

Appendix D:
Noise and Vibration Assessment

***TAMIEN STATION TRANSIT-ORIENTED
DEVELOPMENT REZONING PROJECT
NOISE AND VIBRATION ASSESSMENT***

SAN JOSÉ, CALIFORNIA

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INTRODUCTION

The 6.96-acre project site is located on the west side of Lick Avenue, adjacent to Tamien Light Rail/Caltrain Station and State Route 87, in San José. The project site is currently used as a park and ride lot serving both a VTA light rail and Caltrain commuter rail station. The property also contains a child care center. Single and multi-family residential uses are located across Lick Avenue from the project site.

The project proposes to construct three buildings (Affordable Housing, Market Rate Phase I, Market Rate Phase II) to provide 569 residential units and 3,000 square feet of either child care or commercial space. The Affordable Housing residential building would contain 135 housing units. This building would also contain either commercial space or a child care center, up to 3,000 square feet in size. The two remaining buildings (Market Rate Phase I and Market Rate Phase II) would contain a total of 434 market rate residential units. Access to the project would be provided from two driveway entrances on Lick Avenue. Residential vehicular access would be facilitated on a new interior loop road, connecting from two driveway entrances on Lick Avenue.

Parking would be provided to future residents and VTA users in a ground floor and sub-grade garages associated with each building. The Affordable Housing building would provide a total of 175 spaces, with 17 spaces reserved for commercial/child care and VTA parking. The Market Rate Phase I building would provide a total of 295 spaces, with 78 spaces reserved for VTA parking. The Market Rate Phase II building would provide a total of 274 spaces, with 57 spaces reserved for VTA parking. The total parking to be provided in all buildings would be 744 spaces.

The Setting section of this report presents the fundamentals of environmental noise and vibration, a discussion of policies and standards applicable to the project, and the results of ambient noise and vibration monitoring surveys made at the project site. The compatibility of the proposed uses with the noise and vibration environment at the site is also evaluated for consistency with policies set forth in The Envision San José 2040 General Plan. The Impacts and Mitigation Measures section of the report provides an evaluation of the potential significance of project-related noise and vibration impacts, and where necessary, mitigation to reduce impacts to a less-than-significant level.

Appendix 1 provides a graphical summary of the long-term noise measurement data. The compatibility of the proposed affordable housing component with environmental noise at the site is evaluated with respect to guidelines established by the U.S. Department of Housing and Urban Development (HUD) in Appendix 2.

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (*frequency*) of the

vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

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

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

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

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

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA 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 or frequent intermittent vibration levels produce. The guidelines in Table 3 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

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

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

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

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

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 from rail vehicles has been correlated best with the average, root mean square (RMS) velocity of the ground. The velocity of the ground is expressed on the decibel scale. The reference velocity is 1×10^{-6} in/sec RMS, which 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 decibels to reduce the potential for confusion with sound decibels.

Typical background vibration levels in residential areas are usually 50 VdB or lower, well below the threshold of perception for most humans. 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 4 illustrates some common sources of vibration and the association to human perception or the potential for structural damage.

TABLE 1 Definition of Acoustical Terms Used in this Report

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

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

TABLE 2 Typical Noise Levels in the Environment

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110 dBA	Rock band
Jet fly-over at 1,000 feet		
	100 dBA	
Gas lawn mower at 3 feet		
	90 dBA	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80 dBA	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	70 dBA	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60 dBA	
		Large business office
Quiet urban daytime	50 dBA	Dishwasher in next room
Quiet urban nighttime	40 dBA	Theater, large conference room
Quiet suburban nighttime		
	30 dBA	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20 dBA	
	10 dBA	Broadcast/recording studio
	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	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, 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: Transit Noise and Vibration Impact Assessment Manual, US Department of Transportation Federal Transit Administration, September 2018.

Regulatory Criteria - Noise

The State of California and the City of San José have established plans and policies designed to limit noise exposure at noise sensitive land uses. These plans and policies are contained in the following documents: (1) the State California Environmental Quality Act (CEQA) Guidelines, Appendix G, and (2) the City of San José Noise Element of the General Plan.

State CEQA Guidelines. The CEQA contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. CEQA asks the following applicable questions. Would the project result in:

- (a) Exposure of persons to or generation of noise levels in excess of standards established in the local General Plan or Noise Ordinance, or applicable standards of other agencies?
- (b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?
- (c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?
- (d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?
- (e) For a project located within 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, exposure of people residing or working in the project area to excessive noise levels?
- (f) For a project within the vicinity of a private airstrip, exposure of people residing or working in the project area to excessive noise levels?

Of these guidelines, items (a), (b), (c), and (d), and (e) are applicable to the proposed project. Guideline (f) is not applicable because the project is not located in the vicinity of any private airstrips.

City of San José General Plan. The Environmental Leadership Chapter in The Envision San José 2040 General Plan sets forth policies related to noise and vibration control 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 (Table EC-1). For single-family residential uses, use a standard of 60 dBA DNL for exterior noise in private usable outdoor activity areas, such as backyards.
 - 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.
 - For single family residential uses, use a standard of 60 dBA DNL for exterior noise in private usable outdoor activity areas, such as backyards.

Table EC-1 establishes that residential uses are considered “normally acceptable” where exterior noise exposures are 60 dBA DNL or less. Where the exterior noise exposure is between 60 dBA and 75 dBA DNL residential uses are considered “conditionally acceptable” such that the “specified land use may be permitted only after detailed analysis of the noise reduction requirements and needed noise insulation features included in the design.” Residential uses are considered “unacceptable” in noise environments exceeding 75 dBA DNL 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-1.7 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-1.7 Require noise studies for land use proposals where known or suspected loud intermittent noise sources occur which may impact adjacent existing or planned land uses. For new residential development affected by noise from heavy rail, light rail, BART, or other single-event noise sources, implement mitigation so that recurring maximum instantaneous noise levels do not exceed 50 dBA L_{max} in bedrooms and 55 dBA L_{max} in other rooms.

EC-2.1 Near light and heavy rail lines or other sources of groundborne vibration, minimize vibration impact on people, residences, and businesses through the use of setbacks and/or structural design features that reduce vibration to levels at or below the guidelines of the Federal Transit Administration. Require new development within 100 feet of rail lines to demonstrate prior to project approval that vibration experienced by residents and vibration sensitive uses would not exceed these guidelines.

EC-2.3 Require new development to minimize vibration impacts to adjacent uses during demolition and construction. For sensitive historic structures, a vibration limit of 0.08 in/sec PPV will be used to minimize the potential for cosmetic damage to a building. 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.

Regulatory Criteria – Vibration

The City of San José has not identified quantifiable vibration limits that can be used to evaluate the compatibility of land uses with vibration levels experienced at a project site. Although there are no local standards that control the allowable vibration in a new residential development, the U.S. Department of Transportation (DOT) has developed vibration impact assessment criteria for evaluating vibration impacts associated with transit projects.¹ The Federal Transit Administration (FTA) has proposed vibration impact criteria based on maximum overall levels

¹U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment, May 2006, FTA-VA-90-1003-06.

for a single event. The impact criteria for groundborne vibration are shown in Table 5. Note that there are criteria for frequent events (more than 70 events of the same source per day), occasional events (30 to 70 vibration events of the same source per day), and infrequent events (less than 30 vibration events of the same source per day).

TABLE 5 Groundborne Vibration Impact Criteria

Land Use Category	Groundborne Vibration Impact Levels (VdB re 1 μ inch/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.

Source: Transit Noise and Vibration Impact Assessment Manual, US Department of Transportation Federal Transit Administration, September 2018.

Existing Noise Environment

The project site is located east of Highway 87 and the Tamien Transit Station and west of Lick Avenue in San Jose, California. Residential uses bound the project site to the north, south and east. The existing noise environment at the site and in the vicinity results primarily from traffic on Highway 87, Lick Avenue and passenger train activity associated with the nearby Tamien Transit Station, and UPRR freight train operations. Intermittent noise from aircraft over flights also contributes to the ambient noise environment.

A noise monitoring survey was conducted between July 15, 2015 and July 17, 2015 to document existing noise conditions at the project site and surrounding areas. The noise monitoring survey included two long-term noise measurements (LT-1 and LT-2) and two short-term measurements (ST-1 and ST-2). Noise measurements locations are shown in Figure 1.

Long-term noise measurement LT-1 was located at the east boundary of the project site approximately 40 feet from the center of Lick Avenue and about 12 feet above the ground. Noise levels measured at this site were primarily the result of traffic on Lick Avenue, intermittent noise from train operations, and distant Highway 87 traffic noise. Hourly average noise levels typically ranged from 61 to 67 dBA L_{eq} during the day and from 56 to 67 dBA L_{eq} at night. The calculated day-night average noise level at this location was 70 dBA DNL.

Long-term noise measurement LT-2 was located at the western boundary of the project site, adjacent to Tamien Transit Station, and approximately 100 feet from the nearest rail line. The microphone was positioned about 12 feet above the ground. Noise levels measured at this site were primarily the result of Highway 87 traffic, train operations and intermittent noise from aircraft over flights. Hourly average noise levels typically ranged from 59 to 67 dBA L_{eq} during the day and 56 to 67 dBA L_{eq} at night. The calculated day-night average noise level at this location was 71 dBA DNL. Appendix 1 summarizes the data collected at the two long-term measurement sites.

Two attended short-term noise measurements were made to complete the July 2015 noise monitoring survey. Short-term noise measurement ST-1 was approximately 130 feet from Tamien Station. The ten-minute average noise level during the mid-day was 65 dBA L_{eq} . Short-term noise measurement ST-2 was approximately 180 feet from Tamien Station. The ten-minute average noise level was 60 dBA L_{eq} . Table 6 summarizes the results of these measurements.

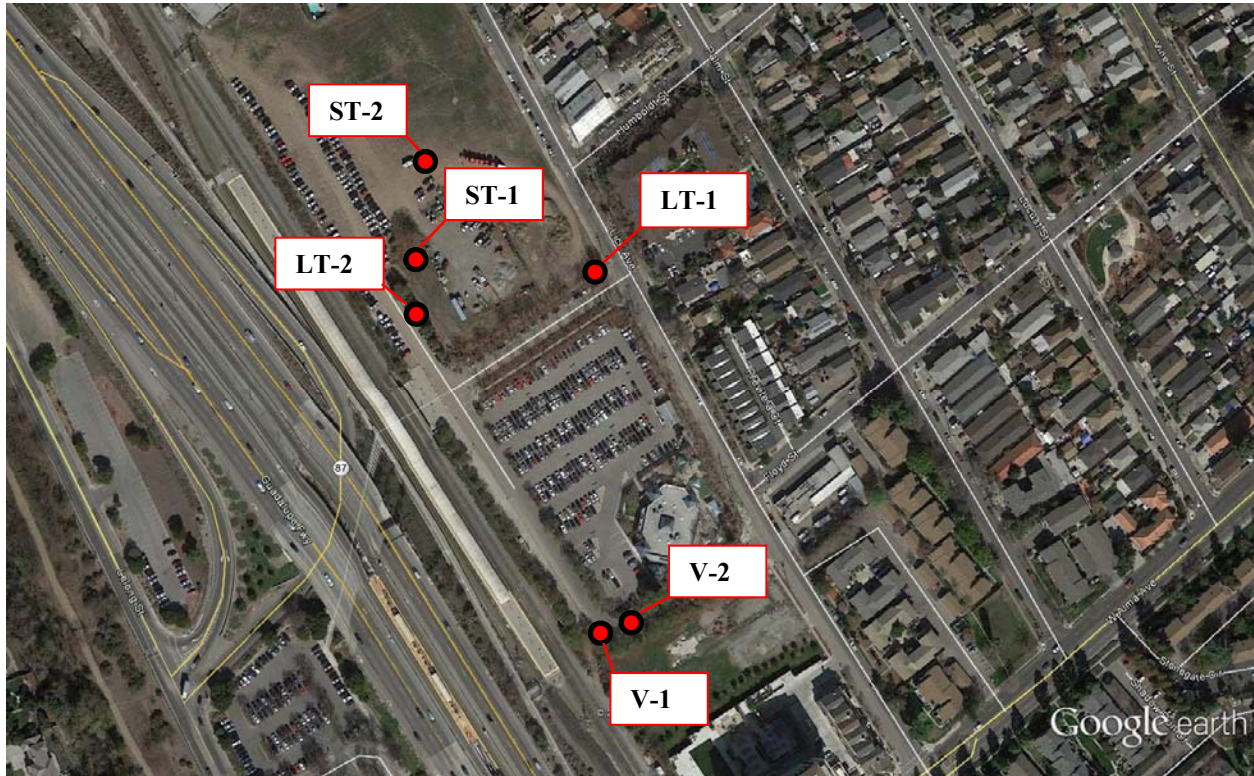
TABLE 6 Summary of Short-Term Noise Measurement Data

Noise Measurement Location	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	L_{eq}	DNL
ST-1: ~130 feet from Tamien Station. (7/17/2015, 10:10 a.m. -10:20 a.m.)	73	72	69	63	57	65	68
ST-2: ~180 feet from Tamien Station. (7/17/2015, 10:30 a.m. -10:40 a.m.)	72	70	61	58	56	60	65

Note: DNL at the short-term site approximated by correlating the noise data to noise data collected at the long-term site during a corresponding time period.

The existing traffic data in 2015 were compared to the existing traffic data in 2018 to confirm that the baseline for the project has not changed substantially. The comparison of these data shows that traffic noise levels are generally plus or minus 1 dBA of the levels measured in 2015 and have not changed substantially during the three-year period. Therefore, the 2015 measured noise conditions continue to represent existing noise conditions in 2018.

FIGURE 1 Noise and Vibration Measurement Locations



Existing Vibration Environment

Groundborne vibration at the site results from railroad train passbys. Vibration measurements of railroad trains were made on Friday, July 17, 2015 at two locations (V-1 and V-2) approximately 65 feet and 95 feet from the nearest railroad tracks, representing the westernmost boundaries of the nearest residential units proposed by the project. The locations of these measurements are shown in Figure 1. The instrumentation used to make the vibration measurements included a Tascam Solid State Audio Recorder and seismic grade, low noise accelerometers firmly fixed to the ground. This system is capable of accurately measuring very low vibration levels. Vibration levels measured on the site are representative of vibration levels at ground level (i.e. vibration levels that would enter the building foundation).

Observations and measurements were made by I&R staff between 8:00 am and 12:00 pm on July 17, 2015. During this time period, five passenger trains passed the site. Passenger trains consisted of Ace, Caltrain and Amtrak trains. No freight trains were observed during the monitoring period.

Vibration data were obtained during five passenger train passbys (one Amtrak, two ACE, and two Caltrains) to get a representative sample of vibration levels at the site. At the 65 foot location, ACE, Caltrain and Amtrak passbys resulted in maximum overall vibration levels ranging from 63 to 65 VdB due to the slow travel speed of trains near the Tamien Train Station. At the 95 foot location, vibration levels from the passenger trains ranged from 58 to 61 VdB. Vibration levels measured at approximately 65 and 95 feet from the UPRR fall below the FTA's

72 VdB “frequent events” criteria for a general vibration assessment and below the FTA’s criteria for conducting a detailed vibration analysis.

GENERAL PLAN CONSISTENCY ANALYSIS

Environmental Leadership Chapter in the Envision San José 2040 General Plan

The proposed project would include noise sensitive land uses located along major transportation corridors that include State Route 87, a commuter/freight railroad and light-rail corridor, and aircraft departing and arriving at Norman Y. Mineta San José International Airport. Proposed residential land uses may also be sensitive to groundborne vibration from heavy-rail and light-rail trains.

Noise from Ground Transportation

Future Exterior Noise Environment

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 standard is 60 dBA DNL or less for the proposed residential use.
- The City’s standard for interior noise at the proposed residential use is 45 dBA DNL.

The future noise environment at the project site will continue to result primarily from vehicular traffic along Highway 87, Lick Avenue, railroad operations along the UPRR and Tamien Station, and intermittent aircraft over flights. Future transportation-related noise levels at the project site were calculated based on adjustments made to existing noise level data assuming future increased traffic along area roadways and the railroad. Noise levels throughout the project site would exceed the City of San José’s “satisfactory” noise and land use compatibility goal of 60 dBA DNL but would vary depending upon the proximity of receptors to area roadways and the presence of shielding features (e.g., proposed buildings) located between the receptors and the noise source.

The California High Speed Train (HST) San José to Merced Section is proposed to pass through the City of San José and Tamien Station. The HST is currently planned to operate on an elevated structure along the existing rail right-of-way as described in the Bay Area to Central Valley High-Speed Train Partially Revised Final Program EIR (August 2012).

Representative noise and vibration data for the proposed California High Speed Rail Project were obtained from various sources, including data from published environmental documents that have studied the project and data provided by the California High Speed Rail Authority, most of which appears to have been based upon the U.S. DOT High Speed Ground

Transportation Noise and Vibration Impact Assessment. Noise and vibration studies and EIRs that were utilized in this assessment were programmatic, as specific development plans for the HST have not been finalized.

For the purpose of this analysis, credible worst case assumptions were made regarding the speed, frequency, location of right-of-way, and other factors. This analysis assumes that trains will travel on an aerial platform (approximately 24 feet above grade) past the site at maximum speeds of 125 mph or less. The average train frequency on a given alignment segment would be approximately 10 trains per hour per direction, although the frequency of passbys would vary throughout the day.

Using data from the California HST Program EIR/EIS, day-night average noise levels are anticipated to range from 60 - 70 dBA DNL at the western boundary of the site, and maximum noise levels generated by a passing HST are anticipated to reach approximately 75 to 80 dBA L_{max} . The HST would make an incremental contribution to the total noise level of up to 3 dBA DNL, and maximum noise levels from trains passing by would be below the noise levels generated by trains utilizing the existing corridor. However, there are other considerations. If the HST is placed on an aerial structure, as currently planned, noise mitigation would need to be incorporated into the HST project design.

Traffic noise levels along Lick Avenue are calculated to increase by 1 dBA DNL, and day-night average noise levels from Lick Avenue traffic are calculated to reach 71 dBA DNL at the proposed setback of residential land uses nearest the roadway. The future exterior noise environment at residential land uses proposed adjacent to the UPRR, Tamien Station, and Highway 87 would continue to result from traffic noise and train activity occurring adjacent to the site. Future day-night average noise levels are calculated to reach 74 dBA DNL at the proposed setback of residential land uses nearest the rail lines and Highway 87.

The Illustrative Site Plan (Figure 2) for the project shows common outdoor uses areas would be located in courtyards at the podium levels of each building. The Market Rate buildings would completely enclose the courtyards and reduce the noise from ground transportation sources in the courtyards to below 55 dBA DNL. The Affordable building would include a north facing opening to the courtyard. The building would provide about 10 dBA of attenuation in the main areas of the courtyard where frequent use would be expected, reducing the noise level to about 60 dBA DNL. The design of the project results in compatible noise levels in proposed common outdoor areas.

FIGURE 2 Illustrative Site Plan



Future Interior Noise Environment

Residential buildings throughout the project site will be exposed to future noise levels greater than 60 dBA DNL with the highest future noise exposures occurring nearest Lick Avenue, Highway 87 and the Tamien Station. Unshielded residential facades nearest these transportation related noise sources would be exposed to exterior noise levels up to 74 dBA DNL. Interior noise levels within new residential units are required to be maintained at or below 45 dBA DNL. Interior noise levels will vary depending on the design of the buildings (relative window area to wall area) and construction materials and methods. Standard residential construction provides approximately 15 dBA of exterior to interior noise reduction assuming the windows are partially open for ventilation. Standard construction with the windows closed provides approximately 20 to 25 dBA of noise reduction in interior spaces.

In exterior noise environments ranging from 60 dBA DNL to 65 dBA DNL, interior noise levels can typically be maintained below City and State standards with the incorporation of an adequate forced air mechanical ventilation system in each residential unit. In noise environments of 65 dBA DNL or greater, a combination of forced-air mechanical ventilation and sound-rated construction methods is often required to meet the interior noise level limit.

Attaining the necessary noise reduction from exterior to interior spaces is readily achievable in noise environments less than 75 dBA DNL with proper wall construction techniques, the

selections of proper windows and doors, and the incorporation of forced-air mechanical ventilation systems.

The following measures should be considered in the project design to maintain exterior noise levels at or below 60 dBA DNL and interior noise levels at or below 45 dBA DNL:

- Common outdoor uses areas should be located in shielded courtyards as proposed to maximize the acoustical shielding of transportation noise sources by the apartment buildings themselves.
- Project-specific acoustical analyses are required to confirm that interior noise levels will be reduced to 45 dBA DNL or lower. Provide sound rated windows and doors to maintain noise levels at acceptable levels. Preliminary calculations indicate that sound-rated windows and doors with a sound transmission class rating of STC 32 to 35 would be sufficient to control noise and achieve the 45 dBA DNL interior noise standard at residential facades with line-of-sight to Lick Avenue, Highway 87, and Tamien Station. The specific determination of what noise insulation treatments are necessary will be conducted on a unit-by-unit basis. Results of the analysis, including the description of the necessary noise control treatments, will be submitted to the City along with the building plans and approved prior to issuance of a building permit.
- If the HST is placed on an aerial structure, noise mitigation would need to be incorporated into the HST project design. The City of San José should continue to coordinate with the California High Speed Rail Authority to ensure that HST incorporates appropriate mitigation measures.
- Building sound insulation requirements would need to include the provision of forced-air mechanical ventilation for units throughout the site, so that windows could be kept closed at the occupant's discretion to control noise.

The implementation of a combination of these feasible mitigations would reduce the impact to a less-than-significant level.

Noise from Aircraft

The Santa Clara County ALUC establishes 65 dBA CNEL as the maximum allowable noise level considered compatible with residential uses. Future noise levels expected from aircraft are best represented by the 2027 CNEL Contours noise exposure map published as part of the Airport Master Plan shown on Figure 3. The project site is located just outside the 60 CNEL noise contour where the noise level would be at or below 60 CNEL and would be considered compatible with respect to the ALUC guidelines.

The buildings would not shield the courtyards from aircraft noise. Overall noise levels resulting from ground transportation and aircraft would be about 60 dBA DNL in the common outdoor areas in the Market Rate buildings, and within the range from 60 to 65 dBA DNL in the common outdoor area in the Affordable building.

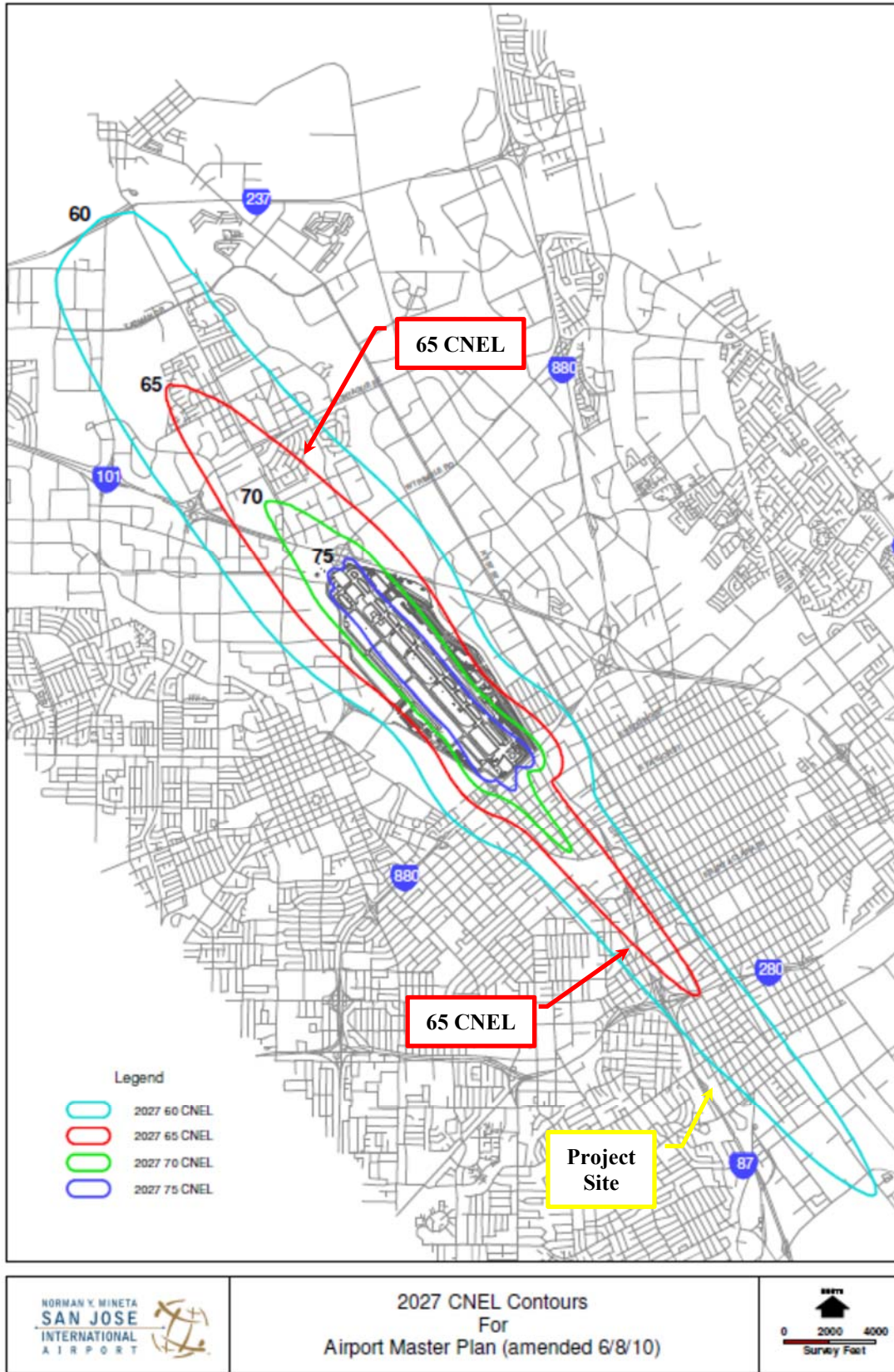
Groundborne Vibration from Trains

Based on observations made at the project site during noise and vibration measurements and future anticipated HST activity, it is likely that train activity at the Tamien Station would reach 70 trains per day. Many of these trains pass during evening and nighttime hours when people are normally at rest. Future conventional and HST train activity would be considered “frequent” with respect to the FTA vibration impact criteria. The 72 VdB limit is used in the evaluation of the project with respect to vibration compatibility. Residential units proposed by the project would be located a minimum of 65 feet from the conventional railroad tracks and would be exposed to vibration levels of about 58 to 65 VdB. Residential land uses would not be exposed to vibration levels greater than the 72 VdB vibration limit for “frequent events” and the impact is less-than-significant.

Using data from the California HST Program EIR/EIS, the vibration level at a distance of 200 feet from the tracks resulting from a train traveling at-grade at 125 mph would be about 70 VdB, increasing to about 75 VdB at a speed of 200 mph. Where speeds are expected to be low, the vibration is confined to within 100 feet of the track. The impact threshold is 72 VdB, so the threshold could be exceeded at the higher travel speed. Utilizing appropriate adjustment factors, vibration levels can be adjusted up or down based on known conditions. An adjustment of 10 VdB is subtracted from the reference level for a train traveling on an aerial platform. If the design option for an aerial structure is selected, projected vibration levels at proposed residences would be below the recommended threshold.

If the HST is placed at-grade and train speeds exceed 125 mph opposite the site, vibration mitigation would need to be incorporated into the HST project design. Consistent with General Plan Policy EC-2.1, new development within 100 feet of high speed rail line must demonstrate that vibration experienced by residents and vibration-sensitive uses would not exceed FTA guidelines. The City of San José should continue to coordinate with the California High Speed Rail Authority to ensure that HST incorporates appropriate mitigation measures.

FIGURE 3 65 CNEL Noise Contour for SJIA (2027) Relative to Project Site



NOISE IMPACTS AND MITIGATION MEASURES

Significance Criteria

Paraphrasing from Appendix G of the CEQA Guidelines, a project would normally result in significant noise impacts if noise levels generated by the project conflict with adopted environmental standards or plans, if the project would generate excessive groundborne vibration levels, or if ambient noise levels at sensitive receivers would be substantially increased over a permanent, temporary, or periodic basis. The following criteria were used to evaluate the significance of environmental noise resulting from the project:

- **Noise Levels in Excess of Standards:** A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the General Plan or Municipal Code.
- **Groundborne Vibration from Construction:** A significant impact would be identified if the construction of the project would expose persons to excessive vibration levels. Groundborne vibration levels exceeding 0.08 in/sec PPV would have the potential to result in cosmetic damage to historic buildings, and groundborne vibration levels exceeding 0.2 in/sec PPV would have the potential to result in cosmetic damage to normal buildings.
- **Project-Generated Traffic Noise Increases:** A significant impact would be identified if traffic generated by the project would substantially increase noise levels at sensitive receivers in the vicinity. A substantial increase would occur if: a) the noise level increase is 5 dBA 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.
- **Construction Noise:** A significant noise impact would be identified if construction-related noise would temporarily increase ambient noise levels at sensitive receptors. Hourly average noise levels exceeding 60 dBA L_{eq} , and the ambient by at least 5 dBA L_{eq} , for a period of more than one year would constitute a significant temporary noise increase at adjacent residential land uses. Where noise from construction activities exceeds 70 dBA L_{eq} and the ambient noise environment by at least 5 dBA L_{eq} at commercial land uses in the project vicinity for a period exceeding one year, the impact would be considered significant.

Impact 1: Noise Levels in Excess of Standards. The proposed project could generate noise in excess of standards established in the City's General Plan and Municipal Code at the nearby sensitive receptors. **This is a potentially significant impact.**

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.

Construction activities will occur only during the allowable hours and project construction would be carried out in staggered phases. Construction of the proposed building would take less than 12 months. Most construction activities would occur within 500 feet of residential land use. This would be a **less-than-significant** impact. Short-term noise increases due to construction are discussed further in Impact 4.

Residential mixed-use buildings typically require various mechanical equipment, such as air conditioners, exhaust fans, and air handling equipment for ventilation of the buildings. The site plan does not provide details pertaining to mechanical equipment expected at the proposed residential buildings. Typically, mechanical equipment, such as air conditioning units, are located on the rooftops of apartment buildings or on the ground level surrounding the structures of condo-type units. Without knowing specific information such as the number and types of units, size, enclosure specifications, source noise levels, and precise locations, the impact of mechanical equipment noise on nearby noise-sensitive uses cannot be assessed at this time.

Residential land uses are located to the north, east, and south. Design planning should consider the noise criteria associated with mechanical equipment and utilize site planning to locate equipment in less noise-sensitive areas, such as the rooftop away from the edge of the building nearest to these residential land uses or on the ground level farthest from the shared property lines. Other controls, such as fan silencers, enclosures, and taller screen walls, etc., may be required.

Under the City's Noise Element, noise levels from building equipment shall not exceed a noise level of 55 dBA DNL at receiving noise-sensitive land uses. Conservatively, mechanical equipment noise for the proposed project has the potential to exceed 55 dBA DNL at the nearby sensitive uses. This is conservatively considered a significant impact.

Mitigation Measure 1:

Mechanical equipment shall be selected and designed to reduce impacts on surrounding uses to meet the City's 55 dBA DNL noise level requirement at the nearby noise-sensitive land uses. A qualified acoustical consultant shall be retained to review mechanical noise as these systems are selected to determine specific noise reduction measures necessary to reduce noise to comply with the City's noise level requirements. Noise reduction measures could include, but are not limited to, selection of equipment that emits low noise levels and installation of noise barriers, such as enclosures and parapet walls, to block the line-of-sight between the noise source and the nearest receptors. Other alternate measures may be optimal, such as locating equipment in less noise-

sensitive areas, such as along the building façades farthest from adjacent neighbors, where feasible.

Impact 2: Construction Vibration. Vibration levels generated during demolition and construction activities may be perceptible at neighboring land uses but would not be excessive or cause cosmetic or structural damage to buildings. **This is a less-than-significant impact.**

The construction of the project may generate perceptible vibration when heavy equipment or impact tools (e.g. jackhammers, etc.) are used in areas adjoining developed properties. Construction activities would include demolition of existing structures, excavation, grading, site preparation work, foundation work, and new building framing and finishing.

The City of San José requires that new development minimize vibration impacts to adjacent uses during demolition and construction activities. General Plan Policy EC-2.3 establishes a vibration limit of 0.08 in/sec PPV for sensitive historic structures and 0.20 in/sec PPV for residential buildings of normal conventional construction.

No sensitive historic buildings, buildings that are documented to be structurally weakened, or residential buildings adjoin the project site. Therefore, groundborne vibration levels exceeding 0.2 in/sec PPV would not have the potential to result in a significant vibration impact at adjacent off-site residential buildings.

Table 7 presents typical vibration levels that could be expected from construction equipment at distances of 25, 50, and 100 feet. Project construction activities such as drilling, the use of jackhammers, rock drills and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.) may generate substantial vibration in the immediate vicinity of the work area. Jackhammers typically generate vibration levels of 0.035 in/sec PPV and drilling typically generates vibration levels of 0.09 in/sec PPV at a distance of 25 feet. Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Vibration levels from typical construction activities would be expected to be 0.04 in/sec PPV at the nearest receptors located 90 to 100 feet from the project site, below the 0.2 in/sec PPV significance thresholds.

Vibration generated by construction activities near existing and Phase I residential land uses would at times be perceptible. However, as with any type of construction, this would be anticipated and would not be considered significant, given the intermittent and short duration of the phases that have the highest potential of producing vibration. By use of administrative controls, such as notifying residents of scheduled construction activities and scheduling construction activities with the highest potential to produce perceptible vibration during hours with the least potential to affect nearby residences, perceptible vibration can be kept to a minimum.

TABLE 7 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	PPV at 50 ft. (in/sec)	PPV at 100 ft. (in/sec)
Pile Driver (Impact)	upper range	1.158	0.540	0.252
	typical	0.644	0.300	0.140
Pile Driver (Sonic)	upper range	0.734	0.342	0.160
	typical	0.170	0.079	0.037
Clam shovel drop		0.202	0.094	0.044
Hydromill (slurry wall)	in soil	0.008	0.004	0.002
	in rock	0.017	0.008	0.004
Vibratory Roller		0.210	0.098	0.046
Hoe Ram		0.089	0.042	0.019
Large bulldozer		0.089	0.042	0.019
Caisson drilling		0.089	0.042	0.019
Loaded trucks		0.076	0.035	0.017
Jackhammer		0.035	0.016	0.008
Small bulldozer		0.003	0.001	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., November 2018.

Mitigation Measure 2: None Required.

Impact 3: Project-Generated Traffic Noise. Project-generated traffic would not substantially increase ambient noise levels at receptors in the project vicinity. **This is a less-than-significant impact.**

Traffic data provided by Hexagon Transportation Consultants were reviewed to calculate project-related traffic noise level increases along roadways serving the project site. These data included turning movement counts at eleven study area intersections for existing conditions and projections for project, background, and background plus project traffic conditions. Roadway link volumes were calculated based on the turning movement data and compared to existing conditions in order to calculate the anticipated noise level increase under each scenario, and the project's relative contribution under each scenario. Based on this comparison, traffic noise levels along roadways serving the project site are anticipated to increase by 1 dBA DNL or less as a result of the project. The project would not result in a measurable or substantial increase in noise at sensitive residential receivers in the vicinity and the impact is less-than-significant.

Mitigation Measure 3: None required.

Impact 4: Temporary Construction Noise. Noise generated by construction activities at the site would not be expected to adversely affect adjacent land uses. **This is a less-than-significant impact.**

The City of San José requires construction operations 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 that construction noise impacts would 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.

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

Construction activities generate considerable amounts of noise, especially during earth moving activities when heavy equipment is used. The highest maximum noise levels generated by project construction would typically range from about 90 to 95 dBA at a distance of 50 feet from the noise source. Typical hourly average construction generated noise levels are about 81 dBA to 88 dBA measured at a distance of 50 feet from the center of the site during busy construction periods (e.g., earth moving equipment, impact tools, etc.). Hourly average noise levels generated by the construction of residential units would range from about 65 dBA to 88 dBA measured at a distance of 50 feet depending on the amount of activity at the site. Construction generated noise levels drop off at a rate of about 6 dBA per doubling of distance between the source and receptor. Shielding by buildings or terrain often result in lower construction noise levels at distant receptors.

The proposed project would be constructed in two phases. Phase I would include construction of the Affordable Housing and Market Rate Phase I Residential buildings. Phase I construction would occur over a period of approximately 15 months beginning in January 2019. Phase II would include construction of the Market Rate Phase II Residential building. Phase II construction would occur over a period of approximately 14 months, beginning in January 2021. It is assumed that the buildings constructed during Phase I would be occupied during the construction of Phase II.

Noise generated by construction activities would temporarily elevate noise levels at adjacent noise sensitive receptors, but this would be considered a less-than-significant impact assuming that construction activities are conducted in accordance with the provisions of the City of San José and with the implementation of the following construction best management practices: 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 potential short-term noise impacts associated with the project would be mitigated by General Plan Policy EC-1.7. This policy states:

Construction operations within the City will be required to use available noise suppression devices and techniques and continue to 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.

A typical construction noise logistics plan would include, but not be limited to, the following measures to reduce construction noise levels as low as practical:

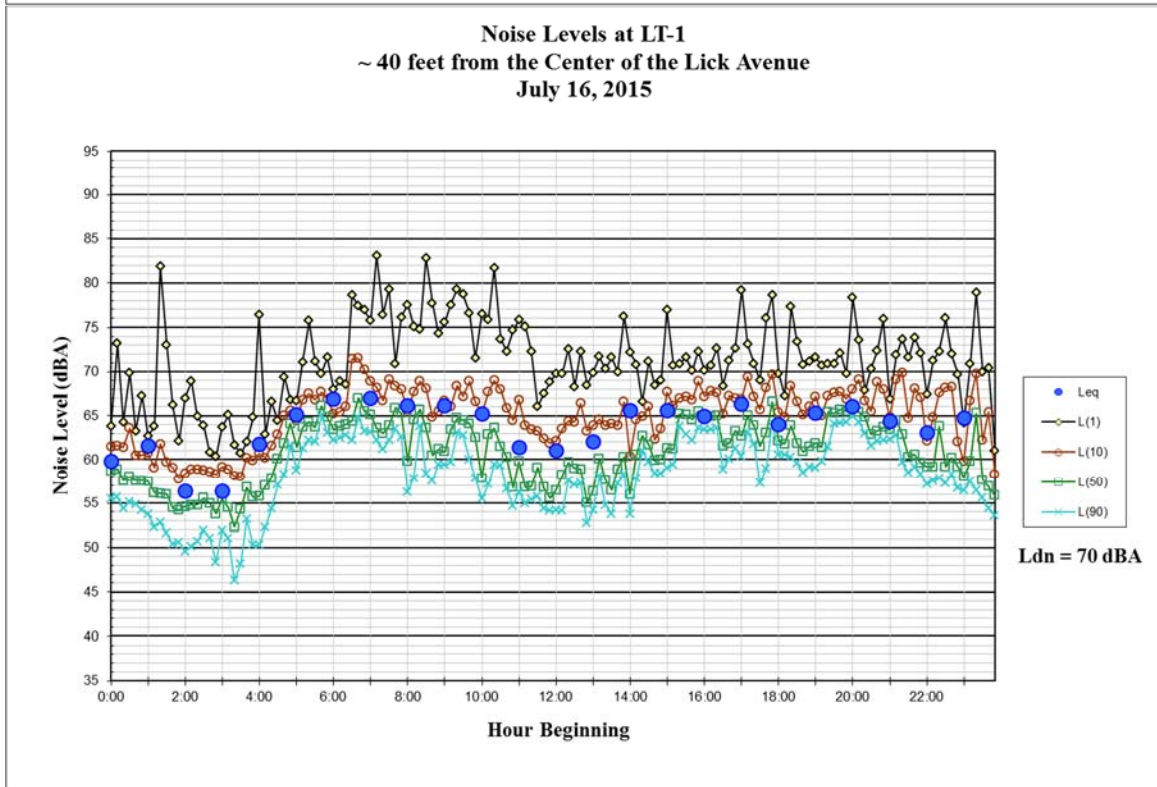
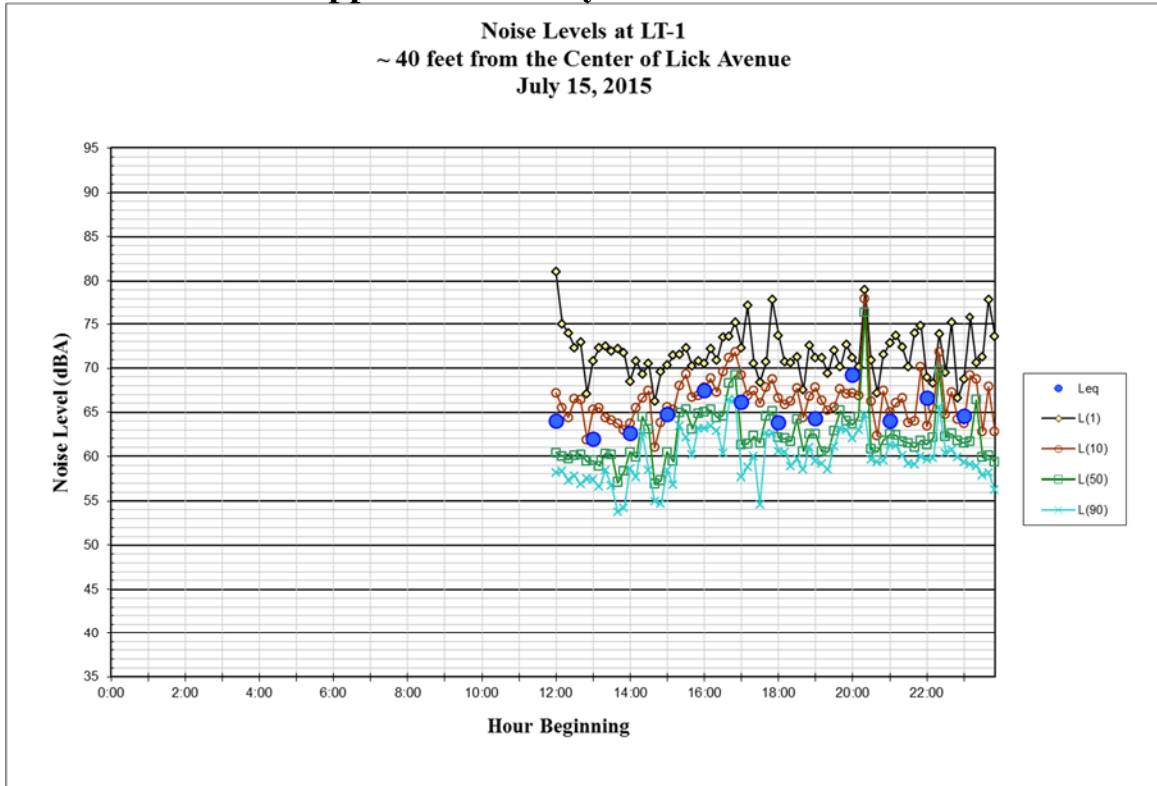
- Utilize 'quiet' models of air compressors and other stationary noise sources where technology exists;
- Equip all internal combustion engine-driven equipment with mufflers, which are in good condition and appropriate for the equipment;
- Locate all stationary noise-generating equipment, such as air compressors and portable power generators, as far away as possible from adjacent land uses;
- Locate staging areas and construction material areas as far away as possible from adjacent land uses;
- Prohibit all unnecessary idling of internal combustion engines;

- If impact pile driving is proposed, multiple-pile drivers shall be considered to expedite construction. Although noise levels generated by multiple pile drivers would be higher than the noise generated by a single pile driver, the total duration of pile driving activities would be reduced.
- If impact pile driving is proposed, temporary noise control blanket barriers shall shroud pile drivers or be erected in a manner to shield the adjacent land uses. Such noise control blanket barriers can be rented and quickly erected.
- If impact pile driving is proposed, foundation pile holes shall be pre-drilled to minimize the number of impacts required to seat the pile. Pre-drilling foundation pile holes is a standard construction noise control technique. Pre-drilling reduces the number of blows required to seat the pile. Notify all adjacent land uses of the construction schedule in writing;
- Designate a "disturbance coordinator" who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., starting too early, bad muffler, etc.) and will require that reasonable measures warranted to correct the problem be implemented. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include it in the notice sent to neighbors regarding the construction schedule.

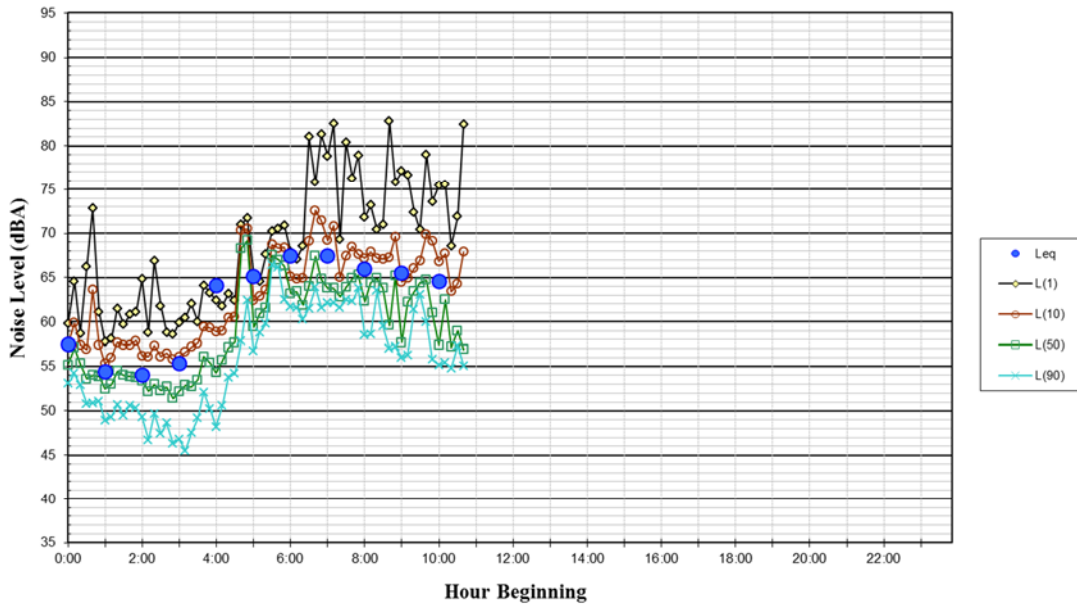
The potential short-term noise impacts associated with construction facilitated by the plan would be mitigated by the implementation of the above policy that requires reasonable noise reduction measures be incorporated into the construction plan and implemented during all phases of construction activity to minimize the exposure of neighboring properties. Policy EC-1.7 in combination with the limitations on hours set forth in the Municipal Code, would reduce the impact to a less-than-significant level.

Mitigation Measure 4: No additional measures are required.

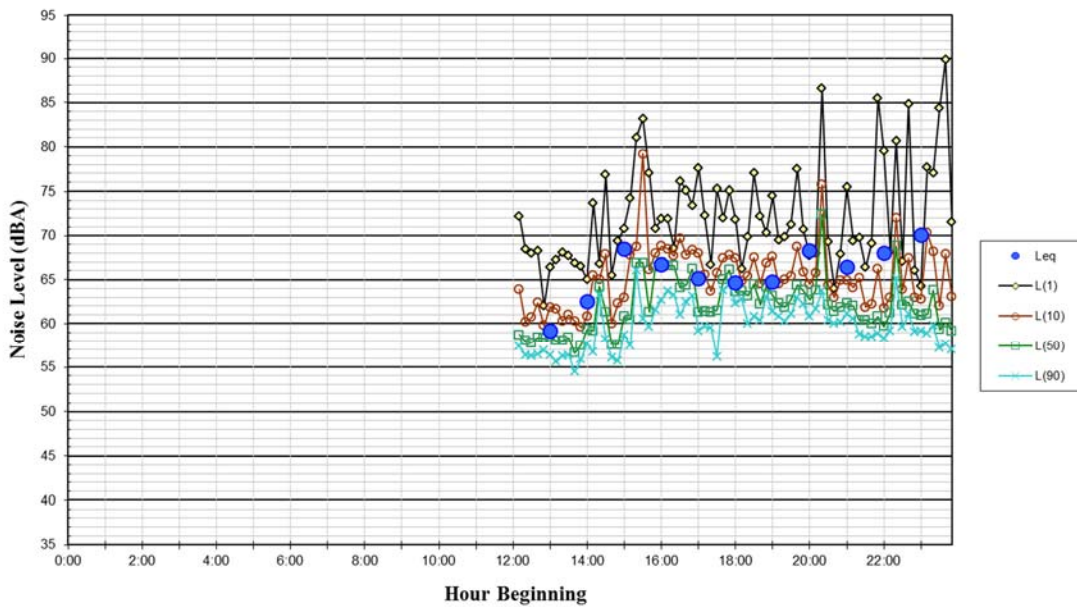
Appendix 1: Daily Trend in Noise Levels



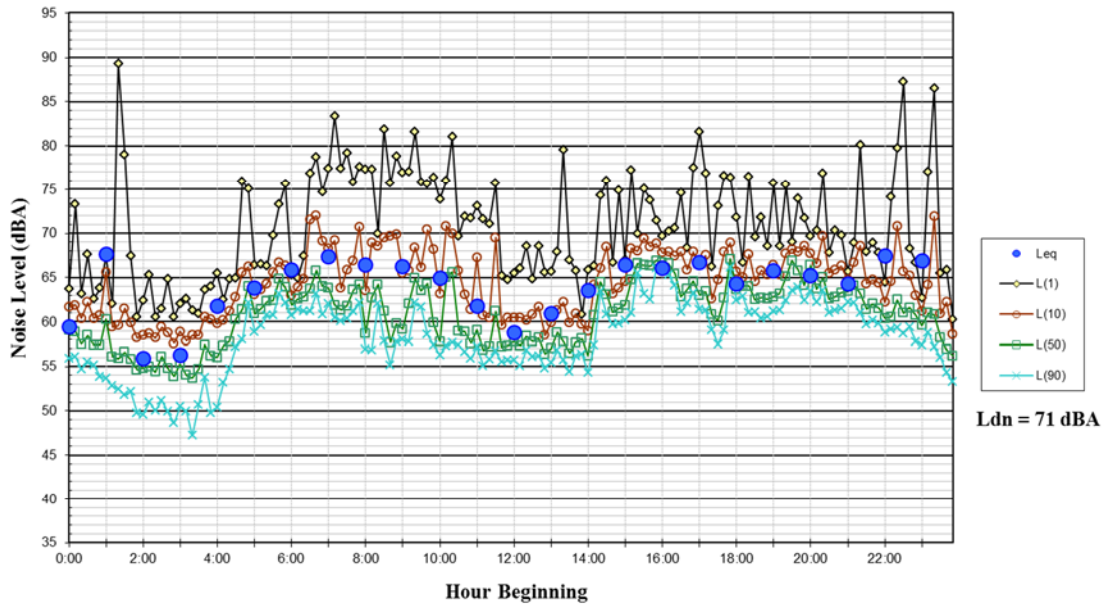
Noise Levels at LT-1
~ 40 feet from the Center of Lick Avenue
July 17, 2015



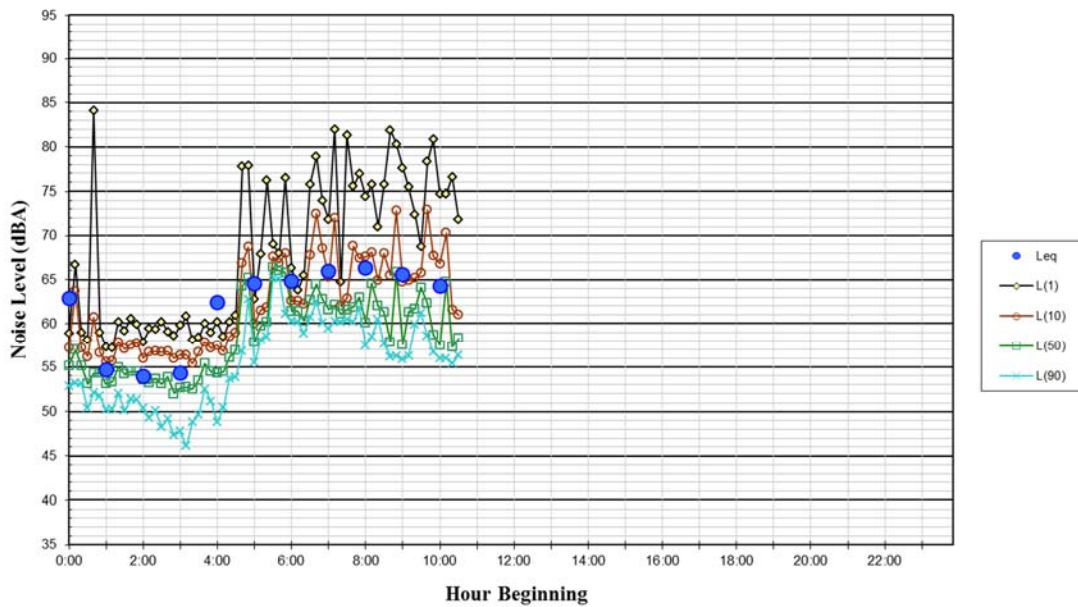
Noise Levels at LT-2
~ 100 feet from the Center of the Nearest Railroad Track
July 15, 2015



Noise Levels at LT-2
~ 100 feet from the Center of the Nearest Railroad Track
July 16, 2015



Noise Levels at LT-2
~ 100 feet from the Center of the Nearest Railroad Track
July 17, 2015



Appendix 2: NEPA Noise Assessment

Regulatory Criteria – NEPA

HUD Guidelines. The U.S. Department of Housing and Urban Development (HUD) environmental noise regulations are set forth in 24CFR Part 51B (Code of Federal Regulations). The following exterior noise standards for new housing construction would be applicable to this project:

- 65 dBA DNL or less – acceptable.
- Exceeding 65 dBA DNL but not exceeding 75 dBA DNL – normally unacceptable (appropriate sound attenuation measures must provide an additional 5 decibels of attenuation over that typically provided by standard construction in the 65 dBA DNL to 70 dBA DNL zone; 10 decibels additional attenuation in the 70 dBA DNL to 75 dBA DNL zone).
- Exceeding 75 dBA DNL – unacceptable.

These noise standards also apply, “... at a location 2 meters from the building housing noise sensitive activities in the direction of the predominant noise source...” and “...at other locations where it is determined that quiet outdoor space is required in an area ancillary to the principal use on the site.”

A goal of 45 dBA DNL is set forth for interior noise levels and attenuation requirements are geared toward achieving that goal. It is assumed that with standard construction any building will provide sufficient attenuation to achieve an interior level of 45 dBA DNL or less if the exterior level is 65 dBA DNL or less. Where exterior noise levels range from 65 dBA DNL to 70 dBA DNL, the project must provide a minimum of 25 decibels of attenuation, and a minimum of 30 decibels of attenuation is required in the 70 dBA DNL to 75 dBA DNL zone. Where exterior noise levels range from 75 dBA DNL to 80 dBA DNL, the project must provide a minimum of 35 decibels of attenuation to achieve an interior level of 45 dBA DNL or less.

Existing Noise Environment

The project site is located east of Highway 87 and the Tamien Transit Station and west of Lick Avenue in San Jose, California. Residential uses bound the project site to the north, south and east. The existing noise environment at the site and in the vicinity results primarily from traffic on Highway 87, Lick Avenue and passenger train activity associated with the nearby Tamien Transit Station, and UPRR freight train operations. Intermittent noise from aircraft over flights also contributes to the ambient noise environment.

A noise monitoring survey was conducted between July 15, 2015 and July 17, 2015 to document existing noise conditions at the project site and surrounding areas. The noise monitoring survey included two long-term noise measurements (LT-1 and LT-2) and two short-term measurements (ST-1 and ST-2). Noise measurements locations are shown in Figure A-1.

Long-term noise measurement LT-1 was located at the east boundary of the project site approximately 40 feet from the center of Lick Avenue and about 12 feet above the ground. Noise levels measured at this site were primarily the result of traffic on Lick Avenue, intermittent noise from train operations, and distant Highway 87 traffic noise. Hourly average noise levels typically ranged from 61 to 67 dBA L_{eq} during the day and from 56 to 67 dBA L_{eq} at night. The calculated day-night average noise level at this location was 70 dBA DNL.

Long-term noise measurement LT-2 was located at the western boundary of the project site, adjacent to Tamien Transit Station, and approximately 100 feet from the nearest rail line. The microphone was positioned about 12 feet above the ground. Noise levels measured at this site were primarily the result of Highway 87 traffic, train operations and intermittent noise from aircraft over flights. Hourly average noise levels typically ranged from 59 to 67 dBA L_{eq} during the day and 56 to 67 dBA L_{eq} at night. The calculated day-night average noise level at this location was 71 dBA DNL. Appendix 1 summarizes the data collected at the two long-term measurement sites.

Two attended short-term noise measurements were made to complete the July 2015 noise monitoring survey. Short-term noise measurement ST-1 was approximately 130 feet from Tamien Station. The ten-minute average noise level during the mid-day was 65 dBA L_{eq} . Short-term noise measurement ST-2 was approximately 180 feet from Tamien Station. The ten-minute average noise level was 60 dBA L_{eq} . Table A-1 summarizes the results of these measurements.

TABLE A-1 Summary of Short-Term Noise Measurement Data

Noise Measurement Location	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	L_{eq}	DNL
ST-1: ~130 feet from Tamien Station. (7/17/2015, 10:10 a.m. -10:20 a.m.)	73	72	69	63	57	65	68
ST-2: ~180 feet from Tamien Station. (7/17/2015, 10:30 a.m. -10:40 a.m.)	72	70	61	58	56	60	65

Note: DNL at the short-term site approximated by correlating the noise data to noise data collected at the long-term site during a corresponding time period.

The existing traffic data in 2015 were compared to the existing traffic data in 2018 to confirm that the baseline for the project has not changed substantially. The comparison of these data shows that traffic noise levels are generally plus or minus 1 dBA of the levels measured in 2015 and have not changed substantially during the three-year period. Therefore, the 2015 measured noise conditions continue to represent existing noise conditions in 2018.

Significance Criteria

An adverse effect would result if noise levels at the affordable housing building would exceed HUD Guidelines for acceptability. Exterior noise levels exceeding 65 dBA DNL or interior noise levels exceeding 45 dBA DNL would exceed HUD’s noise compatibility criteria.

Future Exterior Noise Environment

The proposed project would include noise sensitive land uses located along major transportation corridors that include State Route 87, a commuter/freight railroad and light-rail corridor, and

aircraft departing and arriving at Norman Y. Mineta San José International Airport. Proposed residential land uses may also be sensitive to groundborne vibration from heavy-rail and light-rail trains. Future transportation-related noise levels at the project site were calculated based on adjustments made to existing noise level data assuming future increased traffic along area roadways and the railroad.

The California High Speed Train (HST) San José to Merced Section is proposed to pass through the City of San José and Tamien Station. The HST is currently planned to operate on an elevated structure along the existing rail right-of-way as described in the Bay Area to Central Valley High-Speed Train Partially Revised Final Program EIR (August 2012).

Representative noise and vibration data for the proposed California High Speed Rail Project were obtained from various sources, including data from published environmental documents that have studied the project and data provided by the California High Speed Rail Authority, most of which appears to have been based upon the U.S. DOT High Speed Ground Transportation Noise and Vibration Impact Assessment. Noise and vibration studies and EIRs that were utilized in this assessment were programmatic, as specific development plans for the HST have not been finalized.

For the purpose of this analysis, credible worst-case assumptions were made regarding the speed, frequency, location of right-of-way, and other factors. This analysis assumes that trains will travel on an aerial platform (approximately 24 feet above grade) past the site at maximum speeds of 125 mph or less. The average train frequency on a given alignment segment would be approximately 10 trains per hour per direction, although the frequency of passbys would vary throughout the day.

Using data from the California HST Program EIR/EIS, day-night average noise levels are anticipated to range from 60 - 70 dBA DNL at the eastern boundary of the site, and maximum noise levels generated by a passing HST are anticipated to reach approximately 75 to 80 dBA L_{max} . The HST would make an incremental contribution to the total noise level of up to 3 dBA DNL, and maximum noise levels from trains passing by would be below the noise levels generated by trains utilizing the existing corridor. However, there are other considerations. If the HST is placed on an aerial structure, as currently planned, noise mitigation would need to be incorporated into the HST project design.

Future noise levels expected from aircraft are best represented by the 2027 CNEL Contours noise exposure map published as part of the Airport Master Plan shown on Figure A-2. The project site is located just outside the 60 CNEL noise contour where the noise level would be at or below 60 CNEL/ DNL.

Traffic noise levels along Lick Avenue are calculated to increase by 1 dBA DNL, and day-night average noise levels from Lick Avenue traffic are calculated to reach 71 dBA DNL at the proposed setback of residential land uses nearest the roadway. The future exterior noise environment at residential land uses proposed adjacent to the UPRR, Tamien Station, and Highway 87 would continue to result from traffic noise and train activity occurring adjacent to the site. Future day-night average noise levels are calculated to reach 74 dBA DNL at the

proposed setback of residential land uses nearest the rail lines and Highway 87. These exterior noise level estimates were confirmed with the HUD DNL calculator (Figure A-3).

The Illustrative Site Plan (Figure A-4) for the affordable housing component of the project shows the common outdoor uses area in a courtyard at the podium level of the building. The building would enclose the courtyard on the west, south, and east sides and reduce the noise from ground transportation sources by about 10 dBA in the primary areas of the courtyard where frequent use would be expected, reducing the noise level to about 60 dBA DNL. The buildings would not shield the courtyards from aircraft noise. Overall noise levels resulting from ground transportation and aircraft would be about 60 dBA DNL in the common outdoor areas in the Market Rate buildings, and within the range from 60 to 65 dBA DNL in the common outdoor area in the Affordable building. Exterior noise levels at the proposed common use areas would meet HUD's "normally acceptable" threshold for at outdoor spaces (65 dBA DNL or less).

Future Interior Noise Environment

Preliminary floor plans and building elevations contained in the Planned Development Zoning drawing set dated July 26, 2018 were reviewed, and calculations were made to quantify the transmission loss provided by the proposed building elements and to estimate interior noise levels resulting from exterior noise sources. The relative areas of the building elements (walls, windows, and doors) were input into an acoustical model to calculate interior noise levels within individual rooms.

Residential units proposed along the west façade of the affordable housing building would be exposed to future exterior noise levels of 74 dBA DNL. The predicted exterior noise level would exceed HUD's "normally acceptable" threshold of 65 dBA DNL by 9 dBA DNL, falling under HUD's normally unacceptable designation which requires that appropriate sound attenuation measures must provide an additional 10 decibels additional attenuation in the 70 dBA DNL to 75 dBA DNL zone. Thirty (30) decibels of attenuation would be required for the facades to achieve acceptable levels. Attaining the necessary noise reduction from exterior to interior spaces is readily achievable in noise environments less than 75 dBA DNL with proper wall construction techniques, the selections of proper windows and doors, and the incorporation of forced-air mechanical ventilation systems. In noise environments exceeding 75 dBA DNL, the construction materials and techniques necessary to reduce interior noise levels to acceptable levels become more expensive.

The results of the calculations showed that windows and doors of residential units throughout the site should have minimum Sound Transmission Class ratings ranging from STC 32 to STC 35. Such windows and doors, in combination with the proposed stucco exterior walls (STC 46), would achieve an outdoor-to-indoor composite noise reduction ranging from 35 to 39 decibels and would maintain interior noise levels below 45 dBA DNL with an adequate margin of safety. HUD Figure 19 (Figure A-5) provides a summary example of the inputs used to complete the calculations of interior noise levels at residential units with the future worst-case noise exposure.

To maintain a habitable interior environment, all units should be mechanically ventilated so that windows and doors can be kept closed at the occupant's discretion to control noise intrusion indoors.

FIGURE A-1 Noise and Vibration Measurement Locations

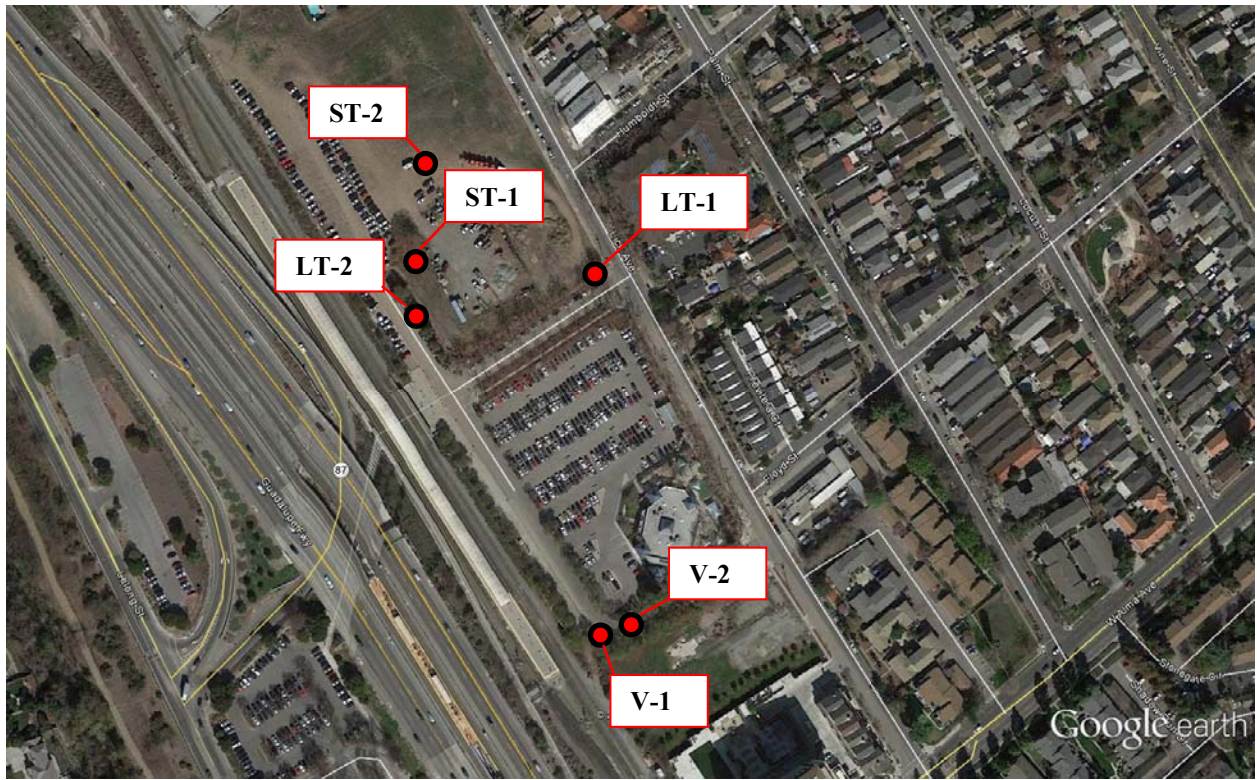


FIGURE A-2 65 CNEL Noise Contour for SJIA (2027) Relative to Project Site

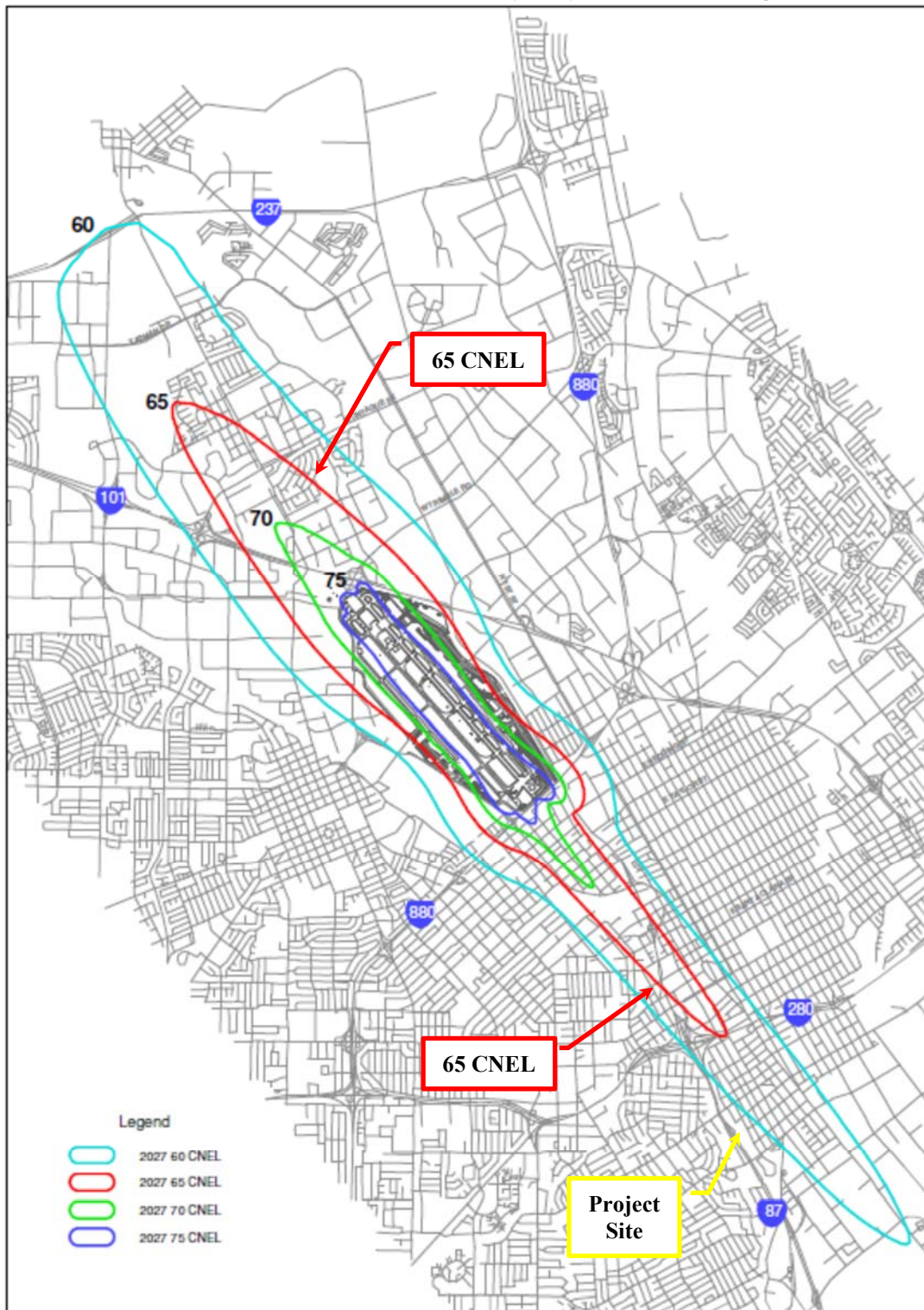


FIGURE A-3

HUD DNL Calculator

DNL Calculator

WARNING: HUD recommends the use of Microsoft Internet Explorer for performing noise calculations. The HUD Noise Calculator has an error when using Google Chrome unless the cache is cleared before each use of the calculator. HUD is aware of the problem and working to fix it in the programming of the calculator.

The Day/Night Noise Level Calculator is an electronic assessment tool that calculates the Day/Night Noise Level (DNL) from roadway and railway traffic. For more information on using the DNL calculator, view the [Day/Night Noise Level Calculator Electronic Assessment Tool Overview \(/programs/environmental-review/daynight-noise-level-electronic-assessment-tool/\)](/programs/environmental-review/daynight-noise-level-electronic-assessment-tool/).

Guidelines

- To display the Road and/or Rail DNL calculator(s), click on the "Add Road Source" and/or "Add Rail Source" button(s) below.
- All Road and Rail input values must be positive non-decimal numbers.
- All Road and/or Rail DNL value(s) must be calculated separately before calculating the Site DNL.
- All checkboxes that apply must be checked for vehicles and trains in the tables' headers.
- **Note #1:** Tooltips, containing field specific information, have been added in this tool and may be accessed by hovering over all the respective data fields (site identification, roadway and railway assessment, DNL calculation results, roadway and railway input variables) with the mouse.
- **Note #2:** DNL Calculator assumes roadway data is always entered.

DNL Calculator

Site ID	Tamien TOD - Affordable Housing Component
Record Date	11/14/2018
User's Name	MST
Road # 1 Name:	SR 87

Road #1

Vehicle Type	Cars <input checked="" type="checkbox"/>	Medium Trucks <input checked="" type="checkbox"/>	Heavy Trucks <input checked="" type="checkbox"/>
Effective Distance	<input type="text" value="375"/>	<input type="text" value="375"/>	<input type="text" value="375"/>
Distance to Stop Sign	<input type="text"/>	<input type="text"/>	<input type="text"/>
Average Speed	<input type="text" value="65"/>	<input type="text" value="60"/>	<input type="text" value="55"/>
Average Daily Trips (ADT)	<input type="text" value="145186"/>	<input type="text" value="1845"/>	<input type="text" value="1969"/>
Night Fraction of ADT	<input type="text" value="15"/>	<input type="text" value="15"/>	<input type="text" value="15"/>
Road Gradient (%)	<input type="text"/>	<input type="text"/>	<input type="text" value="0"/>
Vehicle DNL	<input type="text" value="68.1777"/>	<input type="text" value="58.5232"/>	<input type="text" value="63.9499"/>
<input type="button" value="Calculate Road #1 DNL"/>	<input type="text" value="69.9135"/>	<input type="button" value="Reset"/>	

Railroad #1 Track Identifier:

Rail # 1

Train Type	Electric <input type="checkbox"/>	Diesel <input checked="" type="checkbox"/>
Effective Distance	<input type="text"/>	<input type="text" value="185"/>
Average Train Speed	<input type="text"/>	<input type="text" value="20"/>
Engines per Train	<input type="text"/>	<input type="text" value="1"/>
Railway cars per Train	<input type="text"/>	<input type="text" value="5"/>
Average Train Operations (ATO)	<input type="text"/>	<input type="text" value="86"/>
Night Fraction of ATO	<input type="text"/>	<input type="text" value="15"/>
Railway whistles or horns?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>	Yes: <input type="checkbox"/> No: <input checked="" type="checkbox"/>
Bolted Tracks?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>	Yes: <input type="checkbox"/> No: <input checked="" type="checkbox"/>
Train DNL	<input type="text"/>	<input type="text" value="68.3378"/>
<input type="button" value="Calculate Rail #1 DNL"/>	<input type="text" value="68.3378"/>	<input type="button" value="Reset"/>

Calculate Rail #1 DNL

00.00/0

RESET

Add Road Source

Add Rail Source

Airport Noise Level

60

Loud Impulse Sounds?

Yes No

Combined DNL for all
Road and Rail sources

72.1832

Combined DNL including Airport

72.474

Site DNL with Loud Impulse Sound

Calculate

Mitigation Options

If your site DNL is in Excess of 65 decibels, your options are:

- **No Action Alternative:** Cancel the project at this location
- **Other Reasonable Alternatives:** Choose an alternate site
- **Mitigation**
 - **Contact your Field or Regional Environmental Officer** (</programs/environmental-review/hud-environmental-staff-contacts/>)
 - Increase mitigation in the building walls (only effective if no outdoor, noise sensitive areas)
 - Reconfigure the site plan to increase the distance between the noise source and noise-sensitive uses
 - Incorporate natural or man-made barriers. See *The Noise Guidebook* (</resource/313/hud-noise-guidebook/>)
 - Construct noise barrier. See the **Barrier Performance Module** (</programs/environmental-review/bpm-calculator/>)

Tools and Guidance

[Day/Night Noise Level Assessment Tool User Guide](/resource/3822/day-night-noise-level-assessment-tool-user-guide/) (</resource/3822/day-night-noise-level-assessment-tool-user-guide/>)

[Day/Night Noise Level Assessment Tool Flowcharts](/resource/3823/day-night-noise-level-assessment-) (</resource/3823/day-night-noise-level-assessment->

FIGURE A-4 Illustrative Site Plan



REPUBLIC URBAN PROPERTIES LLC
 REPUBLIC MILLSOME LLC
 1000 W. 10TH ST. SUITE 100
 DENVER, CO 80202

THE CODE COMPANIES
 100 W. 10TH ST. SUITE 100
 DENVER, CO 80202

STUDIO T SQUARE
 100 W. 10TH ST. SUITE 100
 DENVER, CO 80202

HVIT
 ARCHITECTS
 100 W. 10TH ST. SUITE 100
 DENVER, CO 80202

NO.	DESCRIPTION	DATE
1	ISSUED	08/15/2023

TAMIEN RESIDENTIAL
 SAN JOSE, CA, USA
 GENERAL DEVELOPMENT PERMIT
 Illustrative Site Plan

PRELIMINARY AND TENTATIVE
 NOT FOR CONSTRUCTION.
 ALL DIMENSIONS
 SUBJECT TO CHANGE.

PROJECT NO.
 2023-0001
 SHEET NO.
 SP1.1
 DATE
 08/15/2023

SCALE: 1" = 35'-0"

FIGURE A-5 HUD Figure 19

Figure 19
Description of Noise Attenuation Measures
(Acoustical Construction)

Part I

Project Name: Tamien Station TOD, Affordable Housing Component, Unit 3A at West Façade of Building (Worst-Case Noise Exposure)

Location: San Jose, California

Sponsor/Developer: Republic Urban Properties LLC

Noise Level (From NAG): 74 dBA DNL Attenuation Required: 30 dBA

Primary Noise Source(s): SR 87, UPRR, Future HSR

Part II

1. For wall(s) facing and parallel to the noise source(s) (or closest to parallel):
 - a. Description of wall construction*: Stucco exterior siding, insulated wood stud, and gypsum board interior
 - b. STC rating for wall (rated for no windows or doors): STC 46
 - c. Description of windows: Vinyl, dual-pane
 - d. STC rating for window type: STC 35
 - e. Description of doors: Vinyl, dual-pane
 - f. STC rating for doors: NA
 - g. Percentage of wall (per wall, per dwelling unit) composed of windows: 59% and doors: 0%
 - h. Combined STC rating for wall component: 35 dBA
2. For walls perpendicular to noise source(s):
 - a. Description of wall construction*: Stucco exterior siding, insulated wood stud, and gypsum board interior
 - b. STC rating for wall (rated for no windows or doors): STC 46
 - c. Description of windows: Vinyl, dual-pane
 - d. STC rating for window type: STC 35
 - e. Description of doors: Vinyl, dual-pane
 - f. STC rating for doors: NA
 - g. Percentage of wall (per wall, per dwelling unit) composed of windows: 0% and doors: 51%
 - h. Combined STC rating for wall component: 36 dBA
3. Roofing component (if overhead attenuation is required to aircraft noise):
 - a. Description of roof construction: N/A
 - b. STC rating (rated as if no skylights or other openings): N/A
 - c. Description of skylights or overhead windows: N/A
 - d. STC rating for skylights or overhead windows: N/A
 - e. Percentage of roof composed of skylights or windows (per dwelling unit): N/A
 - f. Percentage of roof composed of large uncapped openings such as chimneys: N/A
 - g. Combined STC rating for roof component: N/A
4. Description of type of mechanical ventilation provided: Satisfactory forced air mechanical ventilation system.