APPENDIX D2

Operational Noise Assessment

4350 EL CAMINO REAL
OPERATIONAL NOISE ASSESSMENT

Los Altos, California

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INTRODUCTION

The project proposes to construct a five-story residential complex at 4350 El Camino Real in Los Altos, California. The project would consist of 45 residential units and two below-grade parking levels.

This report evaluates the project's potential to result in significant noise and vibration impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. This report also incorporates findings and recommendations following peer-review of a study performed by Edward L. Pack Associates. Inc. in August 2018[1] for compliance of interior and exterior noise levels with applicable regulations. The report is divided into three sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise, 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'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 mitigation measures, where necessary, to provide a compatible project in relation to adjacent noise sources and land uses.

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

1 Pack, J.K., Noise Assessment Study for the Planned Multi-Family Development, 4350 El Camino Real, Los Altos, CA. Edward L. Pack Associates., Inc., August 2, 2018.

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

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 dB 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 dB with open windows. With standard construction and closed windows in good condition, the noise attenuation factor is around 20 dB for an older structure and 25 dB for a newer dwelling. Sleep and speech interference is therefore of concern 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.

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, DNL or L_{dn}	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.

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 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

The State of California and the City of Los Altos have established regulatory criteria that are applicable in this assessment. The State CEQA Guidelines, Appendix G, are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. A summary of the applicable regulatory criteria is provided below.

State CEQA Guidelines. The California Environmental Quality Act (CEQA) contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise 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;

(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.

Checklist items (a) and (b) are applicable to the proposed project. The project is not located within two miles of a public airport or in the vicinity of a private airstrip and would not expose people

residing or working in the project area to excessive aircraft noise levels; therefore, item (c) is not carried further in this analysis.

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

City of Los Altos General Plan. The Natural Environment & Hazards Element of the City of Los Altos' General Plan contains the following Noise and Land Use Compatibility Standards policies that are applicable to the Project.

Policy 7.2: Enforce the following maximum acceptable noise levels for new construction of various noise-sensitive uses in an existing noise environment.

- 60 dBA CNEL is the maximum acceptable outdoor noise exposure level for single-family residential areas.

- 65 dBA CNEL is the maximum acceptable outdoor noise exposure level for multiple-family residential areas.

- 70 dBA CNEL is the maximum acceptable outdoor noise exposure level for schools (public and private), libraries, churches, hospitals, nursing homes, parks, commercial, and recreation areas. Excepted from these standards are golf courses, stables, water recreation, and cemeteries.

Policy 7.3: Work to achieve indoor noise levels not exceeding 45 dBA CNEL in the event that outdoor acceptable noise exposure levels cannot be achieved by various noise attenuation mitigation measures.

Policy 7.5: Require reasonable mitigation measures to reduce noise levels to those determined to be acceptable in the event that significant increased noise levels will result from an improvement to the circulation system.

Policy 7.9: Minimize stationary noise sources and noise emanating from construction activities.

City of Los Altos Municipal Code. Chapter 6.16 Noise Control of the City's Municipal Code establishes noise level limits applicable to the project as follows:

<u>6.16.050 Exterior noise limits.</u>
A. Maximum permissible sound levels by receiving land use.

1. The noise standards for the various categories of land use identified by the noise control office as presented in Table 4 of this section, unless otherwise specifically indicated, shall apply to all such property within a designated zone.
2. No person shall operate, or cause to be operated, any source of sound at any location within the city, or allow the creation of any noise on property owned, leased, occupied, or otherwise

controlled by such person, which causes the noise level, when measured on any other property, either incorporated or unincorporated, to exceed:

a. The noise standard for that land use as specified in Table 4 for a cumulative period of more than thirty (30) minutes in any hour (L_{50}); or
b. The noise standard plus five dB for a cumulative period of more than fifteen (15) minutes in any hour(L_{25}); or
c. The noise standard plus ten (10) dB for a cumulative period of more than five (5) minutes in any hour(L_{08}); or
d. The noise standard plus fifteen (15) dB for a cumulative period of more than one minute in any hour (L_{02}); or
e. The noise standard plus twenty (20) dB or the maximum measured ambient for any period of time (L_{max});.

3. If the measured ambient level exceeds that permissible within any of the first four noise limit categories above, the allowable noise exposure standard shall be increased in five dB increments in each category as appropriate to encompass or reflect such ambient noise level. In the event the ambient noise level exceeds the fifth noise limit category, the maximum allowable noise level under said category shall be increased to reflect the maximum ambient noise level.
4. If the noise measurement occurs on a property adjacent to a zone boundary, the noise level limit applicable to the lower noise zone, plus five dB, shall apply.
5. If possible, the ambient noise shall be measured at a consistent location on the property with the alleged offending noise source inoperative. If for any reason the alleged offending noise source cannot be shut down, the ambient noise shall be estimated by performing a measurement in the same general source at least ten (10) dB below the ambient in order that only the ambient level be measured. If the difference between the ambient and the noise source is five to ten (10) dB, then the level of the ambient itself can be reasonably determined by subtracting a one decibel correction to account for the contribution of the source.

B. Corrections for character of sound. In the event the alleged offensive noise contains a steady, audible tone, such as a whine, screech, or hum, or contains music or speech conveying informational content, the standard limits set forth in Table 4 shall be reduced by five dB.

TABLE 4: Exterior Noise Limits, L_{50}

Receiving Land Use Category	Time Period	L_{50} Noise Level (dBA)*
All R1 Zoning Districts	10:00 p.m. -- 7:00 a.m.	45
	7:00 a.m. -- 10:00 p.m.	55
All R3 and PCF Zoning Districts	10:00 p.m. -- 7:00 a.m.	50
	7:00 a.m. -- 10:00 p.m.	55
All OA Zoning Districts	10:00 p.m. -- 7:00 a.m.	55
	7:00 a.m. -- 10:00 p.m.	60
All C Zoning Districts	10:00 p.m. -- 7:00 a.m.	60
	7:00 a.m.--10:00 p.m.	65

* Levels not to be exceeded more than 30 minutes in any hour, L_{50}

6.16.060 - Interior noise standards.

A. Maximum permissible dwelling interior sound levels.

1. The interior noise standards for multi-family residential dwellings as presented in Table 5 of this section shall apply, unless otherwise specifically indicated, within all such dwellings with windows in their normal seasonal configuration.
2. No person shall operate, or cause to be operated, within a dwelling unit any source of sound or allow the creation of any noise which causes the noise level when measured inside a neighboring receiving dwelling unit to exceed:
   a. The noise standard as specified in Table 5 for a cumulative period of more than five minutes in any hour; or
   b. The noise standard plus five dB for a cumulative period of more than one minute in any hour; or
   c. The noise standard plus ten (10) dB or the maximum measured ambient for any period of time.
3. If the measured ambient level exceeds that permissible within any of the noise limit categories above, the allowable noise exposure standard shall be increased in five dB increments in each category as appropriate to reflect such ambient noise level.

B. Corrections for character of sound. In the event the alleged offensive noise contains a steady, audible tone, such as a whine, screech, or hum, or contains music or speech conveying informational content, the standard limits set forth in Table 5 shall be reduced by five dB.

TABLE 5: Interior Noise Standards

Noise Zone	Land Use	Time Interval	Allowable Interior Noise Level, dBA
All R3 Zoning Districts	Multi-Family Residential	10:00 p.m. -- 7:00 a.m.	35
		7:00 a.m.--10:00 p.m.	45

6.16.070 Prohibited acts.

A. Noise disturbances prohibited. No person shall unnecessarily make or continue, or cause to be made or continued, any noise disturbance.

B. Specific prohibitions. The following acts, and the causing or permitting thereof, are declared to be in violation of this chapter:

6. Construction and demolition.

a. i. Single-family zoning districts. Operating or causing the operation of any tools or equipment used in construction, drilling, repair, alteration, or demolition work on weekdays before 7:00 a.m. and after 5:30 p.m. and on Saturdays before 9:00 a.m. or after 3:00 p.m. or any time on Sundays or the city observed holidays of New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day and Christmas Day, such that the sound therefrom creates a noise disturbance across a residential or commercial real property line, except for emergency work of public utilities or by special exception. This section shall apply to operations on residentially zoned property only. This section shall not apply to the use of lawn or garden tools;

ii. All other zoning districts (excluding single-family districts). Operating or causing the operation of any tools or equipment used in construction, drilling, repair, alteration, or demolition work on weekdays before 7:00 a.m. and after 7:00 p.m. and Saturdays before 9:00 a.m. or after 6:00 p.m. or any time on Sundays or the city observed holidays of New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day and Christmas Day, such that the sound there from creates a noise disturbance across a residential or commercial real property line, except for emergency work of public service utilities or by special exception. This section shall apply to operations on properties other than residentially zoned property. This section shall not apply to the use of lawn or garden tools;

b. Where technically and economically feasible, construction activities shall be conducted in such a manner that the maximum noise levels at affected properties will not exceed those listed in the following schedules:
   i. Mobile equipment. Maximum noise levels for the nonscheduled, intermittent, short-term operation (less than ten (10) days) of mobile equipment:

TABLE 6: Maximum Noise Levels for the nonscheduled, Intermittent, and Short–Term Operations (Less than ten (10) days) for Mobile Equipment

	All R1 Zoning Districts	**All PCF and R3 Zoning Districts**	**All OA and C Zoning Districts**
Daily, except Sundays and legal holidays 7:00 a.m. & 7:00 p.m.	75 dBA	80 dBA	85 dBA
Daily, 7:00 p.m. & 7:00 a.m. and all day Sundays and legal holidays	50 dBA	55 dBA	60 dBA

ii. Stationary equipment. Maximum noise levels for the respectively scheduled and relatively long-term operation (periods of ten (10) days or more) of stationary equipment:

TABLE 7: Maximum Noise Levels for the nonscheduled, Intermittent, and Short–Term Operations (Less than ten (10) days) for Stationary Equipment

	All R1 Zoning Districts	**All PCF and R3 Zoning Districts**	**All OA and C Zoning Districts**
Daily, except Sundays and legal holidays 7:00 a.m. & 7:00 p.m.	75 dBA	80 dBA	85 dBA
Daily, 7:00 p.m. & 7:00 a.m. and all day Sundays and legal holidays	50 dBA	55 dBA	60 dBA

c. Deliveries, start-up and closing down. The construction times above shall apply to deliveries of materials and equipment, and arrival of workers, start-up and closing down and departure activities on a job site.

12. Air-conditioning or air-handling equipment. Operating or permitting the operation of any air-conditioning or air-handling equipment in such a manner as to exceed any of the following sound levels without a variance:

TABLE 8: Air-Conditioning or Air-Handling Equipment Operational Sound Levels

Measurement Location	**Residentially zoned properties, dB(A)**
Any point on a neighboring property line, five feet above grade level, no closer than three feet from any wall	50
Center of a neighboring patio, five feet above grade level, no closer than three feet from any wall	45
Outside the neighboring living area window nearest the equipment location, not more than three feet from the window opening, but at least three feet from any other surface	45

Existing Noise Environment

The existing noise environment was assessed by Edward L. Pack Associates. Inc. in August 2018. Traffic along El Camino Real was identified as the primary contributor to the existing noise environment. The study reported existing exterior noise exposure of up to 71 dBA CNEL along the most impacted planned areas at the proposed building's northeast setback from El Camino Real. Traffic noise along the western setback from Los Altos Avenue ranged from 63 to 70 dBA CNEL, depending on the distance from El Camino Real. Prior noise assessments by Illingworth & Rodkin, Inc. along El Camino Real in the vicinity of the project site resulted in comparable exterior noise levels.

GENERAL PLAN CONSISTENCY ANALYSIS

The impacts of site constraints such as exposure of the proposed project to excessive levels of noise and vibration are not considered under CEQA. This section addresses Noise and Land Use Compatibility for consistency with the policies set forth in the City's General Plan.

Noise and Land Use Compatibility

The applicable Los Altos General Plan policies were presented in detail in the Regulatory Background section and are summarized below for the proposed project:

- The City's Noise Element establishes 65 dBA CNEL as the maximum acceptable outdoor noise exposure level for multiple-family residential areas.

- The City's standard for interior noise levels in residences is 45 dBA CNEL.

Future Exterior Noise Environment

The future noise environment at the project site would continue to result from vehicular traffic on El Camino Real and Los Altos Avenue. A review of the transportation study[2] provided by the project applicant indicates that there will be a reduction in the number of daily trips generated by the proposed project in comparison to existing conditions.

Based on existing and historical traffic volumes, Edward L. Pack Associates, Inc. calculated a negligible increase in future traffic noise levels along El Camino Real and a 1 dB increase along Los Altos Avenue. These future traffic noise level increases were included in the calculations of future exterior noise levels.

A ground level courtyard is proposed at the southern corner of the site. The courtyard would be well shielded from the surrounding traffic noise sources by the proposed project building. Exterior noise levels were reported by Edward L. Pack Associates, Inc. to reach up to 64 dB CNEL at a distance of 155 feet from the center of El Camino Real. At the center of the courtyard, where it is anticipated that residents will spend most of their time, noise levels would be lower due to the shielding provided by the project building. Levels would be below the maximum acceptable outdoor noise level exposure for multi-family residential uses (65 dB CNEL).

Future exterior noise exposure at patios and balconies directly facing El Camino Real were reported to reach up to 71 dB CNEL. This would exceed the City of Los Altos' multi-family outdoor noise level standard by up to 6 dBA. Edward L. Pack Associates, Inc. reported exterior noise exposures of 63 to 70 dB CNEL along Los Altos Avenue on the northwest façade of the proposed project. This is expected to exceed the City of Los Altos' standard by up to 5 dBA.

2 Black, G.K., Traffic Analysis for the Proposed Residential Project at 4350 El Camino Real in Los Altos, California. Hexagon Transportation Consultants, Inc. November 9, 2018.

Future Interior Noise Environment

Exterior noise levels at residential façades would range from 71 dBA CNEL at façades fronting El Camino Real and 63 to 70 dBA CNEL at façades fronting Los Altos Avenue. Interior noise levels would vary depending upon the design of the buildings (relative window area to wall area) and the selected construction materials and methods. 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 dBA of noise reduction in interior spaces for an older structure and 25 dBA for a newer dwelling. Where exterior noise levels range from 60 to 70 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. In noise environments of 70 dBA CNEL or greater, a combination of forced-air mechanical ventilation and sound-rated construction methods is often required to meet the interior noise level limit. 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.

Edward L. Pack Associates, Inc. applied a 15-dB exterior-to-interior noise reduction with the assumption of standard residential construction methods and windows partially open for ventilation. This equates to 56 dB CNEL in the most impacted living spaces closest to El Camino Real, and 48 to 55 dB CNEL in the most impacted living spaces closest to Los Altos Avenue. Based on these interior noise exposures, the following recommendations were included to achieve compliance with the City of Los Altos Natural Environmental and Hazards Element standard and California Building Code, Title 24:

- Maintain closed at all times all windows and glass doors of living spaces with a direct of side view of El Camino Real, i.e., those on the west, north or east facades on the outer periphery of the building. Noise controls are not required for the windows and glass doors of living spaces viewing directly into the common area. Provide some type of mechanical ventilation for all living spaces with a closed window requirement.
- Install windows and glass doors rated minimum Sound Transmission Class (STC) 35 at the living spaces within 120 ft. of the centerline of El Camino Real and with a direct or side view of the roadway.
- Install windows and glass doors rated minimum Sound Transmission Class (STC) 32 at the living spaces between 85 ft. and 260 ft. of the centerline of El Camino Real and with a direct or side view of the roadway.

Figure 3 of Edward L. Pack Associates, Inc. report, includes the locations of recommended STC ratings. We find these recommendations to be sufficient to reduce interior levels to meet the 45 dBA CNEL interior threshold.

NOISE IMPACTS AND MITIGATION MEASURES

This section describes the significance criteria used to evaluate project impacts under CEQA, provides a discussion of each project impact, and presents mitigation measures, where necessary, to provide a compatible project in relation to adjacent noise sources and land uses.

Significance Criteria

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

1. **Temporary or Permanent Noise Increases in Excess of Established Standards.** A significant impact would be identified if project construction or operations would result in a substantial temporary or permanent increase in ambient noise levels at sensitive receivers in excess of the local noise standards contained in the Los Altos General Plan or Municipal Code, as follows:

    - Operational Noise in Excess of Standards. 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 or Municipal Code. The City of Los Altos limits sound levels generated by air-conditioning or air-handling equipment to 50 dBA at residential property lines and 45 dBA at residential patios and building façades. Other operational noise sources are limits to the levels specified in Table 4.

    - Permanent Noise Increase. A significant impact would be identified if traffic or school activity noise generated by the project would substantially increase noise levels at sensitive receivers in the vicinity. A substantial increase would occur if: a) the noise level increase is 5 dBA CNEL or greater, with a future noise level of less than 60 dBA CNEL, or b) the noise level increase is 3 dBA CNEL or greater, with a future noise level of 60 dBA CNEL or greater.

    - Temporary Noise Increase. A significant temporary noise impact would be identified if construction would occur outside of the hours specified in the Municipal Code or if construction noise levels were to exceed the City's construction noise limits at adjacent noise sensitive land uses. Construction occurring during allowable hours is limited to 75 dBA in single-family residential areas, 80 dBA in multi-family residential areas, and 85 dBA in commercial areas.

2. **Generation of Excessive Groundborne Vibration.** A significant impact would be identified if the construction of the project would generate excessive vibration levels. Groundborne vibration levels exceeding 0.3 in/sec PPV would be considered excessive as such levels would have the potential to result in cosmetic damage to buildings.

Impact 1: **Temporary or Permanent Noise Increases in Excess of Established Standards.** Project traffic would not result in a substantial permanent noise level increase at existing noise-sensitive land uses in the project vicinity. However, existing noise-sensitive land uses could be exposed to construction noise levels in excess of the applicable noise thresholds. **This is a potentially significant impact.**

Permanent Noise Increases from On-Site Operational Noise

The City of Los Altos limits sound levels generated by air-conditioning or air-handling equipment to 50 dBA at residential property lines and 45 dBA at residential patios and building façades. The descriptor for the noise limit is not specified. For consistency with the provisions of the code, a reasonable interpretation of this standard would identify the criteria as an hourly average L_{eq}. Other operational noise sources are limited to the levels specified in Table 4.

Parking

The majority of parking would be provided in the underground garage. Parking activities occurring in the underground garage would not be anticipated to be audible outside of the parking structure. Noise associated with on-site circulation and parking for the residential units would be similar to levels generated by use of the current parking lot and below noise levels generated by vehicular traffic traveling along El Camino Real and those specified in Table 4. This is a **less-than-significant** impact**.**

Mechanical Equipment

The proposed project would include mechanical equipment such as heating, ventilation, and air conditioning systems (HVAC). Based on the project plans, dated December 19, 2018, a boiler room and two sets of condensers would be located near the middle of the 6th floor rooftop. Project plans show that the boiler room would be entirely enclosed, which would provide adequate shielding to reduce levels to be inaudible at off-site locations. The condensers would be as close as 58 feet to the nearest shared property line to the southwest and 48 feet to center of the nearest neighboring patio to the southwest. Condenser equipment specifications were not provided. Based on data for similar equipment, each condenser is assumed to generate a sound power level of 56 dBA. Twenty (20) condenser units are proposed on the rooftop of the central portion of the northern segment of the building and approximately thirty (30) condenser units are proposed in the central portion of the northern segment of the building and twenty (20) condenser units are proposed in the central portion of the western segment of the building. Assuming a credible worst-case scenario, with all equipment operating simultaneously as close as 58 feet from the nearest shared property line and 48 feet from the nearest outdoor patio, the condensers would be anticipated to generate noise levels of 35 to 37 dBA L_{eq}. This is below the 45 and 50 dBA L_{eq} thresholds. This is a **less-than-significant** impact**.**

Permanent Noise Increases from Project Traffic

Neither the City of Los Altos nor the State of California define the traffic noise level increase that is considered substantial. A significant impact would typically be identified if project generated traffic were to result in a permanent noise level increase of 3 dBA CNEL or greater in a residential area where the resulting noise environment would exceed or continue to exceed 60 dBA CNEL or

result in a permanent noise increase of 5 dBA CNEL or greater in a residential area where the resulting in a noise environment would continue to be 60 dBA CNEL or less. For reference, a 3 dBA CNEL noise increase would be expected if the project would double existing traffic volumes along a roadway.

A review of the project's trip generation information indicates that there will be a significant reduction in the number of daily trips generated by the proposed project in comparison to existing conditions. Traffic noise levels resulting from a decrease in traffic volumes would also decrease. Therefore, the proposed project would not result in noise increases of 3 dBA CNEL or more on the surrounding roadway network. This is a **less-than-significant** impact.

Temporary Noise Increases from Project Construction

Chapter 6.16.070 of the City's Municipal Code establishes allowable hours of construction within residentially zoned properties between 7:00 a.m. and 5:30 p.m. Monday through Friday and between 9:00 a.m. and 3:00 p.m. on Saturdays. Construction in all other zoning districts (excluding single-family districts) is permissible between 7:00 a.m. and 7:00 p.m. Monday through Friday and 9:00 a.m. and 6:00 p.m. on Saturdays. Construction activities are not permitted on Sundays or the City observed holidays of New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day and Christmas Day. In addition, where technically and economically feasible, maximum noise levels from construction activities should not exceed those listed in Tables 3 and 4 in Chapter 6.16.070 of the City's Municipal Code.

The City also provides recommended maximum noise level limits for construction activities occurring over a period of less than 10 days but does not provide limits for longer duration construction. This analysis applies the noise limits to project construction, given that construction would occur for a period greater than 10 days. Construction occurring during allowable hours is limited to 75 dBA in single-family residential areas, 80 dBA in multi-family residential areas, and 85 dBA in commercial areas. This code is not explicit in terms of the acoustical descriptor associated with the noise level limit. A reasonable interpretation of this standard would identify the criteria as an hourly average L_{eq}.

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), if the construction occurs in areas immediately adjoining noise-sensitive land uses, or when construction lasts over extended periods of time.

Construction activities would include demolition, excavation, site preparation, grading, building construction, paving, and architectural coating. During each stage of construction, there would be a different mix of equipment operating, and noise levels would vary by stage and vary within stages, based on the amount of equipment in operation and the location at which the equipment is operating. The hauling of excavated materials and construction materials would generate truck trips on local roadways as well. Pile driving is not anticipated as a method of construction.

Typical construction noise levels at a distance of 50 feet are shown in Tables 9 and 10. Table 9 shows the average noise level ranges by construction phase and Table 10 shows the maximum noise level ranges for different construction equipment. Most demolition and construction noise falls with the range of 80 to 90 dBA at 50 feet from the source. 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.

As shown in Tables 9 and 10, construction activities generate considerable amounts of noise, especially during demolition and earth-moving activities when heavy equipment is used. Project construction would occur adjacent to multi-family residential property lines to the southeast and southwest, and across Los Altos Avenue from The Courtyard Marriott Hotel. Construction noise levels would be anticipated to exceed the multi-family residential limit of 80 dBA L_{eq} when heavy construction is located within 80 feet of the shared property line with the housing complex to the southeast and southwest. Construction noise is not anticipated to exceed 85 dBA L_{eq} at the Courtyard Marriott Hotel or 75 dBA L_{eq} at single-family residences located 175 feet to the southwest and shielded by intervening structures.

Construction would be in compliance with City of Los Altos' Municipal Code specified hours of construction but would be anticipated to exceed the construction noise limits during some periods of construction when heavy construction is located adjacent to shared property lines. This is a **potentially significant** temporary impact.

Mitigation Measure 1b: Modification, placement, and operation of construction equipment are possible means for minimizing the impact of construction noise on existing sensitive receptors. Construction equipment should be well-maintained and used judiciously to be as quiet as possible. Additionally, construction activities for the proposed project should include the following best management practices to reduce noise from construction activities near sensitive land uses:

- Construction activities shall be limited to the hours between 7:00 a.m. and 5:30 p.m., Monday through Friday, and on Saturdays between 9:00 a.m. and 3:00 p.m., in accordance with the City's Municipal Code. Construction is prohibited on Sundays and holidays, unless permission is granted with a development permit or other planning approval.

- Use of the concrete saw within 50 feet of shared property lines shall be limited, as feasible.

- Equip all internal combustion engine-driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.

- Unnecessary idling of internal combustion engines should be strictly prohibited.
- Locate stationary noise-generating equipment, such as air compressors or portable power generators, as far as possible from sensitive receptors. If they must be located near receptors, adequate muffling (with enclosures where feasible and appropriate) shall be used reduce noise levels at the adjacent sensitive receptors. Any enclosure openings or venting shall face away from sensitive receptors.

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

- A temporary noise control blanket barrier could be erected, if necessary, along building facades facing construction sites. This mitigation would only be necessary if conflicts occurred which were irresolvable by proper scheduling. Noise control blanket barriers can be rented and quickly erected.

- 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 plan identifying the 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 best management practices 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 impact would be **less-than-significant**.

TABLE 9 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 10 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.

Impact 2 **Exposure to Excessive Groundborne Vibration due to Construction.** Construction-related vibration levels could exceed 0.3 in/sec PPV at the nearest structures. **This is a potentially significant impact.**

The City of Los Altos does not specify a construction vibration limit. 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 0.25 in/sec PPV for historic and some old buildings (see Table 3). The 0.3 in/sec PPV vibration limit would be applicable to properties in the vicinity of the project site. The prior study by Edward L. Pack & Associates, Inc. used a threshold of 0.2 in/sec PPV.

The construction of the project may generate perceptible vibration when heavy equipment or impact tools (e.g. jackhammers, hoe rams) are used. Construction activities would include demolition, site preparation, grading and excavation, trenching and foundation, building (exterior), interior/ architectural coating and paving. Pile driving is not anticipated for construction of the building foundation.

Table 11 presents typical vibration levels from construction equipment at a reference distance of 25 feet. Jackhammers typically generate vibration levels of 0.035 in/sec PPV and drilling typically generates vibration levels of 0.09 in/sec PPV at 25 feet. Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Calculations were made to estimate vibration levels at distances of 18, 40, and 80 feet from the site to represent other nearby buildings. Vibration levels are highest close to the source, and then attenuate with increasing distance at the rate $(D_{ref}/D)^{1.1}$, where D is the distance from the source in feet and D_{ref} is the reference distance of 25 feet.

TABLE 11 Vibration Levels for Construction Equipment at Various Distances

Equipment		PPV at 25 ft. (in/sec)	PPV at 18 ft. (in/sec)	PPV at 40 ft. (in/sec)	PPV at 80 ft. (in/sec)
Clam shovel drop		0.202	0.290	0.127	0.056
Hydromill (slurry wall)	in soil	0.008	0.011	0.005	0.002
	in rock	0.017	0.024	0.011	0.004
Vibratory Roller		0.210	**0.301**	0.132	0.058
Hoe Ram		0.089	0.128	0.056	0.025
Large bulldozer		0.089	0.128	0.056	0.025
Caisson drilling		0.089	0.128	0.056	0.025
Loaded trucks		0.076	0.109	0.048	0.021
Jackhammer		0.035	0.050	0.022	0.010
Small bulldozer		0.003	0.004	0.002	0.001

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, October 2018, as modified by Illingworth & Rodkin, Inc., May 2019.

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 of construction activities. The closest structure to the project site includes a residential complex that wraps around the proposed project as close as 18 feet to the southwest and southeast of the project site. A hotel is located across about 80 feet northwest of the project site, across Los Altos Avenue.

As indicated in Table 11, heavy vibration generating construction equipment, such as vibratory rollers or clam shovel drops, would have the potential to produce vibration levels of 0.3 in/sec PPV or more within 20 feet of construction. Only one structure is located within 20 feet of the project site, a residential building that is setback from the shared southwestern property line by about 18 feet. Heavy construction located within 2 feet of the shared property line to the southwest would have the potential to exceed the 0.3 in/sec PPV threshold for buildings that are found to be structurally sound but not where structural damage is a major concern. Vibration levels at all other buildings in the vicinity are calculated to be below the 0.3 in/sec PPV threshold and would not be anticipated to be impacted by project construction generated vibration.

The US Bureau of Mines has analyzed the effects of blast-induced vibration on buildings in USBM RI 85073, and these findings have been applied to vibrations emanating from construction equipment on buildings[4]. Figure 1 presents the damage probability as reported in USBM RI 8507 and reproduced by Dowding assuming a maximum vibration level of 0.3 in/sec PPV, the maximum vibration level that would be anticipated when construction is located 18 feet from structures. As shown on Figure 1, these studies indicate no observations of "threshold damage" (referred to as cosmetic damage elsewhere in this report), "minor damage", or "major damage" at vibration levels of 0.3 in/sec PPV or less.

In summary, the construction of the project would generate vibration levels exceeding the threshold of 0.3 in/sec PPV at the adjoining commercial structure to the southwest when construction is located within 2 feet of the shared property line. Such vibration levels would be unlikely to cause cosmetic, major, or minor structural damage, but are conservatively identified as significant to provide the ultimate level of protection from construction vibration. Project-generated vibration levels would fall below the 0.3 in/sec PPV threshold at structures located 20 feet or further from construction. This is a **potentially significant** impact.

Mitigation Measure 2: Implementation of the following measures would reduce the vibration impact to a less-than-significant level at the adjoining commercial structure to the southeast of the project:

- A construction vibration-monitoring plan shall be implemented to document conditions at all structures located within 20 feet of proposed construction prior to, during, and after vibration generating construction activities. All plan tasks shall be undertaken under the direction of a licensed Professional Structural Engineer in the State of California and be in

3 Siskind, D.E., M.S. Stagg, J.W. Kopp, and C.H. Dowding, Structure Response and Damage Produced by Ground Vibration form Surface Mine Blasting, RI 8507, Bureau of Mines Report of Investigations, U.S. Department of the Interior Bureau of Mines, Washington, D.C., 1980.

4 Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996.

accordance with industry accepted standard methods. The construction vibration monitoring plan should be implemented to include the following tasks:

- Identification of sensitivity to groundborne vibration of all structures located within 20 feet of construction.

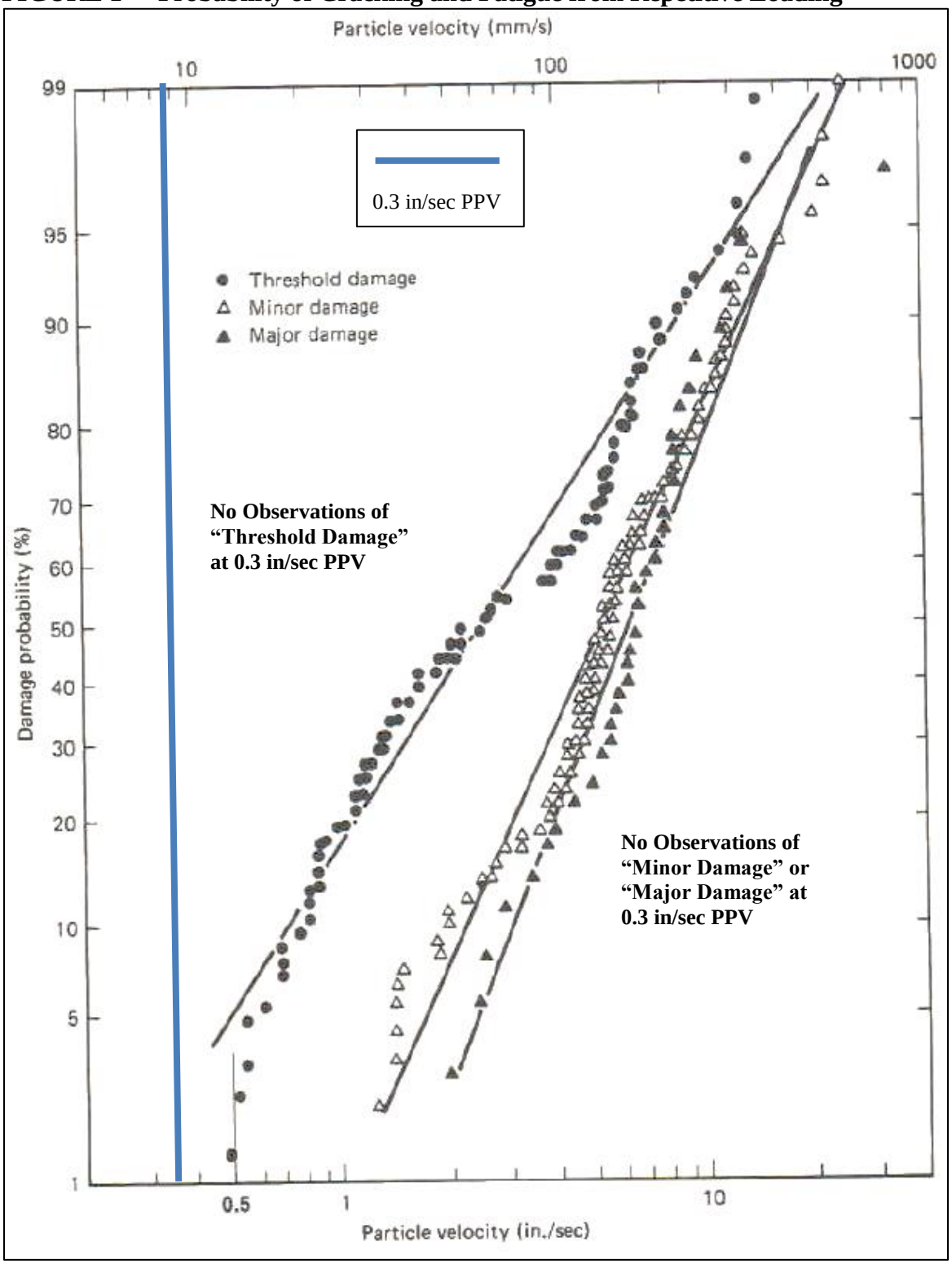
- Performance of a photo survey, elevation survey, and crack monitoring survey for all structures located within 20 feet of construction. Surveys shall be performed prior to, in regular intervals during, and after completion of vibration generating construction activities and shall include internal and external crack monitoring in the structure, settlement, and distress and shall document the condition of the foundation, walls and other structural elements in the interior and exterior of said structure.

- Conduct a post-survey on the structure where either monitoring has indicated high levels or complaints of damage. Make appropriate repairs or provide compensation where damage has occurred as a result of construction activities.

- Designate a person responsible for registering and investigating claims of excessive vibration. The contact information of such person shall be clearly posted on the construction site.

Implementation of the above measures would reduce this impact to a **less-than-significant** level.

FIGURE 1 Probability of Cracking and Fatigue from Repetitive Loading



Source: Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996 as modified by Illingworth & Rodkin, Inc., May 2019.