3.8 NOISE

Introduction

This section describes the ambient, or background, noise conditions in the vicinity around the Project area and key noise sources (primarily traffic noise along Bayfront Expressway and Willow Avenue) that contribute to those ambient conditions. This section also evaluates the potential for noise and ground-borne vibration impacts resulting from construction and operation of the Project. More specifically, the evaluation addresses the potential for the Project to cause a substantial temporary and/or permanent increase in ambient noise levels in the vicinity of the Project area. In addition, the analysis considers whether the Project would cause exposure to off-site residents and schools (e.g., in the Belle Haven neighborhood) or nearby businesses to noise levels or ground-borne vibration in excess of standards established in the City of Menlo Park General Plan (General Plan) and Noise Ordinance, or any other applicable standards.

Issues identified in response to the Notice of Preparation (NOP) (Appendix 1) were considered in preparing this analysis. The main issue that was identified pertains to traffic noise generated by the Project. This issue is addressed in the section.

Applicable Plans and Regulations

Local

City of Menlo Park General Plan. The California Government Code requires that a noise element be included in the general plan of each county and city in the State. The noise element establishes the local government's goals, objectives, and policies relating to noise control.

The Noise Element of the General Plan[1] establishes goals and policies for assuring that existing and proposed land uses are compatible with their noise environments. To this end, the City has adopted quantitative exterior noise compatibility criteria for various land uses. The purpose of these criteria is to reduce the potential adverse effects of noise on people, including sleep disturbance, interference with speech communication, and the general sense of dissatisfaction that is often associated with high noise exposure. Under the City's Noise Element, noise levels up to 60 dBA Community Noise Equivalent Level (CNEL) are considered normally acceptable for residential and hotel uses, while noise levels are conditionally acceptable up to 70 dBA CNEL for these uses, as long as noise insulation features are included in the design to reduce interior noise levels. For parks, noise levels up to 60 dBA CNEL are normally acceptable and 65 dBA are conditionally acceptable. For office and industrial uses, noise levels up to 70 dBA CNEL are considered normally acceptable, and 75 dBA CNEL are conditionally acceptable.

The Noise Element aims "to prevent the escalation of noise levels in areas where noise-sensitive uses are located," and requires that pre-development environmental studies "analyze in detail the potential

[1] City of Menlo Park, Menlo Park General Plan, Noise Element, adopted November 14, 1978.

noise impacts of any actions that the City may take or act upon which could significantly alter noise levels in the community."

The following goal and policies from the Noise Element of the City's General Plan pertain to the Project.

> **Goal:** To prevent the escalation of noise levels in areas where noise-sensitive uses are located.
>
> *Policy:* Analyze in detail the potential noise impacts of any actions that the City may take or act upon which could significantly alter noise level in the community.
>
> *Policy:* Encourage creative solutions when potential conflicts between noise levels and land use arise.
>
> *Policy:* Control unnecessary, excessive and annoying noises within the City where not preempted by Federal or State control.
>
> *Policy:* Enforce applicable Federal and State laws.

City of Menlo Park Municipal Code. In addition to the General Plan, noise regulations are also contained in the City of Menlo Park Municipal Code (Municipal Code). Chapter 8.06 of the Municipal Code contains noise limitations and exclusions for land uses within the City. The Noise Ordinance addresses noise limits that would constitute a noise disturbance, primarily as measured on residential land uses. The following regulations would be applicable to the Project:

8.06.030 Noise Limitations

a. Except as otherwise permitted in this chapter, any source of sound in excess of the sound level limits set forth in Section 8.06.030 shall constitute a noise disturbance. For purposes of determining sound levels from any source of sound, sound level measurements shall be made at a point on the receiving property nearest where the sound source at issue generates the highest sound level.

    1. For all sources of sound measured from any residential property:

        A. "Nighttime" hours—fifty (50) dBA

        B. "Daytime" hours—sixty (60) dBA

8.06.040 Exceptions

a. Construction Activities

    1. Construction activities between the hours of eight (8) a.m. and six (6) p.m. Monday through Friday.

    4. Notwithstanding any other provision set forth above, all powered equipment shall comply with the limits set forth in Section 8.06.040(b).

b. Powered Equipment

1. Powered equipment used on a temporary, occasional or infrequent basis operated between the hours of eight (8) a.m. and six (6) p.m. Monday through Friday. No piece of equipment shall generate noise in excess of eighty-five (85) dBA at fifty (50) feet.

c. Deliveries

1. Deliveries to food retailers and restaurants.
2. Deliveries to other commercial and industrial businesses between the hours of seven (7) a.m. and six (6) p.m. Monday through Friday and nine (9) a.m. to five (5) p.m. Saturdays, Sundays and holidays.

8.06.050 Exemptions

a. Sound Generated by Motor Vehicles. Sound generated by motor vehicles, trucks and buses operated on streets and highways, aircraft, trains, and other public transport.

1. This exemption shall not apply to the operation of any vehicle including any equipment attached to any vehicle (such as attached refrigeration and/or heating units or any attached auxiliary equipment) for a period in excess of ten (10) minutes in any hour while the vehicle is stationary, for reasons other than traffic congestion.

Existing Conditions

Fundamentals of Sound and Environmental Noise

Sound. Sound is created when objects vibrate, resulting in air pressure variations characterized by their amplitude (loudness) and frequency (pitch). The standard unit of sound amplitude is the decibel (dB).[2] The pitch of the sound is related to the frequency of the pressure variation. The human ear's sensitivity to sound is frequency dependent. The A-weighted decibel scale ("dBA") modifies the dB levels to better approximate the frequencies heard by a human ear.

Environmental Noise. Noise is "unwanted" sound. A typical noise environment consists of a base of steady "background" noise that is the sum of many distant and indistinguishable noise sources. Superimposed on this background is the noise from individual distinguishable local sources, such as aircraft overflights or traffic on adjacent roadways. Table 3.8-1 identifies representative environmental noise levels.

[2] The decibel scale is logarithmic rather than arithmetic. In an arithmetic sequence, the numbers in the sequence follow a pattern of adding a fixed number from one number to the next in the sequence. For example, in the following sequence, the number 3 is added from one number to the next: 1, 4, 7, 10, 13. In a logarithmic sequence, the numbers in a sequence represent a fixed base number raised by consecutive exponents. Because the base is multiplied by exponents, the difference between numbers in the sequence is not constant. For example, the logarithm of 10 to base 10 is 1, the logarithm of 100 to base 10 is 2, and the logarithm of 1000 to base 10 is 3. So this sequence to base 10 would be: 10, 100, 1000. When adding two noise sources, the noise levels cannot be added arithmetically. Two noise sources generating 65 dBA do not result in a nose level of 130 dBA. A doubling of sound level results in an increase in sound level of 3 dBA.

Table 3.8-1
Representative Environmental Noise Levels

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

Source: California Department of Transportation (Caltrans), Technical Noise Supplement to the Traffic Noise Analysis Protocol, October 1998.

Several descriptors are commonly used to gauge the noise exposure of individuals and communities. These descriptors are sensitive to noise intensity over time and, in some cases, to the time of day when the noise occurs. Those that are applicable to this analysis are described below.

- **Equivalent Energy Noise Level (L_{eq})**,the equivalent energy noise level, is the average acoustic energy 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.
- **Day-Night Average Noise Level (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} is always higher than its corresponding 24-hour L_{eq} (e.g., a constant 60 dBA noise over 24 hours would have a 60 dBA L_{eq}, but a 66.4 dBA L_{dn}).

- **Community Noise Equivalent Level (CNEL)**, similar to Ldn, CNEL is the energy average of the A-weighted sound levels occurring over a 24-hour period, with a 10 dB penalty applied to A-weighted sound levels occurring during the nighttime hours between 10:00 p.m. and 7:00 a.m., and an additional 5 dB penalty applied to the A-weighted sound levels occurring during evening hours between 7:00 p.m. and 10:00 p.m. L_{dn} and CNEL are typically within one dBA of each other and, for all intents and purposes, are interchangeable.[3]

The decibel level of a sound decreases (or attenuates) exponentially as the distance from the source of that sound increases. For a single point source such as a piece of mechanical equipment, the sound level normally decreases by about 6 dBA for each doubling of distance from the source. Sound that originates from a linear, or "line" source such as a heavily traveled traffic corridor, attenuates by approximately 3 dBA per doubling of distance, provided that the surrounding environment is "hard" (i.e., streets, concrete areas, etc.). Noise from less heavily traveled roadways in "soft" environments (i.e., vegetation) attenuates more rapidly, at about 4.5 dBA for each doubling of distance. Other factors that typically affect sound propagation in an outdoor environment are structural barriers and atmospheric conditions.

Community noise environments are generally perceived as "quiet" when the 24-hour average noise level is below 45 dBA, "moderate" in the 45 to 60 dBA range, and "loud" above 60 dBA. Very noisy urban residential areas are usually around 70 dBA L_{dn}/CNEL. Along major thoroughfares, roadside noise levels are typically between 65 and 75 dBA L_{dn}/CNEL. Three to five dBA increments to existing one-hour L_{eq}, or to the L_{dn}/CNEL are commonly used as thresholds for an adverse community reaction to a noise increase. However, there is evidence that incremental thresholds in this range may not be sufficiently protective in areas where noise sensitive use are located and L_{dn}/CNEL is already high (i.e., above 60 dBA); in these areas, limiting noise increases to 3 dBA or less is recommended.[4] Noise intrusions that cause short-term interior levels to rise above 45 dBA at night can disrupt sleep. Eight-hour or longer exposures to noise levels greater than 85 dBA can cause permanent hearing damage.

Ground-borne Vibration. Vibrating objects in contact with the ground radiate energy through that medium; if a vibrating object is massive enough and/or close enough to the observer, its vibrations are perceptible. Ground-borne vibration is measured by its peak particle velocity (PPV). The PPV is normally described in inches per second. PPV is appropriate for determining potential structure damage, but does not evaluate human response to vibration. The ground motion caused by vibration is also given in decibel notation, referenced as vibration decibels (VdB), which serves to compress the range of numbers required to describe vibration relative to human response.[5] The general human response to different levels of ground-borne vibration velocity levels is described in Table 3.8-2. The rumbling sound caused by the vibration of room surfaces is called ground-borne noise. Like broadband noise, ground-borne noise is measured in dBA. The sound level accompanying vibration is generally

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[3] City of Menlo Park, *City of Menlo Park General Plan Noise Element*, November 1978.

[4] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006.

[5] Federal Railroad Administration, *High Speed Ground Transportation Noise and Vibration Impact Assessment,* October 2005.

25 to 40 dBA lower than the vibration velocity level in VdB. Due to the low-frequency components of ground-borne noise, ground-borne noise sounds louder than broadband noise with the same noise level. Ground-borne vibration levels of 65 VdB can result in ground-borne noise levels up to 40 dBA, which can disturb sleep. Ground-borne vibration levels of 85 VdB can result in ground-borne noise levels up to 60 dBA, which can be annoying to daytime noise sensitive land uses such as schools.[6]

Table 3.8-2
Human Response to Different Levels of Ground-borne Vibration

Vibration Velocity Level	Human Reaction
65 VdB	Approximate threshold of perception for many people.
75 VdB	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find that transportation-related vibration at this level is unacceptable.
85 VdB	Vibration acceptable only if there are an infrequent number of events per day.

Source: Federal Transit Administration, Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06, May 2006.

The background vibration velocity level in residential areas such as the Belle Haven neighborhood is usually around 50 VdB. The vibration velocity level threshold of perception for humans is approximately 65 VdB. A vibration velocity level of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels for many people. Most perceptible indoor vibration is caused by sources within buildings, such as the operation of mechanical equipment, movement of people, or the slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are heavy construction equipment, steel-wheeled trains, and traffic on rough roads. If a roadway is smooth, the ground-borne vibration from traffic is rarely perceptible. The range of interest is from approximately 50 VdB, which is the typical background vibration velocity level, to 100 VdB, which is the general threshold where minor damage can occur in fragile buildings.

Existing Noise Levels

The East Campus and West Campus are separated by Bayfront Expressway/State Route (SR) 84, which runs in an east-west direction between the two campuses. The East Campus is bound by the tidal mudflats and marshes of the San Francisco Bay (Bay) and Ravenswood Slough to the north and west, and Bayfront Expressway to the east and south, including the Bay Trail that runs along the southern portion of the East Campus, directly adjacent to Bayfront Expressway. The West Campus is bound by Bayfront Expressway to the north, Willow Road and a vacant lot to the east, the Dumbarton Rail Corridor to the south, and the TE Connectivity site to the west. The Dumbarton Rail Corridor is currently not in use for any railroad operations. Therefore, the rail corridor is not an existing source of noise in the area. South of the Dumbarton Rail Corridor are noise sensitive land uses, such as the Belle Haven neighborhood west of Willow Road, the residences in East Palo Alto east of Willow Road, Willow Oaks Elementary School, Belle Haven Elementary School, Beechwood School, Mid-Peninsula High School, and Caesar Chavez Elementary School. Vehicular traffic is the primary source of noise in the Project vicinity.

[6] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment,* FTA-VA-90-1003-06, May 2006.

Existing daytime noise levels were measured at five locations around and within the Project area on July 26, 2011. These locations were selected to represent existing noise levels at the Project site and existing sensitive receptors (i.e., land uses that are particularly sensitive to changes in the noise environment, such as residences, schools, convalescent homes, and churches) within the Project vicinity. These locations are identified in Figure 3.8-1. Each measurement location is described and the average, minimum, and maximum noise levels measured at each of these locations are presented in Table 3.8-3. These short-term noise measurements were used as noise reference levels to calibrate the Federal Highway Administration (FHWA) traffic noise model (FHWA Highway Noise Prediction Model (FHWA-RD-77-108)) that was used to determine existing daily average noise exposure and the future impacts of added traffic from the Project and other development.

Table 3.8-3
Daytime Noise Levels Measurements at Selected Locations in/around the Project Area

			Noise Level Statistics[a,b]		
	Noise Measurement Location/Time	**Primary Noise Sources**	L_{eq}	L_{min}	L_{max}
#1	Bayfront Expressway at the entrance to West Campus; start time: 8:59:00 AM	Traffic on Bayfront Expressway	78.1	63.0	93.8
#2	Marsh Road at Florence Street; residential neighborhood; start time: 9:10:00 AM	Traffic on Marsh Road	79.6	65.1	94.4
#3	Willow Road at Alberni Street; residential neighborhood; start time: 7:33:00 AM	Traffic on Willow Road	75.2	62.7	89.5
#4	Willow Road between O'Keefe Street & South Perimeter Road; on Willow Oaks Elementary School campus; start time: 9:54:00 AM	Traffic on Willow Road	75.0	60.6	88.6
#5	University Avenue at Notre Dame Avenue; residential neighborhood; start time: 8:05:00 AM	Traffic on University Avenue	75.3	64.9	88.4

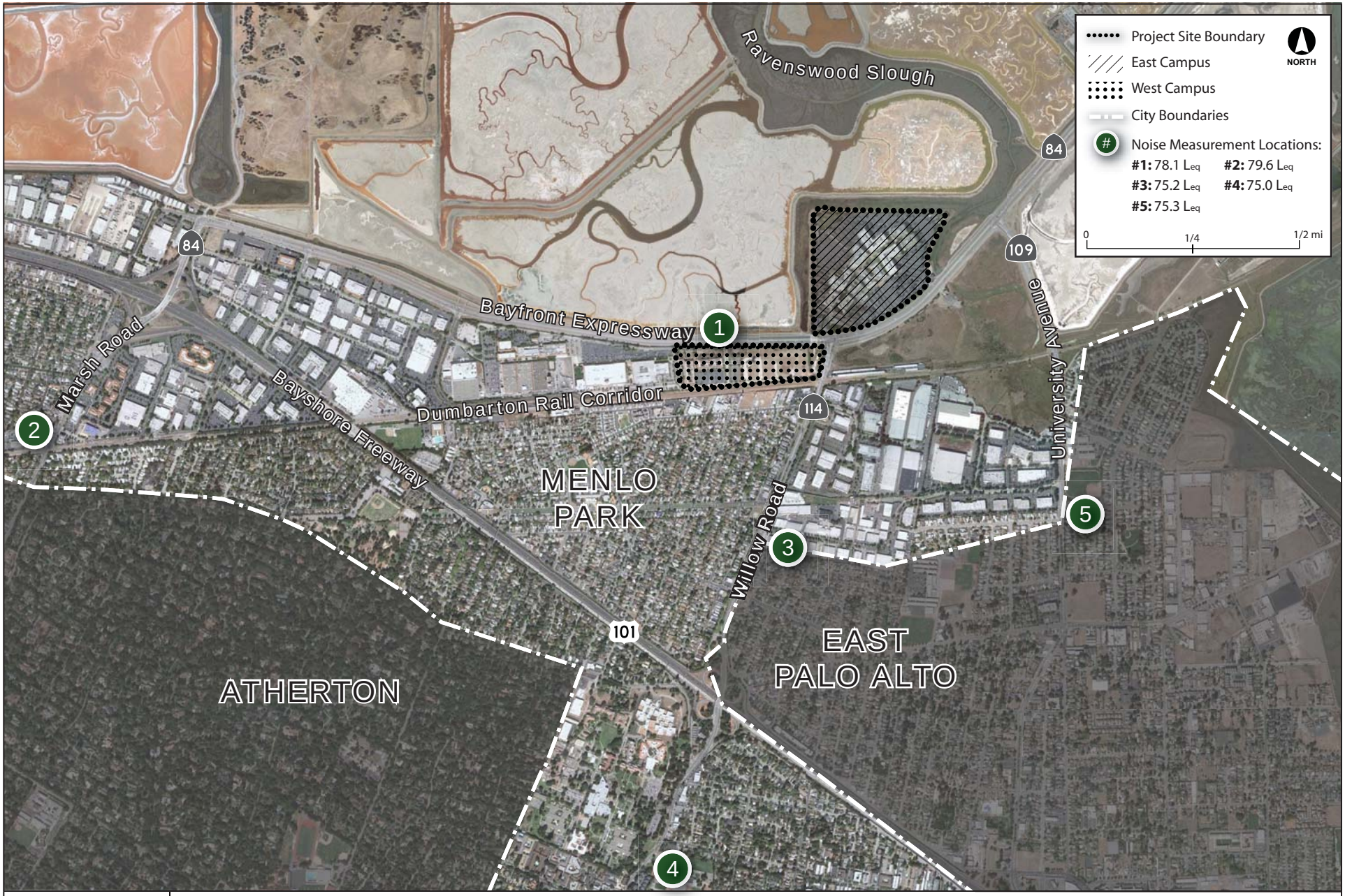
Source: Atkins, 2011. See Appendix 3.8 for data sheets.

Notes:

a. Measurements were taken on July 26, 2011. Each measurement was 15 minutes in duration and was conducted during the AM peak period. Noise levels are assumed to be similar during the PM peak period.

b. L_{eq} is the average noise level over the measurement period, L_{min} is the minimum instantaneous noise level measured during the 15-minute period, while L_{max} is the maximum instantaneous noise level measured during the 15-minute period.

The FHWA Highway Noise Prediction Model was used to calculate the existing 24-hour traffic noise levels (CNEL) at noise-sensitive uses close to where the noise measurements were taken; the modeled CNEL at these locations is presented in Table 3.8-4. The traffic noise levels vary from the measured CNEL because the traffic noise levels represent the CNEL at the sensitive receptor closest to the centerline of the roadway, while some of the noise measurements were taken at a greater distance from the roadway centerline. The existing traffic-generated CNEL are above the City's 60 dBA CNEL standard, described below under Applicable Plans and Regulations, at all of the noise-sensitive locations modeled due to the high volumes of traffic on these roadways, particularly heavy trucks and buses. The noise level at the West Campus boundary is above the City's normally acceptable standard of 70 dBA CNEL for office land uses, but does not exceed the conditionally acceptable standard of 75 dBA CNEL.



Source: Google Earth; Atkins, 2011.

ATKINS

FIGURE 3.8-1
Noise Measurement Locations

100020154

Menlo Park Facebook Campus Project

Table 3.8-4
Existing (Year 2011) Traffic Noise Levels at Selected Locations in the Vicinity of the Project Area (CNEL)

Location/Roadway	CNEL (dBA)[a,b,c]
Bayfront Expressway (Chrysler Drive to Chilco Street)	
At a point 75 feet from centerline of Bayfront Expressway, the distance of the West Campus boundary from the roadway centerline	73
Marsh Road (Scott Drive to Bohannon Drive)	
Residences 50 feet from centerline of Marsh Road	**82**
Willow Road (O'Brien Drive to Newbridge Street)	
Residences 75 feet from centerline of Willow Road	**77**
Willow Road (Durham Street to Coleman Avenue)	
Willow Oaks Elementary School playground, 75 feet from centerline of Willow Road	**72**
University Avenue (O'Brien Drive to Kavanaugh Drive)	
Residences 50 feet from centerline of University Avenue	**75**

Source: FHWA Highway Noise Prediction Model. See Appendix 3.8 for model output.

Notes:

a. Measurements rounded to the nearest decibel.

b. Peak hour intersection traffic volumes provided by DKS Associates were utilized to determine segment volumes near the sensitive receptors. Peak hour volumes were multiplied by ten, based on the assumption that peak hour volumes account for approximately 10 percent of daily traffic.[7] The vehicle mix was adjusted to calibrate the model to reflect the measured noise levels in Table 3.8-3. Section N-2231 of the Caltrans Technical Noise Supplement was used to convert the measured L_{eq} to CNEL.[8] The estimated CNEL is almost equal to the measured Leq, which is typical.[9]

c. Instances where existing exterior noise exposures exceed applicable normally acceptable and conditionally acceptable City Noise Element standards for the specific land use are shown in **bold**.

Existing Ground-borne Vibration Levels

The most common sources of ground-borne vibration in the Project area and the City are construction activities and roadway truck traffic. Heavy trucks currently transport goods and materials along the streets surrounding the Project area (i.e., Bayfront Expressway, University Avenue, Willow Road). Large delivery trucks typically generate ground-borne vibration velocity levels around 63 VdB at 50 feet from the source, and these levels could reach 72 VdB where trucks pass over an uneven road surface.[10] As described above, the vibration velocity level threshold of perception for humans is approximately 65 VdB, and 75 VdB is the approximate dividing line between barely perceptible and

[7] Federal Highway Administration, *Travel Model Improvement Program - Time-of-Day Modeling Procedures Report*, February 1997.

[8] California Department of Transportation (Caltrans), Technical Noise Supplement to the Traffic Noise Analysis Protocol, October 1998.

[9] California Department of Transportation (Caltrans), Technical Noise Supplement to the Traffic Noise Analysis Protocol, October 1998.

[10] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006.

distinctly perceptible levels. Therefore, existing traffic vibration is neither distinctly nor generally perceptible. Additionally, vibration velocity levels around 63 Vdb would generally not produce ground-borne noise that would disturb sleep.

Impacts and Mitigation Measures

Standards of Significance

The Project would result in a significant impact if it would:

- Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinances, or the applicable standards of other agencies.
- Expose persons to or generate excessive ground-borne vibration or ground-borne noise levels.
- Result in a substantial permanent increase in ambient noise levels in the Project vicinity above existing levels.
- Result in a substantial temporary or periodic increase in ambient noise levels in the Project vicinity above existing levels.
- Be located within an airport land use plan or, where such a plan has not been adopted, a public or private airstrip within two miles of the Project site, and expose people residing or working in the Project area to excessive noise levels from an airport.

Methodology

Analysis of the existing and future noise environment is based on noise level monitoring, noise prediction computer modeling, and empirical observations of receptor noise exposure characteristics. Existing noise levels were monitored at selected locations on and around the Project area (see Table 3.8-3) using a Larson-Davis Model 820 sound level meter, which satisfies the American National Standards Institute (ANSI) for general environmental noise measurement instrumentation. Noise modeling procedures involved the use of the FHWA Highway Noise Prediction Model to calculate existing and future vehicular noise levels at the Project site and selected noise-sensitive uses in the Project vicinity, especially off-site residences and schools. Noise sensitive uses were selected based on their proximity to the projected routes for Project-related traffic, which include Bayfront Expressway, University Avenue, Willow Road, and Marsh Road. The model calculates the noise level for a particular reference set of input conditions, using site-specific input criteria such as traffic volumes, distances, roadway speeds, and vehicle mix. Peak hour intersection traffic volumes provided by DKS Associates were utilized to determine segment volumes near the sensitive receptors. The vehicle mix (i.e., the proportion of automobiles, trucks, buses, and other vehicles) for future and Project-related traffic was adjusted consistent with the existing conditions vehicle mix, which was adjusted to reflect the measured noise levels in Table 3.8-3.

The Federal Transit Administration (FTA) incremental traffic noise impact criteria are used to assess impacts associated with traffic noise.[11] Rather than establishing fixed criteria to define noise impacts, the FTA's impact criteria become progressively more stringent as the baseline traffic noise levels increase. Thus, these criteria are more protective of communities with high noise exposure, which is typical of the neighborhoods near the Project and where Project-related traffic would pass. Specifically, where the baseline L_{dn} is less than 60 dBA, a permanent increase in roadway traffic noise levels of more than 3 dBA over baseline ambient noise levels is considered to be substantial and, therefore, significant. Where the baseline L_{dn} is between 60 dBA and 65 dBA, a permanent increase in roadway traffic noise levels of more than 2 dBA over baseline ambient noise levels is considered to be substantial and, therefore, significant. Where the baseline L_{dn} is between 65 dBA and 75 dBA, a permanent increase in roadway traffic noise levels of more than 1 dBA over baseline ambient noise levels is considered to be substantial and, therefore, significant. Where the baseline L_{dn} is over 75 dBA, any permanent increase in roadway traffic noise levels over baseline ambient noise levels is considered significant.

This analysis uses the General Plan's land use compatibility guidelines and the City's Noise Ordinance to assess the noise exposure of land uses in the Project vicinity. The General Plan sets the following thresholds for noise impacts: 60 dBA CNEL for residential land use and 70 dBA L_{dn} for office building, business, and commercial areas. The Noise Ordinance establishes a noise level limit of 60 dBA at residential land uses for short-term increases in noise, and a noise level limit of 85 dBA at 50 feet for operation of construction equipment.

Neither the General Plan nor the Noise Ordinance establishes thresholds for ground-borne vibration or noise. The FTA vibration impact thresholds for infrequent events are used to assess vibration. Infrequent events are defined as fewer than 30 vibration events of the same kind per day. These thresholds are 65 VdB at vibration-sensitive land uses and 80 VdB at residences and buildings where people normally sleep (e.g., nearby residences). The thresholds for ground-borne noise are 65 VdB for buildings where people sleep, and 85 Vdb during the day for noise-sensitive land uses.

Impacts Not Evaluated In Detail

The following impacts are not evaluated in detail because there would be no impact as a result of implementing the Project (East Campus and West Campus).

The Project at the East Campus would not include major construction activities such as demolition, grading and ground clearing, foundation installation, or pile driving. No heavy construction equipment would be required. Therefore, no noise impact would result from construction on the East Campus.

The closest airport to the Project site (East Campus and West Campus) is the Palo Alto Airport Terminal, located approximately 2.25 miles southeast of the East Campus. This general aviation airport does not serve commercial aviation and has one runway; the majority of the aircraft operations

[11] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006.

are small single engine planes.[12] This airport does not have an adopted Airport Land Use Compatibility Plan and the Project site is more than two miles from the airport. Additionally, this airport has noise abatement policies and procedures in place to limit aircraft noise during departures and landings.[13] Therefore, neither the East Campus nor the West Campus would be exposed to excessive noise from this airport. The closest airport with an adopted airport land use plan is the San Carlos Airport, located five miles north of the West Campus. This airport is included in the San Mateo County Comprehensive Airport Land Use Plan, adopted in December 1996. The Project site is not located within the 55 dBA noise contour of this airport.[14] There would be no impact related to operations from public or private airports, and therefore, this impact is not further evaluated.

Environmental Analysis

NO-1 ***Exposure to Excessive Noise Levels.*** *Implementation of the Project, at both the East Campus and West Campus, could result in an increase in the exposure of people to noise potentially in excess of the standards established in the General Plan or Municipal Code:*

- *The increase in vehicular traffic associated with implementation of both the East Campus and West Campus could result in an increase in the exposure of off-site noise sensitive receptors to noise levels potentially in excess of the standards established in the General Plan or Municipal Code. This impact would be potentially significant. (PS)*
- *The East Campus would not increase the exposure of people to noise in excess of the standards established in the General Plan or Municipal Code. This impact would be less than significant. (LTS)*
- *The West Campus could increase the exposure of people to noise in excess of the standards established in the General Plan or Municipal Code. This impact would be potentially significant. (PS)*

Exposure of Off-site Receptors. As noted earlier under the "Existing Conditions," existing residential uses and schools in the Project vicinity, such as along Willow Road, Marsh Road, and University Avenue, are currently exposed to noise levels in excess of the City standards of 60 dBA CNEL for residential uses due to heavy traffic. The addition of Project-related traffic would further increase traffic noise levels above the City's standards for residential uses. Because the existing noise levels along the major arterials in the City are above the City standards, these noise levels would continue to be above the City standards in the near-term and long-term future with the addition of Project-related traffic. As discussed under "Methodology," because existing noise levels are above the City standards, the significance threshold is based on whether the Project's incremental increase would be considered

[12] AirNav.com, "KPAO – Palo Alto Airport of Santa Clara County," website: http://www.airnav.com/airport/KPAO, accessed August 7, 2011.

[13] County of Santa Clara Airports Department, "Noise Abatement Policy/Recommended Procedures," 2007, website: http://www.countyairports.org/PAO_Facts.htm, accessed July 25, 2011.

[14] County of San Mateo, San Carlos Airport Master Plan Update Airport Modernization Project Draft Environmental Impact Report, 2002.

significant. The Project's incremental noise effect is shown in Table 3.8-5. As shown in this table, operation of the Project and the increase in traffic associated with implementation of the Project would result in a maximum noise level increase of 1 dBA. In the short-term, operation of the East Campus would result in a 1 dBA increase on Willow Road compared to existing conditions. The Project would also result in a 1 dBA increase on Marsh Road in the near-term. Similarly, under operation of both the East Campus and West Campus, there would be a 1 dBA increase in the near-term and long-term traffic scenarios. However, using FTA guidance, a 1 dBA increase is considered significant when the noise level without the Project is 75 dBA CNEL or higher. Therefore, the Project would result in a significant incremental increase to noise levels at identified sensitive uses on Marsh Road and Willow Road, and this impact would be considered ***potentially significant.***

Table 3.8-5
Project Increment to Existing and Future Noise Levels at Representative Locations in the Project Vicinity (CNEL)

Segment/Adjacent Land Use[a]	Traffic Noise Level Without Project	Traffic Noise Level With Project	Increase in Noise Level as a Result of Project	Allowable Increase[b]	Significant Impact?
Existing Conditions and Baseline Traffic Scenario[c]					
Bayfront Expressway - Chrysler Drive to Chilco Street	73	73	0	1	No
Marsh Road - Scott Drive to Bohannon Drive	82	82	0	0	No
Willow Road - O'Brien Drive to Newbridge Street	**77**	**78**	**+1**	**0**	**Yes**
Willow Road - Durham Street to Coleman Avenue	72	72	0	1	No
University Avenue - O'Brien Drive to Kavanaugh Drive	75	75	0	0	No
Near Term Project I Scenario[c]					
Bayfront Expressway - Chrysler Drive to Chilco Street	74	74	0	1	No
Marsh Road - Scott Drive to Bohannon Drive	**82**	**83**	**+1**	**0**	**Yes**
Willow Road - O'Brien Drive to Newbridge Street	**78**	**79**	**+1**	**0**	**Yes**
Willow Road - Durham Street to Coleman Avenue	73	73	0	1	No
University Avenue - O'Brien Drive to Kavanaugh Drive	75	75	0	0	No
Near Term Project II Scenario[c]					
Bayfront Expressway - Chrysler Drive to Chilco Street	74	74	0	1	No
Marsh Road - Scott Drive to Bohannon Drive	83	83	0	0	No
Willow Road - O'Brien Drive to Newbridge Street	**79**	**80**	**+1**	**0**	**Yes**
Willow Road - Durham Street to Coleman Avenue	73	73	0	1	No

Table 3.8-5
Project Increment to Existing and Future Noise Levels at Representative Locations in the Project Vicinity (CNEL)

Segment/Adjacent Land Use[a]	Traffic Noise Level Without Project	Traffic Noise Level With Project	Increase in Noise Level as a Result of Project	Allowable Increase[b]	Significant Impact?
University Avenue - O'Brien Drive to Kavanaugh Drive	76	76	0	0	No
Long Term Project I Scenario[c]					
Bayfront Expressway - Chrysler Drive to Chilco Street	74	74	0	1	No
Marsh Road - Scott Drive to Bohannon Drive	83	83	0	0	No
Willow Road - O'Brien Drive to Newbridge Street	79	79	0	0	No
Willow Road - Durham Street to Coleman Avenue	**73**	**74**	**+1**	**1**	**Yes**
University Avenue - O'Brien Drive to Kavanaugh Drive	76	76	0	0	No
Long Term Project II Scenario[c]					
Bayfront Expressway - Chrysler Drive to Chilco Street	74	74	0	1	No
Marsh Road - Scott Drive to Bohannon Drive	83	83	0	0	No
Willow Road - O'Brien Drive to Newbridge Street	**79**	**80**	**+1**	**0**	**Yes**
Willow Road - Durham Street to Coleman Avenue	**73**	**74**	**+1**	**1**	**Yes**
University Avenue - O'Brien Drive to Kavanaugh Drive	76	76	0	0	No

Source: FHWA Highway Noise Prediction Model. See Appendix 3.8 for model output.

Notes:

a. Sensitive receptor and receptor distance from roadway centerline are:
   1. Bayfront Expressway (Chrysler Drive to Chilco Street): West Campus boundary, 75 feet from centerline of Bayfront Expressway
   2. Marsh Road (Scott Drive to Bohannon Drive): Residences 50 feet from centerline of Marsh Road
   3. Willow Road (O'Brien Drive to Newbridge Street): Residences 75 feet from centerline of Willow Road
   4. Willow Road (Durham Street to Coleman Avenue): Willow Oaks Elementary School playground, 75 feet from centerline of Willow Road
   5. University Avenue (O'Brien Drive to Kavanaugh Drive): Residences 50 feet from centerline of University Avenue

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

c. Refer to Section 3.5, Traffic and Circulation, for a description of the traffic scenarios.

Significant impacts shown in **Bold.**

Exposure of On-Site Receptors. Operation of the Project would consist of typical office operations. Noise sources associated with office uses include an increase in human activity; heating, ventilation, and air conditioning (HVAC) systems; parking lot and garage noise; truck

pick-ups and deliveries; and emergency generator testing. The potential for these noise sources to exceed the City's noise standards is discussed below.

East Campus

General On-site Activity. The exterior noise levels on the East Campus would incrementally increase, because with implementation of the Project, the East Campus would accommodate up to approximately 6,600 employees, an increase of 3,000 employees over existing conditions. The noise level for commercial areas is approximately 65 dBA.[15] Human activity in a commercial area would be similar to an office park, including normal conversation and people walking to and from their cars. However, noise from human activity on the East Campus would continue to vary throughout the day. Activity would be concentrated in common areas between buildings towards the middle of the site. Activity would mostly occur during the beginning and end of the work day and during lunch hours; however, the outdoor common areas on campus are intended to encourage informal gatherings throughout the day. Exterior activity and noise levels would be minimal when most employees are inside working and outside of working hours. Additionally, noise would be limited to the center and northwest areas of the East Campus where the office buildings and common areas are located.

Trucks used for pick-up and deliveries at the East Campus would also result in intermittent noise, such as engines idling and beeping from backing warning signals. Truck deliveries are an existing condition; however, the increase in employment would result in an increase of on-site activity that could potentially require additional deliveries. Nonetheless, truck deliveries to the East Campus would involve small-scale deliveries of supplies to the offices, pop-up retail, and food service amenities. Trucks are exempted from the City's short-term noise level limit of 60 dBA at residential land uses, provided the trucks do not idle for more than 10 minutes. State law currently prohibits heavy-duty diesel delivery trucks from idling more than five minutes.[16] Additionally, given the short duration and relative infrequency of truck trips to the campus, truck deliveries would not be a source of excessive ambient noise. Therefore, impacts related to truck deliveries would be ***less than significant.***

Assuming an existing noise level of 65 dBA at the campus structures during the peak activity hours, doubling the number of employees on the campus would generate a noise level of approximately 68 dBA during high activity hours. Doubling of a sound level results in an increase of approximately 3 dBA, because noise levels are added logarithmically.[17] At this level, noise from human activity would be reduced to 56 dBA at the southern Project boundary. Therefore, human activity on the East Campus would not exceed the City's 60 dBA CNEL noise compatibility standard or the 60 dBA Noise Ordinance limit off-site. Additionally, the

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[15] California Department of Transportation (Caltrans), Technical Noise Supplement to the Traffic Noise Analysis Protocol, October 1998.

[16] California Air Resources Board, *Final Regulation Order – Requirements to Reduce Idling Emissions from New and In-Use Trucks, Beginning in 2008*, October 16, 2006.

[17] National Institute for Occupational Safety and Health (NIOHS), Criteria for a Recommended Standard: Occupational Noise Exposure, June 1998.

East Campus is separated from the nearest off-site receptors (the commercial and industrial uses along the Dumbarton Rail Corridor) by Bayfront Expressway, which currently generates noise level of 73 dBA CNEL near the roadway. Existing traffic noise would further diminish the Project's contribution to the ambient noise level. Therefore, the increase in human activity on the East Campus would not be audible to off-site land uses due to distance and existing noise levels, and would not expose persons to noise in excess of standards. Therefore, this impact would be ***less than significant***.

Other On-site Noise Sources. The remaining noise sources associated with operations at the East Campus, including HVAC systems, parking lots, emergency generator testing, and use of the existing sport field and basketball court, would continue to operate as they do under existing conditions. The Project would not result in any additional noise sources besides an increase in employees. Therefore, operational noise associated with the East Campus would not expose persons to noise in excess of City standards. This impact would be ***less than significant.***

Exposure of On-site Receptors. The Project at the East Campus would include office uses and outdoor common areas, which would be subject to the City's 70 dBA CNEL compatibility standard. The primary noise source would be from traffic on Bayfront Expressway, which runs along the southern border of the East Campus. The buildings and common areas on the East Campus are set back farther from Bayfront Expressway; a minimum of 325 feet from the roadway centerline. At this distance, future roadway traffic would be reduced to 67 dBA CNEL and would not exceed the City's noise compatibility standards, resulting in a ***less-than-significant*** impact.

West Campus

General On-site Activity. The West Campus would result in a human activity noise level increase because the West Campus is currently unoccupied. As discussed above, noise from human activity would mostly occur during the beginning and end of the work day and during lunch hours. Similar to the East Campus, the outdoor common areas and amenities provided on the West Campus are intended to encourage informal (and, on occasion, formal) gatherings throughout the day.

The closest sensitive receptors to the West Campus are the residences along Hamilton Avenue, south of the Dumbarton Rail right-of-way, approximately 350 feet from the southern border of West Campus. Assuming a noise level of 65 dBA from human activity on the West Campus during the peak activity hours, the distance to the nearest sensitive receptors would attenuate this noise level to 48 dBA at the residences. Human activity on the West Campus would not exceed 60 dBA at the nearest noise sensitive land use and would not exceed the Noise Ordinance limit for residential land uses or the City's General Plan compatibility standard. A noise level of 65 dBA would also not exceed the City's compatibility standard of 70 dBA for the adjacent office and commercial land uses. Additionally, ambient noise levels along Bayfront Expressway and other busy roadways in the area are currently higher than 65 dBA

due to high traffic volumes. Therefore, noise from the increase in human activity would not be audible over roadway noise at sites near busy roadways, such as the TE Connectivity site along Bayfront Expressway, and the increase in human activity would not expose persons to noise in excess of standards. This impact is ***less than significant***.

HVAC Systems. The new buildings and parking structure on the West Campus would require HVAC systems. Mechanical HVAC equipment located on the ground or on rooftops of new buildings have the potential to generate noise levels that average 72 dBA CNEL at a distance of 50 feet when equipment is operating continuously for 24 hours.[18] Noise from the HVAC systems would be reduced to 55 dBA CNEL at the nearest noise sensitive land uses, the residences south of the West Campus, based solely on distance. The closest land use to the proposed structures is the existing TE Connectivity site, adjacent to the western boundary of the West Campus. The parking structure is located approximately 75 feet from the TE Connectivity parking lot at its nearest location. At this distance, noise from the HVAC systems would be reduced to 69 dBA CNEL and would not exceed the City standard of 70 dBA CNEL. Additionally, as discussed above, traffic on Bayfront Expressway currently exceeds 70 dBA CNEL. At 69 dBA, HVAC noise would not be audible over traffic. Therefore, the new HVAC systems would not expose persons to noise in excess of standards, resulting in ***less-than-significant*** impacts.

Emergency Power Generators. Stand-by emergency power generators would be located in several buildings on the West Campus, including the parking structure, Building 2, and Building 3. The emergency generators create temporary and periodic noise from testing. Sound levels from these generators vary depending on the type of generator and the noise attenuation that has been incorporated into its design and placement. The generators would be tested monthly for approximately 30 minutes. Given the temporary and periodic nature of emergency generator testing, generators would be subject to the City's Noise Ordinance standard of 60 dBA for residential land uses only and would not permanently increase ambient noise levels. Without any noise attenuation, the emergency generators may generate sound levels of up to 97 dBA at 23 feet (7 meters) from the generator.[19]

The closest generator to a residence is the generator on the northwest corner of Building 3, approximately 600 feet away from the nearest residence. At this distance, emergency generator testing could result in noise levels up to 69 dBA. Noise attenuation would be provided to some residences by the intervening commercial uses south of the West Campus and north of the residential neighborhood. Additionally, emergency generators may not be audible over traffic noise at the residences near existing major roads such as Willow Road. However, emergency generator testing could exceed the City's Noise Ordinance if a noise attenuation

[18] City of Santa Ana, City of Santa Ana Transit Zoning Code (SD 84A and SD 84B) Final Environmental Impact Report (SCH No. 2006071100), prepared by PBS&J, May 2010.

[19] Cummins Power Generation, Sound Data - 1500DQGAB, website: http://www.cumminspower.com/www/common/templatehtml/technicaldocument/SoundDataSheets/na/msp-1034.pdf, accessed July 29, 2011.

enclosure were not installed surrounding the emergency generators. Accordingly, this impact is considered ***potentially significant***.

Parking Garage. The West Campus would include a new parking structure on the western side of the campus, and parking in the undercroft of Buildings 4 and 5. Noise sources from parking structures would include human speech, vehicle door slams, car starts, tire squeals, accidental car alarms, and other automotive noise. Quantification of parking structure noise is difficult to predict due to many variables. Variation in sound levels depends on such factors as parking structure design and the number of vehicles moving through the structure at any given time. However, noise from parking garages is characterized as temporary and periodic noise. These temporary and periodic noise sources within the garage would be different from each other in kind, time, duration, and location, so that the overall effects would be separate and, in most cases, would not affect the same receptors at the same time. Therefore, this type of noise associated with parking structures is considered a nuisance noise effect that would result in a ***less-than-significant*** impact.

Truck Deliveries. Trucks used for pick-up and deliveries of supplies would result in intermittent noise, such as engines idling and beeping from backing warning signals. However, operation of the West Campus would not involve large-scale commercial services, manufacturing, or similar work that would require regular, frequent truck deliveries and pick-ups. Truck deliveries to the West Campus would be deliveries of supplies to the offices, pop-up retail, and food service amenities. Simultaneous truck deliveries to the same structure are not anticipated and simultaneous deliveries to the campus as a whole would be expected to occur only occasionally, due to varying delivery schedules. Trucks are exempted from the City's short-term noise level limit of 60 dBA at residential land uses, provided the trucks do not idle for more than 10 minutes. State law currently prohibits heavy-duty diesel delivery trucks from idling more than five minutes.[20] Additionally, given the short duration and relative infrequency of truck trips to the campus, truck deliveries would not be a source of excessive ambient noise. Therefore, impacts related to truck deliveries would be ***less than significant.***

Exposure of On-site Receptors. The proposed development at the West Campus would include office uses and outdoor common areas, which would be subject to the City's 70 dBA CNEL compatibility standard. The primary noise source would be traffic on Bayfront Expressway, which runs along the northern boundary of the West Campus. The roadway currently generates noise levels in excess of the 70 dBA standard at the West Campus site. As shown in Table 3.8-5, traffic on this roadway currently generates a noise level of 73 dBA at the West Campus boundary (75 feet from the roadway centerline), and is estimated to generate a noise level of 74 dBA in the long term. The nearest buildings to the roadway (Buildings 1, 2, and 3) would be located approximately 125 feet from the roadway centerline. At this distance, long-term traffic noise on Bayfront Expressway would be reduced to 72 dBA CNEL. However, the City considers noise levels of up to 75 dBA compatible with office uses if noise

[20] California Air Resources Board, *Final Regulation Order – Requirements to Reduce Idling Emissions from New and In-Use Trucks, Beginning in 2008*, October 16, 2006.

insulation standards are included in the building design. According to the City's Noise Element, conventional construction, but with closed windows and a fresh air supply system or air conditioning, will normally suffice to meet this requirement. Construction at the West Campus would be required to comply with all California Building Code requirements for modern construction and all buildings would include noise insulated HVAC systems, as discussed above. While sustainability strategies identified to reduce the Project's energy use would allow for operable windows, it is not anticipated that the windows would be open during the majority of business days. It is also anticipated that site design and architectural features incorporated as part of the Project would further reduce exterior ambient noise levels for the occupants of the newly constructed buildings. Therefore, a noise level of 75 dBA would be acceptable on site. The traffic noise level would be reduced to 67 dBA CNEL at Buildings 4 and 5 and would not exceed the 70 dBA CNEL thresholds.

The common areas are outside; however, the common area and other activity areas are set back approximately 225 feet from the centerline of Bayfront Expressway. At this distance, future roadway noise would be reduced to approximately 69 dBA. Therefore, noise level in the common areas would not exceed the 70 dBA CNEL threshold. Additionally, the common area is screened from traffic noise on Bayfront Expressway by Buildings 1 and 2, which would provide some noise attenuation. Therefore, employees at the West Campus would not be exposed to excessive noise from Bayfront Expressway, resulting in a ***less-than-significant*** impact.

MITIGATION MEASURES. The Project would result in a potentially significant increase in traffic noise on Marsh Road between Scott Drive and Bohannon Drive and Willow Road between O'Brien Drive and Newbridge Street. There are no feasible mitigation measures that could reduce or eliminate the impact related to traffic noise, other than reducing traffic. Typical sound mitigation consists of walls or other barriers that would attenuate noise to the sensitive receptors behind the barrier. This measure would require installation of a noise wall within private property or within a designated right-of-way, which may not be allowed by an affected property owner or by the City. The feasibility of noise walls is restricted by access requirements for driveways, presences of local cross streets, underground utilities, other noise sources in the area, and safety considerations.[21] For example, a noise wall would be ineffective on the impacted segment of Marsh Road because existing residential driveways directly access Marsh Road, and Rolison Road merges with Marsh Road along this segment. Breaks in the noise wall for access would not provide any noise attenuation and would render the wall ineffective. Additionally, for safety reasons, Caltrans states that noise barriers should not exceed 14 feet in height.[22] Due to the high existing noise level, a noise barrier of more than 14 feet would be required to reduce noise levels along these roadways segments to an acceptable noise level for residential land uses. Finally, sensitive receptors along Marsh Road and Willow Road are currently oriented toward these roadways. Construction of a noise barrier would wall off these uses from the surrounding community, which could result in

[21] California Department of Transportation, *Traffic Noise Analysis Protocol,* May 2011.
[22] California Department of Transportation, *Traffic Noise Analysis Protocol,* May 2011.

adverse impacts to aesthetics[23] and potentially public safety because the noise walls would limit the visibility of the homes from the surrounding area. Natural surveillance is one of the four principles of Crime Prevention through Environmental Design.[24] Therefore, installation of a noise wall along these segments would not be feasible.

As mentioned above, there are no other feasible mitigation measures that could reduce or eliminate the impact related to traffic noise, other than reducing traffic. As noted in Section 2, Project Description, the Project includes a TDM program that sets forth a variety of measures designed to reduce the number of daily trips. However, the TDM program may not reduce trips enough to reduce the Project's contribution to traffic noise to a less-than-significant level. Therefore, the increase in noise level on Marsh Road and Willow Road as a result of Project-generated traffic is considered to be ***significant and unavoidable***. (SU)

Operation of the West Campus would involve new emergency generator testing that would have the potential to exceed the Noise Ordinance noise level limit for residential land uses. Mitigation Measure NO-1.1 would require emergency generators to be shielded in order to reduce the sound level from emergency generator testing to less than 60 dBA at the nearest noise sensitive land uses. Mitigation Measure NO-1.2 would limit generator testing to daytime hours only. Implementation of these mitigation measures would reduce this impact to a ***less-than-significant*** level. (LTS)

NO-1.1 *Install Sound Enclosures Around Emergency Generators on the West Campus.* The Project Sponsor shall reduce the sound level from the operating generators to a maximum sound level of 88 dBA at 23 feet (7 meters) from the enclosure. Measures that could accomplish this standard include, but are not limited to, installing sound enclosures around all emergency generators, or purchasing equipment that meets this standard.

NO-1.2 *Limit Generator Testing to Daytime Hours on the West Campus.* The Project Sponsor shall limit generator testing to between the hours of 8:00 a.m. and 6:00 p.m.

NO-2 ***Temporary Increases in Ambient Noise Level.*** *The Project at the West Campus could result in levels of vibration that would disrupt operations at nearby vibration-sensitive land uses. This impact is potentially significant. (PS)*

Construction of the West Campus is anticipated to start in January 2013 and would last approximately 18 months. The West Campus construction would require the demolition of the existing buildings and surface parking lots, removal of trees and other landscaping, site grading, and building and parking garage construction. The construction of all the buildings would conclude in July 2014 phasing the occupation of the building for a four-month period. The construction of the buildings would be phased so that each building is constructed in sequence, with each building

[23] Federal Highway Administration, *Noise Barrier Design Handbook,* website: http://www.fhwa.dot.gov/environment/noise/noise_barriers/design_construction/design/design00.cfm, accessed September 20, 2011.

[24] National Crime Prevention Council, *Crime Prevention Through Environmental Design Guidebook,* October 2003.

being approximately six to eight weeks apart. The parking garage construction would be scheduled to ensure completion prior to occupancy of the first building.

Ground-borne Vibration. Typical equipment that would be used during construction at the West Campus would include, but not be limited to, concrete crushers, cranes, tractors, excavators, pile drivers, forklifts, off-highway tractors and trucks, material handling equipment, pavers, pumpers, rollers, bulldozers, surfacing and grading equipment, backhoes, and trenchers. Project construction activities would have the potential to generate low levels of ground-borne vibration (other than during pile driving).

Construction-related vibration has three potential effects. First, vibration at high enough levels can interfere with sleep. Thresholds for this vibration have been developed by the FTA, which has determined that any vibration over 80 VdB can be a significant impact at places where people sleep. Second, vibration at relatively low levels can disturb vibration-sensitive research and manufacturing equipment, such as electron microscopes and high resolution lithographic equipment. Even normal optical microscopes will sometimes be difficult to use at vibration levels well below the human annoyance level. The FTA has developed a vibration threshold of 65 VdB, based on acceptable vibration for moderately vibration-sensitive equipment, such as optical microscopes and electron microscopes with vibration isolation systems. Third, ground-borne vibration can potentially damage the foundations and exteriors of existing, older structures. Ground-borne vibration that can cause this kind of damage is typically limited to impact equipment, especially pile-drivers. The FTA damage thresholds indicate that, for buildings not extremely sensitive to vibration, a damage threshold of between 0.2 in/sec to 0.5 in/sec would apply depending on the type of building.

Table 3.8-6 identifies various vibration velocity levels for the types of construction equipment that are expected at the Project area during construction. As shown in this table, construction equipment would have the potential to interfere with vibration-sensitive equipment or disturb people trying to sleep in close proximity to construction activities. Structural damage to existing buildings due to construction vibration would only be an issue during pile-driving, because pile-driving can produce PPV values of up to 1.5 at 25 feet. Impact pile drivers produce a high level of vibration for short periods (0.2 second) with sufficient time between impacts to allow a building's resonant effects to decay before the next vibration event.[25]

[25] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006.

Table 3.8-6
Vibration Source Levels for Construction Equipment

Construction Equipment	At 25 feet		At 100 feet	
	Approximate VdB	Peak Particle Velocity (in/sec)	Approximate VdB[a]	Peak Particle Velocity (in/sec)[b]
Large Bulldozer	87	0.089	69	0.011
Loaded Trucks	86	0.076	68	0.010
Jackhammer	79	0.035	61	0.004
Small Bulldozer	58	0.003	40	0
Caisson Drilling	87	0.089	69	0.011
Roller	94	0.210	76	0.026
Pile Driver (impact, upper range)	112	1.518	94	0.190
Pile Driver (sonic, upper range)	105	0.734	87	0.011

Source: FTA, 2006.

Notes:

a. Based on the formula $PPV_{equip} = PPV_{ref} * (25/D)^{1.5}$ provided by the FTA (2006).

b. Based on the formula VdB = VdB(25 feet) – 30log(d/25) provided by the FTA (2006).

The nearest residential uses to the West Campus are along Hamilton Avenue, south of the Dumbarton Rail right-of-way, approximately 350 feet from the southern border of West Campus. Based on the information presented in Table 3.8-6, vibration levels from construction activities, including the construction of internal roads and pile driving, would not exceed 80 VdB at a distance of 350 feet. The most vibration-intensive activity, pile-driving, would not exceed 78 VdB at 350 feet, while internal road construction would not exceed 76 VdB. Therefore, exposure of residential areas to excessive ground-borne vibration during construction would be ***less than significant***.

Existing occupied office and commercial uses are directly west of the West Campus and south of the Dumbarton Rail Corridor. Office and commercial uses are generally not considered sensitive receptors; however, because of the nature of the businesses that are present in the vicinity, these uses may include vibration-sensitive equipment, such as could be used for computer chip manufacturing. Some manufacturing does take place at the TE Connectivity site to the west of the West Campus. Therefore, the adjacent buildings are assumed to include vibration-sensitive uses. The closest buildings to the West Campus are the easternmost TE Connectivity site building and the commercial buildings south of the campus. These buildings are located approximately 100 feet from the nearest property boundary.

Based on the information in Table 3.8-6, vibration levels from construction activities could reach up to 76 VdB for normal construction activities and up to 94 VdB during pile driving. These vibration levels would be above the FTA recommended threshold for vibration-sensitive equipment of 65 VdB. Construction activities would take place throughout the West Campus

and varying distances from the adjacent land uses. Based on the information in Table 3.8-6, vibration levels from normal construction activities, such as internal road building could exceed 65 VdB up to 225 feet away, and up to 900 feet away from pile-driving activities. Therefore, construction throughout the West Campus would have the potential to result in vibration levels exceeding 65 VdB at nearby vibration-sensitive uses, resulting in a ***potentially significant*** impact.

If pile driving resulted in vibration levels in excess 0.2 in/sec to 0.5 in/sec, the Project could result in damage to adjacent structures. As shown in Table 3.8-6, at a distance of 100 feet, peak vibration levels during pile driving would be below the FTA thresholds. Therefore, vibration from construction activities would not result in damage to existing off-site buildings. Buildings on the Project site would be constructed in sequence, so that some buildings would be completed while others are under construction. However, all pile-driving and foundation activities would be completed prior to construction of any buildings. The closest point between two buildings is approximately 50 feet between Buildings 1 and 2. General construction activities would not generate vibration that exceeds 0.2 in/sec at distance of 50 feet. Therefore, construction activities would not result in excessive vibration to any on-site structures.

Ground-borne Noise. As discussed above, vibration levels from normal construction activities could exceed 65 VdB up to 225 feet away, and up to 900 feet away from pile-driving activities. Vibration levels of 65 VdB can produce ground-borne noise levels up to 40 dBA and result in sleep disturbance. The nearest residences to the Project site are located 350 feet south of the West Campus. Therefore, these residences would be located within the 900 foot screening distance for pile-driving activities. However, construction activities would take place during the day in accordance with the City's Noise Ordinance. No nighttime construction would be required or allowed; therefore, no impacts related to sleep disturbance would occur. Ground-borne vibration levels of 85 VdB can result in noise levels up to 60 dBA, which can result in a disturbance to quiet daytime activities in noise-sensitive land uses. Vibration levels from normal construction activities would not exceed 85 VdB more than 50 feet from the source, and pile-driving activities would not exceed 85 VdB more than 200 feet from the source. The nearest sensitive receptors to the Project site are the residences located 350 feet away from the West Campus. Therefore, construction activities on the West Campus would not result in a disturbance to daytime uses. Ground-borne noise impacts would be ***less than significant.***

In summary, construction of the West Campus would not result in significant impacts related to sleep disturbance or damage during pile driving. However, impacts to buildings within 225 feet of general construction activities and 900 feet of pile-driving activities could occur if they include vibration-sensitive equipment. It is assumed that there is vibration-sensitive equipment within these distances, and thus the Project's impact to vibration-sensitive equipment is ***potentially significant***.

MITIGATION MEASURES. Construction of the West Campus would have the potential to result in significant ground-borne vibration that would disturb vibration-sensitive land uses. Mitigation Measure NO-2.1 would require the notification of nearby businesses of potential impacts to

vibration-sensitive equipment, in order to identify any vibration-sensitive equipment in the Project vicinity, and implement best management practices, as described in Mitigation Measure NO-2.2, to help reduce impacts to buildings with vibration-sensitive equipment. However, even though implementation of these measures would reduce ground-borne vibration impacts from construction, vibration-sensitive equipment at the TE Connectivity site, the Menlo Science and Technology Park (AMB's Park along Willow Road), and other commercial facilities (if identified), could still be exposed to excessive construction-generated vibration levels. Therefore, this impact is considered to be ***significant and unavoidable***. (SU)

NO-2.1 *Notify Nearby Businesses of Construction Activities on the West Campus that Could Affect Vibration-Sensitive Equipment*. The Project Sponsor shall provide notification to property owners and occupants of vibration-sensitive buildings within 225 feet of general construction activities and 900 feet of pile-driving activities, prior to the start of construction at the West Campus, informing them of the estimated start date and duration of vibration-generating construction activities, such as would occur during site preparation, grading, and pile driving. This notification shall include information warning about potential for impacts related to vibration-sensitive equipment. The Project Sponsor shall provide a phone number for the property owners and occupants to call if they have vibration-sensitive equipment on their sites. A copy of the notification and any responses shall be provided to the Planning Division prior to building permit issuance.

NO-2.2 *Implement Construction Best Management Practices to Reduce Construction Vibration on the West Campus*. If vibration-sensitive equipment is identified within 225 feet of general construction activities, including internal road construction or 900 feet of pile-driving activities on the West Campus, the Project Sponsor shall implement the following measures during construction:

- To the extent feasible, construction activities that could generate high vibration levels at identified vibration-sensitive locations shall be scheduled during times that would have the least impact on nearby land uses. This could include restricting construction activities in the areas of potential impact to the early and late hours of the work day, such as from 8:00 am to 10:00 a.m. or 4:00 p.m. to 6:00 p.m. Monday to Friday.
- Stationary sources, such as construction staging areas and temporary generators, shall be located as far from nearby vibration-sensitive receptors as possible.
- Trucks shall be prohibited from idling along streets serving the construction site where vibration-sensitive equipment is located.

NO-3 ***Substantial Permanent Increase in Noise Level.*** *Operation of the Project, at the East Campus and West Campus, would result in a substantial permanent ambient noise level increase in the Project vicinity due to an increase in traffic. This would be a potentially significant impact. (PS)*

Potential permanent increases in noise levels associated with the Project include roadway noise, an increase in human activity, and HVAC systems. The noise levels associated with these sources are discussed under Impact NO-1. As discussed there, roadways in the Project area would experience an increase in traffic noise levels associated with buildout of the Project (East Campus and West Campus). The changes in future noise levels at selected noise-sensitive locations along roadways in the Project vicinity are identified in Table 3.8-5. As shown, the Project would result in a significant increase in local traffic noise levels on Marsh Road and Willow Road, based on FTA's guidance. This would be a ***potentially significant*** impact of the Project.

Operational noise sources at the East Campus would be the same as existing conditions, with the exception of the increase in human activity. Activity on the East Campus would not generate noise levels that would exceed the City's noise standards on-site or at the nearest land uses. Noise from the increase in human activity and use of new HVAC systems at the West Campus would not exceed the City's noise standards on-site or at the adjacent land uses. Therefore, this impact would be ***less than significant***.

MITIGATION MEASURE. Implementation of the Project would have the potential to result in a significant increase in noise level on Marsh Road and Willow Road. As described under Impact NO-1, no feasible mitigation is available to reduce traffic-related noise exposure to a less-than-significant level. This impact would be ***significant and unavoidable***. (SU)

NO-4 ***Substantial Temporary Increase in Noise Level.*** *Construction of the Project at the West Campus would generate a short-term substantial increase in noise levels that would exceed ambient noise levels in the area. This would be considered a potentially significant impact. (PS)*

Construction of the West Campus would require the use of heavy equipment for building demolition, site grading and excavation, pile-driving, paving, and building fabrication. Construction activities would also involve the use of smaller power tools, generators, mechanical equipment, and other noise sources. During each construction stage, there would be a different mix of equipment operating and noise levels would vary based on the amount of equipment in operation and the location of the construction activity. Noise levels associated with the operation of heavy construction equipment typically range from about 65 to 88 decibels at 50 feet from the source, as shown in Table 3.8-7.[26] The noise-generating characteristics of specific types of construction equipment are presented in Table 3.8-8.

[26] Bolt, Baranek and Newman, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, prepared for the U.S. Environmental Protection Agency, December 31, 1971.

Table 3.8-7
Noise Level of Typical Construction Phases

Construction Phase	Noise Level in dBA L_{eq} at 50 feet[a] – Minimum Required Equipment	Noise Level in dBA L_{eq} at 50 feet[a] – All Pertinent Equipment Present at Site
Ground Clearing	83	83
Excavation	75	88
Foundations	81	81
Building Construction	65	81
Finishing	72	88

Source: Bolt, Baranek and Newman, 1971.

Note:

a. Machinery equipped with noise-control devices or other noise-reducing design features do not generate the same level of noise emissions as that shown in this table.

Table 3.8-8
Noise Level of Typical Construction Equipment

Construction Equipment	Noise Levels in dBA L_{eq} at 50 feet[a]
Front Loader	79
Dozer	80
Trucks	91
Cranes	83
Vibrator	76
Saws	78
Pneumatic Impact Equipment	86
Jackhammers	88
Pumps	76
Generators	78
Compressors	81
Concrete Mixers	85
Concrete Pumps	82
Back Hoe	85
Pile Driving (peaks)	101
Tractor	80
Scraper/Grader	88
Paver	89

Source: FTA, 2006.

Note:

a. Machinery equipped with noise-control devices or other noise-reducing design features do not generate the same level of noise emissions as that shown in this table.

Construction noise in the City is subject to Section 8.06.040 of the Noise Ordinance. Construction noise is exempted from the City's 60 dBA noise level limit for noise disturbances to residences; however, the Noise Ordinance prevents a substantial increase in ambient noise from construction equipment by prohibiting operation of equipment that would generate noise levels in excess of 85 dBA at 50 feet from the construction site, and limiting construction activities to between the hours of 8:00 a.m. and 6:00 p.m., Monday through Friday.

Assuming the worst-case construction noise level for general construction activities of 88 dBA at 50 feet from the construction site, construction noise would have the potential to exceed the threshold established in the Noise Ordinance. Additionally, pile drivers would be required for the building foundations. As shown in Table 3.8-8, pile-driving equipment generates the highest noise level of the listed general construction equipment, and resulting noise levels would be approximately 101 dBA at 50 feet. Pile driving would only be required at the building locations. The nearest building to the West Campus boundary would be the parking structure, which would be located a minimum of 45 feet from the Project boundary. At an attenuation rate of 6 dBA per doubling of distance to a receiver, the resulting noise level at 50 feet from the Project site would be approximately 95 dBA and would exceed the 85 dBA threshold.

Construction equipment would operate throughout the Project site on a daily and monthly basis and would only occasionally be operating on the edges of the construction site closest to the adjacent commercial uses and nearby residences. Construction would generally not result in the worst case scenario noise level because all construction equipment would not be operating simultaneously all day. Pile-driving activities would only be required for a few weeks of the 18-month construction period. Nevertheless, the potential exists for general construction activities to exceed the City's Noise Ordinance for construction equipment, a ***potentially significant*** impact.

Vehicle trips from construction traffic, including trucks hauling export material and worker trips, would temporarily increase noise levels along area roadways, primarily Bayfront Expressway, and the segments of Marsh Road, Willow Road, and University Avenue between the Project site and US 101. A maximum of 210 truck trips would be necessary per day. A maximum of 250 workers would be necessary on-site during construction. It is assumed that every worker would generate four trips per day, two related to commuting and two related to their lunch break. Therefore, construction would result in a maximum increase of 1,210 daily trips on Bayfront Expressway. Table 3.8-9 shows the existing noise level along the roadway segments of concern for construction traffic, and the noise level with the addition of construction trips. During construction of the West Campus, the increase of 1,210 ADT would not increase the noise level above existing conditions. Although individual truck pass-bys may be audible to nearby land uses, no changes in ambient noise levels during construction would occur on the Project site or at sensitive receptors along the probable construction truck routes. Therefore, noise impacts from truck trips and construction workers trips would be ***less than significant***.

Table 3.8-9
West Campus Construction Increment to Existing Noise Levels at Representative Locations in the Project Vicinity (CNEL)

Segment/Adjacent Land Use[a,b]	Existing Traffic Noise Level Without Project	Traffic Noise Level With Construction Traffic	Increase in Noise Level as a Result of Project	Allowable Increase[c]	Significant Impact?
Bayfront Expressway - Chrysler Drive to Chilco Street	73	73	0	1	No
Marsh Road - Scott Drive to Bohannon Drive	82	82	0	0	No
Willow Road - O'Brien Drive to Newbridge Street	77	77	0	0	No
University Avenue - O'Brien Drive to Kavanaugh Drive	75	75	0	0	No

Source: FHWA Highway Noise Prediction Model. See Appendix 3.8 for model output.

Notes:

a. Sensitive receptor and receptor distance from roadway centerline are:
   1. Bayfront Expressway (Chrysler Drive to Chilco Street): West Campus boundary, 75 feet from centerline of Bayfront Expressway
   2. Marsh Road (Scott Drive to Bohannon Drive): Residences 50 feet from centerline of Marsh Road
   3. Willow Road (O'Brien Drive to Newbridge Street): Residences 75 feet from centerline of Willow Road
   4. Willow Road (Durham Street to Coleman Avenue): Willow Oaks Elementary School playground, 75 feet from centerline of Willow Road
   5. University Avenue (O'Brien Drive to Kavanaugh Drive): Residences 50 feet from centerline of University Avenue

b. Refer to Section 3.5, Transportation, for a description of the traffic scenarios.

c. Federal Transit Administration. Transit Noise and Vibration Impact Assessment. May 2006.

In summary, vehicle trips during construction would not result in significant noise impacts; however, operation of heavy construction equipment would generate a substantial increase in ambient noise and would potentially exceed the City's Noise Ordinance standards. The impact is considered ***potentially significant***.

MITIGATION MEASURE. Construction of the West Campus would have the potential to result in noise levels that would exceed the City's Noise Ordinance standards for construction equipment. Implementation of the following measure would reduce construction noise associated with the Project to a ***less-than-significant*** level. (LTS)

NO-4.1 *Implement a Construction Noise Plan to Reduce Construction Noise on the West Campus*. The Project Sponsor shall submit a Construction Noise Plan for review and approval by the Planning and Building Divisions prior to the issuance of the demolition permit. The Project Sponsor shall implement the following measures during demolition and construction of the Project:

- To the extent feasible, the noisiest construction activities shall be scheduled during times that would have the least impact on nearby residential land uses. This would include restricting typical demolition and exterior construction activities to the hours of 8:00 a.m. to 6:00 p.m. Monday to Friday.

- Equipment and trucks used for Project construction shall use the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures and acoustically attenuating shields or shrouds) wherever feasible.
- Impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for Project construction shall be hydraulically or electrically powered wherever possible to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used; this muffler can lower noise levels from the exhaust by up to about 10 dBA. External jackets on the tools themselves shall be used where feasible, and this could achieve a reduction of 5 dBA. Quieter procedures shall be used, such as drills rather than impact equipment, whenever feasible.
- Prior to any pile-driving activities, notification shall be sent to all surrounding property owners and occupants within 300 feet of the Project site informing them of the estimated start date and duration.
- Construction contractors, to the maximum extent feasible, shall be required to use "quiet" gasoline-powered compressors or other electric-powered compressors, and use electric rather than gasoline or diesel powered forklifts for small lifting.
- Stationary noise sources, such as temporary generators, shall be located as far from nearby receptors as possible, and they shall be muffled and enclosed within temporary sheds, incorporate insulation barriers, or other measures to the extent feasible.
- Install temporary plywood noise barriers eight feet in height around the construction site to minimize construction noise to 90 dBA as measured at the applicable property lines of the adjacent uses, unless an acoustical engineer submits documentation that confirms that the barriers are not necessary to achieve the attenuation levels.
- Trucks shall be prohibited from idling along streets serving the construction site.
- Implement "quiet" pile driving technology (e.g., vibratory pile driving or pre-drilled pile holes), where feasible, in consideration of geotechnical and structural requirements and conditions.
- Monitor the effectiveness of noise attenuation measures by taking noise measurements during pile driving activities.

Cumulative Analysis

The geographic context for the cumulative noise analysis from localized construction and stationary source noise includes areas immediately surrounding the Project site, as noise diminishes rapidly with distance (3 dBA for each doubling of distance). For cumulative vehicular noise impacts, the cumulative context is based on the cumulative context for the traffic analysis, which includes existing and future developments, including other current projects, probable future projects, and projected future growth within the City through the year 2025.

C-NO-1 ***Cumulative Exposure to Excessive Noise.*** *The Project, in combination with other development within the City, could result in a substantial increase in exposure of persons to noise in excess of the standards established in the General Plan or Municipal Code. The Project's contribution would be cumulatively significant. (PS)*

Tier 1 and Tier 2

Exposure of Offsite Receptors – Stationary Noise Sources. Similar to the Project, operation of the cumulative projects would also have the potential to increase ambient noise levels above the City's compatibility standards of 60 dBA CNEL for residential areas and 70 dBA for commercial and industrial uses. This potential impact is limited to cumulative projects in the immediate vicinity of the Project site, because projects dispersed throughout the City would not combine to increase noise levels. This is due to distance and intervening buildings that provide noise attenuation, as well as existing traffic volumes that exceed the noise standards.

As described in Section 3.1, Tier 1 cumulative projects consist of reasonably foreseeable development projects identified by the City and within City limits. Three cumulative projects listed in Table 3.1-1 are in the immediate vicinity of the West Campus: a new 21 unit residential building at 297 Terminal Avenue, a police and City services building at 1283 Willow Road, and Menlo Gateway at 100-155 Constitution Drive and 100-190 Independence Drive. Noise from residential projects is generally limited to intermittent nuisance noise such as a dog barking or loud music. Therefore, the project at 297 Terminal Avenue would not contribute significantly to an increase in ambient noise levels. Similar to the Project, the new City Services building, and the office and hotel uses west of the West Campus would increase human activity in the area and would include HVAC systems that would have the potential to permanently increase noise levels in the Project vicinity. However, similar to the Project, the noise level of human activity would not exceed existing ambient noise levels due to heavy traffic on Bayfront Expressway and Willow Road. Noise from stationary or point sources, including regular human speech or crowd noise, is reduced by about 6 to 7.5 dBA for every doubling of distance at acoustically hard and soft locations, respectively. Noise levels may also be reduced by intervening structures; generally, a single row of buildings between the receptor and the noise source reduces the noise level by about 5 dBA, while a solid wall or berm reduces noise levels by 5 to 10 dBA. Existing homes in California generally provide a reduction of

exterior-to-interior noise levels of about 20 to 25 dBA with closed windows. The exterior-to-interior reduction of newer residential units is generally 30 dBA or more.[27]

Noise levels are not strictly additive. Rather, when adding a noise level to an approximately equal noise level, the total noise level increases 3 dBA. For example, doubling the traffic on a highway would result in an increase of 3 dBA. Conversely, reducing traffic by one half would reduce the noise level by 3 dBA. Second, when two noise levels are 10 dBA or more apart, the lower value does not contribute significantly (less than 0.5 dB) to the total noise level. For example, 60 dBA + 70 dBA ≈ 70 dBA.

This can also be expressed by the following equation:

$$SPL_{Total} = 10\log_{10}[10^{SPL_{1/10}} + 10^{SPL_{2/10}} + \ldots 10^{SPL_{n/10}}]$$ [28]

Utilizing the above equation, it can be reasonably assumed that noise levels from stationary point sources in the Project vicinity from cumulative development would not increase significantly, would remain below City compatibility standards, and would not combine to exceed noise standards. Therefore, a cumulative impact would not occur as a result of the Tier 1 cumulative projects. However, as discussed under Impact NO-1, operation of the West Campus would not result in an increase in noise levels from stationary sources above ambient noise levels. Therefore, the cumulative impact of the Project on stationary noise levels would be ***less than significant.***

Exposure of Offsite Receptors – Vehicular Noise Sources. Cumulative growth in the City could lead to increased noise levels from vehicular traffic, although there is the possibility that future traffic noise could be decreased through implementation of TDM measures and a focus on transit-oriented development that would reduce vehicle trips. For areas of the City where noise levels already exceed significance thresholds, cumulative development would result in a significant cumulative impact. The traffic model used to predict future traffic levels assumed approved development and City growth through the year 2025. Table 3.8-10 compares noise levels with implementation of the cumulative projects to existing noise levels. The increase from existing noise levels would be significant under cumulative conditions if the increase would exceed the 1 dBA threshold for roadways currently generating noise levels between 65 and 75 dBA, and any increase would be considered significant for roadways generating noise levels above 75 dBA. As shown in Table 3.8-10, cumulative development would have the potential to exceed these thresholds along Marsh Road, Willow Road, and University Avenue and there would be a significant cumulative impact from vehicular noise.

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[27] U.S. Department of Housing and Urban Development, *Noise Guidebook*, 1985.

[28] SPL = Sound Pressure Level. If the number of SPLs to be added is N, and SPL1, SPL2, and ... SPLn represent the first, second, and nth SPL. Equation from Caltrans *Technical Noise Supplement*, November, 2009.

Table 3.8-10
Project Increment to Existing and Future Noise Levels at Representative Locations in the Project Vicinity (CNEL)

Segment/Adjacent Land Use[a]	Existing Noise Level[b]	Traffic Noise Level Without Project – Long Term Project I Scenario[b] (Cumulative without Project)	Traffic Noise Level With Proposed Project – Long Term Project II Scenario (East Campus and West Campus) [b]	Cumulative Increase in Noise Level	Allowable Increase[c]	Significant Cumulative Impact?	Increase in Noise Level as a Result of Project	Cumulatively Considerable Contribution?
Bayfront Expressway - Chrysler Drive to Chilco Street	73	74	74	+1	1	No	0	No
Marsh Road - Scott Drive to Bohannon Drive	82	83	83	+1	0	Yes	0	No
Willow Road - O'Brien Drive to Newbridge Street	77	79	80	**+3**	**1**	**Yes**	**+1**	**Yes**
Willow Road - Durham Street to Coleman Avenue	72	73	74	**+2**	**1**	**Yes**	+1	No
University Avenue - O'Brien Drive to Kavanaugh Drive	75	76	76	**+1**	**0**	**Yes**	0	No

Source: FHWA Highway Noise Prediction Model. See Appendix 3.8 for model output.

Notes:

a. Sensitive receptor and receptor distance from roadway centerline are:

1. Bayfront Expressway (Chrysler Drive to Chilco Street): West Campus boundary, 75 feet from centerline of Bayfront Expressway
2. Marsh Road (Scott Drive to Bohannon Drive): Residences 50 feet from centerline of Marsh Road
3. Willow Road (O'Brien Drive to Newbridge Street): Residences 75 feet from centerline of Willow Road
4. Willow Road (Durham Street to Coleman Avenue): Willow Oaks Elementary School playground, 75 feet from centerline of Willow Road
5. University Avenue (O'Brien Drive to Kavanaugh Drive): Residences 50 feet from centerline of University Avenue

b. Refer to Section 3.5, Traffic and Circulation, for a description of the traffic scenarios.

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

Significant impacts shown in **Bold.**

One cumulative project listed in Table 3.1-2, Cumulative Projects for the Tier 2 Analysis, is located in the immediate vicinity of the West Campus: the Dumbarton Rail Corridor Project. Commuter trains have the potential to generate noise levels of 92 dBA at 50 feet from the track, and train horns can generate noise levels of 110 dBA at 50 feet from the track.[29] Therefore, the Dumbarton Rail Corridor Project would have the potential to result in a substantial increase in ambient noise levels and a potentially significant cumulative impact could occur.

[29] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006.

As noted above, for the purposes of this analysis, in areas where the existing noise level exceeds the City's standards, the significance of the Project's impacts are based on the Project's incremental increase. Future noise levels in the year 2025 with and without the Project are shown in the long-term traffic scenarios in Table 3.8-5 of this section. The increase attributable to the Project would exceed the threshold on Willow Road; therefore, the Project's contribution to exceedance of noise thresholds from vehicular traffic would be cumulatively considerable. The cumulative impact as a result of increased traffic noise would be ***potentially significant.***

Exposure of On-site Receptors. As noted above under Impact NO-1, the noise level on the West Campus currently exceeds the City's normally acceptable standard for office uses, but is below the conditionally acceptable standard. With the addition of future traffic noise, noise levels would continue to be below the conditionally acceptable noise level of 75 dBA, as shown in Table 3.8-10. As discussed above, noise levels from cumulative development of the Tier 1 projects would not contribute to an exceedance of the City's conditionally acceptable noise standards. For uses that fall within the conditionally acceptable exterior noise limits, the interior noise levels for office and residential uses can be reduced to acceptable levels with incorporation of noise-insulating materials. Conventional building methods are generally sufficient, according to the City's General Plan. Therefore, there would be no significant cumulative impact as a result of implementation of Tier 1 projects. The Project, and all cumulative projects, would be constructed using conventional building methods consistent with the most recent building code and would comply with the City's interior and exterior noise standards.

The Dumbarton Rail Corridor Project, a Tier 2 project, would have the potential to result in a cumulatively considerable increase in ambient noise level on the Project site. The Dumbarton Rail Corridor Project would be subject to CEQA and would be required to mitigate impacts to the extent feasible. As discussed under Impact NO-1, the Project itself would not generate noise levels that would result in an increase in ambient noise levels above the City's noise standards. When taken together, the additive effect of other contributions (specifically the Dumbarton Rail Corridor Project) to this impact is significant. However, since the Project's contribution is not considerable, the cumulative impact with respect to stationary noise sources is ***less than significant.***

MITIGATION MEASURE. Implementation of the Project would result in a cumulatively considerable increase in noise levels from vehicular traffic on Marsh Road and Willow Road. As described under Impact NO-1, Mitigation Measure NO-1.1 would reduce noise levels to below the existing noise level along Willow Road. However, installation of a noise wall would not be feasible and no other feasible mitigation is available to reduce traffic-related noise exposure to a less-than-significant level. Therefore, the Project's cumulative impact would be ***significant and unavoidable.*** (SU)

C-NO-2 ***Cumulative Exposure to Ground-borne Vibration.*** *Construction activities associated with Project-related development and other future development in the City would not expose sensitive receptors to excessive ground-borne vibration. The Project's cumulative impact would be less than significant. (LTS)*

Tier 1 and Tier 2

The most common sources of ground-borne vibration in the Project area and the City are construction activities and roadway truck traffic. Heavy trucks currently transport goods and materials along the streets surrounding the Project area (i.e., Bayfront Expressway, University Avenue, Willow Road). Large delivery trucks typically generate ground-borne vibration velocity levels around 63 VdB at 50 feet from the source, and these levels could reach 72 VdB where trucks pass over an uneven road surface.[30] As described above, the vibration velocity level threshold of perception for humans is approximately 65 VdB, and 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels. Therefore, existing traffic vibration is neither distinctly nor generally perceptible. Additionally, vibration velocity levels around 63 Vdb would generally not produce ground-borne noise that would disturb sleep. Cumulative development in the City would not result in the exposure of people to or the generation of excessive groundborne vibration due to the localized nature of vibration impacts and the fact that construction throughout the City would not occur at the same time. High groundborne vibration at each of the construction sites would continue to be isolated and only affect receptors within close proximity to the individual pieces of construction equipment. Therefore, cumulative development would not result in a significant cumulative vibration impact.

Typical equipment that would be used during construction at the West Campus would include, but not be limited to, concrete crushers, cranes, tractors, excavators, pile drivers, forklifts, off-highway tractors and trucks, material handling equipment, pavers, pumpers, rollers, bulldozers, surfacing and grading equipment, backhoes, and trenchers. Project construction activities would have the potential to generate low levels of ground-borne vibration (other than during pile driving). The nearest residential uses to the West Campus are along Hamilton Avenue, south of the Dumbarton Rail right-of-way, approximately 350 feet from the southern border of West Campus. Based on the information presented in Table 3.8-6, vibration levels from construction activities, including pile driving, would not exceed 80 VdB at a distance of 350 feet. The most vibration-intensive activity, pile-driving, would not exceed 78 VdB at 350 feet. Therefore, exposure of residential areas to excessive ground-borne vibration during construction would be less than significant. As such, the vibration impact of the Project, in conjunction with vibration from other cumulative development, would result in a ***less-than–significant*** cumulative impact.

[30] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006.

C-NO-3 ***Cumulative Permanent Increase in Noise Levels.*** *Operation of the Project, in combination with other development in the City, would result in a substantial permanent ambient noise level increase in the Project vicinity. The Project's contribution would be cumulatively significant. (PS)*

Tier 1 and Tier 2

As described above under Impact C-NO-1, cumulative increases in traffic would result in substantial noise level increases from vehicular traffic at four of the selected locations because the increase would exceed the FTA significance thresholds that the City is utilizing for this Draft EIR. The Project's contribution would be cumulatively considerable on Willow Road. No feasible mitigation is available to reduce this impact to a less-than-significant level; therefore, the Project's cumulative impact for increased noise levels from vehicular traffic would be ***potentially significant.***

MITIGATION MEASURE. Implementation of the Project would have the potential to result in a significant increase in noise level on Marsh Road and Willow Road. No feasible mitigation is available to reduce traffic-related noise exposure to a less-than-significant level. Therefore, cumulative impacts would be ***significant and unavoidable***. (SU)

C-NO-4 ***Cumulative Temporary Increase in Noise Levels.*** *Construction activities associated with Project-related development and other future development in the City would not expose sensitive receptors to a substantial temporary increase in ambient noise level. The Project's cumulative impact would be less than significant. (LTS)*

Tier 1 and Tier 2

Cumulative development in the City would not result in the exposure of people to a substantial temporary increase in ambient noise level during construction due to the localized nature of construction noise impacts and the fact that construction throughout the City would not occur at the same time. The construction activity with the potential to generate the highest noise levels, pile driving, would not exceed the construction noise threshold of 85 dBA more than 250 feet from the source. None of the cumulative projects are located within 250 feet of the Project site, with the exception of the Dumbarton Rail Corridor Project. The Dumbarton Rail Corridor Project is in the preliminary stages of planning and would not be constructed at the same time as the Project. Therefore, construction noise from the cumulative projects would not combine to exceed the City's Noise Ordinance standards for construction. As such, the Project would have a ***less-than-significant*** cumulative impact due to temporary increases in ambient noise levels.

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