from these sources.

Waste Disposal Services (Section 2904)

The Noise Ordinance limits noise from waste disposal services mechanical or hydraulic device to 75 dBA when measured from 50 feet. This maximum noise level does not apply to the noise associated with crushing, impacting, dropping, or moving garbage on the truck, but only to the truck's mechanical processing system.

Construction (Sections 2907 and 2908)

The Noise Ordinance limits noise from powered construction equipment to a level of 80 dBA at a distance of 100 feet (or an equivalent level at some other distance).[214] This does not apply to impact tools

[214] By definition, Noise Ordinance Section 2901j states "Powered construction equipment" means any tools, machinery, or equipment used in connection with construction operations which can be driven by energy in any form other than

(provided they are equipped with appropriate noise control features recommended by the manufacturers and approved by the Director of Public Works or the Director of Building Inspection) nor to construction equipment used in connection with emergency work. Also, construction activities are generally prohibited between the hours of 8:00 P.M. and 7:00 A.M. if the noise created would be in excess of the ambient noise level by 5 dBA at the nearest property line (although exceptions to these limits can be made in certain cases by the Director of Public Works or the Director of Building Inspection).

Noise Limits (Section 2909)

The Noise Ordinance limits noise from sources defined as "any machine or device, music or entertainment or any combination of same" located on residential or commercial/industrial property to 5 dBA or 8 dBA, respectively, above the local "ambient"[215] at any point outside of the property plane of a residential, commercial/industrial or public land use, respectively, containing the noise source. An additional low-frequency criterion applies to noise generated from a licensed Place of Entertainment, specifically that no associated noise or music shall exceed the low-frequency ambient noise level by more than 8 dBC.

The Noise Ordinance limits noise from a fixed "source"[216] from causing the noise level measured inside any sleeping or living room in any dwelling unit located on residential property to 45 dBA between the hours of 10:00 P.M. to 7:00 A.M. or 55 dBA between the hours of 7:00 A.M. to 10:00 P.M. with windows open except where building ventilation is achieved through mechanical systems that allow windows to remain closed.

Variances (Section 2910)

The Noise Ordinance gives the Directors of Public Health, Public Works, Building Inspection, or the Entertainment Commission, or the Chief of Police authority to grant variances to noise regulations over which they have jurisdiction. The Department of Public Health has jurisdiction over sources specified in Noise Limits (Section 2909), the Departments of Building Inspection and Public Works over sources specified in Construction (Sections 2907 and 2908), and the Director of the Entertainment Commission may enforce noise standards associated with licensed Places of Entertainment.

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manpower, including all types of motor vehicles when used in the construction process of any construction site, regardless of whether such construction site be located on-highway or off-highway, and further including all helicopters or other aircraft when used in the construction process except as may be preempted for regulation by state or federal law.

[215] By definition, Noise Ordinance Section 2901a states "ambient" means the lowest sound level repeating itself during a minimum ten-minute period as measured with a type 1, precision sound level meter, set on slow response and A-weighting … in no case shall the ambient be considered or determined to be (1) less than 35 dBA for interior residential noise, and (2) 45 dBA in all other locations."

[216] By definition, Noise Ordinance (Section 2901e) states "fixed source" means a machine or device capable of creating a noise level at the property upon which it is regularly located, including but not limited to: industrial and commercial process machinery and equipment, pumps, fans, air-conditioning apparatus or refrigeration machines.

III.I.4 Impacts

Significance Criteria

The City and Agency have not formally adopted significance standards for impacts related to noise, but generally consider that implementation of the Project would have significant impacts if it were to:

I.a Result in exposure of persons to or generation of noise levels in excess of standards established in the Environmental Protection Element of the *San Francisco General Plan* or San Francisco Noise Ordinance (Article 29, *San Francisco Police Code*)

I.b Result in exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels

I.c Result in a substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project

I.d Result in a substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project

I.e For a project located within an airport land use plan area, or, where such a plan has not been adopted, in an area within two miles of a public airport or public use airport, would the Project expose people residing or working in the area to excessive noise levels

I.f For a project located in the vicinity of a private airstrip, would the Project expose people residing or working in the project area to excessive noise levels

I.g Be substantially affected by existing noise levels

Based on the following quantitative significance thresholds specifically included in the City of San Francisco *General Plan* or Noise Ordinance, the Project would cause or be subject to a significant noise or vibration impact if it would:

- **During Construction**
  - > Generate construction noise between the hours of 8:00 P.M. and 7:00 A.M. that exceeds the ambient noise level by 5 dBA at the nearest property line (unless a special permit has been granted by the Director of Public Works or the Director of Building Inspection); or produce noise by any construction equipment (except impact tools) that would exceed 80 dBA at 100 feet. (Criteria I.a and I.d)
- **During Operation**
  - > Cause an increase in noise (i.e., as produced by "any machine or device, music or entertainment or any combination of same") greater than 5 dBA or 8 dBA above the local ambient (i.e., defined as the "lowest sound level repeating itself during a minimum 10-minute period as measured with a sound level meter, using slow response and A-weighting")[217] at any point outside the property plane of a residential, commercial/industrial or public land use, respectively, containing the noise source. (Criteria I.a, I.c, or I.d)

[217] Although not explicitly stated in the San Francisco Noise Ordinance (Section 2901), the "ambient" level would most likely correspond to the L_{90} descriptor (i.e., the sound level exceeded 90% of the time) because of the operative words *"lowest sound level repeating itself"* in the Ordinance definition; there is a 10% chance that sound levels at or lower than L90 would repeat during a 10-minute period, whereas the L_{min} would likely occur only once.

> In the case of noise or music generated from a "licensed Place of Entertainment," cause an increase in low frequency ambient noise (i.e., defined as the "lowest sound level repeating itself during a 10-minute period as measured with a sound level meter, using slow response and C-weighting") by more than 8 dBC. (Criteria I.a, I.c, or I.d)

In the following cases where quantitative significance thresholds may not be included in the City of San Francisco *General Plan* or Noise Ordinance, the Project would cause or be subject to a significant noise or vibration impact if it would:

- For football game or concert noise from the proposed Stadium:[218]
  - > Cause L_{dn} on a typical football day to increase by 1 dBA or more in a residential area where existing ambient L_{dn} already exceeds 65 dBA or would exceed 65 dBA with the game/concert noise added[219] (Criteria I.a, I.c, or I.d)
  - > Result in L_{max} levels in the residential area that exceed 75 dBA.[220] (Criteria I.a, I.c, or I.d)
  - > Expose persons to or generate groundborne vibrations from construction activities that exceed the FTA vibration impact thresholds for residential and other vibration-sensitive land uses as specified in Table III.I-10. (Criterion I.b)
- Cause outdoor traffic noise levels at existing or proposed residential and other noise-sensitive uses to increase by more than the FTA criteria specified in Table III.I-9, which vary depending on the baseline ambient noise levels. (Criterion I.c)
- Cause excessive annoyance, activity disruption, or sleep disturbance due to noise from SFO-related aircraft operations at the proposed residential uses to be located on the Project site according to FAA criteria (i.e., aircraft noise level of 65 dBA L_{dn} or greater). (Criteria I.e, I.f, and I.g)

Analytic Method

As noted above, long-term 24-hour ambient noise measurements were taken at six locations in the residential neighborhoods north and west of the Project site for a total of six days in 2009. The long-term ambient noise measurements were conducted over the course of three days in January 2009, and again in July 2009. Both the A-weighted and C-weighted measurements were for 24-hour periods during the respective measurement times and were recorded using Larson Davis digital sound level meters. Table III.I-3 through Table III.I-5 show the results of the long-term L_{eq} and the A-and C-weighted results respectively, while Figure III.I-1 shows the locations of these measurements.

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[218] Although there is an existing football stadium on the Candlestick Point site, construction of the proposed Stadium at a different location on the Hunters Point Shipyard site has the potential to expose other noise-sensitive uses near the new location to substantial additional football game and concert noise. Also, the public address system in the proposed Stadium is likely to be different than the one at the existing facility and this difference is included in the noise model used for this analysis. The football game/concert noise impact analysis focuses only on potential adverse noise impacts from the proposed Stadium with respect to the significance criteria presented above.

[219] The General Plan *Land Use Compatibility Chart for Community Noise* sets 65 dBA L_{dn} as the lowest level at which "*new [residential] construction or development should generally be discouraged.*" This level is taken as the point at which noise from the proposed stadium would begin to substantially interfere with the residential character of the existing neighborhood.

[220] Interior L_{max} noise levels that exceed 60 dBA would generally be considered to cause interference with normal speech indoors or with activities that involve speech comprehension (e.g., watching television), whereas L_{max} noise levels that are less than 55 dBA would generally not interfere. Since residential structures typically provide 15 to 20 dBA of exterior-to-interior noise level reduction with windows closed, as long as exterior L_{max} noise levels did not exceed 75 dBA substantial interference with normal speech or speech comprehension would not occur indoors.

The analysis of the existing and future noise environments is based on noise-level monitoring, noise-prediction computer modeling, and empirical observations of receptor noise exposure characteristics. Existing short-term noise levels were monitored at selected locations in and around the Project site using a Larson-Davis Model 820 sound level meters. These short-term noise measurements were taken on May 20, 2009, between the hours of 3:00 P.M. and 6:00 P.M. for 15 minutes each. The results of these noise measurements are shown in Table III.I-6, while Figure III.I-2 shows the location of these measurements.

Traffic noise modeling procedures involved the calculation of existing and future vehicular noise levels at selected noise-sensitive uses in the vicinity of the Project site using the FHWA Traffic Noise Model (TNM). The model calculates the average noise level at specific locations based on traffic volumes, average speeds, roadway geometry, truck mix, distance from roadway to receptor, and site environmental conditions. The average vehicle noise rates (energy rates) utilized in TNM reflects the latest measurements of average vehicle noise rates for all vehicle classes. Traffic volumes utilized as data inputs in the noise prediction model were provided through the traffic analysis prepared for this EIR. For purposes of analysis, the average peak-hour traffic volumes were extrapolated from the Project traffic study and input into the model to estimate existing and future traffic noise levels on roadway segments in the Project vicinity where existing or reasonably foreseeable sensitive receptors are located.

The proposed stadium would primarily be used for football games, but may also be used occasionally for popular music concerts. The proposed stadium design, measured game and concert noise data gathered from similar existing facilities, the influence of surrounding topography and meteorology, and the location of noise-sensitive receptors (primarily residential) in the area were developed as input parameters to the community noise prediction computer model SoundPLAN®. The sound emission characteristics of both the stadium's "house" sound system (the permanent sound system that would be utilized during football games) and that of a portable system characteristic of concerts were used in the SoundPLAN® model to (1) project noise levels in the community for both games and concerts; (2) to evaluate whether noise impacts would potentially occur; and (3) determine the possible need for mitigation and the details of such mitigation.

Aircraft noise levels on the Project site were estimated using available data from SFO. The noise analysis considered the existing CNEL and SEL noise data as likely exposure for the proposed residential uses on site.

Construction noise and vibration levels were quantified using equipment noise reference levels and modeling techniques developed by the FTA.[221]

[221] It is the City's standard that noise impact findings be based on the City's General Plan and Noise Ordinance significance criteria. However, for the purposes of this EIR analysis, the traffic noise and vibration analysis are based on the FTA (2006) criterion. The methodology and impact conclusions would be the same using either criterion.

Construction Impacts

Impact NO-1: Exposure of Persons to Excessive Noise Levels

Impact of Candlestick Point

Impact NO-1a **Construction at Candlestick Point would generate increased noise levels for both off-site and on-site sensitive receptors; however, the Project's construction noise impacts would occur primarily in noise-sensitive areas adjacent or near to active construction sites (which would vary in location and duration over the entire period the proposed Project would be under construction), they would not occur during recognized sleep hours, and would be consistent with the requirements for construction noise that exist in Sections 2907 & 2908 of the *Municipal Code*. (Less than Significant with Mitigation) *[Criterion I.a]***

It is anticipated that the Project would be constructed beginning in 2010 with full build-out by 2029, which represents an approximately 19-year construction period. Figure II-16 (Proposed Site Preparation Schedule) illustrates the site preparation sequence that precedes building construction. Figure II-17 (Proposed Building and Parks Construction Schedule) illustrates the building construction sequence.

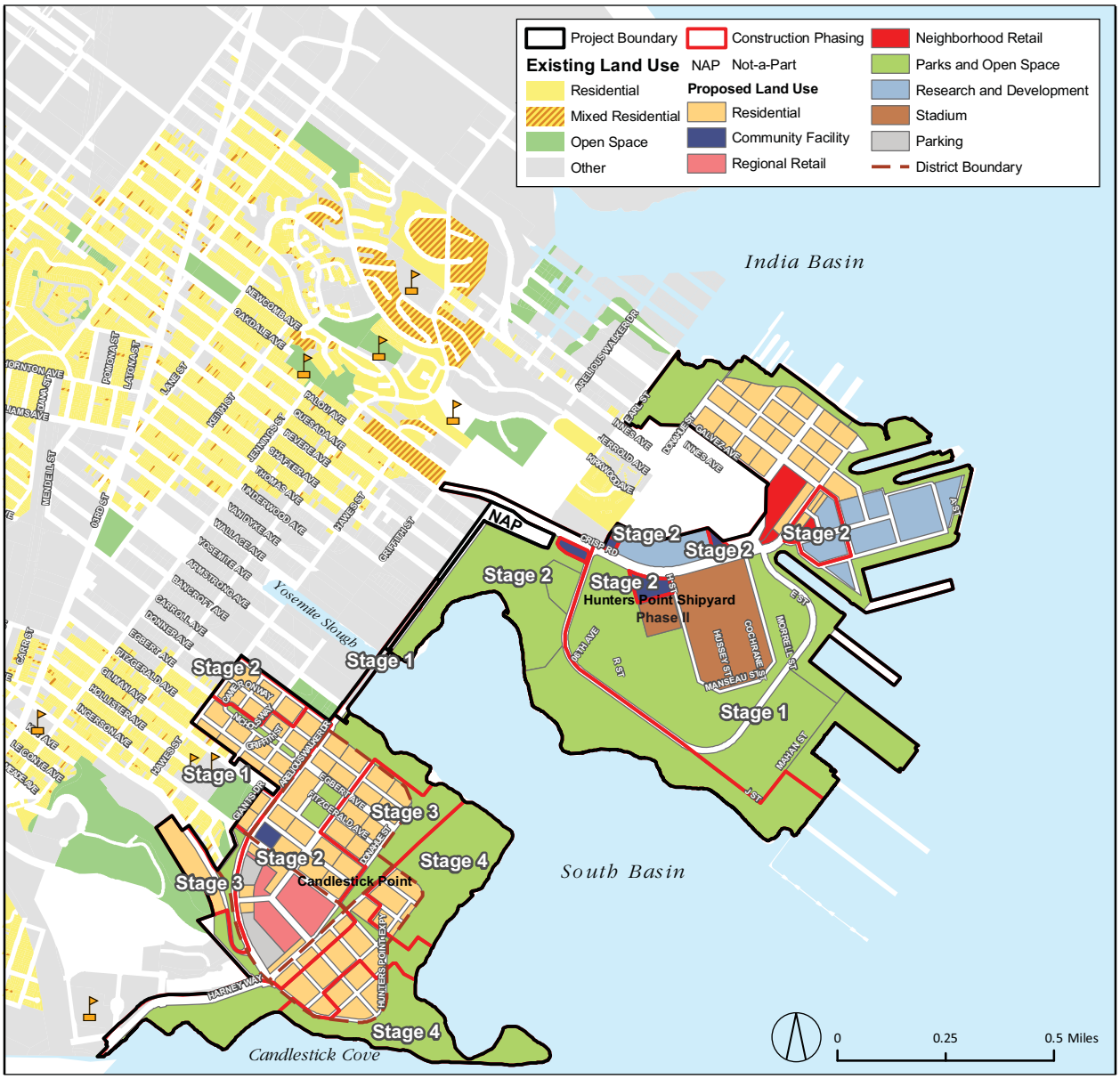
Construction activities would include demolition, site preparation, grading, placement of infrastructure, placement of foundations for structures, and fabrication of structures. Demolition and construction activities would require the use of heavy trucks, excavating and grading equipment, concrete breakers, concrete mixers, and other types of mobile and stationary construction equipment. The Project's construction would require heavy-duty equipment such as excavators, a drill rig, concrete mixers, and pump trucks would be used during the demolition of existing buildings, grading and foundation work. Excavation and grading in the Jamestown and Alice Griffith districts would be likely to encounter hard bedrock, requiring the use of heavy construction equipment. Heavy construction equipment rock removal methods include ripping (such as a Caterpillar D9 tractor with ripper attachment) and mechanical rock-breaking utilizing hammers, splitters or cutters. The mid and high-rise residential towers to be developed at CP North and CP South, as well as the shoreline improvements and development of the Yosemite Slough bridge would require the use of pile-driving equipment.

Construction activities would also involve the use of smaller power tools, generators, and other equipment that generate noise. Haul trucks using the local roadways would generate noise as they move along the road. Each stage of construction would involve a different mix of operating equipment, and noise levels would vary based on the amount and types of equipment in operation and the location of the activity. Table III.I-11 (Construction Equipment Noise Emission Levels) provides average noise levels for standard construction equipment. Figure III.I-5 (Existing and Future Noise-Sensitive Land Uses in Project Site and Vicinity) illustrates the location of existing and future noise-sensitive land uses within and in the vicinity of the Project site.

Table III.I-11 Construction Equipment Noise Emission Levels

Equipment	*Typical Noise Level (dBA) 50 ft from Source*
Air Compressor	81
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane, Derrick	88
Crane, Mobile	83
Dozer	85
Generator	81
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	85
Paver	89
Pile-driver (Impact)	101
Pile-driver (Sonic)	96
Pneumatic Tool	85
Pump	76
Rail Saw	90
Rock Drill	98
Roller	74
Saw	76
Scarifier	83
Scraper	89
Shovel	82
Spike Driver	77
Tie Cutter	84
Tie Handler	80
Tie Inserter	85
Truck	88

SOURCE: Table based on an EPA report (US Environmental Protection Agency, "Noise from Construction Equipment and Operations, Building Equipment and Home Appliances," NTID300.1, December 31, 1971), measured data from railroad construction equipment taken during the Northeast Corridor Improvement Project, and other measured data.



SOURCE: Lennar 2009; CCSF, 2007; PBS&J, 2009.

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Candlestick Point — Hunters Point Shipyard Phase II EIR

FIGURE III.I-5

EXISTING AND FUTURE NOISE-SENSITIVE LAND USES IN PROJECT SITE AND VICINITY

Construction Impacts at Off-Site Noise-Sensitive Receptors

Average noise levels at sensitive receptors off site would vary by construction phase and depend on the equipment used, the duration of the construction phase, and the proximity of construction activity to the noise-sensitive receptors. The Project would improve existing roadways to serve Candlestick Point and HPS Phase II and surrounding Bayview and Hunters Point neighborhoods. Improvements would be within the Project boundaries, and off site as shown in Figure II-12 (Proposed Roadway Improvements) in Chapter II (Project Description). These improvements would include widening, re-striping, and/or reconfiguration of roadway segments and intersections. Construction activities associated with roadway improvements would be located within 25 feet of existing residential uses in the BVHP neighborhood along Gilman Avenue, Carroll Avenue, and Ingalls Street. Additionally, construction activities that would occur within Candlestick Point, including the demolition and redevelopment of the Alice Griffith Public Housing and within the Jamestown district would be located within 25 feet of existing residential uses along Gilman Avenue and Jamestown Avenue, respectively.

Due to different densities of the underlying bedrock at Candlestick Point, controlled rock fragmentation may be utilized during general excavation and grading of the residential uses in the Jamestown and Alice Griffith districts. Controlled rock fragmentation technologies include pulse plasma rock fragmentation (PPRF), controlled foam or hydraulic injection, and controlled blasting (CB). In some scenarios it may be necessary to utilize a combination of these techniques. Controlled blasting can typically be performed at noise levels below typical building demolition levels (80-100 dBA) at the same distance. Table III.I-12 (Noise Levels for Controlled Rock Fragmentation Technologies) provides average noise levels for both PPRF and controlled blasting.

Table III.I-12 Noise Levels for Controlled Rock Fragmentation Technologies

Distance (Meters)	*PPRF (dBA)*	*CB (dBA)*
20	67.6	82.2
30	65.8	78.9
40	65.3	73.3

SOURCE: MACTEC Engineering and Consulting, Inc.

Off-site roadway improvements would utilize a pavement crusher (similar in noise levels to a grader), loaders and graders, as well as water and haul trucks. Based on the noise levels presented in Table III.I-11, the approximate noise levels experienced by adjacent noise-sensitive uses due to construction activities occurring during off-site roadway improvements, which are conservatively assumed to be 50 feet from the proposed improvement activity, would be approximately 85 dBA during the loudest off-site activities (noise from a grader).

Noise levels from excavation and grading activities associated with development at the Jamestown and Alice Griffith districts are estimated to be approximately 92 dBA due to the use of heavy construction equipment, such as D-9 Caterpillar Bulldozers. Controlled rock fragmentation activities (whether PPRF or CB) would also result in noise levels of approximately 67.6 to 82.2 dBA at distances of approximately 60 feet.

Construction Impacts at Future On-Site Noise-Sensitive Receptors

Residential uses that would be developed as part of the Project in Candlestick Point would be occupied starting in 2017, as shown in Table II-15 (Building Construction Completion Dates) in Chapter II (Project Description). These residential uses would be located in the Alice Griffith district. Subsequent residential uses in Candlestick Point are scheduled for occupancy in 2021, 2025, and 2029 in the CP North, CP South, CP Center, and Jamestown districts as shown in Figure II-16 (Proposed Site Preparation Schedule) and Figure II-17 (Proposed Building and Parks Construction Schedule). As shown in Table II-15, the commercial, neighborhood and regional retail, hotel and performance venue associated with Candlestick Point would be completed by 2021.

The Project would include redevelopment of Alice Griffith Public Housing to provide one-for-one replacement units. Eligible Alice Griffith Public Housing residents would have the opportunity to move to the new units directly from their existing Alice Griffith Public Housing units without having to relocate to any other area. Therefore, while construction would occur at one parcel, residents would continue to reside at the remaining parcels. As such, these residents have been identified as on-site receptors during Project construction. Construction activities associated with grading and excavation, including controlled rock fragmentation activities in the Alice Griffith district, are estimated to be approximately 92 dBA at the residential uses of Alice Griffith due to the use of heavy construction equipment, such as D-9 Caterpillar Bulldozers. Controlled rock fragmentation activities (whether PPRF or CB) would also result in noise levels of approximately 67.6 to 82.2 dBA at distances of approximately 60 feet.

Construction of the residential and commercial uses in the remainder of Candlestick Point would include the development of high-rise mixed-use residential towers. Based on Table III.L-7 (Geotechnical Treatments for Candlestick Point Geotechnical Subparcels) in Section III.L (Geology and Soils), these high-rise towers would require the construction of deep foundations. The recommended construction method for these deep foundations would be to utilize pile drivers. As shown in Table III.I-11, pile drivers produce noise levels of approximately 101 dBA. As shown in Figure II-4 (Proposed Land Use Plan), the high-rise towers that would be closest to existing noise-sensitive uses would be located in the southwestern portion of the CP North district, approximately 150 feet from the redeveloped Alice Griffith district. Therefore, it is estimated that the greatest construction noise levels (during pile driving activities) associated with construction of Candlestick Point would be approximately 91 dBA at the residential uses in the Alice Griffith district.

Pile driving would also be required in the CP Center and CP South districts after residential uses have been occupied in these districts; therefore, pile-driving activities would also be located within 50 feet of occupied residential structures, and these uses would experience noise levels of approximately 101 dBA.

Pile driving activities would also be required for implementation of the shoreline improvements within Candlestick Point; however, as shown in Figure III.I-5, no noise-sensitive uses are located within approximately 500 feet of the shoreline improvement areas. It is, therefore, anticipated that pile-driving activities associated with the shoreline improvements would result noise levels for noise-sensitive receptors that are below the level of significance.

Construction activities that would not require pile driving would also generate noise levels in excess of 80 dBA in the occupied Alice Griffith district. Specifically, construction of the medium- and low-density residential uses in the CP North district would be located within approximately 50 feet of the residential uses in the Alice Griffith district. Based on the noise levels presented in Table III.I-11, and the diminishment of noise levels at a rate of 6 dBA per doubling of distance, the approximate noise levels from construction in the CP North district would result in noise levels of up to 88 dBA at the property line of the Alice Griffith residential uses from activities associated with excavation, paving, and external finishing.

Construction of Candlestick Point must comply with the San Francisco Noise Ordinance, which prohibits construction 8:00 P.M. and 7:00 A.M. Further, the Noise Ordinance would limit noise from any individual piece of construction equipment (except impact tools) to 80 dBA at 100 feet unless the construction activity occurred during allowable hours.

As shown above, both on- and off-site noise-sensitive receptors in the Project vicinity could experience noise levels up to 91 dBA L_{eq} as a result of construction activities. *San Francisco Municipal Code* Sections 2907 & 2908 require that (1) noise levels from individual pieces of construction equipment, other than impact tools, not exceed 80 dBA at a distance of 100 feet from the source (the equipment generating the noise); (2) impact tools, such as jackhammers, must have both the intake and exhaust muffled to the satisfaction of the Director of Department of Public Works (DPW); and (3) if the noise from construction would exceed the ambient noise levels at the property line of the site by 5 dBA, the work must not be conducted between 8:00 P.M. and 7:00 A.M., unless the Director of DPW authorizes a special permit for conducting the work during that period.[222]

To reduce the noise levels resulting from construction of the Project to the extent feasible for both on-site and off-site noise-sensitive receptors, the following mitigation measures shall be implemented:

MM NO-1a.1 *Construction Document Mitigation to Reduce Noise Levels During Construction. The Project Applicant shall incorporate the following practices into the construction documents to be implemented by the Project contractor:*

- *Provide enclosures and mufflers for stationary equipment, shrouding or shielding for impact tools, and barriers around particularly noisy operations on the site*
- *Use construction equipment with lower noise emission ratings whenever possible, particularly air compressors*
- *Provide sound-control devices on equipment no less effective than those provided by the manufacturer*
- *Locate stationary equipment, material stockpiles, and vehicle staging areas as far as practicable from sensitive receptors*
- *Prohibit unnecessary idling of internal combustion engines*
- *Require applicable construction-related vehicles and equipment to use designated truck routes to access the Project site*

[222] Warren, Elaine, email communication with Deputy City Attorney, City and County of San Francisco, October 2, 2009.

- *Implement noise attenuation measures to the extent feasible, which may include, but are not limited to, noise barriers or noise blankets. The placement of such attenuation measures will be reviewed and approved by the Director of Public Works prior to issuance of development permit for construction activities.*
- *Designate a Noise Disturbance Coordinator who shall be responsible for responding to complaints about noise during construction. The telephone number of the Noise Disturbance Coordinator shall be conspicuously posted at the construction site and shall be provided to the City. Copies of the construction schedule shall also be posted at nearby noise-sensitive areas.*

MM NO-1a.2 *Noise-reducing Pile Driving Techniques and Muffling Devices. The Project Applicant shall require its construction contractor to use noise-reducing pile driving techniques if nearby structures are subject to pile driving noise and vibration. These techniques include pre-drilling pile holes (if feasible, based on soils) to the maximum feasible depth, installing intake and exhaust mufflers on pile driving equipment, vibrating piles into place when feasible, and installing shrouds around the pile driving hammer where feasible.*

Contractors shall be required to use construction equipment with state-of-the-art noise shielding and muffling devices. In addition, at least 48 hours prior to pile-driving activities, the Project Applicant shall notify building owners and occupants within 500 feet of the Project site of the dates, hours, and expected duration of such activities.

Under mitigation measure MM NO-1a.1, the implementation of noise attenuation measures may include the use of noise barriers (e.g., sound walls) or noise blankets. As a general rule of thumb, if a noise source is completely enclosed or completely shielded with a solid barrier located close to the source, an 8 dBA noise reduction can be expected; if the enclosure and/or barrier is interrupted, noise would be reduced by only 5 dBA.[223] In addition, mitigation measure MM NO-1a.1, which requires that construction staging areas and earthmoving equipment be located as far away from noise and vibration-sensitive land uses as possible, would also reduce construction-related noise levels. Mitigation measure MM NO-1a.1 also would require that heavily loaded trucks traverse along pre-approved routes only, which would serve to reduce noise impacts from construction related truck trips. Mitigation measure MM NO-1a.2 would require that noise impacts from pile driving activities be reduced to the extent practicable by requiring pre-drilled holes and utilizing vibratory pile driving techniques as soil conditions would allow. MM NO-1a.2 would also require that the contractor utilize noise shrouds around the pile driving, which would serve to reduce noise levels by approximately 5 to 10 dBA.

While the construction activities would occur over an approximately 19-year timeline, the activities that impact individual receptors would be temporary. The conditions under which noise levels would be considered excessive during construction activities, such as excavation or pile driving, would only occur for the duration of the specified activity and would only impact receptors located within 150 feet or closer of the noise producing activity. Once that particular construction activity was completed, the associated noise would no longer be experienced by the affected receptor.

The City allows for construction noise levels to exceed the standards established if the project complies with the Noise Ordinance as required by law, as well as include other construction noise attenuating

[223] US Department of Transportation, Federal Highway Administration, *FHWA Roadway Construction Noise Model, Version 1.0 User's Guide*, Appendix A: Best Practices for Calculating Estimated Shielding for Use in the RCNM, January 2006.

features, such as those identified in mitigation measures MM NO-1a.1 and MM NO-1a.2, project-related construction noise impact would be considered to be less than significant. Construction noise would be reduced by mitigation measures MM NO-1a.1 and MM NO-1a.2. Further, as construction activities would only occur under the hours allowed under Sections 2907 and 2908, this impact would be less than significant.

Impact of Hunters Point Shipyard Phase II

Impact NO-1b **Construction at HPS Phase II would generate increased noise levels for both off-site and on-site sensitive receptors; however, the Project's construction noise impacts would be temporary, they would also not occur during recognized sleep hours, and would be consistent with the requirements for construction noise that exist in Sections 2907 and 2908 of the *Municipal Code*. (Less than Significant with Mitigation) *[Criterion I.a]***

Construction Impacts at Off-Site Noise-Sensitive Receptors

Off-site roadway improvements to Innes Avenue would result in construction activities occurring within 25 feet of residential uses along Innes Avenue. As described under Impact NO-1, noise levels associated with these off-site roadway improvements would be approximately 85 dBA at 50 feet; at 25 feet, which is a halving of distance, noise levels would increase by 6 dBA, which would result in a noise level 91 dBA due to grading activities.

Construction of the proposed football stadium would be located in HPS Phase II and would require pile-driving activities. As shown in Table III.I-11, pile drivers produce noise levels of approximately 101 dBA within 50 feet of the source. The closest off-site noise-sensitive receptor to the proposed football stadium would be the residential uses located in HPS Phase I. These residential uses are located approximately 600 feet from the proposed stadium; therefore, as stationary noise levels diminish by 6 dBA per doubling of distance, it is estimated that the greatest construction noise levels (during pile driving activities) associated with construction of the stadium would be approximately 77 dBA to 83 dBA, depending on the exact distance. It should be noted that the residential uses located at HPS Phase I are located along a ridge that serves to shield the residential uses from the stadium site, which would serve to further reduce construction related noise levels.

All off-site construction activities associated with HPS Phase II would be required to comply with Sections 2907 and 2908 of the Noise Ordinance and implement mitigation measures MM NO-1a.1 and MM NO-1a.2. Compliance with the Noise Ordinance and the identified mitigation measures would reduce the impact of construction noise to off-site receptors from construction related noise associated with HPS Phase II.

Construction Impacts at Future On-Site Noise-Sensitive Receptors

At HPS Phase II, new development would begin with the construction of the 49ers stadium, scheduled for completion during the 2014–2017 time period. HPS North district residential development would begin during 2011–2015 and is planned for completion by 2017. Build-out of the R&D district is planned by 2017. The mixed-use, neighborhood retail, and residential development at the HPS Village Center district would be completed in 2021. Based on the construction schedule, construction activities

associated with the stadium, HPS North district, and R&D district would not impact on-site noise-sensitive uses. Construction of the HPS Village Center district would occur while the HPS North district residential uses are occupied and, therefore, could potentially impact the HPS North district residential uses.

Construction of the residential and commercial uses in the HPS Village Center district would include the development of high-rise mixed-use residential towers. Based on Table III.L-8 (Geotechnical Treatments for HPS Phase II Geotechnical Subparcels) in Section III.L, these high-rise towers would require the construction of deep foundations. The recommended construction method for these deep foundations would be to utilize pile drivers. The HPS Village Center district would be located within 50 feet of the HPS North district residential uses, as shown in Figure II-4. As shown in Table III.I-11, noise levels from pile driving activities could be as high as 107 dBA for the residential uses within the HPS North district (assuming a distance of 25 feet). Other construction activities such as grading, excavation, paving, and structural finishes would be anticipated to produce noise levels of up to 89 dBA.

Pile driving activities would also be required for implementation of the shoreline improvements within HPS Phase II; however, as shown in Figure III.I-5, no noise-sensitive uses are located within approximately 500 feet of the shoreline improvement areas. It is, therefore, anticipated that pile-driving activities associated with the shoreline improvements would not result in excessive noise levels for noise-sensitive receptors.

As stated under Impact NO-1a, the conditions under which noise levels would be considered excessive during construction activities, such as excavation or pile driving, would only occur for the duration of the specified activity and would only impact receptors located within 150 feet or closer of the noise producing activity. Once that particular construction activity was completed, the associated noise would no longer be experienced by the affected receptor.

Construction of HPS Phase II must comply with the San Francisco Noise Ordinance, which prohibits construction between 8:00 P.M. and 7:00 A.M. Further, the Noise Ordinance would limit noise from any individual piece of construction equipment (except impact tools) to 80 dBA at 100 feet unless the construction activity occurred during allowable hours. Additionally, mitigation measures MM NO-1a.1 and MM NO-1a.2 would be implemented during construction of HPS Phase II. Construction noise would be reduced as required by mitigation measures MM NO-1a.1 and MM NO-1a.2. Further, as construction activities would only occur under the hours allowed under Sections 2907 and 2908 of the Noise Ordinance, noise from project construction would not violate any City Codes or other requirements placed on construction activity by the City or Agency and, therefore, this impact would be less than significant.

Combined Impact of Candlestick Point and Hunters Point Shipyard Phase II

Impact NO-1 **Construction activities associated with the Project would generate increased noise levels for both off-site and on-site sensitive receptors; however, the Project's construction noise impacts would occur primarily in noise-sensitive areas adjacent or near to active construction sites (which would vary in location and duration over the entire period the proposed Project would be under construction); they would also not occur during recognized sleep hours, and would be consistent with the requirements for construction noise that exist in Sections 2907 and 2908 of the *Municipal Code*. (Less than Significant with Mitigation) *[Criterion I.a]***

Construction activities for the Project would create a substantial temporary increase in ambient noise levels on the site and in existing residential neighborhoods adjacent to the site. While construction activities would occur over a 19-year timeline, the conditions under which noise levels would be considered excessive during construction activities, such as excavation or pile driving, would only occur for the duration of the specified activity and would only impact receptors located within 150 feet or closer of the noise producing activity. Construction activities must comply with the San Francisco Noise Ordinance, which prohibits construction between 8:00 P.M. and 7:00 A.M. and limits noise from any individual piece of construction equipment (except impact tools) to 80 dBA at 100 feet. Implementation of mitigation measures MM NO-1a.1 and MM NO-1a.2, which would require implementation of construction best management practices to reduce construction noise and the use of noise-reducing pile driving techniques, would reduce any potentially significant impacts to less-than-significant levels.

Impact NO-2: Exposure of Persons to Excessive Vibration Levels

Impact of Candlestick Point

Impact NO-2a **Construction at Candlestick Point would create excessive groundborne vibration levels in existing residential neighborhoods adjacent to the Project site and at proposed on-site residential uses should the latter be occupied before Project construction activity on adjacent parcels is complete. Although the Project's construction vibration impacts would be temporary, would not occur during recognized sleep hours, and would be consistent with the requirements for construction activities that exist in Sections 2907 & 2908 of the *Municipal Code*, vibration levels would still be significant. (Significant and Unavoidable with Mitigation) *Criterion I.b]***

Although construction-related vibration associated with the Project would be temporary there are two potential impacts that could occur. First, vibration at high enough levels can result in human annoyance. Second, groundborne vibration can potentially damage the foundations and exteriors of fragile structures close enough to the construction activity. Damage potential is typically limited to vibration generated by impact equipment, especially pile drivers.

Most construction activities would only have the potential to generate low levels of groundborne vibration. Table III.I-13 (Vibration Source Levels for Construction Equipment) identifies various

vibration velocity levels for the types of construction equipment that would operate on the Project site during construction.

Table III.I-13 Vibration Source Levels for Construction Equipment

Equipment	Approximate VdB			
	25 Feet	50 Feet	75 Feet	100 Feet
Large Bulldozer	87	78	69	60
Loaded Trucks	86	77	68	52
Jackhammer	79	70	61	52
Small Bulldozer	58	49	40	31
Pile Driver (Impact)	112	103	94	85
Pile Driver (Sonic)	105	96	87	78

SOURCE: Federal Transit Administration, 2006.

Construction Impacts as to Vibration at Off-Site Vibration-Sensitive Receptors

Roadway improvements would occur off site near Candlestick Point, and as stated under Impact NO-1a, the construction activity associated with these improvements would occur within 25 feet of residential uses long Gilman Avenue, Carroll Avenue, and Ingalls Street. Off-site roadway improvements would utilize pavement crushers, loaders and graders, as well as water and haul trucks. Based on the vibration levels presented in Table III.I-13, and the diminishment of vibration levels at a rate of 9 VdB per doubling of distance, the approximate groundborne vibration levels experienced by adjacent sensitive uses due to construction activities occurring during off-site roadway improvements would be approximately 86 VdB during the off-site construction activities (vibration from loaded trucks), which exceeds the 80 VdB threshold and would be significant.

Construction activities at off-site vibration-sensitive receptors would be significant and unavoidable. Implementation of mitigation measure MM NO-1a.1 would reduce this impact by requiring that vibration-producing equipment be located as far away from sensitive receptors as practicable. Additionally, construction activities would only occur during the hours of 7:00 A.M. to 8:00 P.M. and construction activity would be intermittent and temporary in nature. Implementation of MM NO-1a.1 would reduce vibration impacts, but not to a less-than-significant level; therefore, this impact would remain significant and unavoidable.

Construction Impacts as to Vibration at Future On-Site Vibration-Sensitive Receptors

The construction of residential towers in Candlestick Point would be developed after the redeveloped residential uses in the Alice Griffith district are occupied. Construction of these residential towers would likely require pile-driving activities. The closest residential towers that would be constructed when the housing within the Alice Griffith district is occupied would be located in the southwestern portion of the CP North district, approximately 150 feet from the residential uses. As groundborne vibration levels attenuate at a rate of approximately 9 VdB per doubling of distance, it is estimated that vibration levels at the Alice Griffith Public Housing residential uses would be approximately 76 VdB. This would be below the 80 VdB threshold for human annoyance for infrequent events established in Table III.I-10. Pile

driving would also be required in the CP Center and CP South districts; however, these areas would be located farther than 150 feet from the Alice Griffith Public Housing residential uses. It is, therefore, anticipated that vibration levels would be lower than 76 VdB identified for the CP North district.

Additionally, activities that would not require pile driving but would be located closer to the Alice Griffith Public Housing residential uses would not result in vibration levels that would exceed the 80 VdB threshold established for this EIR. While construction of the low and medium density residential uses within the CP North district would be located within 50 feet of the Alice Griffith Public Housing residential uses, these activities would not result in groundborne vibration above 80 VdB. Based on the data presented in Table III.I-13, vibration from large bulldozers that may be utilized during excavation activities would be approximately 78 VdB, which would be below the 80 VdB threshold.

Pile driving would also be required in the CP Center and CP South districts after residential uses have been occupied in these districts; therefore, pile driving activities would also be located within 50 feet of occupied residential structures. As shown in Table III.I-10, pile driving activities would potentially result in groundborne vibration levels of approximately 103 VdB at the residential uses located in the CP Center and CP South. This impact would be considered potentially significant.

Pile driving activities would also be required for implementation of the shoreline improvements within Candlestick Point; however, as shown in Figure III.I-5, no vibration-sensitive uses are located within approximately 500 feet of the shoreline improvement areas. It is, therefore, anticipated that pile-driving activities associated with the shoreline improvements would not result in excessive vibration levels for vibration-sensitive receptors.

No other construction activities associated with Candlestick Point would result in vibration levels that would exceed the threshold for on-site residential uses that would be located in Candlestick Point or Alice Griffith district during construction. This impact is less than significant.

In order to reduce potential impacts from pile driving activities, the following mitigation measure has been identified.

MM NO-2a *Pre-construction Assessment to Minimize Pile Driving Impacts. The Project Applicant shall require its geotechnical engineering contractor to conduct a pre-construction assessment of existing subsurface conditions and the structural integrity of nearby buildings subject to pile driving impacts prior to receiving a building permit. If recommended by the geotechnical engineer, for structures or facilities within 50 feet of pile driving, the Project Applicant shall require groundborne vibration monitoring of nearby structures. Such methods and technologies shall be based on the specific conditions at the construction site such as, but not limited to, the following:*

- *Pre-pile driving surveying of potentially affected structures*
- *Underpinning of foundations of potentially affected structures, as necessary*
- *The construction plan shall include a monitoring program to detect ground settlement or lateral movement of structures in the vicinity of an excavation. Monitoring results shall be submitted to DBI. In the event of unacceptable ground movement, as determined by DBI inspections, all pile driving work shall cease and corrective measures shall be implemented. The pile driving program and ground stabilization measures shall be reevaluated and approved by DBI.*

In summary, construction activities at off-site vibration-sensitive receptors would be significant and unavoidable. Implementation of mitigation measure MM NO-1a.1 would reduce this impact by requiring that vibration-producing equipment be located as far away from sensitive receptors as practicable. Mitigation measure MM NO-1a.2 would also be implemented, which would also serve to reduce potentially significant vibration impacts by requiring pre-drilled holes and alternate methods for driving piles, such as a vibratory/sonic pile driver in order to reduce noise and vibration levels. However, these methods would not reduce impacts from pile driving activities to less-than-significant levels. As shown in Table III.I-13, vibration levels from vibratory pile driving methods would be approximately 96 VdB at distances of 50 feet. Implementation of mitigation measure MM NO-2a would require that buildings within 50 feet of pile driving activities be monitored to ensure that groundborne vibration does not result in damage to structures.

Similar to construction noise levels, the conditions under which vibration levels would be considered excessive during construction activities, such as excavation or pile driving, would only occur for the duration of the specified activity and would only impact receptors located within 100 feet or closer of the vibration producing activity. Once the vibration producing activities were completed, the affected receptors would no longer be impacted. Additionally, construction activities would only occur during the hours of 7:00 A.M. to 8:00 P.M. as required by Sections 2907 and 2908 of the Noise Ordinance. Implementation of MM NO-1a.1, MM NO-1a.2, and MM NO-2a would reduce vibration impacts, but not to a less-than-significant level; therefore, this impact would remain significant and unavoidable.

Impact of Candlestick Point in the Alice Griffith and Jamestown Districts

Impact NO-2b **Rock removal activities in the Alice Griffith and Jamestown districts would result in vibration levels that exceed the FTA threshold of 80 VdB or could cause damage to structures from vibration caused by the fracturing of bedrock for excavation. (Significant and Unavoidable with Mitigation)** ***[Criterion I.b]***

Construction activities that would occur within Candlestick Point, including the demolition and redevelopment of Alice Griffith Public Housing and within the Jamestown district would be located within 25 feet of existing residential uses along Gilman Avenue and Jamestown Avenue, respectively. Hard bedrock encountered at both sites during general excavation and grading would be removed utilizing heavy construction equipment. Heavy construction equipment rock removal methods include ripping (such as a Caterpillar D9 tractor with ripper attachment) and mechanical rock-breaking utilizing hammers, splitters or cutters. Harder areas of bedrock may require alternative techniques for removal such as controlled rock fragmentation. Controlled rock fragmentation technologies include pulse plasma rock fragmentation (PPRF), controlled foam or hydraulic injection and controlled blasting.

As detailed further in Section III.L, vibration impacts from either PPRF or CB may result in damage to adjacent structures due to these activities fracturing adjacent rock bed and causing settlement or shifting of the structures above. In order to ensure that this vibration-related impact is reduced to a less-than-significant level, mitigation measure MM GE-3a would be implemented and adjacent properties would be monitored during controlled rock fragmentation activities. With implementation of MM GE-3a, vibration from controlled rock fragmentation in the area would not cause damage to adjacent or nearby

properties. Consequently, vibration impacts to buildings and structures related to controlled rock fragmentation would be reduced to less-than-significant levels.

While PPRF and CB would not result in vibration-related impacts, the use of heavy construction equipment, such as a D-9 tractor, would potentially result in vibration levels that would exceed 80 VdB. As stated under Impact NO-1a.1, the demolition and redevelopment of the Alice Griffith Public Housing and the Jamestown district would be located within 25 feet of existing residential uses along Gilman Avenue and Jamestown Avenue, respectively. As shown in Table III.I-13, vibration levels from a large bulldozer (equivalent to a D-9 tractor) would be approximately 87 VdB at distances of 25 feet. While mitigation measure MM NO-1a.1 would reduce this impact by requiring that construction equipment be staged and operated as far from noise and vibration-sensitive uses as practicable, the excavation activity would occur within 25 feet of vibration-sensitive uses. Therefore, this impact would be significant and unavoidable.

Impact of Hunters Point Shipyard Phase II

Impact NO-2c **Construction at HPS Phase II would create excessive groundborne vibration levels in existing residential neighborhoods adjacent to the Project site and at proposed on-site residential uses should the latter be occupied before Project construction activity on adjacent parcels is complete. Although the Project's construction vibration impacts would be temporary, would not occur during recognized sleep hours, and would be consistent with the requirements for construction activities that exist in Sections 2907 & 2908 of the *Municipal Code*, vibration levels would be significant. (Significant and Unavoidable with Mitigation) *[Criterion I.b]***

Construction Impacts as to Vibration at Off-Site Vibration-Sensitive Receptors

Off-site roadway improvements to Innes Avenue would result in construction activities occurring within 25 feet of existing residential uses along Innes Avenue. As described under Impact NO-2a, the approximate groundborne vibration levels experienced by adjacent sensitive uses due to construction activities occurring during off-site roadway improvements would be approximately 86 VdB during the off-site construction activities (vibration from loaded trucks).

Construction of the proposed football stadium would require pile-driving activities. The closest off-site vibration-sensitive receptor to the proposed football stadium would be the residential uses located in HPS Phase I. These residential uses are located approximately 600 feet from the proposed stadium; therefore, as stationary vibration levels diminish by 9 dBA per doubling of distance, it is estimated that the greatest construction vibration levels (during pile driving activities) associated with construction of the stadium would be approximately 62.5 VdB, which is below the level of significance. Additionally, the elevated location of HPS Phase I would further reduce vibration levels from HPS Phase II construction activities.

Construction Impacts as to Vibration at Future On-Site Vibration-Sensitive Receptors

Construction of the residential and commercial uses in the HPS Village Center would include the HPS Phase II Geotechnical Subparcels) in Section III.L, these high-rise towers would require the construction

of deep foundations. The recommended construction method for these deep foundations would be to utilize pile drivers. The HPS Village Center would be located within 50 feet of the HPS North district residential uses, as shown in Figure II-4. As shown in Table III.I-13, vibration levels from pile driving activities could be as high as 103 VdB for the residential uses within the HPS North district. This is a potentially significant impact.

Groundborne vibration levels associated with off-site roadway improvements along Innes Avenue would be approximately 86 VdB due to the vibration from loaded trucks and bulldozers for grading. This would exceed the FTA's 80 VdB threshold for residential uses for infrequent events. Additionally, construction activities associated with development of the HPS Village Center district would result in vibration levels of approximately 103 VdB at the newly developed HPS North district residential uses.

Implementation of mitigation measure MM NO-1a.1 would help to reduce this impact by requiring that vibration-producing equipment be located as far away from sensitive receptors as practicable. Mitigation measure MM NO-1a.2 would also be implemented, which would also serve to reduce potentially significant vibration impacts by requiring pre-drilled holes and alternate methods for driving piles, such as a vibratory/sonic pile driver in order to reduce vibration levels. However, these methods would not reduce impacts from pile driving activities to less-than-significant levels. Implementation of mitigation measure MM NO-2a would require that buildings within 50 feet of pile driving activities be monitored to ensure that groundborne vibration does not result in damage to structures.

Similar to construction noise levels, the conditions under which vibration levels would be considered excessive during construction activities, such as excavation or pile driving, would only occur for the duration of the specified activity and would only impact receptors located within 100 feet of the vibration producing activity. Once the vibration producing activities were completed, the affected receptors would no longer be impacted. Additionally, construction activities would only occur during the hours of 7:00 A.M. to 8:00 P.M. as required by Sections 2907 and 2908 of the Noise Ordinance. Implementation of mitigation measures MM NO-1a.1, MM NO-1a.2, and MM NO-2a would reduce vibration impacts, but not to a less-than-significant level; therefore, this impact would remain significant and unavoidable.

Combined Impact of Candlestick Point and Hunters Point Shipyard Phase II

Impact NO-2 **Construction activities associated with the Project would create excessive groundborne vibration levels in existing residential neighborhoods adjacent to the Project site and at proposed on-site residential uses should the latter be occupied before Project construction activity on adjacent parcels is complete. Although the Project's construction vibration impacts would be temporary, would not occur during recognized sleep hours, and would be consistent with the requirements for construction activities that exist in Sections 2907 & 2908 of the *Municipal Code*, vibration levels would still be significant. (Significant and Unavoidable with Mitigation)** ***[Criterion I.b]***

Construction activities could also create excessive groundborne vibration levels in existing residential neighborhoods adjacent to the site and at proposed on-site residential uses, should the latter be occupied before construction activity on adjacent parcels is complete. Implementation of mitigation measures MM NO-1a.1, MM NO-1a.2, and MM NO-2a would require implementation of construction best

management practices, noise-reducing pile driving techniques as feasible, and monitoring of buildings within 50 feet of pile driving activities. Implementation of these measures would reduce vibration impacts, but not to a less-than-significant level as vibration levels from pile driving activities could be as high as 103 VdB for the residential uses within the HPS North District and the CP Center and South Districts when occupied. Additionally, excavation activities at the Alice Griffith area would result in vibration levels of approximately 87 VdB, due to the use of heavy construction equipment; therefore, this impact would remain significant and unavoidable, even with implementation of the identified mitigation measures.

Impact NO-3: Increases in Ambient Noise Levels

Impact NO-3 **Construction activities associated with the Project would result in a substantial temporary or periodic increase in ambient noise levels. (Significant and Unavoidable with Mitigation)** ***[Criterion I.d]***

Construction activities occurring within the Project site and in the Project vicinity for roadway and infrastructure improvements would involve demolition, grading, and excavation activities, followed by construction and external finishing of the proposed facilities and associated parking areas, as well as roadway and landscaping improvements. These activities would involve the use of heavy equipment. Pile driving activities would be required for development of the residential towers in the CP South district and the HPS North district, with noise levels of up to 107 dBA at a distance of 50 feet. Further, based on the noise levels presented in Table III.I-11, the approximate noise levels experienced by adjacent noise-sensitive uses due to construction activities occurring during off-site roadway improvements, which are conservatively assumed to be 50 feet from the proposed improvement activity, would be approximately 85 dBA during the loudest off-site activities (noise from a grader). Excavation activities at the Jamestown and Alice Griffith districts are estimated to be approximately 92 dBA for existing off-site receptors, due to the use of heavy construction equipment, such as D-9 Caterpillar Bulldozers.

Construction activities would also involve the use of smaller power tools, generators, and other equipment that generate noise. Each stage of construction would use a different mix of equipment, and noise levels would vary based on the amount and types of equipment in operation and the location of the activity related to potential receptors.

Mitigation measures MM NO-1a.1, MM NO-1a.2 and MM NO-2a have been identified to minimize or reduce construction related noise levels to the extent feasible. Implementation of mitigation measure MM NO-1a.1 would reduce this impact by requiring that noise-producing equipment be located as far away from sensitive receptors as practicable; however, construction activities would still occur within 25 feet of existing and future residential uses. Mitigation measure MM NO-1a.2 would also be implemented, which would also serve to reduce potentially significant vibration impacts by requiring pre-drilled holes and alternate methods for driving piles, such as a vibratory/sonic pile driver in order to reduce noise and vibration levels. However, these methods would not reduce impacts from pile driving activities to less-than-significant levels. As shown in Table III.I-11, noise levels during pile driving activities could reach up to 107 dBA at the existing residential use in the Project vicinity, or in the new residential uses developed during earlier phases of the Project. The construction contractor would be required to implement noise attenuation measures during pile driving activities, including but not limited to the

utilization of noise blankets, which would reduce noise levels up to 10 dBA. However, pile-driving and excavation activities would last throughout the 18-year construction phasing, and, therefore, this temporary increase in ambient noise levels would be noticeable and would likely be cause for human annoyance. Implementation of the above-mentioned mitigation measures would reduce the noise levels associated with impact the loudest construction activities identified above, but not to a less-than-significant level. Therefore, construction related temporary increases in ambient noise levels would be considered significant and unavoidable.

Operational Impacts

Impact NO-4: Exposure of Persons to Excessive Noise Levels

Impact NO-4 **Implementation of the Project, including the use of mechanical equipment or the delivery of goods, would not expose noise-sensitive land uses on or off site to noise levels that exceed the standards established by the City. (Less than Significant)** ***[Criterion I.c]***

Both Candlestick Point and HPS Phase II would include development of new commercial, retail, and residential uses. Daily operations of these uses would require mechanical cooling systems, deliveries of retail and commercial products and activities such as trash collection. These operational activities and systems would occur on a daily basis throughout the Project site once operational. Noise levels from these activities and systems would be similar throughout the entire Project site on a daily basis. It is anticipated upon build-out that the entire Project site would have a daily noise environment of a typical urban area with average noise levels ranging between 60 and 70 dBA.

Large-scale HVAC systems would be installed for the new residential, retail, and commercial buildings located on the Project site. Large HVAC systems associated with the residential, retail and commercial buildings can result in noise levels that average between 50 and 65 dBA L_{eq} at 50 feet from the equipment. As a project design feature, these HVAC units would be mounted within HVAC wells on the rooftops of the proposed buildings and would be screened with sufficient noise insulation by the walls and other building features, and, therefore, noise levels would not impact sensitive receptors on or off the Project site. Additionally, as additional project design features, noise from mechanical equipment associated with operation of the Project would be required to comply with Title 24 of the *California Building Code* requirements pertaining to noise attenuation, which requires that all multi-family residential units achieve an interior noise level of 45 dBA. Therefore, HVAC equipment would not be anticipated to produce noise levels that would be 5 dBA above the ambient noise level, which is the threshold under *Municipal Code* Section 2909(a).

Operation of the Project would also involve the delivery of goods and food stuffs to the commercial and retail operations associated with the Project, as well as refuse pick up for both the commercial and residential components. Two noise sources would be identified with delivery operations: the noise of the diesel engines of the semi-trailer trucks and the backup beeper alarm that sounds when a truck is put in reverse, as is required and regulated by Cal-OSHA. The noise generated by idling diesel engines typically ranges between 64 and 66 dBA L_{eq} at 75 feet. This noise would be temporary in nature, typically lasting no more than five minutes. Backup beepers are required by Cal-OSHA to be at least 5 dBA above

ambient noise levels. These devices are highly directional in nature, and when in reverse the trucks and the beeper alarm would be directed towards the loading area and adjacent commercial structures. Backup beepers are, of course, intended to warn persons who are behind the vehicle when it is backing up. Further, the loading docks associated with the Project would be screened from sensitive receptors both on site and off site by intervening structures and design of the loading spaces. In addition, noise generated by authorized City refuse collectors would be limited to 75 dBA per Section 2904 of the *Municipal Code*.

Daily operation of the Project such as loading dock activity, regional retail and other commercial activities would generate noise levels that are comparable to a typical urban environment. As such, mechanical systems, daily deliveries, and trash collection would not result in increases of 5 dBA over the anticipated ambient noise level. Therefore, the daily operational activity would not exceed the noise standards established by the *Municipal Code* and this impact would be considered less than significant. No mitigation is required.

Impact NO-5: Exposure of Persons to Excessive Vibration Levels

Impact NO-5 **Implementation of the Project would not generate or expose persons on or off site to excessive groundborne vibration. (Less than Significant)** ***[Criterion I.b]***

Typical background vibration levels in inhabited areas are about 50 VdB.[224] Such vibration background levels would be expected generally on the project site after the completion of all project-related construction activities. This is substantially less than the FTA's vibration impact threshold of 80 VdB for human annoyance. Ground-borne vibration resulting from operation of the Project would primarily be generated by trucks making periodic deliveries to the Project site (including, but not limited to, garbage trucks, freight trucks and moving trucks). However, these types of deliveries would be consistent with deliveries that are currently made along roadways in the Project vicinity to nearby commercial uses, and on site as a result of ongoing commercial and R&D operations, and would not increase groundborne vibration above existing levels. No substantial sources of groundborne vibration would be built as part of the Project; therefore, operation of the Project would not expose sensitive receptors on site or off site to excessive groundborne vibration or groundborne noise levels, and this impact would be less than significant. No mitigation is required.

Impact NO-6: Exposure of Persons to Excessive Noise Levels

Impact NO-6 **Operation of the Project would generate increased local traffic volumes that could cause a substantial permanent increase in ambient noise levels in existing residential areas along the major Project site access routes. (Significant and Unavoidable)** ***[Criterion I.c]***

The increase in traffic resulting from implementation of the Project and ambient growth over the next 20 years would increase the ambient noise levels at noise-sensitive locations along the major vehicular access routes to the Project site. Table III.I-14 (Modeled Noise Levels along Major Project Site Access Roads)

[224] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment* (May 2006), Figure 7-3.

identifies the changes in future noise levels along the study area roadway segments that have residential uses (and, therefore, are sensitive receptors). The noise levels identified in Table III.I-14 are presented in dBA L_{dn}. All future roadway analysis assumed completion of capital improvements as well as roadway improvement measures required as part of the Project's traffic mitigation measures as detailed in Section III.D (Transportation and Circulation).

Table III.I-14 Modeled Traffic Noise Levels along Major Project Site Access Roads

Roadway	*Land Use*	*Existing Noise Level*	*2030 Without Project*	*2030 With Project*	*Project-Related Increase*	*Allowable Increase*	*Significant Impact?*
Innes north of Carroll Avenue	Residential	53.3	60.9	60.9	0	2	No
3rd Street south of Carroll Avenue	Residential	62.8	67.3	68.3	1.0	1	No
Cesar Chavez Boulevard west of 3rd Street	Residential	59	63.5	63.5	0	2	No
Palou Avenue east of 3rd Street	Residential	56.8	61.6	62.1	0.5	2	No
Ingalls Street north of Carroll Avenue	Residential	56.7	61.7	63.1	1.4	2	No
Carroll Avenue east of 3rd Street[a]	Commercial	**52.6**	**53.8**	**58.1**	**4.3**	3	**Yes**
Gilman Avenue east of 3rd Street	Residential	**57.7**	**60.6**	**64.6**	**4.0**	2	**Yes**
Jamestown Avenue north of Harney Way	Residential	**51.4**	**55.5**	**61.2**	**5.7**	5	**Yes**
Harney Way west of Jamestown Avenue	Residential	52.6	59	59.6	0.6	3	No
Bayshore Boulevard north of Visitacion	Residential	65.1	68.5	68.6	0.1	1	No

SOURCE: PBS&J 2009

Noise model data sheets are available in Appendix I3 (Traffic Noise Model Output)

a. The land uses along Carroll Avenue are almost all commercial/industrial uses; the only exception is Alice Griffith Public Housing which is proposed for demolition and reconstruction and would be subject to Title 25 Noise Insulation Standards.

As stated in thresholds of significance, increases in ambient noise due to increases in Project-related traffic are based upon the FTA criteria specified in Table III.I-9. As baseline ambient levels increase, smaller and smaller increments are allowed to limit increases in community annoyance (e. g., in residential areas with a baseline ambient noise level of 50 dBA L_{dn}, a 5 dBA increase in noise levels would be acceptable, while at 70 dBA L_{dn}, only a 1 dBA increase would be allowed). Further, in order to demonstrate the Project's contribution to future noise levels, the baseline for traffic noise levels is the year 2030 without the Project compared to the year 2030 with the Project.

The greatest Project-related traffic noise increase (5.7 dBA L_{dn}) would occur along Jamestown Avenue, north of Harney Way. Additionally, two other roadway segments would experience substantial Project-related traffic noise level increases: Carroll Avenue, east of 3rd Street (4.3 dBA L_{dn}) and Gilman Avenue, east of 3rd Street (4.0 dBA L_{dn}). As shown in Table III.I-14, these increments are large enough to exceed the adopted threshold for a "substantial permanent increase" in traffic noise in residential areas. Figure III.I-6 (Project-Related Roadway Noise Level Increases) illustrates the roadways where noise levels would exceed the adopted threshold for a permanent increase in traffic noise.

Measures available to address significant traffic noise increases in these residential areas are limited. For example, the construction of continuous noise barriers at curbside along the entire length of the

SOURCE: PBS&J, 2009.

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FIGURE III.I-7 Candlestick Point — Hunters Point Shipyard Phase II EIR

PROJECT-RELATED ROADWAY NOISE LEVEL INCREASES

identified roadways would not be feasible because it would preclude residents' main vehicular access route to their homes and would conflict with the aesthetic character of the BVHP neighborhood by placing 6- to 8-foot-high cinder block walls in front of residential front yards. While exterior noise levels would exceed the thresholds established in this EIR, in order to reduce human annoyance at existing residential uses from permanent increases in ambient noise levels, acoustical testing and retrofitting the interior of such uses could potentially be performed to ensure that interior noise levels would not exceed 45 dBA. Investigation into the need for such acoustical upgrades would only be necessary for the residences along Gilman and Jamestown Avenues. The land uses along Carroll Avenue are almost all commercial/industrial uses (and, therefore, much less noise sensitive); the only exception is the existing Alice Griffith Public Housing at the west end of Carroll Avenue. But this residential use is proposed for demolition and reconstruction as part of the Project. As a multi-family residential use, the reconstructed Alice Griffith Public Housing residential uses would be required under California Noise Insulation Standards (Title 25) to ensure acceptable interior noise levels appropriate to its expected future noise exposure.

However, the ultimate feasibility and implementation of the noise insulation measures that would be required to reduce interior noise levels to 45 dBA would be dependent on factors that would be beyond the control of the City as the lead agency or the Project Applicant to guarantee. In order to implement an acoustical analysis and retrofitting program, the Project Applicant would have to gain to access to all potentially affected private residential units along the identified sections of Gilman and Jamestown Avenues, perform noise measurements and other tests within these private residential units, and install structural noise attenuation features and verify their effectiveness. Further, it is unknown whether the proper attenuation would be achievable at every impacted property. While double and triple paned windows would serve to reduce interior noise levels, due to the age of several structures, this may not be sufficient to reduce noise levels. Additionally, it is unlikely that many of these structures have air conditioning or other internal cooling mechanisms, and as such, open windows provide the main source of ventilation and cooling for these structures. Therefore, the residents would be required to choose between open windows for ventilation or closed windows for sound attenuation. In some cases, the structure may have to be entirely rebuilt in order to achieve the proper attenuation level.

Additionally, as shown in Table III.I-14, the change from current noise levels to 2030 without the Project is greater than 3 dBA for all roadway segments except for Carroll west of 3rd Street. In fact, along Innes north of Carroll Avenue the "without project" increase is 7.6 dBA, while the "with project" increase is 0.0 dBA. As such, it would be difficult to determine the ultimate contribution of the Project to the increase in ambient noise levels in a manner that would not unfairly burden this Project with reducing interior noise levels in existing residential uses. Therefore, as measures to reduce this impact would be considered infeasible, this impact would be considered significant and unavoidable. It should also be noted that the project future increase with the project would not result in a 24-hour community noise level above an estimated 68.6 dBA $L_{dn.}$ As shown in Table III.I-1, this would be within the range typical of a urban environment.

Further, while an acoustical and retrofitting program could reduce interior noise levels in some affected residential structures, if feasible, the exterior noise level increase would still exceed the threshold of significance established in this EIR, even with implementation of an acoustical and retrofitting program.

Impact NO-7: Exposure of Persons to Excessive Noise Levels

Impact NO-7 **Noise during football games and concerts at the proposed stadium would result in temporary increases in ambient noise levels that could adversely affect surrounding residents for the duration of a game or concert. (Significant and Unavoidable with Mitigation)** ***[Criterion I.d]***

Although the current stadium exists at Candlestick Point, this analysis recognizes that the proposed location on HPS Phase II could result in noise impacts on different and new receptors. This impact analysis is based upon the findings presented in the *Bayview DEIR San Francisco 49ers Stadium Operational Noise Study*, prepared by Wilson, Ihrig & Associates.

There are two general sources of noise during football games/concerts in the stadium that could produce noise that affects the surrounding community:

- The game spectators/concert audience
- Amplified speech and music broadcast over the stadium/concert sound system

There would also be event day changes to the traffic flows, with consequent changes in traffic noise levels and patterns, in the community. However, the traffic noise levels in the community during a game or concert day were not modeled for the following reasons:

- The percentage of game/concert attendees using local transit service and the site's improved connectivity to regional transit service are expected to increase from 19 percent under existing conditions to 25 percent.
- Levels of background traffic (i.e., motor vehicle use by local residents and others non-game attendees) using local streets would be suppressed due to avoidance of the area during a game/concert day.
- Since game/concert traffic would be temporally concentrated during the few hours before and after such events, such congestion would reduce the average traffic speeds with consequent lowering of traffic noise emissions.

Thus, the traffic noise levels presented above in Table III.I-14 for a non-event weekday could be considered upper bounds for the location and degree of traffic noise impacts on an event day and the potential significance of their cumulative impacts will be considered further below.

Unlike noise in the existing residential neighborhoods surrounding the stadium site, which is typically dominated by transportation sources that have a predictable pattern day-to-day and year-to-year, game/concert noise would occur on only a few days per year and would last only a few hours on those days, although it would be much louder than the current background noise in the immediate vicinity of the stadium than on non-game and non-concert days. For the purposes of this EIR, and as stated under the Significance Criteria for this section, an increase in community noise levels exceeding 65 L_{dn} at a noise-sensitive receptor, or an L_{max} increase above 75 dBA at a noise-sensitive receptor would be considered a significant impact.

Noise intensity during games/concerts, its variation over time, and the duration of games/concerts are important with regard to determining noise impacts. A 3-D computer noise model was developed using SoundPLAN® to estimate game/concert noise levels in the surrounding community. As shown in

Figure III.I-1, the model receivers (i.e., R1 through R6) were located at representative locations in the potentially affected existing residential areas near the project site, which are the same locations as the long-term noise monitoring sites (i.e., N1 through N6). The following new receivers were added to the noise model:

- R7 on Coleman Street at the proposed Project's new residential development closest to the stadium (mixed use at the HPS Village Center district)
- R8 at the closest point to the proposed Project's HPS Phase II Residential Density III area (HPS North district)
- R9 on Palou Avenue and Lane Street in the BVHP neighborhood
- R10 on Bayview Circle near Newhall Street in the BVHP neighborhood

Wind effects can increase noise levels downwind of a noise source, while reducing noise levels upwind. The prevailing winds for the Project study area originate from the west, northwest, or west-northwest directions, which would be acoustically favorable for neighborhood receivers and could reduce noise levels from the stadium as they would "carry" the noise over the San Francisco Bay. However, "no wind" conditions were chosen for modeling purposes to produce worst-case noise levels in the surrounding neighborhood.

A temperature inversion is a reversal of the normal atmospheric temperature gradient (i.e., lower temperature with increasing height above the ground). This can cause increased noise levels at distant receivers. Temperature inversion effects are difficult to model accurately and were not included in SoundPLAN® for this study.

Modeling of Crowd and Public Address System Noise Levels

Potential noise impacts associated with noise from the crowd and the proposed stadium's sound system were evaluated for a typical full-capacity football game. Projections assume a typical game is on the order of three hours with crowd and/or public address system (PA) noise sustained at typical maximum levels for an aggregate 45 minutes over the 3-hour period.

For each noise source, estimates were made for typical maximum noise levels (L_{max}) and the day night level (L_{dn}) for a typical game day. The game day L_{dn} calculations are based on a noise energy summation of the existing ambient hourly L_{eq} noise levels at each location (i.e., as measured or extrapolated from measured data) and the projected game noise levels at that location. The L_{dn} calculations assume typical games would be during evening hours and would not continue past 10:00 P.M., which could substantially affect the L_{dn}, as this noise scale is adjusted to account for some individuals' increased sensitivity to noise levels during the evening and nighttime hours. Thus, game delays or other reasons for game operations continuing past 10:00 P.M. would increase the potential for noise impacts.

Table III.I-15 (Predicted Crowd and PA Combined Noise Levels [No Wind Condition]) present the modeling results for combined crowd noise and PA system noise. The combined noise levels are slightly higher than the larger of the crowd or PA noise level components, but present a more conservative estimate, which would vary at each receiver location. The location of the model receiver locations is illustrated by Figure III.I-7 (3-D Computer Noise Model).

Table III.I-15 Predicted Crowd and PA Combined Noise Levels (No Wind Condition)

Model Receiver	*Distance from proposed Stadium(miles)[a]*	*L_{max} (dBA)[b]*	*Game Day L_{dn}[c]*	*L_{dn} Increase over Existing[d]*	*Proposed Criteria Exceeded*
R1	1.0	61	63 to 67	<1 dBA	None
R2	1.0	64	63 to 65	<1 dBA	None
R3	0.3	**76**	**62 to 65**	**3 to 4 dBA**	**65 L_{dn}, 75 dBA L_{max}**
R4	0.7	66	65 to 66	<1 dBA	None
R5	0.9	62	62 to 65	<1 dBA	None
R6	1.4	58	59 to 60	<1 dBA	None
R7	0.2	**83**	**69**	**7 to 9 dBA**	**65 L_{dn}, 75 dBA L_{max}**
R8	0.3	**78**	**64 to 66**	**4 to 6 dBA**	**65 L_{dn}, 75 dBA L_{max}**
R9	1.3	55	63 to 65	<1 dBA	None
R10	1.6	57	65 to 66	<1 dBA	None

SOURCE: Wilson, Irhig & Associates, 2009.

a. Approximate distance to center of stadium.

b. L_{max} was estimated by SoundPLAN® and represents anticipated typical maximum noise levels expected during football games.

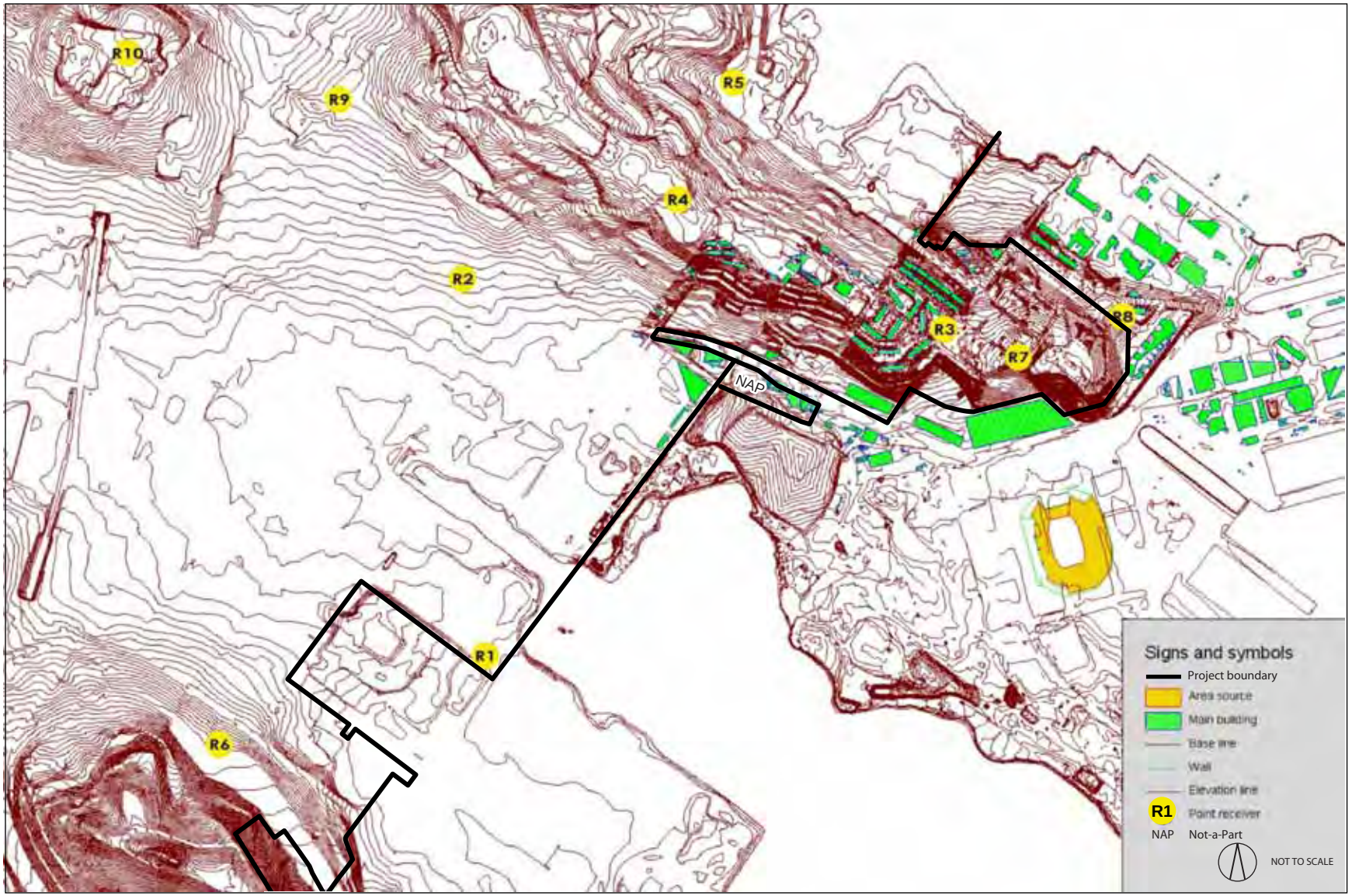
c. Based on noise energy summation of measured or assumed ambient plus SoundPLAN® predicted game noise levels.

d. Relative to representative ambient data.

The modeled noise impacts would occur at:

- R3, which is representative of the existing Hunters Point Hill residential neighborhood closest to the stadium. Here combined noise sources would increase the existing L_{dn} by 3 to 4 dBA, to a resultant L_{dn} as high as 65 dBA, while game-day maximum noise levels could be as high as 75 dBA. Thus, there is the potential to equal the L_{dn} impact criterion of 65 dBA and exceed the L_{max} criterion of 75 dBA at this location.
- R7, which is representative of the new residential development located in Hunters Point Phase I closest to the stadium (but not part of the Project). Here combined noise sources would increase the existing L_{dn} by 7 to 9 dBA, to a resultant L_{dn} as high as 69 dBA, while game-day maximum noise levels could be as high as 83 dBA. Thus, there is the potential to exceed both the L_{dn} and L_{max} criteria at this location.
- R8, which is representative of new Project residential use in the HPS North district, closest to the stadium. Here combined noise sources, would increase the existing L_{dn} by 4 to 6 dBA, to a resultant L_{dn} as high as 66 dBA, while game-day maximum noise levels could be as high as 78 dBA. Thus, there is the potential to exceed both the L_{dn} and L_{max} criteria at this location.

In general, potential football game noise impacts would be limited to areas near the stadium (i.e., within about 3,300 ft. from the stadium). In more distant areas, it is not likely that game operational levels would exceed the 65 dBA L_{dn} or the 75 dBA L_{max} noise impact criteria. However, for the existing residential uses closest to the proposed stadium (as characterized by Receiver R3) and possibly for the new residential uses closest to the proposed stadium (as characterized by Receivers R7 and R8) there would be significant noise impacts during football game days.



SOURCE: WILSON, IHRIG & Associates, Inc.

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FIGURE III.I-7

Candlestick Point — Hunters Point Shipyard Phase II EIR

3-D COMPUTER NOISE MODEL

Although game noise would not exceed the above-mentioned significance criteria outside a 3,300-foot radius from the stadium, there would be a potential for audibility at greater distances from noise generated during football games when background ambient noise in the neighborhoods is low (i.e., whenever the A-weighted game noise level is equal or greater than the A-weighted community background noise level, L_{90}). However, audibility alone is not sufficient for a finding of significance in this EIR. Candlestick Park is currently used for football games. Noise from 49er home games are audible over a wide area that would largely overlap with the area of audibility of football games played at the proposed stadium. Consequently, football game noise is already part of the existing ambient condition in the residential neighborhoods north and west of the Project site.

Nevertheless, the potential for football game noise to be easily detectable both outdoors and indoors was modeled and the results shown in Table III.I-16 (Audibility of Game Noise at Model Receivers). Crowd noise that is less than the background L_{90} would be masked at least 90% of the time, while crowd noise that exceeds the L_{10} would be easily detectable at least 90 percent of the time. Crowd noise would be easily detectable outdoors at times at distances up to about 1.6 miles from the stadium. Also, game L_{max} would exceed ambient background levels (i.e., L_{90}) at all modeled receivers by 8 dBA or more at all modeled receivers; this would equal or exceed the 8 dBA noise limit set by the San Francisco Noise Ordinance (Section 2909b). As for interior effects, assuming a 15 dBA nominal exterior-to-interior noise reduction provided by the building shell, which is typical for single family homes without special acoustical mitigation, maximum game noise levels would be audible indoors at times at Receivers R1, R2, R4, and R5. The location of the model receiver locations is illustrated by Figure III.I-7.

Table III.I-16 Audibility of Game Noise at Model Receivers

Model Receiver	*Distance from proposed Stadium (miles)*	*Exterior Ambient L_{10} (dBA)*	*Exterior Ambient L_{50} (dBA)*	*Exterior Ambient L_{90} (dBA)*	*Exterior Game L_{max}*	*Detectable Outdoors?*	*Interior Game L_{max} (dBA)*	*Detectable Indoors?*
R1	1.0	52 to 55	44 to 48	42 to 45	61	At least 22.5% of the time	46	**Yes**
R2	1.0	60 to 64	48 to 53	45 to 47	64	At least 12.5% of the time	49	**Yes**
R4	0.7	60 to 63	48 to 52	44 to 46	66	At least 12.5% of the time	51	**Yes**
R5	0.9	61 to 63	47 to 50	43 to 44	62	At least 12.5% of the time	47	**Yes**
R6	1.4	58 to 62	49 to 50	45 to 46	58	At least 12.5% of the time	43	No
R9	1.3	60 to 64	48 to 53	45 to 47	55	At least 2.5% of the time	40	No
R10	1.6	60 to 63	48 to 52	44 to 46	57	At least 2.5% of the time	42	No

SOURCE: Wilson, Irhig & Associates, 2009.

a. Ranges of "Exterior Ambient" for L_{10}, L_{50} and L_{90} are representative of afternoon or evening hours when games are most likely to occur.

b. Judgment of "Detectability" is based on comparisons of game L_{max} with an assumed indoor ambient background noise level of 45 dBA.

Modeling of Concert Noise Levels

The proposed stadium may be used occasionally as a venue for popular music concerts performed in front of a large audience. The sound system used for such a concert would not be the one permanently installed at the proposed stadium, but one specifically designed for and temporarily installed by each touring band.

The typical stage configuration during concerts would likely have the stage in the end zone for large events or at the 50-yard line for smaller shows. The noise impacts associated with large events were analyzed since this represents a worst-case condition for concert noise levels. Although the stage could be located at either end of the field (north or south), it was assumed the stage would be at the northern end of the field pointing south. In this way, most of the sound would be projected towards the Bay and away from residences.

Noise levels from a music concert would fluctuate greatly depending on the type of music being performed (e.g., rock, pop, hip-hop, etc.) and on the performers' preferred style of loudness. The latter affects the sound power settings used for the event. The loudness is also related to the size of the venue and to some degree the size of the audience. To address the variable range of music genre possible, recorded music samples were used to obtain sound spectra for rock and hip-hop music as two different styles of music that might use the Stadium as a concert venue. Other styles of music would generally be less percussive and, therefore, presumably have less of an impact on the surrounding community.

Table III.I-17 (Predicted Concert Sound System Noise Levels) present the modeling results for concert noise. Unless mitigations were implemented for the existing residential uses closest to the proposed stadium (as characterized by Receiver R3) and possibly for the new residential uses closest to the proposed stadium (as characterized by Receivers R7 and R8), there would be a potential for significant Project-induced concert noise impacts.

Table III.I-17 Predicted Concert Sound System Noise Levels

Model Receiver	*Distance (miles)*	*L_{max} (dBA)*	*L_{max} (dBC)*	*Concert L_{dn} (dBA)*	*L_{dn} Increase over existing (dBA)*	*Proposed Criteria Exceeded*
R1	1.0	57	78	63 to 67	< 1 dBA	None
R2	1.0	63	83	64 to 65	<1 to 1 dBA	None
R3	0.3	72	92	63 to 65	**3 to 5 dBA**	**65 L_{dn}**
R4	0.7	64	84	65 to 67	< 1 to 1 dBA	None
R5	0.9	63	82	62 to 65	< 1 dBA	None
R6	1.4	56	76	59 to 60	< 1 dBA	None
R7	0.2	75	95	65 to 67	**5 to 7 dBA**	**65 L_{dn}**
R8	0.3	63	83	59 to 63	1 dBA	None
R9	1.3	56	76	63 to 65	< 1 dBA	None
R10	1.6	58	78	65 to 66	< 1 dBA	None

SOURCE: Wilson, Irhig & Associates, 2009.

As with football game noise, there would also be a potential for outdoor audibility of concert noise at all receivers modeled, and for indoor audibility at distances up to 1.0 mile from the proposed Stadium. Also, game L_{max} would exceed both A-weighted and C-weighted ambient background levels at all modeled receivers by at least 8 dBA or 8 dBC, respectively; this would equal or exceed the noise limits set by the San Francisco Noise Ordinance (Section 2909b).

MM NO-7.1 *Mitigation to Minimize Game/Concert-related Temporary Increases in Ambient Noise Levels at Nearby Residences. To ensure that stadium game-and event-induced interior L_{max} noise levels do not exceed an interior noise level of 60 dBA and interfere with speech and other indoor activities in the existing Hunters Point Hill residential community closest to and north of the proposed Stadium (i.e., as identified by the R3 stadium noise model receiver), the Stadium Operator shall:*

- *After certification of the EIR, send notification of the establishment of a stadium noise mitigation program (SNMP) to the residential property owners in the identified neighborhood potentially affected by noise from the proposed Stadium*
- *Allow property owners an appropriate time after the date of notification about the SNMP to apply for the program, with a reminder sent to the owners before the end of the application period*
- *Determine if responding property owners meet qualifications*
- *Compile for property-owners reference and send to them a summary of standard types of structural acoustical mitigations*
- *Choose a qualified acoustical consultant to survey the potentially affected residential units and recommend sound reduction measures appropriate to offset the modeled stadium noise impacts, which may include:*
  - *Acoustical upgrades to windows and doors*
  - *Acoustical stripping around doors and other openings*
  - *Ventilation improvements*
- *Estimates cost of recommended sound reduction measures, which shall include labor and materials, permit fees, and City inspections; material costs will, as much as possible, be based on "like-for-like", that is, for replacement of existing materials similar in quality or appearance*
- *Pay each qualifying property owner the amount of this estimate after obtaining a release from future claims for stadium event noise impacts at each property with each property owner responsible for implementing the sound reduction improvements*
- *Establish an ad hoc community working group of neighbors to develop a mediation process should any future disputes arise over the effectiveness of the SNMP in eliminating stadium noise intrusions*

MM NO-7.2 *Residential Use Plan Review by Qualified Acoustical Consultant. To ensure that stadium game-and event-induced interior L_{max} noise levels do not exceed an interior noise level of 60 dBA and interfere with speech and other indoor activities in the proposed on-site residential uses closest to the proposed Stadium, the Stadium Operator shall choose a qualified acoustical consultant to review plans for the new residential uses planned for areas closest to the proposed Stadium and follow their recommendations to provide acoustic insulation or other equivalent measures to ensure that interior peak noise events would not exceed 60 dBA L_{max}.*

Unless mitigations were implemented for the residential uses that would be impacted as represented by modeling location R3, there would be a potential for significant stadium induced noise impacts during

football games and concerts at this location. Implementation of mitigation measure MM NO-7.1 would ensure that these residential uses do not experience game/concert-related transient increases in ambient noise levels within their homes that would exceed 60 dBA L_{max}. Mitigation measure MM NO-7.2 would be implemented for new residential uses associated with the HPS Phase II site located in proximity of the proposed Stadium. Implementation of mitigation measure MM NO-7.2 would ensure that new residential uses at the HPS Phase II site would not experience noise levels associated with the Stadium uses that would interfere with regular interior activities, including speech and sleep.

However, the ultimate feasibility and implementation of the noise insulation measures recommended under mitigation measure MM NO-7.1 would depend on factors that would be beyond the control of the City as the lead agency, or the Project Applicant to guarantee. Implementation of mitigation measure MM NO-7.1, would require access all potentially affected residential units at the identified location outside of the Project site, performance of noise measurements and other tests within these private residential units, installation of structural noise attenuation features and verification of the effectiveness of the installed noise attenuation features during football games and concerts at the proposed Stadium. Further, installation of such noise attenuation features may not be practicable or possible at all locations due to the age and integrity of the residential structures as noted under Impact NO-6. Therefore, as the ultimate feasibility and practicality of mitigation measure MM NO-7.1 cannot be guaranteed at this time, noise impacts from football games and concerts this impact would be considered as significant and unavoidable.

Impact NO-8: Exposure of Persons to Excessive Noise Levels

Impact NO-8 **Implementation of the Project would not expose residents and visitors to excessive noise levels from flights from San Francisco International Airport such that the noise would be disruptive or cause annoyance. (Less than Significant)** ***[Criteria I.e, I.f]***

The Project would not expose people living or working on site to excessive noise from commercial aircraft overflights associated with SFO operations. As shown on Figure III.I-3, the Project site is well outside SFO's existing 65 dBA CNEL contour and is expected to remain outside this contour for the foreseeable future, which the FAA regards as an impact threshold for noise-sensitive land uses (i.e., residential). Although the Project site is under some of the main aircraft approach and departure tracks, these flights all pass over the site at considerable altitude. The typical SEL associated with such overflights (as observed during the football game noise measurements conducted at Candlestick Park) would be in the low 70s dBA. Given the 20 to 30 dBA of acoustic insulation that would be typical for the new residential uses that would be built as part of the Project, the expected daily/nightly sleep disturbance probability in the residential interiors would be very low even with the relatively large number of daily flight operations typical for SFO. Additionally, a review of *Airport Director's Reports* from the past 6 months indicates that no complaints were received from BVHP neighborhood residents regarding aircraft noise. Therefore, this impact would be considered less than significant. No mitigation is required.

Cumulative Impacts

The geographic context for an analysis of cumulative impacts with regard to noise and vibration is limited to the immediate vicinity of the Project. This is due to the dissipation of noise and vibration with the increase of distance between receptors and noise sources. Noise impacts from cumulative development in the Project area can be largely attributed to an increase in vehicular traffic that is generated by the development both within and in the immediate vicinity of the Project, as well as noise generated from the use of the proposed stadium as included in the Project. The past and present development in the City is described in the Setting section of this chapter, representing the baseline conditions for evaluation of cumulative impacts. The noise assessment relies on the future transportation projections, which reflect the traffic Project and reasonably foreseeable background growth and development within the study area as well as modeled noise from stadium activities. Therefore, the analysis as conducted in Section III.I covers both Project-specific and cumulative impacts.

Construction activities include pile driving, which can reach levels up to 107 dBA L_{eq} at existing residential uses in the Project vicinity, and because these activities would be periodic throughout the 20-year construction phasing, thereby noticeably increasing ambient noise levels likely resulting in human annoyance, construction-related temporary increases in ambient noise levels would be considered significant and unavoidable. As discussed in Section III.I, construction activities would implement noise attenuation measures including, but not limited to, limiting the hours when pile driving can occur to the daytime (i.e., 7:00 A.M. to 8:00 P.M.) and the utilization of noise blankets, which could reduce noise levels up to 10 dBA. Although the implementation of mitigation measures would reduce the noise levels associated with pile-driving activities and limit the time of day that the noise could occur, it would not be reduced to a less-than-significant level. Therefore, because pile-driving activities would be periodic over a 20-year period, and may overlap with other nearby construction activities during Project development, construction-related temporary increases in ambient noise levels would be considered cumulatively significant and unavoidable.

After construction is complete, Project operation would create a substantial, permanent increase in traffic noise levels that would affect existing and future residential uses along all Project site access roads. These noise increases, as modeled on ten of the major site access roads, are expected to raise ambient noise levels by between 3.5 dBA L_{dn} to 9.8 dBA L_{dn} above the existing ambient levels, as shown in Table III.I-18 (Modeled Cumulative Traffic Noise Levels along Major Project Site Access Roads).

In addition, the operation of the stadium for both football games and concerts are anticipated to result in increases of ambient noise levels during these events that would be up to 9 dBA L_{dn} above the existing ambient levels at locations near the proposed Stadium, and at lesser but audible levels at distances at least within 2 miles of this facility.

Conducting the acoustic studies and implementing their recommendations as proposed above could not guarantee that either traffic and stadium event noise impacts would be reduced to an individually less-than-significant level. Further, at many noise-sensitive locations in the project site vicinity, traffic noise, stadium event noise and noise from other sources identified above would be additive. Thus, project operational noise from each identified sources category would be cumulatively considerable and their collective impacts would be cumulatively significant and unavoidable.

Table III.I-18 Modeled Cumulative Traffic Noise Levels along Major Project Site Access Roads

Roadway	Land Use	Existing Noise Level	2030 Without Project	2030 With Project	Cumulative Increase	Allowable Increase	Significant Cumulative Impact?
Innes north of Carroll Avenue	Residential	53.3	60.9	60.9	7.6	5	**Yes**
3rd Street south of Carroll Avenue	Residential	62.8	67.3	68.3	**5.5**	2	**Yes**
Cesar Chavez Boulevard west of 3rd Street	Residential	59	63.5	63.5	4.5	3	**Yes**
Palou Avenue east of 3rd Street	Residential	56.8	61.6	62.1	5.3	3	**Yes**
Ingalls Street north of Carroll Avenue	Residential	56.7	61.7	63.1	6.4	3	**Yes**
Carroll Avenue east of 3rd Street	Residential	**52.6**	**53.8**	**58.1**	**5.5**	5	**Yes**
Gilman Avenue east of 3rd Street	Residential	**57.7**	**60.6**	**64.6**	**6.9**	3	**Yes**
Jamestown Avenue north of Harney Way	Residential	**51.4**	**55.5**	**61.2**	**9.8**	5	**Yes**
Harney Way west of Jamestown Avenue	Residential	52.6	59	59.6	7.0	5	**Yes**
Bayshore Boulevard north of Visitacion	Residential	65.1	68.5	68.6	**3.5**	1	**Yes**

SOURCE: PBS&J, 2009.

As with their noise impacts, the pile-driving activities during construction have the potential to cause vibration effects that would be considered significant. Due to the construction phasing, it is possible that pile driving and other heavy construction equipment would operate on multiple sites and collectively result in vibration impacts in excess of 85 VdB at nearby sensitive receptors Implementation of Best Management Practices could reduce the severity of potential impact, but could not guarantee a less-than-significant level. Therefore, impacts for vibration from the 20-year construction schedule would remain cumulatively significant and unavoidable.

Vibration sources anticipated with the operation of the Project could occur from trucks, buses, and light-rail vehicles entering the Project site. These vehicles would not be expected to exceed 85 VdB FTA threshold individually nor collectively act to produce an exceedance of this threshold. Also, there are no substantial fixed sources of groundborne vibration included as part of Project development; therefore, impacts from operational groundborne vibrations are anticipated to be cumulatively less than significant.