APPENDIX E

Environmental Noise and Vibration Assessment

HARKER SCHOOL PROJECT ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT

San José, California

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INTRODUCTION

The Harker School project proposes to construct new classroom and gymnasium/auditorium buildings on the existing preschool building campus located at 4525 Union Avenue in San José, CA. The project also proposes five new basketball courts and reconfiguration of the existing playing field.

This report evaluates the project's potential to result in significant impacts with respect to the applicable 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, 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 land use compatibility utilizing noise-related 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 are shown in Table 2. Because sound levels can vary notably 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 DNL. Typically, the highest steady traffic noise level during the daytime is about equal to the DNL 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 12-17 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 57-62 dBA DNL with open windows and 65-70 dBA DNL if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 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 DNL 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 DNL. At a DNL of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the DNL increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a DNL of 60-70 dBA. Between a DNL of 70-80 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 DNL is 60 dBA, approximately 30-35 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 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 induce structural 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. Perceptible vibration levels inside residences are attributed to the operation of heating and air conditioning systems, door slams and foot traffic. Construction activities, train operations, and street traffic are some of the most common external sources of vibration that can be perceptible inside residences.

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.

TABLE 4 Typical Levels of Groundborne Vibration

Human/Structural Response	Velocity Level, VdB (re 1µinch/sec, RMS)	Typical Events (50 –foot setback)
Threshold, minor cosmetic damage	100	Blasting, pile driving, vibratory compaction equipment
		Heavy tracked vehicles (Bulldozers, cranes, drill rigs)
Difficulty with tasks such as reading a video or computer screen	90	
		Commuter rail, upper range
Residential annoyance, infrequent events	80	Rapid transit, upper range
Residential annoyance, frequent events		Commuter rail, typical Bus or truck over bump or on rough roads
	70	Rapid transit, typical
Approximate human threshold of perception to vibration		Buses, trucks and heavy street traffic
	60	
		Background vibration in residential settings in the absence of activity
Lower limit for equipment ultra-sensitive to vibration	50	

Source: Illingworth & Rodkin, Inc. and U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment, May 2006, FTA-VA-90-1003-0

Regulatory Background

The State of California and the City of San José have established regulatory criteria that are applicable in this noise assessment. The State CEQA Guidelines, Appendix G, are used to assess the potential significance of environmental noise impacts pursuant to local policies and Municipal Code set forth in the City of San José General Plan. A summary of applicable regulatory criteria is provided below.

State CEQA Guidelines. The California Environmental Quality Act (CEQA) contains guidelines to evaluate the significance of environmental noise impacts 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 in the vicinity of a public airport or private airstrip; therefore, item (c) is not carried further in this analysis.

The impacts of the project on the surrounding land uses are addressed in the Noise Impacts and Mitigation Measures Section of the report. The impacts of site constraints such as exposure of the proposed project to excessive levels of noise and vibration are not considered under CEQA and are discussed in a separate section addressing Noise and Land Use Compatibility for consistency with the policies set forth in the City's General Plan.

2016 California Green Building Standards Code (Cal Green Code). The State of California established exterior sound transmission control standards for new non-residential buildings as set forth in the 2016 California Green Building Standards Code (Section 5.507.4.1 and 5.507.4.2). Section 5.507 states that either the prescriptive (Section 5.507.4.1) or the performance method (Section 5.507.4.2) shall be used to determine environmental control at indoor areas. The prescriptive method is very conservative and not practical in most cases; however, the performance method can be quantitatively verified using exterior-to-interior calculations. For the purposes of this report, the performance method is utilized to determine consistency with the Cal Green Code. The sections that pertain to this project are as follows:

5.507.4.1 Exterior noise transmission, prescriptive method. Wall and roof-ceiling assemblies exposed to the noise source making up the building envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 when the building falls within the 65 dBA L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway noise source, as determined by the local general plan noise element.

5.507.4.2 Performance method. For buildings located, as defined by Section 5.507.4.1, wall and roof-ceiling assemblies exposed to the noise source making up the building envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level ($L_{eq\ (1\text{-}hr)}$) of 50 dBA in occupied areas during any hour of operation.

The performance method, which establishes the acceptable interior noise level, is the method typically used when applying these standards.

California Collaborative for High Performance School (CHPS). CHPS provides criteria for interior noise levels in learning spaces of schools due to exterior noise sources, summarized in Table 5. The CHPS criteria shown in the table refer to hourly average noise levels ($L_{eq(h)}$) during the loudest hour of the school day.

TABLE 5 Exterior-to-interior noise intrusion criteria for schools

	CHPS Prerequisite	**CHPS Enhanced Acoustics**
Core learning spaces	45 dB(A) or less indoors	35 dB(A) or less indoors
Ancillary learning & assembly spaces	N/A	40 dB(A) or less indoors

City of San José General Plan. The Environmental Leadership Chapter in the Envision San José 2040 General Plan sets forth policies with the goal of minimizing the impact of noise and vibration on people, residences, and businesses in the City of San José. The following policies are applicable to the proposed project:

EC-1.1 Locate new development in areas where noise levels are appropriate for the proposed uses. Consider federal, State, and City noise standards and guidelines as a part of new development review. Applicable standards and guidelines for land uses in San José include:

Interior Noise Levels

The City's standard for interior noise levels in residences, hotels, motels, residential care facilities, and hospitals is 45 dBA DNL. Include appropriate site and building design, building construction and noise attenuation techniques in new development to meet this standard. For sites with exterior noise levels of 60 dBA DNL or more, an acoustical analysis following protocols in the City-adopted California Building Code is required to demonstrate that development projects can meet this standard. The acoustical analysis shall base required noise

attenuation techniques on expected Envision General Plan traffic volumes to ensure land use compatibility and General Plan consistency over the life of this plan.

Exterior Noise Levels

The City's acceptable exterior noise level objective is 60 dBA DNL or less for residential and most institutional land uses including schools (Table EC-1). Outdoor sports and recreation areas and playgrounds are considered acceptable in noise environments of 65 dBA DNL or less.

Table EC-1: Land Use Compatibility Guidelines for Community Noise in San José

LAND USE CATEGORY	EXTERIOR NOISE EXPOSURE (DNL IN DECIBELS (DBA)) 55 60 65 70 75 80
1. Residential, Hotels and Motels, Hospitals and Residential Care[1]	
2. Outdoor Sports and Recreation, Neighborhood Parks and Playgrounds	
3. Schools, Libraries, Museums, Meeting Halls, Churches	
4. Office Buildings, Business Commercial, and Professional Offices	
5. Sports Arena, Outdoor Spectator Sports	
6. Public and Quasi-Public Auditoriums, Concert Halls, Amphitheaters	

[1]Noise mitigation to reduce interior noise levels pursuant to Policy EC-1.1 is required.

Normally Acceptable:

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

Conditionally Acceptable:

- Specified land use may be permitted only after detailed analysis of the noise reduction requirements and needed noise insulation features included in the design.

Unacceptable:

- New construction or development should generally not be undertaken because mitigation is usually not feasible to comply with noise element policies.

EC-1.2 Minimize the noise impacts of new development on land uses sensitive to increased noise levels (Categories 1, 2, 3 and 6) by limiting noise generation and by requiring use of noise attenuation measures such as acoustical enclosures and sound barriers, where feasible. The City considers significant noise impacts to occur if a project would:

- Cause the DNL at noise sensitive receptors to increase by five dBA DNL or more where the noise levels would remain "Normally Acceptable;" or
- Cause the DNL at noise sensitive receptors to increase by three dBA DNL or more where noise levels would equal or exceed the "Normally Acceptable" level.
-

EC-1.3 Mitigate noise generation of new nonresidential land uses to 55 dBA DNL at the property line when located adjacent to existing or planned noise-sensitive residential and public/quasi-public land uses.

EC-1.7 Require construction operations within San José to use best available noise suppression devices and techniques and limit construction hours near residential uses per the City's Municipal Code. 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.

EC-2.3 Require new development to minimize vibration impacts to adjacent uses during demolition and construction. A vibration limit of 0.20 in/sec PPV will be used to minimize the potential for cosmetic damage at buildings of normal conventional construction.

City of San José Municipal Code. The City's Municipal Code contains a Zoning Ordinance that limits noise levels at adjacent properties. Chapter 20.30.700 states that sound pressure levels generated by any use or combination of uses on a property shall not exceed 55 dBA at any property line shared with land zoned for residential use, except upon issuance and in compliance with a Conditional Use Permit. This code is not explicit in terms of the acoustical descriptor associated with the noise level limit. Consistent with General Plan policy E.C.-1.3, a reasonable interpretation of this standard would identify the ambient base noise level criteria as the day/night noise level (DNL) for continuously operating noise sources such as mechanical equipment. For noise sources that are not operating on a 24-hour per day basis, such as sporting events, a reasonable interpretation of this standard would identify the ambient base noise level criteria as the hourly average noise level (L_{eq}).

Chapter 20.100.450 of the Municipal Code establishes allowable hours of construction within 500 feet of a residential unit between 7:00 am and 7:00 pm Monday through Friday unless permission is granted with a development permit or other planning approval. No construction activities are permitted on the weekends at sites within 500 feet of a residence.

Existing Noise Environment

The project site is located at 4525 Union Avenue to the south of Barrett Avenue in San José. The existing campus houses a preschool and playground. The campus is surrounded by residential land uses.

A noise monitoring survey was conducted from March 6th through March 8th, 2018 to document existing noise conditions at the site and in the surrounding area. The noise monitoring survey included two long-term (48-hour) measurements and three short-term (10-minute) noise measurements. Noise measurement locations are shown in Figure 1.

Long-term site LT-1 was located on the west fence of the site. The primary noise source at this location was vehicular traffic on Barrett Avenue and Esther Drive. Hourly average noise levels at LT-1 ranged from 45 to 53 dBA L_{eq} during the day and from 43 to 47 dBA L_{eq} during the night. The day-night equivalent noise level at LT-1 was calculated to be 54 dBA DNL on Wednesday, March 7th, 2018.

Long-term site LT-2 was located on the north side of the site, 30 feet south of the northern wall. The primary noise source at LT-2 was the distant vehicular traffic along Barrett Avenue and occasional noise from activities on the playground. Hourly average noise levels at LT-2 ranged from 48 to 60 dBA L_{eq} during day and 42 to 51 dBA L_{eq} during the night. The day-night equivalent noise level at LT-2 was calculated to be 56 dBA DNL. The daily trend in noise levels over the noise monitoring periods for LT-1 and LT-2 are shown in Figure 2 and Figure 3.

Short-term (10-minute interval) noise measurements were made at three locations to complete the noise monitoring survey. Table 6 summarizes the results of these measurements.

Table 6: Summary of Short-Term Noise Measurement Data, March 6th, 2018

ID	Location (Start Time)	Measured Noise Levels, dBA				Primary noise source
		L_{10}	L_{50}	L_{90}	L_{eq}	
ST-1	Between the school's southern wall and business park's parking area. (01:20 p.m. to 01:30 p.m.)	51	48	47	50	Distant traffic noise from Union Avenue, parking lot activities
ST-2	Intersection of Esther Drive and Ebbesen Avenue. (01:40 p.m. to 01:50 p.m.)	48	44	42	47	Traffic Esther Drive and Ebbesen Avenue
ST-3	In front of 2069 Barrett Avenue, 30 feet from centerline of Barrett Avenue (12:10 p.m. to 12:20 p.m.)	61	45	40	57	Traffic on Barrett Avenue

Figure 1: Noise Measurement and Existing Noise Barrier Locations

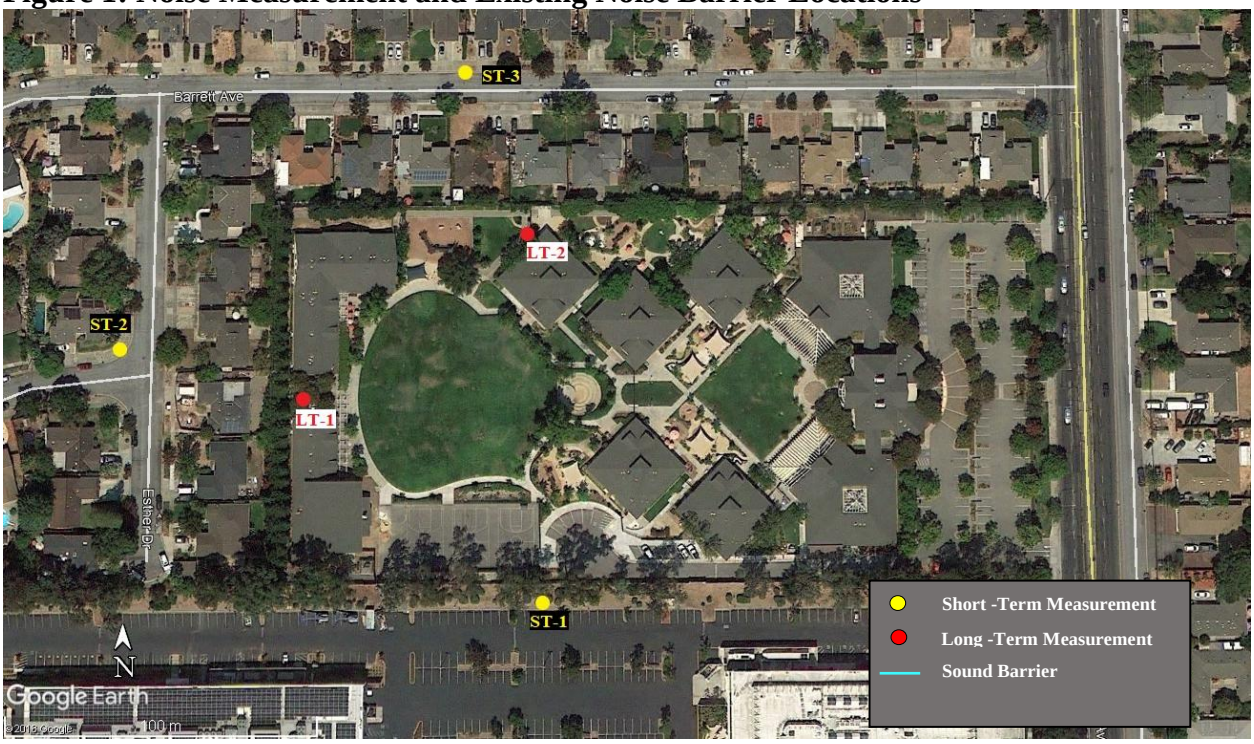


Figure 2 – Daily Trend in Noise Levels at LT-1, March 7th, 2018

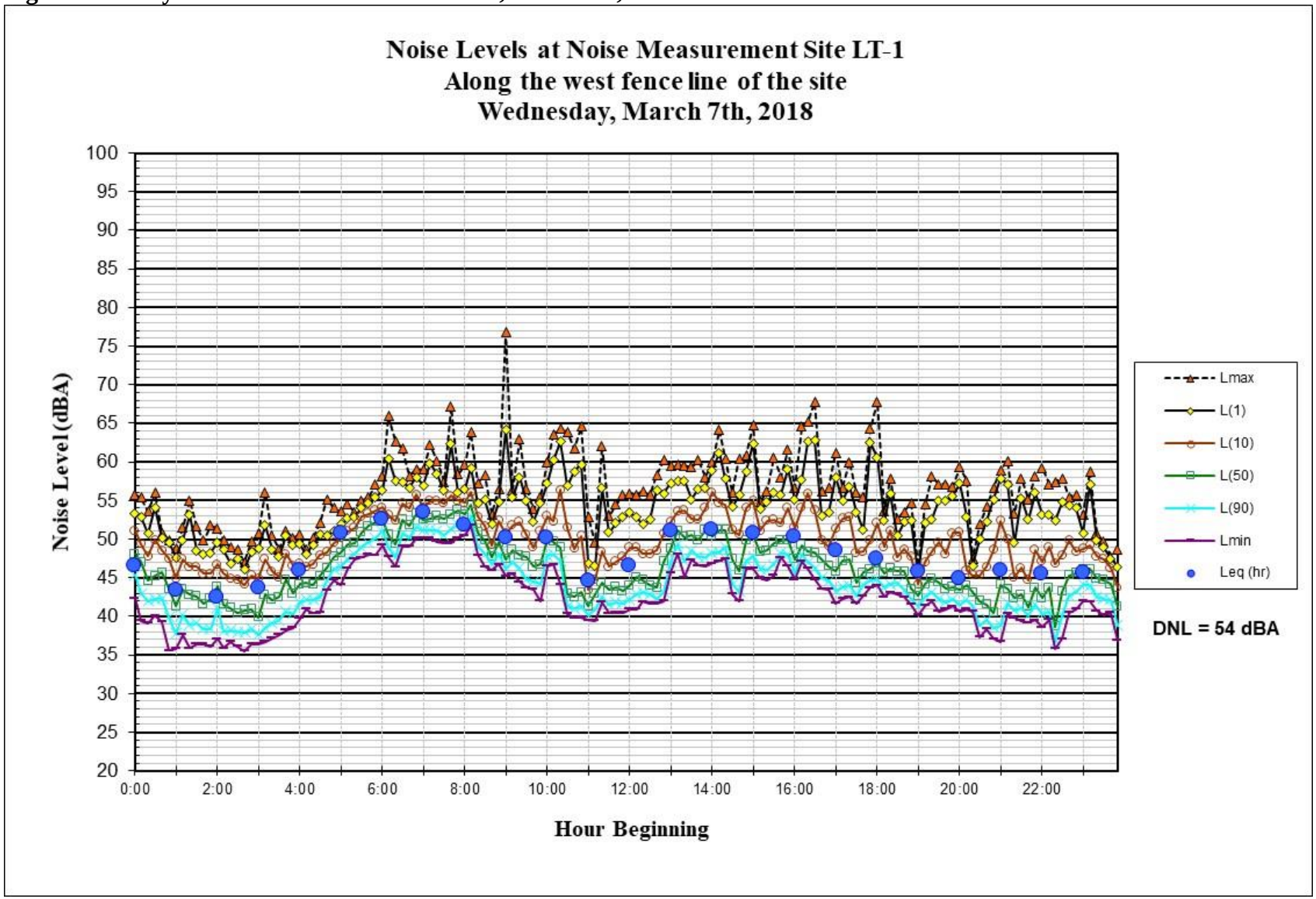
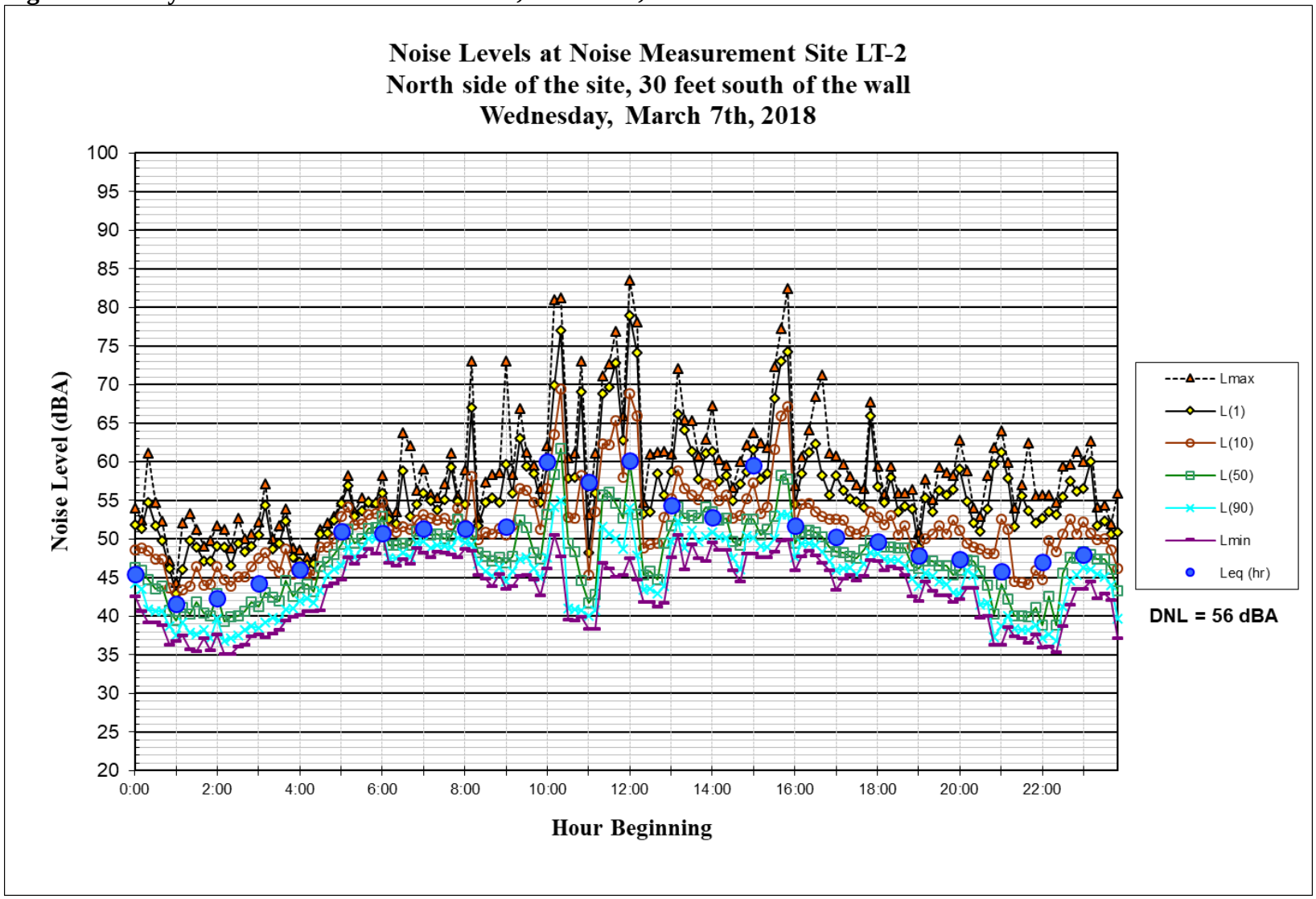


Figure 3 – Daily Trend in Noise Levels at LT-2, March 7th, 2018



GENERAL PLAN CONSISTENCY ANALYSIS

The impacts of site constraints such as exposure of the proposed project to excessive levels of noise 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.

Consistency Analysis Thresholds

The Environmental Leadership Chapter in the Envision San José 2040 General Plan sets forth policies with the goal of minimizing the impact of noise on people through noise reduction and suppression techniques, and through appropriate land use policies in the City of San José. The applicable General Plan policies were presented in detail in the Regulatory Background section and are summarized below for the proposed project:

- The City's acceptable exterior noise level objective is 60 dBA DNL or less for the proposed school use and 65 dBA DNL for outdoor sports and recreational uses (Table EC-1).

- The Cal Green Code standards specify an interior noise environment attributable to exterior sources not to exceed an hourly equivalent noise level ($L_{eq\ (1\text{-}hr)}$) of 50 dBA in occupied areas of non-residential uses during any hour of operation.

Noise and Land Use Compatibility

The project proposes to construct new classroom (Building E) and gymnasium/auditorium (Building C) buildings on the existing preschool campus, which currently includes a preschool building and playground. Three existing buildings would be demolished. The new 45,000 square foot classroom building would be located near the northern property line in the western portion of the site, and the new 10,682 square foot recreation center would be an addition to the existing preschool building located in the southwest corner of the project site. The project also includes construction of five new basketball courts, reconfiguration of the existing playing field, and a new vehicle turnaround and emergency vehicle access road in the western portion of the site to connect to the existing parking lot and access driveways on Union Avenue at the east side of the site.

Future Exterior Noise Environment

Exterior use areas include the playing field and basketball courts. The primary background noise source for these outdoor areas is the traffic on Union Avenue, Barrett Avenue and Esther Drive. The playing field and basketball courts will be shielded on north, east and west by proposed buildings. Based on measurements made during the noise monitoring survey (see Setting Section) and traffic volumes provided in the Traffic Impact Assessment Report[1] (see Impact 3), proposed outdoor areas would be exposed to a noise level of up to 55 dBA DNL. Noise levels at

[1] Harker Middle School – 4525 Union Avenue, Draft Transportation Impact Analysis; Hexagon Transportation Consultants, Inc., May 21, 2018.

the school's playfield and basketball courts would not exceed the City's acceptable exterior noise level criteria of 65 dBA DNL for outdoor sports and recreation uses.

Future Interior Noise Environment

The Cal Green code requires interior noise attributable to exterior sources to not exceed 50 dBA $L_{eq\text{-}1hr}$ in non-residential spaces. The calculated exterior noise level exposures of building façades are summarized in Table 7, based on the results of the noise monitoring survey and the increase in noise level due to future traffic projections.

TABLE 7 Calculated Noise Levels at Proposed Buildings, dBA

Façade	**Building**	Exterior, DNL	Interior with Windows Open, DNL	Interior with Windows Open, $L_{eq\text{-}hr}$	Interior with Windows Closed, $L_{eq\text{-}hr}$
West	Gymnasium/Auditorium (Building C)	55	40	39	29-34
North	Classroom Building E	57	42	43	33-38

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 school 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.

As shown in Table 7, noise levels inside the buildings would be expected to be below 45 dBA DNL and the CalGreen criteria of 50 dBA $L_{eq(1\text{-}hr)}$ assuming standard construction methods with the windows in the open or closed position. Interior levels in the classroom building would meet the CHPS Prerequisite Goal for core learning spaces of 45 dBA L_{eq} with standard construction and windows in the open or closed position and the CHPS Enhanced Acoustics Goal of 35 dBA L_{eq} with closed windows and the use of classroom windows with sound insulation ratings of STC 28 or greater. The gymnasium/auditorium would meet the CHPS Enhanced Acoustics Goal of 40 dBA L_{eq} for axillary learning and assembly spaces with standard construction and windows in the open or closed position. Where closed windows are required to reduce noise levels indoors, a suitable form of mechanical ventilation would be necessary to maintain a habitable interior environment.

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 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 San José General Plan or Municipal Code, as follows:

    a. Operational Noise in Excess of Standards. A significant noise impact would be identified if on-site project operations (i.e., mechanical equipment or parking) would generate noise levels that would exceed 55 dBA DNL at adjacent residential property lines or 60 dBA DNL at adjacent commercial property lines.

    b. Permanent Noise Increase. A significant permanent noise increase would occur if project traffic resulted in an increase of 3 dBA DNL or greater at noise-sensitive land uses where existing or projected noise levels would equal or exceed the noise level considered satisfactory for the affected land use (60 dBA DNL for single-family residential areas) and/or an increase of 5 dBA DNL or greater at noise-sensitive land uses where noise levels would continue to be below those considered satisfactory for the affected land use.

    c. Temporary Noise Increase. A significant temporary noise impact would be identified if construction-related noise 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.

2. **Generation of Excessive Groundborne Vibration:** A significant impact would be identified if the construction of the project would expose persons to vibration levels exceeding the San José thresholds.

Impact 1: **Temporary or Permanent Noise Increases in Excess of Standards.** Project traffic would not result in substantial permanent noise level increase at existing noise-sensitive uses in the project vicinity. Noise levels from mechanical equipment and outdoor school activities would not exceed the noise limits. However, noise generating construction activities would occur within 500 feet of residential land use for a period exceeding 12 months. This is a **potentially significant impact**.

a. Permanent Noise from On-Site Operations

Noise generating on-site operational components of the project would include school activities and mechanical equipment. Operational noise levels are limited to 55 dBA DNL at adjacent residential property lines and 60 dBA DNL at adjacent commercial property lines. For noise sources not occurring on a 24-hour basis (such as school activities), noise levels would be limited to 55 dBA L_{eq} at residential property lines.

School Activities

The project proposes an outdoor soccer field in the center of the site and five basketball courts adjacent to the southern property line. Noise levels generated by field hockey, track meets, soccer, and lacrosse games are generally limited to whistles and some cheering. Based on noise monitoring of soccer games at few high schools,[2,3] whistles and cheering would be anticipated to generate maximum noise levels of about 58 to 63 dBA L_{max} at residences adjoining the field. Hourly average noise levels during field hockey, soccer, and lacrosse events would be anticipated to be about 60 dBA L_{eq} at a distance of about 100 feet from the center of the field. Noise levels generated during activities at the elementary and middle school athletic field would be lower.

The nearest residences would be at least 200 feet from the center of soccer field to the west and north and shielded from outdoor activities by intervening buildings. Outdoor field activities would result in noise levels of 45 dBA L_{eq} or less at these nearest receptors, taking the shielding from the intervening school buildings into account. This would be well below the 55 dBA L_{eq} threshold. On a DNL basis, noise levels would be considerably lower due to the occasional and daytime nature of the activities. This is a **less-than-significant** impact.

Mechanical Equipment Noise

The project would include various mechanical equipment, including such as heating, ventilation, and air conditioning systems. Equipment located inside or in a fully enclosed room with a roof would not be anticipated to be audible at off-site locations. Based on review of the mechanical plans, dated February 14, 2019, rooftop mechanical equipment would be utilized for both buildings.

[2] Silver Creek High School Sports Lighting Project Environmental Noise Assessment, Prepared by Illingworth & Rodkin, Inc., September 9, 2013.

[3] Santa Teresa High School Sports Lighting Project Environmental Noise Assessment, Prepared by Illingworth & Rodkin, Inc., September 12, 2013.

Rooftop equipment on the classroom building (Building E) would include six (6) VRF units, five (5) exhaust fans, and two (2) make-up air units, all located within the central portion of the roof. The VRF units are specified to generate noise levels in the range of 66 to 67 dB at an unspecified distance, assumed to be at a distance of 3 feet in this analysis. All rooftop equipment would be shielded by an 85-inch high equipment screen. The closest residences are located about 60 feet north and 200 feet west of the proposed equipment. The screen is calculated to provide about 16 dBA of sound attenuation to residences to the north and 14 dBA of attenuation to residences to the west.

Rooftop equipment on the gymnasium/auditorium building (Building C) would include one (1) VRF unit, seven (7) exhaust fans, and two (2) AC units, all located in the central portion of the rooftop. The VRF unit is specified to generate a noise level of 65 dB at an unspecified distance, assumed to be at a distance of 3 feet in this analysis. Rooftop equipment would be shielded by a 90-inch high equipment screen. The closest residences are located about 60 feet west and 240 feet north of the proposed Building C rooftop equipment. The screen is calculated to provide about 17 dBA of sound attenuation to residences to the west and 15 dBA of attenuation to residences to the north.

With the inclusion of the equipment screens, as specified on the mechanical plans, noise levels would be below 55 dBA L_{eq} and 55 dBA DNL at the closest residences. This is a **less-than-significant** impact.

Mitigation Measure 1a: None required.

b. Permanent Noise Increases from Project Traffic

A significant permanent noise impact would occur if the project resulted in an increase of 3 dBA DNL or greater at noise-sensitive land uses where existing or projected noise levels would exceed the noise level considered satisfactory for the affected land use (60 dBA DNL for school or residential uses) an increase of 5 dBA DNL or greater at noise-sensitive land uses where noise levels would continue to be below those considered satisfactory for the affected land use. For reference, a 3 dBA DNL noise increase would be expected if the project would double existing traffic volumes along a roadway.

Traffic data provided by Hexagon Transportation Consultants, Inc. was reviewed to calculate potential traffic noise level increases attributable to the project expected along roadways serving the site. Roadways evaluated in the analysis included Union Avenue, Charmeran Avenue, Cole Avenue, and Logic Drive. Link volumes under the existing plus project scenario were compared to existing conditions to calculate the traffic noise increase attributable to the project.

The data indicate that traffic volumes in the site vicinity will slightly increase as a result of the proposed project. Traffic noise levels due to the proposed project are calculated to increase existing traffic noise levels by 0 to 1 dBA L_{eq} during the AM and PM peak traffic hours. Traffic

noise levels would not be substantially increased during off-peak hours when school related traffic is normally light (e.g., mid-morning, mid-afternoon, evening, and night). The daily average noise level increase attributable to the project would be less than 1 dBA DNL along roadways in the vicinity of the campus. Traffic noise increases resulting from the proposed project would not increase ambient noise levels by 3 dBA DNL or more and would not be considered substantial. This is a **less-than-significant** impact.

Mitigation Measure 1b: None required.

c. Temporary Noise Increases from Project Construction

Chapter 20.100.450 of the City's Municipal Code establishes allowable hours of construction within 500 feet of a residential unit between 7:00 am and 7:00 pm Monday through Friday unless permission is granted with a development permit or other planning approval. No construction activities are permitted on the weekends at sites within 500 feet of a residence. Policy EC-1.7 of the City's General Plan states that for large or complex projects within 500 feet of residential land uses or within 200 feet of commercial land uses or offices involving substantial noise-generating activities lasting more than 12 months, 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.

The significance of temporary noise increases resulting from construction depend upon the noise levels generated by various pieces of construction equipment, the timing and duration of noise-generating activities, the distance between construction noise sources and noise-sensitive areas, and the presence of intervening shielding features such as buildings or terrain. 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.

Construction activities would be carried out in stages. 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. Typical construction noise levels at a distance of 50 feet are shown in Tables 8 and 9. Table 8 shows the average noise level range by construction phase and Table 9 shows the maximum noise level range for different construction equipment. Table 9 levels are consistent with construction noise levels calculated for the project in the Federal Highway Administration (FHWA) Roadway Construction Noise Model (RCNM), including the anticipated equipment that would be used for each phase of the project. Most school demolition and construction noise is in the range of 78 to 89 dBA at a distance of 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.

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 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.

Project construction is scheduled to begin in May 2020 and is anticipated to finish by July 2021. The construction of the proposed project would involve demolition of existing structures and pavement, site preparation, grading and excavation, trenching, building erection, and paving. The hauling of excavated materials and construction materials would generate truck trips on local roadways as well. Table 10 shows the anticipated construction noise levels calculated for each phase of construction using the RCNM. Pile driving is not anticipated as a method of construction.

TABLE 10 Calculated Construction Noise Levels for Each Phase of Construction

Construction Phase	At Distance of 50 ft.	
	L_{eq}, dBA	**L_{max}, dBA**
Demolition (30 days)	85	90
Site Preparation (60 days)	83	85
Grading/Excavation (60 days)	84	85
Trenching (60 days)	78	81
Building-Exterior (240 days)	78	81
Building-Interior (90 days)	74	78
Paving (60 days)	80	80

Construction activities generate considerable amounts of noise, especially during earth-moving activities when heavy equipment is used. As indicated in Table 10, at 50 feet from the noise source, maximum instantaneous noise levels generated by project construction equipment are calculated to range from 78 to 90 dBA L_{max} and hourly average noise levels are calculated to range from 74 to 85 dBA L_{eq}.

Noise sensitive uses surrounding the site include residential buildings, located 20 feet west and north of the project site. Taking into account a 7 dBA noise reduction from the existing 7-foot high wall located along the shared property line, maximum noise levels of 91 dBA L_{max} during demolition and 79 to 85 dBA L_{max} during other phases of construction would be anticipated at a distance of 20 feet. Typical hourly average noise levels of 86 dBA L_{eq} during demolition and 75 to 85 dBA L_{eq} during other phases of construction are anticipated at 20 feet, taking into account the noise reduction provided by the existing wall. Construction noise levels would be lower as heavy construction moves away from shared property lines or into shielded locations. The nearest commercial use area is located 100 feet south of the project site. The northern façade of the commercial building would be exposed to a maximum noise level of 84 dBA L_{max} during demolition and 72 to 79 dBA L_{max} during other phases of construction. Typical hourly average noise levels of 79 dBA L_{eq} during demolition and 68 to 78 dBA L_{eq} during other phases of construction are anticipated at the commercial building.

Construction activities would occur within 500 feet of residential land use for a period exceeding 12 months. This is a **potentially significant** impact.

Mitigation Measure 1c: Implementation of the following *Best Construction Management Practices* would reduce construction noise levels emanating from the site, limit construction hours, and minimize disruption and annoyance.

Best Construction Management Practices

- Construction activities shall be limited to the hours between 7:00 am and 7:00 pm, Monday through Friday, unless permission is granted with a development permit or other planning approval. Construction is prohibited on weekends at sites located within 500 feet of residential units.

- 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. Construct temporary noise barriers to screen stationary noise-generating equipment when located near adjoining sensitive land uses. Temporary noise barriers could reduce construction noise levels by 5 dBA.

- 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.

- Utilize the best available noise suppression devices and techniques during construction activities, including "quiet" air compressors and other stationary noise sources where technology exists.

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

- Notify all adjacent business, residences, and other noise-sensitive land uses of the construction schedule, in writing, and provide a written schedule of "noisy" construction activities to the adjacent land uses and nearby residences.

- 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.

With the implementation of these best management practices and recognizing that noise generated by construction activities would occur over a temporary period, this would be a **less-than-significant** impact.

Impact 2: **Groundborne Vibration.** The proposed project will not result in excessive groundborne vibration at structures in the vicinity. **This is a less-than-significant impact.**

Policy EC-2.3 of the City of San José General Plan specifies a vibration limit of 0.2 in/sec PPV to minimize damage at buildings of normal conventional construction. A significant impact would be identified if project construction activity or project-related vehicle traffic would result in vibration levels of 0.2 in/sec PPV or greater at nearby structures. Project-related vehicle traffic is not anticipated to generate perceptible levels of groundborne vibration at nearby structures (vibration levels are anticipated to be below 0.01 in/sec PPV). Project construction equipment to be used on the project is anticipated to include backhoes/tractors, cranes, drill rigs, generator sets, welders, air compressors, areal lift, trucks, concrete pumpers and concrete mixer trucks, excavators, graders, rubber-tired dozers, fork lifts, pavers and rollers. Pile driving is not anticipated as part of the construction of the project.

Construction activities with the greatest potential of generating perceptible vibration levels would include the removal of pavement and soil, the movement of heavy tracked equipment, and vibratory compacting of roadway base materials by use of a roller. Table 11 summarizes typical vibration levels associated with varying pieces of construction equipment at a distance of 50 feet.

Table 11: Vibration Source Levels for Construction Equipment at Various Distances

Equipment		PPV at 25 ft. (in/sec)	PPV at 50 ft. (in/sec)
Clam shovel drop		0.202	0.094
Hydromill (slurry wall)	in soil	0.008	0.004
	in rock	0.017	0.008
Vibratory Roller		0.210	0.098
Hoe Ram		0.089	0.042
Large bulldozer		0.089	0.042
Caisson drilling		0.089	0.042
Loaded trucks		0.076	0.035
Jackhammer		0.035	0.016
Small bulldozer		0.003	0.001

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., April 2019.

The nearest residential structures are located as close as about 50 feet from heavy construction activities to the north and west of the project site. A review of the anticipated construction equipment and the vibration level data provided in Table 11 indicates that vibration levels generated by proposed activities and equipment would be below the 0.2 in/sec PPV criteria when

construction occurs at distances of 30 feet or greater from sensitive structures. Vibration levels generated by construction activities would be perceptible indoors when construction is located adjacent to structures and secondary vibration, such as a slight rattling of windows or doors, may be considered annoying at times. However, architectural damage to normal residential structures would not be anticipated and vibration levels would be below those anticipated to cause structural damage. In addition, construction would occur during daytime hours only, thus reducing the potential for residential annoyance during typical periods of rest or sleep. This is a **less-than-significant** impact.

Mitigation Measure 2: None Required.