HILLBROOK HIGH SCHOOL OPERANTIONAL NOISE AND VIBRATION ANALYSIS

San José, California

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INTRODUCTION

The Hillbrook School project proposes converting the Armory Building located at 240 North 2nd Street and the Moir Building located at 227 North 1st Street to a private secondary school (grades 9-12). The Moir Building would be used primarily for classrooms. The Armory Building will serve as classroom space for first year students, as well as the school's gymnasium and community gathering space. The Armory Building's large central floor will become the future home of Hillbrook's athletic program, and possibly a theater space. The upper floors will be used as art labs and classrooms. No exterior construction work is proposed at this time. Interior work would consist of minor construction and modifications to include new doors, lockers, gym, kitchen, common area/social space, classrooms, and administrative offices.

This report evaluates the project's potential to result in significant environmental noise or vibration impacts with respect to 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 and vibration-related policies in the City's General Plan; and, 3) the Impacts and Mitigation Measures Section describes the significance criteria used to evaluate operational impacts, provides a discussion of each project impact, and presents measures, where necessary, to mitigate the project's impact to a less-than-significant level.

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

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA)*. This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This *energy-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

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

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

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA 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 additional decibel increases the percentage of the population highly annoyed by about 3 percent. 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 is the Peak Particle Velocity (PPV) and another is the Root Mean Square (RMS) velocity. The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. The RMS velocity is defined as the average of the squared amplitude of the signal. The PPV and RMS vibration velocity amplitudes are used to evaluate human response to vibration. 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.

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. In high noise environments, that are more prevalent where groundborne vibration approaches perceptible levels, this rattling phenomenon may also be produced by loud airborne environmental noise causing induced vibration in exterior doors and windows.

Railroad and light rail operations are potential sources of substantial ground vibration depending on distance, the type and the speed of trains, and the type of railroad track. People's response to ground vibration has been correlated best with the RMS velocity level of the ground. The velocity of the ground is expressed on the decibel scale. The reference velocity is 1 x 10-6 in/sec RMS, that equals 0 VdB, and 1 in/sec equals 120 VdB. Although not a universally accepted notation, the abbreviation "VdB" is used in this document for vibration levels in decibels to reduce the potential for confusion with airborne sound levels in decibels.

Typical background vibration levels in residential areas are usually 50 VdB or lower, well below the threshold of perception for most humans (60 to 70 VdB). Perceptible vibration levels inside residences are attributed to the operation of heating and air conditioning systems, door slams and foot traffic. Table 3 illustrates some common sources of vibration and the association to human perception or the potential for structural damage. Construction activities, train operations, and heavy truck and bus traffic are some of the most common external sources of vibration that can be perceptible inside residences.

Groundborne vibration levels from heavy trucks and buses are not normally perceptible, especially if roadway surfaces are smooth. Buses and trucks typically generate groundborne vibration levels to about 63 VdB at a distance of 25 feet when traveling at a speed of 30 mph. Higher vibration levels can occur when buses or trucks travel at higher rates of speed or when the pavement is in poor condition. Vibration levels below 65 VdB are below the threshold of human perception.

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 that 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 Typical Levels of Groundborne Vibration

Human/Structural Response	Velocity Level, VdB	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 computer screen	90	
		Commuter rail, upper range
Residential annoyance, infrequent events	80	Rapid transit, upper range
Residential annoyance, occasional events		Commuter rail, typical Bus or truck over bump or on rough roads
Residential annoyance, frequent events	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: U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, September 2018, FTA Report No. 0123.

Regulatory Background – Noise

The State of California, Santa Clara County, and the City of San José 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 of California

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.

2019 California Building Cal Green Code. The State of California established exterior sound transmission control standards for new non-residential buildings as set forth in the 2019 California Green Building Standards Code (Section 5.507.4.1 and 5.507.4.2). 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, that establishes the acceptable interior noise level, is the method typically used when applying these standards.

2014 California Collaborative For High Performing Schools Acoustical Performance. The CCHP has established acoustical performance criteria for environmental noise from exterior sources for new construction modernizations.

General performance criteria for background noise: In Core Learning Spaces the Exterior-source background A-weighted noise levels shall be 45 dBA or less.

For an enhanced rating the following criteria shall be achieved:

a) In Core Learning Spaces and spaces designated as PAS or APS, exterior source background A-weighted noise levels shall be 35 dBA or less.
b) In Ancillary Learning Spaces and LAS, exterior-source background A-weighted noise levels shall be 40 dBA or less.

Santa Clara County

Santa Clara County Airport Land Use Commission Comprehensive Land Use Plan. The Comprehensive Land Use Plan (CLUP) adopted by the Santa Clara County Airport Land Use Commission contains standards for projects within the vicinity of Norman Y. Mineta San José International Airport that are relevant to this project:

4.3.2.1 Noise Compatibility Policies

N-1 The Community Noise Equivalent Level (CNEL) method of representing noise levels shall be used to determine if a specific land use is consistent with the CLUP.

N-2 In addition to the other policies herein, the Noise Compatibility Policies presented in Table 4-1 shall be used to determine if a specific land use is consistent with this CLUP.

N-3 Noise impacts shall be evaluated according to the Aircraft Noise Contours presented on Figure 5 (not shown in this report).

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

Table 4 - 1

NOISE COMPATIBILITY POLICIES

LAND USE CATEGORY	CNEL					
	55-60	60-65	65-70	70-75	75-80	80-85
Residential – low density Single-family, duplex, mobile homes	*	**	***	****	****	****
Residential – multi-family, condominiums, townhouses	*	**	***	****	****	****
Transient lodging - motels, hotels	*	*	**	****	****	****
Schools, libraries, indoor religious assemblies, hospitals, nursing homes	*	***	****	****	****	****
Auditoriums, concert halls, amphitheaters	*	***	***	****	****	****
Sports arena, outdoor spectator sports, parking	*	*	*	**	***	****
Playgrounds, neighborhood parks	*	*	***	****	****	****
Golf courses, riding stables, water recreation, cemeteries	*	*	*	**	***	****
Office buildings, business commercial and professional, retail	*	*	**	***	****	****
Industrial, manufacturing, utilities, agriculture	*	*	*	***	***	****
* Generally Acceptable	Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements. Mobile homes may not be acceptable in these areas. Some outdoor activities might be adversely affected.					
** Conditionally Acceptable	New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Outdoor activities may be adversely affected. Residential: Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.					
*** Generally Unacceptable	New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design. Outdoor activities are likely to be adversely affected.					
**** Unacceptable	New construction or development shall not be undertaken.					

Source: Based on General Plan Guidelines, Appendix C (2003), Figure 2 and Santa Clara County ALUC 1992 Land Use Plan, Table 1

Source: Comprehensive Land Use Plan Santa Clara County, Norman Y Mineta San José International Airport, May 25, 2011, Amended May 23, 2019.

City of San Jose

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 on people through noise reduction and suppression techniques, and through appropriate land use policies in the City of San José. The following policies are generally 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. Note: Schools are not specifically addressed in this policy, but are similarly sensitive.

Exterior Noise Levels

- The City's acceptable exterior noise level objective is 60 dBA DNL or less for residential and most institutional land uses (Table EC-1). The acceptable exterior noise level objective is established for the City, except in the environs of the San José International Airport and the Downtown, as described below:

    - For new multi-family residential projects and for the residential component of mixed-use development, use a standard of 60 dBA DNL in usable outdoor activity areas, excluding balconies and residential stoops and porches facing existing roadways. Some common use areas that meet the 60 dBA DNL exterior standard will be available to all residents. Use noise attenuation techniques such as shielding by buildings and structures for outdoor common use areas. On sites subject to aircraft overflights or adjacent to elevated roadways, use noise attenuation techniques to achieve the 60 dBA DNL standard for noise from sources other than aircraft and elevated roadway segments.

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-1.6 Regulate the effects of operational noise from existing and new industrial and commercial development on adjacent uses through noise standards in the City's Municipal Code.

EC-1.11 Require safe and compatible land uses within the Norman Y. Mineta San José International Airport noise zone (defined by the 65 CNEL contour as set forth in State law) and encourage aircraft operating procedures that minimize noise.

Regulatory Background – Vibration

Federal

The U.S. Department of Transportation (U.S. DOT) Federal Transit Administration (FTA) has developed rational vibration limits that can be used to evaluate human annoyance to groundborne vibration. These limits are summarized in Table 4. These criteria are primarily based on experience with passenger train operations, such as rapid transit and commuter rail systems. The main difference between passenger and freight operations is the time duration of individual events; a passenger train lasts a few seconds whereas a long freight train may last several minutes, depending on speed and length.

TABLE 4 Groundborne Vibration Impact Criteria

Land Use Category	Groundborne Vibration Impact Levels (VdB re 1 µinch/sec, RMS)		
	Frequent Events[1]	**Occasional Events[2]**	**Infrequent Events[3]**
Category 1 Buildings where vibration would interfere with interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]
Category 2 Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB
Category 3 Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB

Notes:
1. "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
2. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
3. "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research should always require detailed evaluation to define the acceptable vibration levels. Ensuring low vibration levels in a building requires special design of HVAC systems and stiffened floors.

Existing Noise Environment

The existing noise environment in the area consists primarily of local vehicular traffic, light rail train, and aircraft noise. On-site traffic counts indicate that there is slightly more traffic along N 2nd Street than along N 1st Street, resulting in marginally higher noise levels at the Armory Building than at the Moir Building. This part of downtown includes nearby public, residential, office, and restaurant buildings, and parks. Figure 1 shows an aerial image of the sites and vicinity, along with noise measurement locations.

A noise monitoring survey was performed to quantify and characterize ambient noise levels at the sites and in the project vicinity between Tuesday, December 13, 2022 and Thursday, December 15, 2022. The monitoring survey included two long-term noise measurements (LT-1 and LT-2) and two short-term measurements (ST-1 and ST-2), as shown in Figure 1.

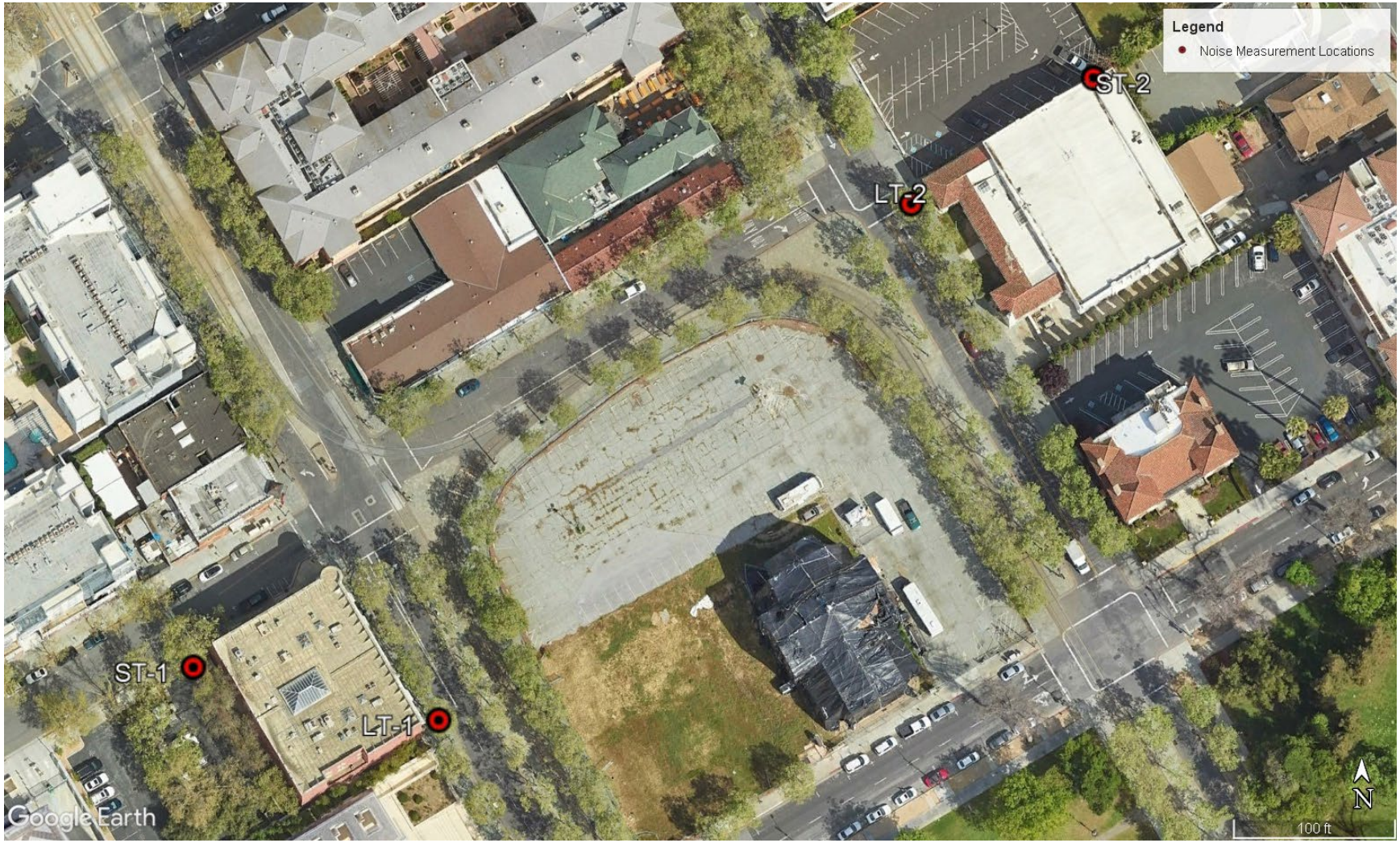
Long-term noise measurement LT-1 was made next to the Moir Building, approximately 15 feet from the centerline of N 1st Street. This location was selected to quantify noise levels at the building façade along N 1st Street. Hourly average noise levels at this location ranged from 62 to 69 dBA L_{eq} during the day and from 51 to 64 dBA L_{eq} at night. The day-night average noise level from Tuesday, December 13, 2022 through Thursday, December 15, 2022 was 68 dBA DNL. The daily trends in noise levels at LT-1 are shown in Appendix A.

Long-term noise measurement LT-2 was made next to the Armory Building, approximately 20 feet from the centerline of N 2nd Street. This location was selected to quantify noise levels at the building façade along N 2nd Street. Hourly average noise levels at this location ranged from 63 to 71 dBA L_{eq} during the day and from 52 to 66 dBA L_{eq} at night. The day-night average noise level from Tuesday, December 13, 2022 through Thursday, December 15, 2022 was 70 dBA DNL. The daily trends in noise levels at LT-2 are shown in Appendix A.

Short-term noise measurements ST-1 and ST-2 were conducted on Tuesday, December 13, 2022, in ten-minute intervals starting at 10:40 a.m. and concluding at 11:10 a.m. ST-1 was made on the west side of the Moir Building, approximately 25 feet from the centerline of Devine Street. This location was selected to quantify noise levels along the building façade adjacent to Devine Street. The 10-minute average noise level measured at this location was 59 dBA L_{eq}. During the noise measurement, thirteen vehicles passed by on Devine Street, producing maximum noise levels ranging from 57 to 70 dBA L_{max}. Fourteen vehicles passed by on N 1st Street, approximately 130 feet to the northeast, producing maximum noise levels ranging from 53 to 55 dBA L_{max}. A bus along N 1st Street produced a maximum noise level of 60 dBA L_{max}. Four light rail trains, approximately 165 feet to the northeast produced maximum noise levels ranging from 64 to 74 dBA L_{max}. Aircraft noise was not audible over the aforementioned noise sources.

ST-2 was made on the north side of the Armory Building, approximately 155 feet from the centerline of N 2nd Street and 255 or more feet from the light rail tracks. This location was selected to quantify noise levels at the rear of the Armory Building and backyard of the residence located at 253 N 3rd Street. The 10-minute average noise level measured at this location was 57 dBA L_{eq}. During the noise measurement, twenty-one vehicles passed by on N 2nd Street, producing maximum noise levels ranging from 51 to 61 dBA L_{max}. Two buses passed by on N 2nd Street

FIGURE 1 Noise Measurement Locations



Source: Google Earth, December 2022. Modified by Illingworth & Rodkin, Inc., December 2022

producing maximum noise levels ranging from 58 to 66 dBA L_{max}. A fire engine, without sirens, along N 2nd Street produced a maximum noise level of 67 dBA L_{max}. Two light rail trains along N 2nd Street produced maximum noise levels ranging from 63 to 69 dBA L_{max}, while one along N 1st Street produced a maximum noise level of 58 dBA L_{max}. Aircraft noise ranged from 58 to 65 dBA L_{max}. A summary of the short-term noise measurements is presented in Table 5.

TABLE 5 Summary of Short-Term Noise Measurement Data (dBA)

Noise Measurement Location	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	L_{eq}
ST-1: Approximately 25 feet from the centerline of Devine Street. (12/13/2022, 10:40 a.m. - 10:50 a.m.)	74	69	62	55	50	59
ST-2: Approximately 155 feet from the centerline of N 2nd Street. (12/13/2022, 11:00 a.m. - 11:10 a.m.)	69	67	60	52	48	57

PLAN CONSISTENCY ANALYSIS – NOISE/VIBRATION AND LAND USE COMPATIBILITY

Noise and Land Use Compatibility 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 "normally acceptable" exterior noise level is 60 dBA DNL or less for the proposed school use (Table EC-1) and "conditionally acceptable" exterior noise level is 60 – 75 dBA DNL.

- The California Green Building Code limits interior noise levels within new non-residential land uses to an hourly equivalent noise level ($L_{eq\,(1\text{-}hr)}$) of 50 dBA in occupied areas during any hour of operation.

- The CCHP has established acoustical performance criteria for environmental noise from exterior sources for new construction modernizations:

  General performance criteria for background noise:
  In Core Learning Spaces the Exterior-source background A-weighted noise level shall be 45 dBA or less.

  For an enhanced rating the following criteria shall be achieved:
  a) In Core Learning Spaces and spaces designated as PAS or APS, exterior source background A-weighted noise levels shall be 35 dBA or less.

b) In Ancillary Learning Spaces and LAS, exterior-source background A-weighted noise levels shall be 40 dBA or less.

Noise and Land Use Compatibility

The project does not include outdoor activity that would be sensitive to noise. All noise sensitive uses would be located inside the buildings. The Moir Building would be used primarily for classrooms. The Armory Building will serve as classroom space for first year students, as well as the school's gymnasium and community gathering space. The Armory Building's large central floor will become the future home of Hillbrook's athletic program, and possibly a theater space. The upper floors will be used as art labs and classrooms.

The existing noise exposure for the Moir Building on 1st Street, located about 25 feet from the roadway centerline, is calculated to be 66 dBA DNL. The existing noise exposure for the Armory Building on 2nd Street, located about 30 feet from the roadway centerline, is calculated to be 68 dBA DNL. These facades have the highest noise exposure. The future noise environment at the project site would continue to result primarily from local vehicular traffic and light rail trains. Traffic data was gathered for the proposed project by *Hexagon Transportation Consultants, Inc*. According to this traffic data, the future background plus project conditions are expected to increase traffic noise levels by 1-2 dBA DNL along N. 1st Street and by 2-3 dBA DNL along N. 2nd Street. Noise from light rail trains is not expected to change. To estimate the future noise environment at the project site, the contribution due to the increase in noise levels due to increased traffic volumes is applied to the results of the existing measurements described above. The future overall noise exposure level is projected to be up to 68 dBA DNL at the Moir Building and 70 dBA DNL at the Armory Building. The noise environment at the project is, therefore, in the "conditionally acceptable" category as described in the General Plan. Given that there are no outdoor activities, the conditionally acceptable designation is satisfactory provided that the buildings provide adequate sound insulation.

Noise measurements were made simultaneously inside and outside the Moir Building on Wednesday, December 21, 2022, to determine the sound insulation provided by the façade facing N. 1st Street. Measurements were made on the first and second floors located at the Devine Street corner. These rooms were determined by observation to represent the "worst case" conditions at the project. The measured outdoor to indoor noise reduction was 26-27 dBA L_{eq}. The rooms are currently bare. The acoustical absorption that will be provided by room furnishings and occupants would increase the noise reduction by about 3 dBA, to 29-30 dBA $L_{eq.}$ Future hourly average noise levels during the daytime hours when the school will be occupied are projected to range from 65 – 67 dBA L_{eq}. Interior noise levels are projected to range from 35 – 38 dBA $L_{eq.}$ Noise levels would meet the general performance criteria for High Performance Schools and approach the threshold for an enhanced rating. Noise levels would be substantially below the 50 dBA L_{eq} threshold set forth in the California Green Building Code. The environmental noise would be below the general thresholds for speech interference (45 dBA for continuous noise and 55 dBA for fluctuating noise). Existing sound insulation is, therefore, adequate to meet the thresholds established by the General Plan and other agencies.

Vibration and Land Use Compatibility

VTA light rail lines are located along 1st and 2nd Streets adjoining the project's buildings. Pursuant to the Federal Transit Agency guidance, the vibration impact criterion for frequent light rail trains upon the proposed school is 75 VdB (See Table 4).

Vibration levels produced by VTA light-rail trains in downtown San Jose were measured by Illingworth and Rodkin, Inc. in 2018[1]. Conditions at this measurement location are representative of the conditions observed at the project site. The measurements were made 60 feet from the track. The Moir Building is located about 55 feet from the nearest track along 1st Street and the Armory Building is located about 57 feet from the nearest track along 2nd Street. Vibration levels from six trains were measured ranging from 59 VdB to 64 VdB. Vibration levels are below the FTA threshold and compatible with the proposed school.

NOISE IMPACTS AND MITIGATION MEASURES

Significance Criteria

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

- A significant permanent noise level increase would occur if project-generated traffic or operations 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 DNL or greater, with a future noise level of less than 60 dBA DNL, or b) the noise level increase is 3 dBA DNL or greater, with a future noise level of 60 dBA DNL or greater.

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

Impact 1: **Substantial Permanent Noise Increase.** Project-generated traffic and school activities would not cause a permanent noise level increases at existing noise-sensitive land uses in the project vicinity. **This is a less-than-significant impact.**

A significant noise impact would occur if traffic or activities generated by the project would substantially increase noise levels at sensitive receptors in the project vicinity. A substantial increase would occur if: a) the noise level increase is 5 dBA DNL or greater, with a future noise level of less than 60 dBA DNL, or b) the noise level increase is 3 dBA DNL or greater, with a future noise level of 60 dBA DNL or greater.

The project's trip generation data was reviewed to determine the change in traffic noise levels along roadways serving the site due to the proposed project. The project would result in 423 new trips per day, with 129 new trips in the AM peak hour and 37 new trips in the PM peak hour. The remaining trips would be distributed throughout the school day, and project trips would not be expected outside of school hours. This small increase in daily/hourly trips would not measurably

1 27 South First Street Noise and Vibration Assessment, Illingworth & Rodkin, Inc., December 14, 2018.

increase traffic noise levels in the project vicinity. Noise from vehicles utilizing the parking areas would be similar to existing conditions considering that there are no physical changes proposed by the project to the existing lots.

Exterior recreation areas are not proposed by the project. The only potential sounds outdoors would occur during lunch when students may congregate outside. Normal conversations would be expected during lunch. Given the limited activity occurring outside, audible sounds produced by lunchtime conversations would not be expected to measurably contribute to the ambient noise environment in the area produced by transportation noise sources.

The permanent noise level increase due vehicle traffic, parking, and lunchtime activities would be less than 1 dBA DNL. The ambient noise environment in the area exceeds 60 dBA DNL, therefore, the proposed project would not cause a substantial permanent noise level increase at sensitive receptors in the project vicinity (i.e., 3 dBA DNL or greater) resulting in a less-than-significant impact.

Mitigation Measure 1: **None required.**

Impact 2: **Excessive Aircraft Noise.** The project sites are located approximately 1.5 miles from Norman Y. Mineta San José International Airport, and the noise environment attributable to aircraft is considered acceptable under the Santa Clara County ALUC noise compatibility policies. This is a **less-than-significant** impact.

Norman Y. Mineta San José International Airport is a public-use airport located approximately 1.5 miles northwest of the project sites. According to the City's Airport Master Plan Environmental Impact Report,[2] the project sites lie just outside the 60 dBA CNEL/DNL contour line (see Figure 2). According to Policy EC-1.11 of the City's General Plan, the required safe and compatible threshold for exterior noise levels would be at or below 65 dBA CNEL/DNL for aircraft. Therefore, the proposed project would be compatible with the City's exterior noise standards for aircraft noise. Interior noise levels due to aircraft would be 45 dBA DNL or less assuming existing construction materials and methods. This is a less-than-significant impact.

Mitigation Measure 2: **None required.**

[2] David J. Powers & Associates, Inc., Integrated Final Environmental Impact Report, Amendment to Norman Y. Mineta San Jose International Airport Master Plan, April 2020.

FIGURE 2 2037 CNEL Noise Contours for SJIA Relative to Project Site

Figure 5
Scenario 2: With Project 2037 Noise Contour Map

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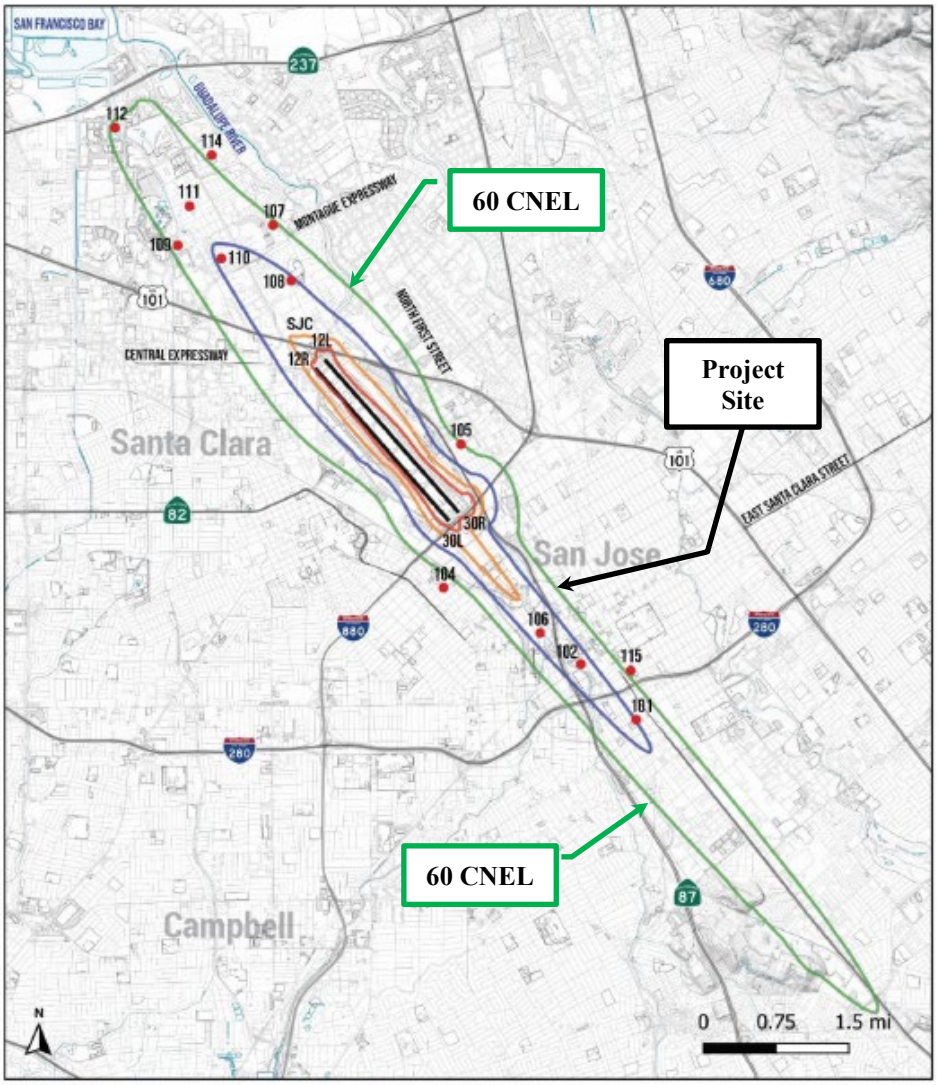

Source: BridgeNet International 2019

APPENDIX A: Daily Trend in Long Term Noise Levels at LT-1 and LT-2