APPENDIX H

ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT

965 WEEKS STREET AFFORDABLE HOUSING PROJECT NOISE AND VIBRATION ASSESSMENT

EAST PALO ALTO, CALIFORNIA

November 1, 2019

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INTRODUCTION

A four-story, 136-unit affordable apartment complex and parking garage is proposed on a vacant lot at 965 Weeks Street in East Palo Alto, California. The proposed project would provide housing for 442 persons with affordability levels between 30% and 60% of the area mean income. The proposed apartments would include four studio units, 23 one-bedroom units, 75 two-bedroom units, 19 three-bedroom units, and 15 four-bedroom units. The 73,000-square foot garage structure would include a roof-top level and a total of 215 parking spaces.

This report evaluates the project's potential to result in significant noise and vibration impacts with respect to California Environmental Quality Act (CEQA) guidelines. The report is divided into three sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise and groundborne vibration, summarizes applicable regulatory criteria, and discusses the results of the ambient noise monitoring survey completed to document existing noise conditions; 2) the General Plan Consistency Section discusses noise and land use compatibility utilizing policies in the City of East Palo Alto's General Plan; and 3) the Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts, provides a discussion of each project impact, and presents measures, where necessary, to mitigate the impacts of the project on sensitive receptors in the vicinity.

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (*frequency*) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A *decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA).* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. Because sound levels can vary markedly over a short period of time, a

method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This *energy-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level* (*CNEL*) is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels. The *Day/Night Average Sound Level* (*DNL* or L_{dn}) is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA CNEL. Typically, the highest steady traffic noise level during the daytime is about equal to the CNEL and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12 to 17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57 to 62 dBA CNEL with open windows and 65 to 70 dBA CNEL if the windows are closed. Levels of 55 to 60 dBA are common along collector streets and secondary arterials, while 65 to 70 dBA is a typical value for a primary/major arterial. Levels of 75 to 80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed; those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The CNEL as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA CNEL. At a CNEL of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the CNEL increases to 70 dBA, the percentage of the population highly annoyed increases to about 25 to 30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a CNEL of 60 to 70 dBA. Between a CNEL of 70 to 80 dBA, each decibel increase increases by about 3 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the CNEL is 60 dBA, approximately 30 to 35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous or frequent intermittent vibration levels produce. The guidelines in Table 3 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess groundborne vibration and almost exclusively to assess the potential of vibration to cause damage and the degree of annoyance for humans.

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table 3 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from "Historic and some old buildings" to "Modern industrial/commercial buildings". Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage.

TABLE 1 Definition of Acoustical Terms Used in this Report

Term	Definition
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e. g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

TABLE 2 Typical Noise Levels in the Environment

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110 dBA	Rock band
Jet fly-over at 1,000 feet		
	100 dBA	
Gas lawn mower at 3 feet		
	90 dBA	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80 dBA	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	70 dBA	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60 dBA	
		Large business office
Quiet urban daytime	50 dBA	Dishwasher in next room
Quiet urban nighttime	40 dBA	Theater, large conference room
Quiet suburban nighttime		
	30 dBA	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20 dBA	
		Broadcast/recording studio
	10 dBA	
	0 dBA	

Source: Technical Noise Supplement (TeNS), California Department of Transportation, September 2013.

TABLE 3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, September 2013.

Regulatory Background

State CEQA Guidelines. CEQA contains guidelines to evaluate the significance of effects of noise or vibration attributable to a proposed project. Under CEQA, noise or vibration impacts would be considered significant if the project would result in:

(a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local General Plan or Noise Ordinance, or applicable standards of other agencies;

(b) Generation of excessive groundborne vibration or groundborne noise levels; or

(c) For a project located within the vicinity of a private airstrip or an airport land use plan or where such a plan has not been adopted within two miles of a public airport or public use airport, if the project would expose people residing or working in the project area to excessive noise levels.

CEQA does not define what noise level increase would be considered substantial. Typically, an increase in the CNEL noise level resulting from the project at noise sensitive land uses of 3 dBA or greater would be considered a significant impact when projected noise levels would exceed those considered acceptable for the affected land use. An increase of 5 dBA CNEL or greater would be considered a significant impact when projected noise levels would remain within those considered acceptable for the affected land use.

2016 California Building Code, Title 24, Part 2. The current version of the California Building Code (CBC) requires interior noise levels in multi-family residential units attributable to exterior environmental noise sources to be limited to a level not exceeding 45 dBA DNL/CNEL in any habitable room.

Vista 2035 East Palo Alto General Plan. The City of East Palo Alto adopted the 2035 General Plan October 4, 2016. The Safety and Noise Chapter of the General Plan[1] provides goals and policies to reduce noise within the community. The goals and policies that apply to the proposed project are as follows:

Goal SN-6: Minimize the effects of noise through proper land use planning.

Intent: To ensure that new noise-sensitive land uses in the City are located in a compatible noise environment or adequately mitigated in order to provide a compatible exterior and interior noise environment.

> **Policy 6.1. Noise standards.** Use the Interior and Exterior Noise Standards (Table 10-1) for transportation noise sources. Use the City's Noise Ordinance for evaluating non-transportation noise sources when making planning and development decisions. Require that applicants demonstrate that the noise standards will be met prior to project approval.
>
> **Policy 6.2. Compatibility standards.** Utilize noise/land use compatibility standards and the Noise Ordinance as guides for future development decisions.
>
> **Policy 6.3. Noise control.** Provide noise controls measures, such as berms, walls, and sound attenuating construction in areas of new construction or rehabilitation.
>
> **Policy 6.4. Airport-adjacent land uses.** Maintain the non-residential designation for land near the airport in order to prevent new noise-sensitive residential uses from being constructed in areas with excessive aircraft noise.

Goal SN-7: Minimize transportation- and non-transportation-related noise impacts, especially on noise-sensitive land uses.

Intent: To maintain and improve the noise environment at noise-sensitive land uses throughout the City.

> **Policy 7.1. Noise ordinance.** Continually enforce and periodically review the City's Noise Ordinance for adequacy (including requiring construction activity to comply with established work schedule limits). Amend as needed to address community needs and development patterns.
>
> **Policy 7.2. CEQA acoustical analysis.** Require an acoustical analysis to evaluate mitigation measures for noise-generating projects that are likely to cause the following criteria to be exceeded or to cause a significant adverse community response:
>
> - Cause the L_{dn}/CNEL at noise-sensitive uses to increase by 3 dBA or more and exceed the "normally acceptable" level.

[1] City of East Palo Alto, *Vista 2035 East Palo Alto General Plan*, Safety and Noise Chapter, October 4, 2016.

- Cause the L_{dn}/CNEL at noise-sensitive uses to increase by 5 dBA or more and remain "normally acceptable."

Policy 7.5. Traffic and truck noise. Regulate traffic flow to enforce speed limits to reduce traffic noise. Periodically evaluate and enforce established truck and bus routes to avoid noise impacts on sensitive receptors.

Policy 7.7. Site design review. Utilize site design review to identify potential noise impacts on new development, especially from nearby transportation sources. Encourage the use of noise barriers (walls, berms, or landscaping), setbacks and/or other buffers.

Policy 7.8. Quiet asphalt. Consider a "quieter" pavement that also meets other criteria established by the City for pavements for use in resurfacing roadways. Encourage its use in future capital projects.

Table 10-1. Interior and Exterior Noise Standards

Land Use	Noise Standards[1]	
	Interior[2, 3]	Exterior
Residential – Single family, multifamily, duplex, mobile home	CNEL 45 dB	CNEL 65 dB[4]
Residential – Transient lodging, hotels, motels, nursing home, hospitals	CNEL 45 dB	CNEL 65 dB[4]
Private offices, church sanctuaries, libraries, board rooms, conference rooms, theaters, auditoriums, concert halls, meeting halls, etc.	Leq(12) 45 dB(A)	-
Schools	Leq(12) 45 dB(A)	Leq(12) 67 dB(A)[5]
General offices, reception, clerical, etc.	Leq(12) 50 dB(A)	-
Bank lobby, retail store, restaurant, typing pool, etc.	Leq(12) 55 dB(A)	-
Manufacturing, kitchen, warehousing, etc.	Leq(12) 65 dB(A)	-
Parks, playgrounds	-	CNEL 65 dB[5]
Golf courses, outdoor spectator sports, amusement parks	-	CNEL 70 dB[5]

Notes:

1. CNEL: Community Noise Equivalent Level; Leq (12): The A-weighted equivalent sound level averaged over a 12-hour period (usually the hours of operation).
2. Noise standard with windows closed. Mechanical ventilation shall be provided per UBC requirements to provide a habitable environment.
3. Indoor environment excluding bathrooms, toilets, closets, and corridors.
4. Outdoor environment limited to rear yard of single family homes, multifamily patios, and balconies (with a depth of 6' or more) and common recreation areas.
5. Outdoor environment limited to playground areas, picnic areas and other areas of frequent human use.

Source: Title 24, California Code of Regulations

City of East Palo Alto Municipal Code. Chapter 8.52, Noise Control, of the City's Municipal Code seeks to protect the citizens of East Palo Alto from unnecessary, excessive, and annoying noise; to maintain quiet in areas where noise levels are low; and to implement programs to reduce unacceptable noise. The regulations limit the amount of noise that may be created as

measured at the exterior of any dwelling unit, school, hospital, church, or public library. Table 4 provides the Municipal Code's exterior noise standards. In addition, Chapter 8.52 limits the creation of noise that results in excessive noise levels within any dwelling unit. Table 5 provides the standards for interior noise in dwelling units. Exemptions to these standards are provided for activities such as special events and noise sources due to construction activities not taking place between 8:00 p.m. and 7:00 a.m.[2]

TABLE 4 Exterior Noise Level Standards for Single- or Multi-Family Residences, Schools, Hospitals, Churches, and Public Libraries

Category	Cumulative Number of Minutes in Any 1-Hour Time Period	Noise Level Standards, dBA	
		Daytime (7:00 am – 10:00 pm)	Nighttime (10:00 pm – 7:00 am)
1	30	55	50
2	15	50	55
3	5	65	60
4	1	70	60
5	0	75	70

Source: City of East Palo Alto Municipal Code, 2017.

Notes:

A. In the event the measured background noise level exceeds the applicable noise level standard in any category above, the applicable standard shall be adjusted in 5 dBA increments so as to encompass the background noise level.

B. Each of the noise level standards specified above shall be reduced by 5 dBA for simple tone noises, consisting primarily of speech or music, or for recurring or intermittent impulsive noises.

C. If the intruding noise source is continuous and cannot reasonably be stopped for a period of time whereby the background noise level can be measured, the noise level measured while the source is in operation shall be compared directly to the noise level standards in this table.

While Table 4 does summarize the levels provided in the Municipal Code for each category, the original Municipal Code document has two typos: Category 2 should be 60 dBA during daytime hours and 55 dBA during nighttime hours, and Category 4 should be 70 dBA during daytime hours and 65 dBA during nighttime hours. For any analysis involving these categories, the corrected levels are used.

Section 15.04.125 of the City's Municipal Code limits construction activity to the hours of 7:00 a.m. to 6:00 p.m. Monday through Friday and 9:00 a.m. to 5:00 p.m. on Saturdays. No construction activity is allowed on Sundays or national holidays.

2 City of East Palo Alto, 2017, *East Palo Alto Municipal Code*, Chapter 8.52, Noise Control.

TABLE 5 Interior Noise Level Standards – Dwelling Unit

Category	Cumulative Number of Minutes in Any 1-Hour Time Period	Noise Level Standards, dBA	
		Daytime (7:00 am – 10:00 pm)	Nighttime (10:00 pm – 7:00 am)
1	5	45	40
2	1	50	45
3	0	55	50

Source: City of East Palo Alto Municipal Code, 2017.

Notes:

A. In the event the measured background noise level exceeds the applicable noise level standard in any category above, the applicable standard shall be adjusted in 5 dBA increments so as to encompass the background noise level.

B. Each of the noise level standards specified above shall be reduced by 5 dBA for simple tone noises, consisting primarily of speech or music, or for recurring or intermittent impulsive noises.

C. If the intruding noise source is continuous and cannot reasonably be stopped for a period of time whereby the background noise level can be measured, the noise level measured while the source is in operation shall be compared directly to the noise level standards in this table.

Santa Clara County Airport Land Use Commission Comprehensive Land Use Plan. The Comprehensive Land Use Plan adopted by the Santa Clara County Airport Land Use Commission contains standards for projects within the vicinity of Palo Alto Airport, which are relevant to this project:

4.3.2.1 Noise Compatibility Policies

Policy N-3 Noise impacts shall be evaluated according to the Aircraft Noise Contours presented on Figure 5 (2022 Aircraft Noise Contours).

Policy N-4 No residential construction shall be permitted within the 65 dB CNEL contour boundary unless it can be demonstrated that the resulting interior sound levels will be less than 45 dB CNEL, and there are no outdoor patios or outdoor activity areas associated with the residential project. (Sound wall noise mitigation measures are not effective in reducing noise generated by aircraft flying overhead.) All property owners within the 65 dB CNEL contour boundary who rent or lease their property for residential use shall include in their rental/lease agreement with the tenant, a statement advising that they (the tenants) are living within a high noise area, and the exterior noise level is predicted to be greater than 65 dB CNEL.

Policy N-6 Noise level compatibility standards for other types of land uses shall be applied in the same manner as the above residential noise level criteria. Table 4-1 presents acceptable noise levels for other land uses in the vicinity of the Airport.

Policy N-7 Single-event noise levels (SENL) are also to be considered when evaluating the compatibility of highly noise-sensitive land uses, such as schools, libraries, outdoor theaters, and mobile homes. Single-event noise levels are especially important in the areas regularly overflown by aircraft, but which may not produce significant CNEL contours, such as the down-wind segment of the traffic pattern, and airport entry and departure flight corridors.

Table 4 - 1

NOISE COMPATIBILITY GUIDELINES

LAND USE CATEGORY	CNEL					
	55-60	60-65	65-70	70-75	75-80	80-85
Residential – low density Single-family, duplex, mobile homes	*	**	**	**	****	****
Residential – multi-family, condominiums, townhouses	*	**	**	**	****	****
Transient lodging - motels, hotels	*	**	**	**	****	****
Schools, libraries, churches, hospitals, nursing homes	*	**	**	**	****	****
Auditoriums, concert halls, amphitheaters	**	**	**	**	****	****
Sports arena, outdoor spectator sports, parking	*	*	**	**	**	****
Playgrounds, neighborhood parks	*	*	**	**	**	****
Office buildings, business commercial and professional	*	*	*	**	**	****
Industrial, manufacturing, utilities, agriculture	*	*	*	**	**	**
* Generally Acceptable	Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements. Outdoor activities are not likely to be adversely affected.					
** Conditionally Acceptable	Specified land uses may be permitted only after detailed analysis of the noise reduction requirements and needed noise insulation features included in the design. Outdoor activities may be adversely affected.					
**** Unacceptable	New construction or development should generally not be undertaken because mitigation is usually not feasible to comply with noise element policies. Outdoor activities are likely to be adversely affected.					

Source: Palo Alto Comprehensive Plan (1998), Land Use Compatibility for Community Noise Environment Element, page N-28

Existing Noise Environment

Figure 1 shows the proposed project and vicinity. The project site is currently vacant and is surrounded by single-family residences to the east, to the north, to the west, and to the south, opposite Weeks Street. Additionally, light industrial uses are also located to the east.

A noise monitoring survey was performed at the site beginning on Tuesday, August 27, 2019 and concluding on Thursday, August 29, 2019. The monitoring survey included one long-term and two short-term noise measurements, as shown in Figure 1. The noise environment at the site and in the project vicinity is dominated by traffic noise along Weeks Street and nearby Clarke Avenue, Bay Road, and Pulgas Avenue. Frequent aircraft overflights associated with the Palo Alto Airport also affect the noise environment.

Long-term noise measurement LT-1 was made near the center of the project site, approximately 30 feet north of the centerline of Weeks Street. Hourly average noise levels at this location typically ranged from 55 to 65 dBA L_{eq} during the day and from 43 to 55 dBA L_{eq} at night. The average community noise equivalent level measured on Wednesday, August 28, 2019 was 60 dBA CNEL. The daily trend in noise levels measured at LT-1 is shown in Figures 2 through 4.

Short-term measurements were made on Tuesday, August 27, 2019 in 10-minute intervals between 12:40 p.m. and 1:10 p.m. Table 6 summarizes the results of both short-term noise measurements.

ST-1 was located along the western boundary of the project site, approximately 200 feet north of the centerline of Weeks Street and approximately 155 feet east of the centerline of Clarke Avenue. Noisy birds, generating noise levels of 52 dBA, were in the vicinity of ST-1 during the 10-minute measurement period. Typical passenger car noise levels measured at ST-1 ranged from 46 to 48 dBA, and truck pass-bys ranged from 56 to 66 dBA. Overhead aircraft was also observed during this time period, with noise levels ranging from 49 to 53 dBA. The 10-minute average noise level measured at ST-1 was 50 dBA $L_{eq(10\text{-}min)}$.

ST-2 was located along the eastern boundary of the project site, approximately 170 feet north of the centerline of Weeks Street. During this measurement period, passenger car pass-bys along Weeks Street generated noise levels of 45 to 46 dBA, while overhead planes and jets generated noise levels of 48 to 60 dBA. Two helicopters generated noise levels of 62 to 65 dBA. At ST-2, the 10-minute average noise level was 53 dBA $L_{eq(10\text{-}min)}$.

FIGURE 1 Noise Measurement Locations

Source: Google Earth, 2019.

FIGURE 2 Daily Trend in Noise Levels at LT-1, Tuesday, August 27, 2019

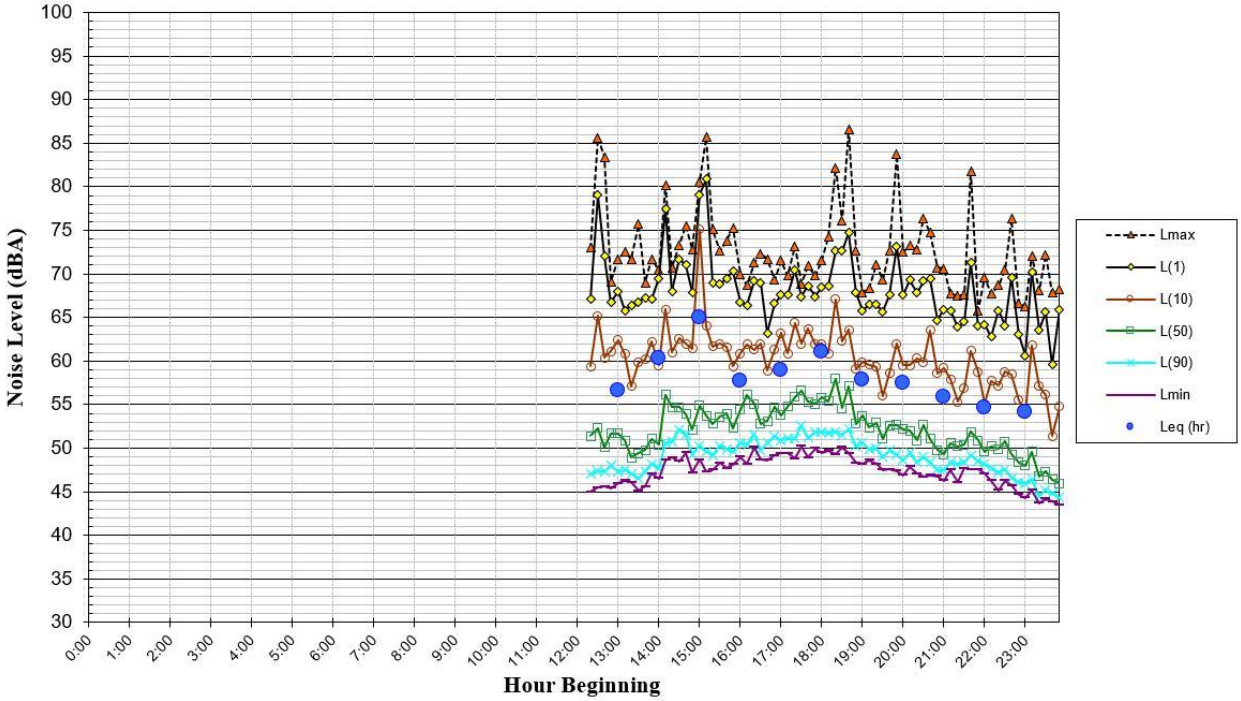

FIGURE 3 Daily Trend in Noise Levels at LT-1, Wednesday, August 28, 2019

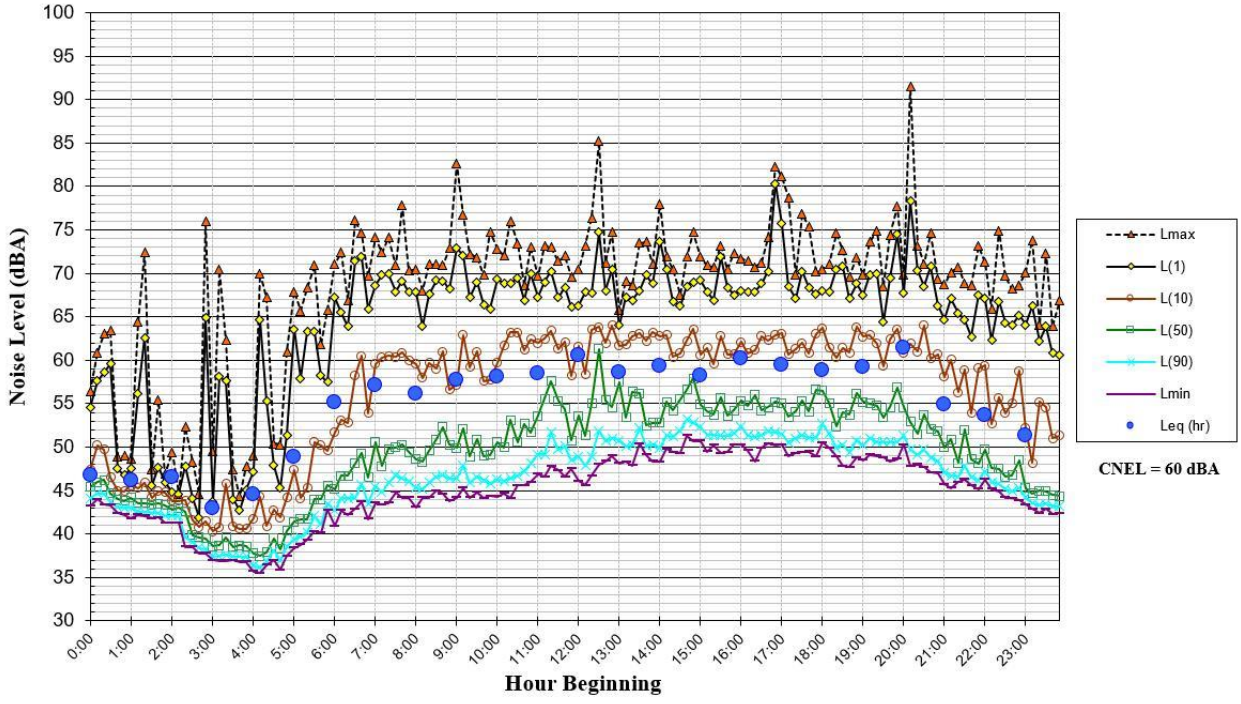

FIGURE 4 Daily Trend in Noise Levels at LT-1, Thursday, August 29, 2019

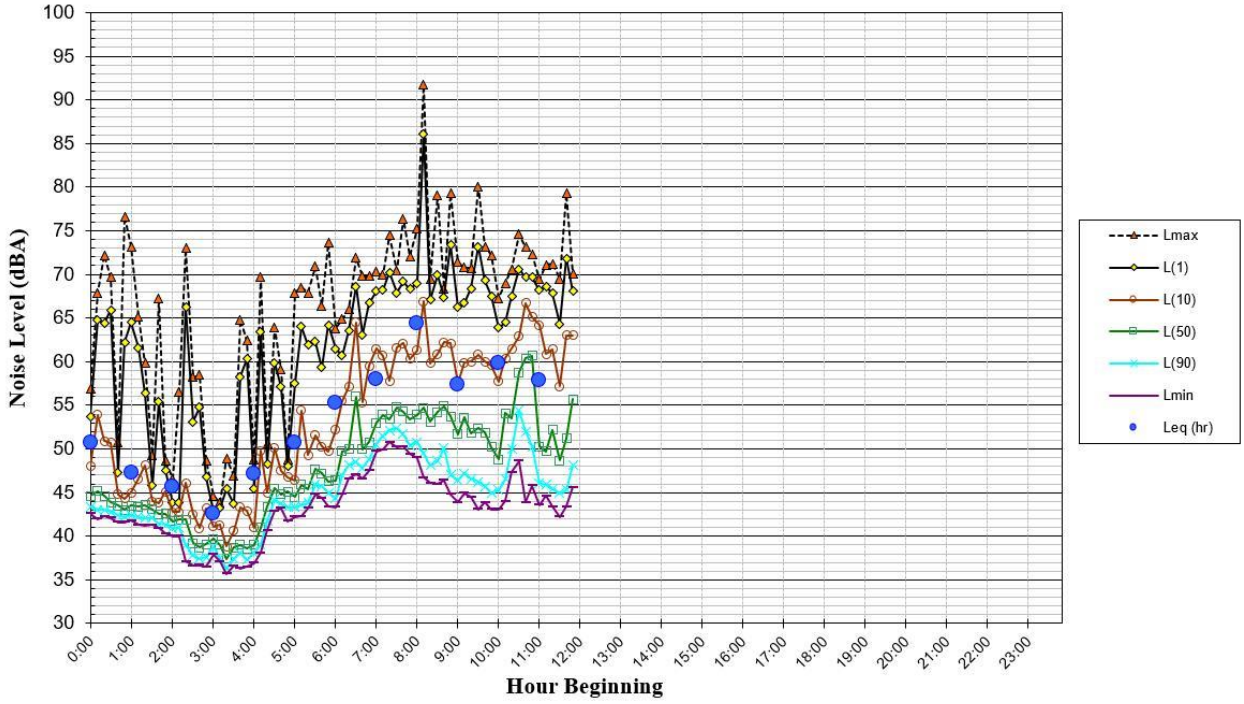

TABLE 6 Summary of Short-Term Noise Measurement Data

Noise Measurement Location	Date, Time	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	$L_{eq(10)}$
ST-1: Western boundary of the project site	8/27/2019, 12:40-12:50	66	61	51	47	44	50
ST-2: Eastern boundary of the project site	8/27/2019, 13:00-13:10	65	63	57	46	42	53

GENERAL PLAN CONSISTENCY ANALYSIS

Noise and Land Use Compatibility

According to Table 10-1 of the City of East Palo Alto General Plan, exterior noise levels should be maintained at or below 65 dBA CNEL at common outdoor use areas of multi-family residential buildings, and interior noise levels should be maintained at or below 45 dBA CNEL.

The future noise environment at the project site would continue to result primarily from vehicular traffic along Weeks Street and the other surrounding roadways. A traffic study was completed for the proposed project by *Hexagon Transportation Consultants, Inc.*[3] in October 2019. This study included peak hour turning movements for existing conditions and future cumulative plus project traffic volumes. The traffic study included two cumulative plus project scenarios: with and without the construction of a new "loop road," which would extend

[3] *Hexagon Transportation Consultants, Inc.*, "965 Weeks Street Residential Development Traffic Impact Analysis," October 28, 2019.

northward from the current terminus of Demeter Street and turn westward to connect to University Avenue at the northern edge of the Ravenswood Specific Plan area. For purposes of estimating the worst-case scenario, the cumulative scenario resulting in the highest peak hour traffic volumes along Weeks Street under future conditions was modeled with the Federal Highway Administration's Traffic Noise Model (FHWA TNM), version 2.5 to estimate the peak hour noise levels. Based on the results at LT-1, the peak hour noise level was equivalent to the average community noise equivalent level, and future cumulative noise levels were estimated to be 65 dBA CNEL under future project conditions at a setback of 30 feet from the centerline of Weeks Street (LT-1).

Future Exterior Noise Environment

One common outdoor use area is shown in the site plan dated August 6, 2019. This proposed courtyard would be used as a play area and gathering space. The center of the courtyard would be set back approximately 80 feet north of the centerline of Weeks Street and would be surrounded by the building along the northern, eastern, and western boundaries. Therefore, the building would provide partial shielding for the outdoor use area. Assuming partial shielding, the future exterior noise levels at the center of the courtyard would be 61 dBA CNEL. The exterior noise environment at the outdoor use space included in the proposed project would be compatible with the levels required by the City of East Palo Alto.

Future Interior Noise Environment

The residential units located along the southern building façade, which is adjacent to Weeks Street, would have setbacks from the centerline of the roadway of approximately 40 feet. At this distance, the units along the southern façade would be exposed to future exterior noise levels up to 64 dBA CNEL.

While the units located on the eastern and western façades would be partially shielded by the project building and the surrounding existing buildings, the upper floors would have direct line-of-sight to Weeks Street. With setbacks from the centerline ranging from 40 to 200 feet, the units on the eastern side of the proposed building would be exposed to future exterior noise levels ranging from below 60 to 64 dBA CNEL. With setbacks from the centerline ranging from 40 to 265 feet, the units on the western side of the proposed building would be exposed to future exterior noise levels ranging from below 60 to 64 dBA CNEL.

The northern building façade would be mostly shielded from traffic noise along Weeks Street by the proposed building. While the units along this façade on the eastern portion of the building would also be shielded from traffic noise along Bay Road, the units on the western portion of the building would have direct line-of-sight, with setbacks from the centerline of 350 to 575 feet. The units located along the northern building façade would be exposed to future exterior noise levels ranging from below 60 to 64 dBA DNL.

Standard residential construction provides approximately 15 dBA of exterior-to-interior noise reduction, assuming the windows are partially open for ventilation. Standard construction with the windows closed provides approximately 20 to 25 dBA of noise reduction in interior spaces.

Where exterior noise levels range from 60 to 65 dBA CNEL, the inclusion of adequate forced-air mechanical ventilation is often the method selected to reduce interior noise levels to acceptable levels by closing the windows to control noise. Where noise levels exceed 65 dBA CNEL, forced-air mechanical ventilation systems and sound-rated construction methods are normally required. Such methods or materials may include a combination of smaller window and door sizes as a percentage of the total building façade facing the noise source, sound-rated windows and doors, sound rated exterior wall assemblies, and mechanical ventilation so windows may be kept closed at the occupant's discretion.

Assuming windows to be partially open for ventilation, the interior noise levels for the proposed project would be up to 49 dBA CNEL at the units along the eastern façade. This would exceed the 45 dBA CNEL threshold for interior noise and require noise insulation features.

Noise Insulation Features to Reduce Future Interior Noise Levels

The following noise insulation features shall be incorporated into the proposed project to reduce interior noise levels to 45 dBA CNEL or less:

- Provide a suitable form of forced-air mechanical ventilation, as determined by the local building official, for all residential units on the project site, so that windows can be kept closed at the occupant's discretion to control interior noise and achieve the interior noise standards.

- Preliminary calculations indicate that the residential units located along the southern building façade, which face Weeks Street, would meet the City's 45 dBA CNEL interior noise threshold with standard construction materials and the incorporation of forced-air mechanical ventilation.

- A qualified acoustical specialist shall prepare a detailed analysis of interior residential noise levels resulting from all exterior sources during the design phase pursuant to requirements set forth in the State Building Code. The study will review the final site plan, building elevations, and floor plans prior to construction and recommend building treatments to reduce residential interior noise levels to 45 dBA CNEL or lower. Results of the analysis, including the description of the necessary noise control treatments, shall be submitted to the City, along with the building plans and approved design, prior to issuance of a building permit.

The implementation of these noise insulation features would reduce interior noise levels to 45 dBA CNEL or less.

NOISE IMPACTS AND MITIGATION MEASURES

Significance Criteria

The following criteria were used to evaluate the significance of noise and vibration resulting from the project:

- A significant noise impact would be identified if the project would generate a substantial temporary or permanent noise level increase over ambient noise levels at existing noise-sensitive receptors surrounding the project site and that would exceed applicable noise standards presented in the General Plan or Municipal Code at existing noise-sensitive receptors surrounding the project site.

    - A significant noise impact would be identified if temporary construction noise would exceed 60 dBA L_{eq} at nearby noise-sensitive receptors or exceeded 70 dBA L_{eq} at nearby commercial land uses and exceed the ambient noise environment by 5 dBA L_{eq} or more for a period longer than one year.

    - According to Policy 7.2 of the City's General Plan, a significant impact would occur if the permanent noise level increase due to project-generated traffic was 3 dBA CNEL and exceed the "normally acceptable" level or was 5 dBA CNEL or greater and remained "normally acceptable." Based on Table 10-1, it is assumed that the 65 dBA CNEL exterior noise standard would be considered "normally acceptable" for residential land uses.

    - A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the General Plan.

- A significant impact would be identified if the construction of the project would generate excessive vibration levels surrounding receptors. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to normal buildings.

- A significant noise impact would be identified if the project would expose people residing or working in the project area to excessive aircraft noise levels.

Impact 1a: **Temporary Construction Noise.** Existing noise-sensitive land uses would be exposed to a temporary increase in ambient noise levels due to project construction activities. The incorporation of **Mitigation Measure NOI-3** of the General Plan Update EIR, **Mitigation Measures NOI-5a** and **NOI-5b** of the Ravenswood/4 Corners TOD Specific Plan EIR, and construction best management practices as project conditions of approval would result in a **less-than-significant** temporary noise impact.

Noise impacts resulting from construction depend upon the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, and the distance between construction noise sources and noise-sensitive areas. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (e.g., early morning, evening, or nighttime hours), the construction occurs in areas immediately adjoining noise-sensitive land uses, or when construction lasts over extended periods of time.

Section 15.04.125 of the City's Municipal Code limits construction activities to between 7:00 a.m. and 6:00 p.m. on weekdays and to between 9:00 a.m. and 5:00 p.m. on Saturdays. Construction activities are prohibited on Sundays and national holidays. During these allowable hours, construction noise would be exempt from the City's exterior and interior noise level standards at single- or multi-family residences, schools, hospitals, churches, and public libraries.

As discussed in the Fundamentals section of this report, thresholds for speech interference indoors is 45 dBA. Assuming a 15 dBA exterior-to-interior reduction for standard residential construction and a 25 dBA exterior-to-interior reduction for standard commercial construction, this would correlate to an exterior threshold of 60 dBA L_{eq} at residential land uses and other noise-sensitive receptors and 70 dBA L_{eq} at commercial land uses. Additionally, temporary construction would be annoying to surrounding land uses if the ambient noise environment increased by at least 5 dBA L_{eq} for an extended period of time. Therefore, the temporary construction noise impact would be considered significant if project construction activities exceeded 60 dBA L_{eq} at nearby noise-sensitive receptors or exceeded 70 dBA L_{eq} at nearby commercial land uses and exceeded the ambient noise environment by 5 dBA L_{eq} or more for a period longer than one year.

Ambient noise levels at noise-sensitive receptors in the vicinity of the project site range from 50 to 65 dBA L_{eq} during daytime hours, based on noise data collected at LT-1, ST-1, and ST-2.

Construction activities generate considerable amounts of noise, especially during earth-moving activities when heavy equipment is used. The highest maximum noise levels generated by project construction would typically range from about 80 to 90 dBA L_{max} at a distance of 50 feet from the noise source. A list of typical maximum instantaneous noise levels measured at 50 feet are provided in Table 7. Typical hourly average construction-generated noise levels for residential buildings are about 81 to 88 dBA L_{eq} measured at a distance of 50 feet from the center of the site during busy construction periods (e.g., earth moving equipment, impact tools, etc.), as shown in Table 8. Construction-generated noise levels drop off at a rate of about 6 dBA per doubling of the distance between the source and receptor. Shielding by buildings or terrain can provide an additional 5 to 10 dBA noise reduction at distant receptors.

Based on the expected construction schedule provided for the proposed project, site preparation would start at the end of January 2020 and conclude in mid-January 2021, which would take fewer than 12 months. Table 9 summarizes the dates expected for each phase, the equipment to be used during each phase, and the estimated noise levels calculated at the property lines of the nearest surrounding residences. The estimated noise levels were calculated by assuming the geometrical center of the active construction site would be located at the center of the project site. Construction work occurring along shared boundaries of the surrounding residences would potentially be louder than the noise levels summarized in Table 9; however, noise levels would also be lower when work would occur at the farthest boundary. Therefore, the noise levels in Table 9 represent the average construction noise throughout project construction when each piece of equipment operates simultaneously during each phase of construction. Once construction moves indoors, minimal noise would be generated at off-site locations, and for the purpose of showing the worst-case scenario, the noise levels in Table 9 assume no shielding from existing fences or from intervening buildings.

TABLE 7 Construction Equipment, 50-foot Noise Emission Limits

Equipment Category	L_{max} Level (dBA)[1,2]	Impact/Continuous
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Bar Bender	80	Continuous
Boring Jack Power Unit	80	Continuous
Chain Saw	85	Continuous
Compressor[3]	70	Continuous
Compressor (other)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Insitu Soil Sampling Rig	84	Continuous
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tractor	84	Continuous
Truck (dump, delivery)	84	Continuous
Vacuum Excavator Truck (vac-truck)	85	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes: [1] Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant.

[2] Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.

[3]Portable Air Compressor rated at 75 cfm or greater and that operates at greater than 50 psi.

TABLE 8 Typical Ranges of Construction Noise Levels at 50 Feet, L_{eq} (dBA)

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	**II**	**I**	**II**	**I**	**II**	**I**	**II**
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

I - All pertinent equipment present at site.
II - Minimum required equipment present at site.

Source: U.S.E.P.A., Legal Compilation on Noise, Vol. 1, p. 2-104, 1973.

TABLE 9 Estimated Construction Noise Levels at Nearby Land Uses

Phase	Total Number of Days	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq} at Noise-Sensitive Receptors, dBA			
			Residences- North (90 ft)	Residences- South (125 ft)	Residences- East (325 ft)	Residences & Commercial- West (315 ft)
Site Preparation	1/29/2020-1/31/2020	Scraper (1) Grader (1) Tractor/Loader/Backhoe (1)	80 dBA L_{eq}	77 dBA L_{eq}	69 dBA L_{eq}	69 dBA L_{eq}
Grading/Excavation	2/1/2020-2/10/2020	Grader (1) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (2)	81 dBA L_{eq}	78 dBA L_{eq}	70 dBA L_{eq}	70 dBA L_{eq}
Building – Exterior	2/11/2020-12/14/2020	Crane (1) Forklift (2) Generator Set (1) Tractor/Loader/Backhoe (1) Welder (3)	78 dBA L_{eq}	75 dBA L_{eq}	67 dBA L_{eq}	67 dBA L_{eq}
Paving	12/15/202-12/28/2020	Cement and Mortar Mixer (1) Paver (1) Paving Equipment (1) Roller (2) Tractor/Loader/Backhoe (1)	81 dBA L_{eq}	78 dBA L_{eq}	69 dBA L_{eq}	70 dBA L_{eq}
Building – Interior/ Architectural Coating	12/29/2020 -1/11/2021	Air Compressor (1)	69 dBA L_{eq}	66 dBA L_{eq}	57 dBA L_{eq}	58 dBA L_{eq}

Estimated construction levels shown in Table 9 would exceed 60 dBA L_{eq} at residential land uses and would exceed ambient levels by more than 5 dBA L_{eq} throughout construction, which is expected to last less than one year.

Reasonable regulation of the hours of construction, as well as regulation of the arrival and operation of heavy equipment and the delivery of construction material, are necessary to protect the health and safety of persons, promote the general welfare of the community, and maintain the quality of life. **Mitigation Measure NOI-3** of the City's General Plan Update Draft EIR provides mitigation for temporary construction noise where noise levels would exceed 60 dBA L_{eq} at residential land uses or exceed 70 dBA L_{eq} at sensitive industrial, office, or commercial land uses when the noise would exceed the ambient noise environment by 5 dBA L_{eq} or more for more than one construction season. This mitigation measure shall be incorporated into the project as a condition of approval.

> **Mitigation Measure NOI-3**: The General Plan Update shall be amended to include the following policy:
>
> The City shall require that contractors use available noise suppression devices and techniques and limit construction hours near residential uses. Reasonable noise reduction measures shall be incorporated into the construction plan and implemented during all phases of construction activity to minimize the exposure of neighboring properties.
>
> The City considers significant construction noise impacts to occur if a project located within 500 feet of residential uses or 200 feet of commercial or office uses would:
>
> - Involve substantial noise-generating activities (such as building demolition, grading, excavation, pile driving, use of impact equipment, or building framing) continuing for more than 12 months.
>
> For such large or complex projects, a construction noise logistics plan that specifies hours of construction, noise and vibration minimization measures, posting or notification of construction schedules, and designation of a noise disturbance coordinator who would respond to neighborhood complaints will be required to be in place prior to the start of construction and implemented during construction to reduce noise impacts on neighboring residents and other uses.
>
> A typical construction noise logistics plan would include, but not be limited to, the following measures to reduce construction noise levels as low as practical:
>
> - Limit construction activity to weekdays between 7:00 a.m. and 7:00 p.m. and Saturdays and holidays between 9:00 a.m. and 7:00 p.m., with no construction on Sundays;
>
> - Utilize "quiet" models of air compressors and other stationary noise sources where such technology exists;

- Equip all internal combustion engine-driven equipment with mufflers, which are in good condition and appropriate for the equipment;

- Locate all stationary noise-generating equipment, such as air compressors and portable power generators, as far away as possible from adjacent land uses;

- Locate staging areas and construction material areas as far away as possible from adjacent land uses;

- Prohibit all unnecessary idling of internal combustion engines;

- If impact pile driving is proposed, multiple-pile drivers shall be considered to expedite construction. Although noise levels generated by multiple pile drivers would be higher than the noise generated by a single pile driver, the total duration of pile driving activities would be reduced; *(pile driving not expected for this project)*

- If impact pile driving is proposed, temporary noise control blanket barriers shall shroud pile drivers or be erected in a manner to shield the adjacent land uses. Such noise control blanket barriers can be rented and quickly erected; *(pile driving not expected for this project)*

- If impact pile driving is proposed, foundation pile holes shall be pre-drilled to minimize the number of impacts required to seat the pile. Pre-drilling foundation pile holes is a standard construction noise control technique. Pre-drilling reduces the number of blows required to seat the pile. Notify all adjacent land uses of the construction schedule in writing; *(pile driving not expected for this project)*

- Designate a "disturbance coordinator" who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., starting too early, bad muffler, etc.) and will require that reasonable measures warranted to correct the problem are implemented.

- Conspicuously post a telephone number for the disturbance coordinator at the construction site and include it in the notice sent to neighbors regarding the construction.

Additionally, the Ravenswood/4 Corners TOD Specific Plan EIR,[4] within which the proposed project falls, included two mitigation measures to be implemented as conditions of approval for development in the plan area. These are as follows:

> **Mitigation Measure NOI-5a**: Implement the provisions of Section 8.52.350-E of the East Palo Alto Municipal Code that regulate construction hours.

[4] *The Planning Center DC&E*, "Ravenswood/4 Corners TOD Specific Plan Final EIR," July 30, 2012.

Mitigation Measure NOI-5b: Construction equipment shall be well-maintained and used judiciously to be as quiet as practical. The following measures, when applicable, shall be required to reduce noise from construction activities:

- Ensure that all internal combustion engine-driven equipment is equipped with mufflers that are in good operating condition and appropriate for the equipment.

- Utilize "quiet" models of air compressors and other stationary noise sources where such technology exists.

- Locate stationary noise-generating equipment as far as reasonable from sensitive receptors where sensitive receptors adjoin or are near a construction project area.

- Prohibit unnecessary idling of internal combustion engines in excess of 5 minutes.

- Pre-drill foundation pile holes to minimize the number of impacts required to seat the pile. *(pile driving not expected for this project)*

- Construct solid plywood fences around construction sites adjacent to operational business, residences or noise-sensitive land uses.

- Erect temporary noise control blanket barrier, if necessary, along building façades facing construction sites. This mitigation would only be necessary if conflicts occurred that were irresolvable by proper scheduling. Noise control blanket barriers can be rented and quickly erected and with proper installation can typically lower construction noise levels by 10 dBA (10 dBA represents a perceived halving of noise levels).

- Route construction-related traffic along major roadways and as far as feasible from sensitive receptors.

- Ensure that construction activities, including the loading and unloading of materials and truck movements, are limited to the hours specified in Section 8.52 of the East Palo Alto Municipal Code.

- Notify businesses, residences, and noise-sensitive land uses adjacent to construction sites of the construction schedule in writing. Designate a "construction liaison" who is responsible for responding to any local complaints about construction noise. The liaison shall determine the cause of the noise complaints (for example starting too early, or a bad muffler) and institute reasonable measures to correct the problem. Conspicuously post a telephone number for the liaison at the construction site.

In addition to these measures, the following Construction Best Management Practices would further reduce noise levels in the vicinity of the construction site:

Construction Best Management Practices

Develop a construction noise control plan, including, but not limited to, the above mitigation measures provided by **Mitigation Measure NOI-3** of the East Palo Alto General Plan Update Draft EIR and **Mitigation Measures NOI-5a** and **NOI-5b** of the Specific Plan EIR and the following available controls:

- Limit construction activities to the hours of 7:00 a.m. to 6:00 p.m. Monday through Friday and 9:00 a.m. to 5:00 p.m. on Saturdays. No construction activities shall be permitted on Sundays or holidays. These allowable construction hours, as established in Section 15.04.125 of the City's Municipal Code, are in accordance with Section 8.52 of the City's Municipal Code.

- Construction staging areas shall be established at locations that will create the greatest distance between the construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction.

- Locate material stockpiles, as well as maintenance/equipment staging and parking areas, as far as feasible from residential receptors.

- Control noise from construction workers' radios to a point where they are not audible at existing residences bordering the project site.

- The contractor shall prepare a detailed construction schedule for major noise-generating construction activities. The construction plan shall identify a procedure for coordination with adjacent residential land uses so that construction activities can be scheduled to minimize noise disturbance.

- Designate a "disturbance coordinator" who would be responsible for responding to any complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., bad muffler, etc.) and will require that reasonable measures be implemented to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include in it the notice sent to neighbors regarding the construction schedule.

Implementation of the above measures would reduce construction noise levels emanating from the site, limit construction hours, and minimize disruption and annoyance. With the implementation of these measures, and recognizing that noise generated by construction activities would occur over a temporary period, the temporary increase in ambient noise levels would be less-than-significant.

Mitigation Measure 1a: No further mitigation required.

Impact 1b: **Permanent Noise Level Increase.** The proposed project is not expected to cause a substantial permanent noise level increase at the existing residential land uses in the project vicinity. **This is a less-than-significant impact.**

According to Policy 7.2, a significant impact would occur if the permanent noise level increase due to project-generated traffic was 3 dBA CNEL and exceed the "normally acceptable" level or was 5 dBA CNEL or greater and remained "normally acceptable." While the General Plan does not define what level would be "normally acceptable," it is assumed that the 65 dBA CNEL exterior noise standard in Table 10-1 would be considered "normally acceptable."

The future noise levels at LT-1, which represent residences located along Weeks Street, would be 65 dBA CNEL, which would be considered "normally acceptable;" however, previous measurements made within the Ravenswood/4 Corners TOD Specific Plan area along Pulgas Avenue, Bay Road, and other roadways with higher existing traffic volumes would have future noise levels that exceed 65 dBA CNEL. Therefore, a significant impact would occur if project-generated traffic increased noise levels along Weeks Street by 5 dBA CNEL or more and noise levels along Pulgas Avenue and Bay Road by 3 dBA CNEL or more. Conservatively, a 3 dBA CNEL increase along all other segments included in the traffic study would also result in a significant impact. For reference, a 3 dBA CNEL noise increase would be expected if the project would double existing traffic volumes along a roadway, and a 5 dBA CNEL increase would occur if the traffic tripled due to the project.

The traffic study provided for the proposed project included peak hour existing and existing plus project (with and without loop) traffic scenarios. By comparing the traffic volumes of both existing plus project scenarios to the existing volumes, a traffic noise increase of 2 dBA CNEL was calculated along Weeks Street, east of Clarke Avenue under both the existing plus project scenarios. Additionally, a 3 dBA CNEL increase was calculated along Demeter Street, north of Bay Road, under the existing plus project (with loop) scenario; however, an increase of less than 1 dBA CNEL was calculated along this segment under the existing plus project (without loop) scenario. Since this increase was calculated under one project scenario and not the other, the increase is attributable to the construction of the new loop and not to the proposed project. Further, there are no residential uses along this roadway segment. Therefore, this would not result in a significant impact.

Along every other roadway segment included in the traffic study, a noise level increase of 1 dBA CNEL or less was calculated under both project scenarios. Therefore, the permanent traffic noise increase attributable to the project would be 2 dBA CNEL or less in the project vicinity. This would not be considered a significant permanent noise level increase. This is a less-than-significant impact.

Mitigation Measure 1b: None required.

Impact 1c: **Cumulative Noise Increase.** The proposed project would not result in a "cumulatively considerable" permanent noise level increase at the existing residential land uses in the project vicinity. **This is a less-than-significant impact.**

A significant impact would occur if two criteria are met: 1) if the cumulative traffic noise level increase was 3 dBA CNEL or greater for future levels exceeding 60 dBA CNEL or was 5 dBA CNEL or greater for future levels at or below 60 dBA CNEL; and 2) if the project would make a

"cumulatively considerable" contribution to the overall traffic noise increase. A "cumulatively considerable" contribution would be defined as an increase of 1 dBA CNEL or more attributable solely to the proposed project.

Cumulative traffic noise level increases were calculated by comparing the cumulative no project traffic volumes and the cumulative plus project volumes (with and without loop) to existing traffic volumes. A traffic noise increase of 3 dBA CNEL or more was calculated under both cumulative scenarios along the following roadway segments: along Bay Road, east and west of University Avenue; along Bay Road, east and west of Clarke Avenue; along Weeks Street, east and west of Clarke Avenue; along Bay Road, east and west of Demeter Street; along Bay Road, east and west of Pulgas Avenue; along Weeks Street, east and west of Pulgas Avenue; along Pulgas Avenue, north and south of Bay Road; along Pulgas Avenue, north and south of Weeks Street; along Pulgas Avenue, north and south of Runnymede Street; and along Pulgas Avenue, north and south of O'Connor Street. Since the same increase was calculated for the cumulative no project and both cumulative plus project scenarios (with and without loop), the project's contribution along these roadway segments would be less than 1 dBA CNEL, which would not be considered a "cumulatively considerable" contribution.

Additionally, a traffic noise increase along Demeter Street, north of Bay Road, would be more than 3 dBA CNEL under each cumulative scenario, with the cumulative plus project (with loop) scenario resulting in an increase 1 dBA CNEL greater than the cumulative and cumulative plus project (without loop) scenarios. Since this increase was calculated under one project scenario and not the other, the increase is attributable to the construction of the new loop and not to the proposed project. Further, there are no residential uses along this roadway segment. Therefore, this would not be considered a "cumulatively considerable" contribution due to the proposed project.

The project would not cause a significant cumulative traffic noise impact at noise-sensitive uses in the project vicinity. This is a less-than-significant impact.

Mitigation Measure 1c: None required.

Impact 1d: **Noise Levels in Excess of Standards.** The proposed project could generate noise in excess of standards established in the City's General Plan or Municipal Code at the nearby sensitive receptors. The incorporation of mitigation measures to reduce operational noise levels as project conditions of approval would result in a **less-than-significant** noise impact.

Tables 4 and 5 summarize the thresholds for exterior and interior noise levels, respectively, as measured on the receiving land uses. Adjacent to the site to the east and west, as well as opposite Weeks Street to the south and opposite the Bay Trail to the north are single-family residences. Since mechanical equipment could run during daytime and nighttime hours, the exterior noise level thresholds would be 55 dBA L_{50} between 7:00 a.m. and 10:00 p.m. and 50 dBA L_{50} between 10:00 p.m. and 7:00 a.m. The interior noise level thresholds would be 45 dBA L_{50} during the daytime hours and 40 dBA L_{50} during nighttime hours.

The proposed project would include mechanical equipment, such as heating, ventilation, and air conditioning systems (HVAC). According to the site plan, the proposed project would include rooftop solar panels as well. However, detailed information on the location of the HVAC units and specific equipment to be used were not available at the time of this analysis. Typical residential HVAC units are anticipated to generate noise levels of 53 to 63 dBA at 3 feet from the equipment, depending on the equipment selected. Solar panels do not typically generate substantial noise levels measurable above other types of mechanical equipment.

Without knowing the specific locations for the HVAC units, the worst-case conditions were assumed for this analysis, which would be 10 feet from the edge of the building's rooftop. For multi-family residential buildings, it is typical for multiple HVAC units to operate simultaneously at any given time. Assuming up to eight units would operate simultaneously from the same relative location, the worst-case scenario was calculated by estimating HVAC noise levels to the property lines of the nearest residential land uses surrounding the site. Table 10 summarizes the distance from the noise source to the nearest surrounding residential land uses and the calculated mechanical equipment noise at that distance.

TABLE 10 Summary of Mechanical Equipment Noise Generated at the Proposed Project Site

Receptor	Distance from Nearest Collective Noise Source to Nearest Residential Property Line	Estimated Mechanical Equipment Noise Level
Residences east of the site	35 feet	41 to 51 dBA
Residences west of the site	35 feet	41 to 51 dBA
Residences north of the site, opposite the Bay Trail	45 feet	39 to 49 dBA
Residences south of the site, opposite Weeks Street	80 feet	34 to 44 dBA

From the results of Table 10, mechanical equipment noise at the project site would potentially exceed the City's exterior noise threshold during nighttime hours at the adjacent residential property lines to the east and to the west. This would be a potentially significant impact.

Assuming standard residential construction materials for the existing residences surrounding the project site, which estimates a 15 dBA reduction from exterior-to-interior, the expected interior noise levels due to the mechanical equipment noise would be at or below 40 dBA L_{eq} at each of the surrounding land uses. This would meet the City's interior noise threshold for daytime and nighttime. This would be a less-than-significant impact.

Mitigation Measure 1d:

Prior to the issuance of building permits, mechanical equipment generated at the proposed project building shall be selected and designed to reduce impacts on surrounding uses to meet the City's exterior and interior noise level requirements. A qualified acoustical consultant shall be retained by the project applicant to review mechanical noise as the equipment systems are

selected in order to determine specific noise reduction measures necessary to reduce noise to comply with the City's 50 dBA L_{50} exterior limit at the nearest residential property lines. Noise reduction measures could include, but are not limited to, selection of equipment that emits low noise levels and/or installation of noise barriers such as enclosures and parapet walls to block the line-of-sight between the noise source and the nearest receptors. Alternate measures may include locating equipment in less noise-sensitive areas, where feasible. The measures recommended by the acoustical consultant to ensure compliance with the City's requirements would be implemented as project conditions of approval.

Impact 2: **Exposure to Excessive Groundborne Vibration due to Construction.** Construction-related vibration levels resulting from activities at the project site would exceed 0.3 in/sec PPV at the nearest noise-sensitive receptor. **This is a potentially significant impact.**

The construction of the project may generate vibration when heavy equipment or impact tools (e.g. jackhammers, hoe rams) are used. Construction activities would include grading, foundation work, paving, and new building framing and finishing. According to the list of construction equipment expected to be used for the proposed project, pile driving, which can cause excessive vibration, would not be required.

For structural damage, the California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a conservative limit of 0.08 in/sec PPV for ancient buildings or buildings that are documented to be structurally weakened. No known ancient buildings or buildings that are documented to be structurally weakened adjoin the project area. Therefore, conservatively, groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in a significant vibration impact.

Table 11 presents typical vibration source levels that could be expected from construction equipment at a distance of 25 feet. Project construction activities, such as drilling, the use of jackhammers, rock drills and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.), may generate substantial vibration in the immediate vicinity. Jackhammers typically generate vibration levels of 0.035 in/sec PPV, and drilling typically generates vibration levels of 0.09 in/sec PPV at a distance of 25 feet. Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Table 11 also includes vibration levels calculated at the nearest residential and commercial structures surrounding the site, as measured from the nearest location of heavy construction equipment. According to the site plan, a 10-foot side setback would be located on the eastern and western sides of the proposed building. This 10-foot side setback is accounted for in the vibration level estimates summarized in Table 11.

The residential buildings to the north, to the south, and to the east would be setback from the project's boundary by at least 25 feet, and therefore, vibration levels would be below 0.3 in/sec PPV at each of the nearest structures on the shared properties. However, the nearest commercial buildings to the west (the wellness center and the market) would be 5 to 10 feet from the shared

property line, which means the nearest heavy construction equipment would be 15 to 20 feet from the nearest buildings to the west. At 20 feet, vibration levels would be below 0.3 in/sec PPV; however, at 15 feet, the market would be exposed to vibration levels exceeding 0.3 in/sec PPV when clam shovel drops and vibratory rollers (or similar types of equipment) are used within 10 feet of the shared property line. This would be a potentially significant impact.

Mitigation Measure 2:

Mitigation Measure NOI-4a of the Ravenswood/4 Corners TOD Specific Plan EIR[4] provided the following mitigation for construction vibration:

> The following measures, in addition to the best practices specified in **Mitigation Measure NOI-5b**, shall be followed to reduce vibration from construction activities and should be employed where feasible:
>
> - Avoid impact pile driving, where feasible. Drilled piles cause lower vibration levels where geological conditions permit their use. *(pile driving not expected for this project)*
>
> - Avoid using vibratory rollers and tampers near sensitive areas, where feasible.

Applying the second condition to the proposed project, prohibiting the use any piece of equipment, such as vibratory rollers, tampers, and clam shovel drops, within 20 feet of the shared property line to the west would reduce construction vibration levels to a less-than-significant level.

TABLE 11 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	Estimated Vibration Levels at Surrounding Structures, in/sec PPV				
			Residences- North (25ft)	Residences- South (70ft)	Residences- East (30ft)	Residences- West (35ft)	Wellness Center & Market- West (5 to 10ft)
Clam shovel drop		0.202	0.202	0.065	0.165	0.140	0.258 to **0.354**
Hydromill (slurry wall)	in soil	0.008	0.008	0.003	0.007	0.006	0.010 to 0.014
	in rock	0.017	0.017	0.005	0.014	0.047	0.022 to 0.030
Vibratory Roller		0.210	0.210	0.068	0.172	0.145	0.268 to **0.368**
Hoe Ram		0.089	0.089	0.029	0.073	0.061	0.114 to 0.156
Large bulldozer		0.089	0.089	0.029	0. 073	0.061	0.114 to 0.156
Caisson drilling		0.089	0.089	0.029	0. 073	0.061	0.114 to 0.156
Loaded trucks		0.076	0.076	0.024	0.062	0.052	0.097 to 0.133
Jackhammer		0.035	0.035	0.011	0.029	0.024	0.045 to 0.061
Small bulldozer		0.003	0.003	0.001	0.002	0.002	0.004 to 0.005

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, May 2006, as modified by Illingworth & Rodkin, Inc., September 2019.

Impact 3: **Excessive Aircraft Noise.** The project would not expose people residing or working in the project area to excessive aircraft noise levels. **This is a less-than-significant impact.**

The Palo Alto Airport is a general aviation airport located approximately 0.9 miles southeast of the project site. The project site lies outside the 60 dBA CNEL noise contour for 2022, as shown in Figure 5. This means aircraft noise associated with this airport would result in noise levels at or below 60 dBA CNEL by the year 2022. Since the number of flights expected in the future would not increase from the existing aircraft traffic at the time of the ambient noise monitoring survey, noise due to future aircraft overflights is not expected to substantially increase ambient noise levels at the project site. Based on the 15 to 20 dBA exterior-to-interior noise reduction provided by standard residential construction materials, depending on whether windows are open or closed, the noise levels inside residential units of the proposed building would be below 45 dBA CNEL, and the exterior and interior noise levels would be compatible with the City's threshold.[2]

Other airports in the vicinity of the project site include the Moffett Federal Airfield (5.1 miles southeast), Norman Y. Mineta San José International Airport (12.3 miles southeast), San Carlos Airport (6.7 miles northwest), and San Francisco International Airport (15.6 miles northwest). The project site lies outside the areas of influence for each of the airports, and the noise environment at the site would not substantially increase due to aircraft noise from these airports.

Exterior and interior noise levels resulting from aircraft would be compatible with the proposed project.

Mitigation Measure 3: **None required.**

FIGURE 5 2022 CNEL Noise Contours for Palo Alto Airport Relative to Project Site