Appendix D

Noise Assessment

ASSESSMENT OF ENVIRONMENTAL NOISE

COMMUNICATIONS HILL SPECIFIC PLAN

FINAL

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By

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Contents

ASSESSMENT OF ENVIRONMENTAL NOISE

INTRODUCTION

This report evaluates potential impacts associated with construction and operation of the Communications Hill Specific Plan (the PROJECT).

PROJECT DESCRIPTION

The entire Communications Hill Specific Plan Area comprises approximately 900 acres of land located approximately four miles south of downtown San José. The Plan Area is bounded by Curtner Avenue to the north, Monterey Road to the east, Capitol Expressway, Snell Avenue, and Hillsdale Avenue to the south, and Guadalupe Freeway (SR 87) to the west. The Oak Hill Cemetery is located adjacent to the northeastern boundary of the Plan area.

The proposed project site is within the Specific Plan Area near the top of the hill adjacent to the existing KB Home Tuscany Hills development. The site is generally bounded by the Caltrain/Union Pacific railroad tracks on the north, Old Hillsdale Avenue to the east, the Tuscany Hills development to the south, and the Millpond and Dairy Hill neighborhoods to the west.

The proposed project is the build-out of the remaining approximately 2,200 residential units allowed within the Specific Plan Area, which is anticipated to occur over a 12-15 year timeframe. It also includes construction of up to 67,500 square feet of commercial/retail uses, parks, open space, trails, streets, storm water facilities, and other associated supporting infrastructure. The SEIR will also provide program-level environmental review for the development of an elementary school, centrally located on approximately 4.2 acres.

The proposed project also includes the future development of approximately 55 acres of industrial park uses in the eastern portion of the site near the base of Communications Hill adjacent to Old Hillsdale Avenue. Details for this development have not yet been determined, although it is anticipated that it would have a Floor Area Ratio (FAR) of approximately 0.6. This would allow approximately 1.44 million square feet of industrial park development, consistent with the Specific Plan and the City's Zoning Ordinance.

The project proposes the development of up to 2,200 residential units consisting of townhomes/flats, detached alley townhomes, detached row townhomes, podium condominiums, and apartments in the Village Center. Four podium condominium buildings are proposed as part of the project.

Uses within the commercial/retail area would include restaurants, shops, entertainment, and small office consistent with the Specific Plan. Approximately 16 acres of parks and 112 acres of open space will be constructed as part of the proposed project.

There is an existing abandoned mercury mine and a former rock quarry within the boundary of the proposed project site. The project proposes to close these existing uses according to all local, state, and federal laws. An aggregate recycling center is currently using the quarry property which has been identified for future industrial park uses. It is anticipated that the recycling center will continue to operate until its Use Permit expires in approximately 10 years.

CHARACTERISTICS OF NOISE

Noise is usually defined as unwanted sound and can be an undesirable by-product of society's normal day-to-day activities. Sound becomes unwanted when it interferes with normal activities, causes actual physical harm, or has an adverse effect on health.

People judge the relative magnitude of sound sensation in subjective terms such as "noisiness" or "loudness." However, the sound pressure magnitude can be objectively measured and quantified using a logarithmic ratio of pressures which yields the level of sound, utilizing the measurement scale of decibels (dB). The decibel is generally adjusted to the A-weighted level (dBA) which de-emphasizes very low frequencies to better approximate the human ear's range of sensitivity. In practice, the noise level of a sound source is measured using a sound level meter that includes an electronic filter corresponding to the A-weighting curve. Table A.1 in Appendix A of this report defines the decibel along with other technical terms used in this analysis.

Even though the A-weighted scale accounts for the relative loudness perceived by the human ear and, therefore, is commonly used to quantify individual events or general community sound levels, the degree of annoyance or other response effects also depends on several other perceptibility factors, including:

- Ambient (background) sound level
- Magnitude of the event sound level relative to the background noise
- Spectral (frequency) composition (e.g., presence of tones)
- Duration of the sound event
- Number of event occurrences, repetitiveness, and intermittency

- Time of day the event occurs.

In determining the daily level of environmental noise, it is important to account for the difference in human responses to daytime and nighttime noises. At night, exterior background noise levels are generally lower than daytime levels. However, most household noise also decreases at night, and exterior noise may become increasingly noticeable. Further, most people sleep at night and have greater sensitivity to noise intrusion. To account for human sensitivity to nighttime noise levels, a 24-hour descriptor, the Community Noise Equivalent Level (CNEL) has been developed. The CNEL divides the 24-hour day into a daytime period of 7:00 a.m. to 7:00 p.m., an evening period from 7:00 p.m. to 10:00 p.m., and a nighttime period of 10:00 p.m. to 7:00 a.m. In determining the CNEL, noise levels occurring during the evening period are increase by 5 dB, while noise levels occurring during the nighttime period are increased by 10 dB to account for the greater sensitivity during the evening and nighttime periods.

The effects of noise on people fall into three general categories:

- Subjective effects of annoyance and nuisance
- Interference with activities such as speech, sleep and learning
- Physiological effects such as hearing loss

In most cases, the levels associated with environmental noise produce effects only in the first two categories. However, workers in industrial plants may experience noise effects in the last category. There is no completely effective way to measure the subjective effects of noise or the corresponding reactions of annoyance, because of the wide variation in individual thresholds of annoyance and degrees to which people become acclimated to noise. Thus, an important way of determining a person's subjective reaction to a new noise source is by comparison to the existing environment to which they are accustomed (the "ambient" environment"). In general, the more the level of a noise event exceeds the prevailing ambient noise level, the less acceptable the noise source will be to those exposed to it.

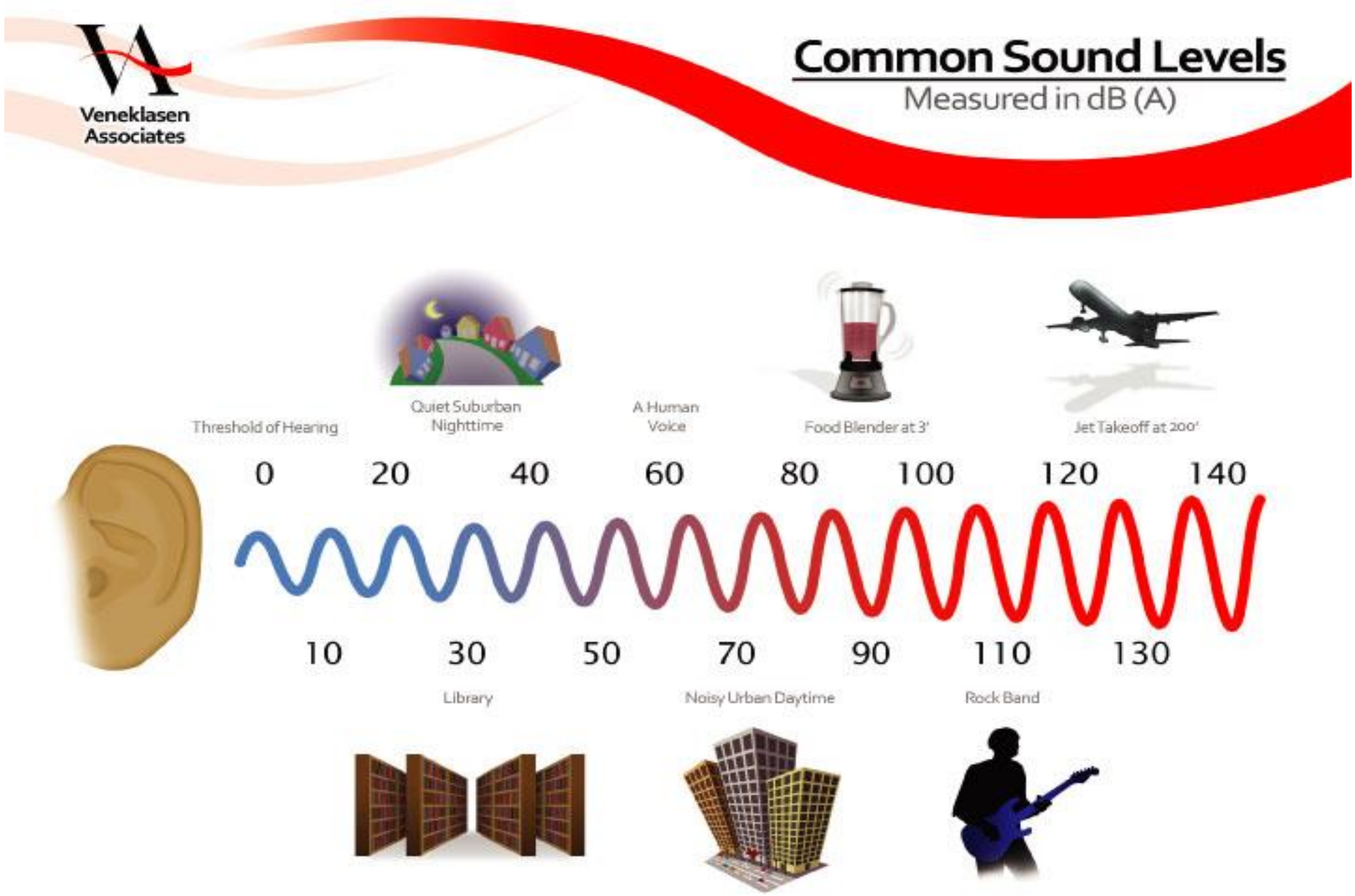
With regard to increases in A-weighted noise levels, the following relationships are applicable to this analysis:

- Except in carefully controlled laboratory experiments, a 1 dB change cannot be perceived.
- Outside of a laboratory, a 3 dBA change will be generally perceivable by most people.
- A change in level of at least 5 dBA is considered a noticeable change by most people.

- A 10 dBA change will result in the perception of doubling or halving the loudness of the noise.

Common noise levels associated with various activities are shown on **Figure 1, Common Noise Levels**.

Figure 1 - Common Noise Levels



Noise sources are either "point sources", such as stationary equipment or individual motor vehicles or "line sources" such as a roadway with a large number of mobile point sources (motor vehicles). Sound generated by a stationary point source typically diminishes (attenuates) at a rate of 6 dBA for each doubling of distance from the source to the receptor at acoustically "hard" sites, and at a rate of 7.5 dBA at acoustically "soft" sites.[1] For example, a 60 dBA noise level measured at 50 feet from a point source at an acoustically hard site would be 54 dBA at 100 feet from the source and it would be 48 dBA at 200 feet from the source. Sound generated by a line source typically attenuates at a rate of 3 dBA and 4.5 dBA per doubling of distance from the source to the receptor for hard and soft sites, respectively.[2] Man-made or natural barriers can also attenuate sound levels.

The minimum attenuation of exterior to interior noise provided by typical structures is provided in **Table 1, Outside to Inside Noise Attenuation**.

Table 1
Outside to Inside Noise Attenuation (dBA)

Building Type	Open Windows	Closed Windows[1]
Residences	17	25
Schools	17	25
Churches	20	30
Hospitals/Convalescent Homes	17	25
Offices	17	25
Theaters	20	30
Hotels/Motels	17	25

Source: Transportation Research Board, National Research Council, Highway Noise: A Design Guide for Highway Engineers, *National Cooperative Highway Research Program Report 117.*
[1] *As shown, structures with closed windows can attenuate exterior noise by a minimum of 25 to 30 dBA.*

1 U.S. Department of Transportation, Federal Highway Administration, *Highway Noise Fundamentals*, (Springfield, Virginia: U.S. Department of Transportation, Federal Highway Administration, September 1980), p. 97. A "hard" or reflective site does not provide any excess ground-effect attenuation and is characteristic of asphalt, concrete, and very hard packed soils. An acoustically "soft" or absorptive site is characteristic of normal earth and most ground with vegetation.

2 U.S. Department of Transportation, Federal Highway Administration, *Highway Noise Fundamentals*, (Springfield, Virginia: U.S. Department of Transportation, Federal Highway Administration, September 1980), p. 97.

CHARACTERISTICS OF VIBRATION

Vibration is minute variation in pressure through structures and the earth, whereas, noise is minute variation in pressure through air. Some vibration effects can be caused by noise; e.g., the rattling of windows from truck pass-bys. This phenomenon is related to the coupling of the acoustic energy at frequencies that are close to the resonant frequency of the material being vibrated. Ground-borne vibration attenuates rapidly as distance from the source of the vibration increases. Vibration amplitude can be measured as peak particle velocity (PPV), the maximum instantaneous peak amplitude in inches per second, or root-mean-square (RMS) velocity in inches per second or as vibration level in decibels (VdB) referenced to 1 micro-inch per second. The ratio between the PPV and the maximum RMS amplitude is termed the "crest factor." According to the Federal Transit Administration (FTA), the PPV level for construction equipment is typically 1.7 to 6 times greater than the RMS vibration level. The FTA uses a crest factor of 4 for the conversion of PPV levels to RMS vibration levels. For the purposes of ground-borne vibration analysis of impacts to existing structures, vibration velocity is described in terms of PPV. For the analysis of the human response to vibration, VdB is utilized.

The vibration velocity threshold of perception for humans is approximately 65 VdB, and a vibration velocity of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels for many people[3]. Most perceptible indoor vibration is caused by sources within buildings such as operation of mechanical equipment, movement of people, or the slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. Common ground-induced vibrations related to roadway traffic and construction activities pose no threat to buildings or structures. If a roadway is smooth, the ground-borne vibration from traffic is barely perceptible. The range of interest is from approximately 50 VdB, which is the typically background vibration velocity, to 94 VdB. This 94 VdB vibration level corresponds to 0.2 PPV, which is the general threshold where minor damage can occur in non-engineered timber and masonry buildings.

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[3] – U.S. Department of Transportation, Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, (Washington, DC: U.S. Department of Transportation, Federal Transit Administration, May 2006), p. 7-8.

REGULATORY FRAMEWORK

Many government agencies have established noise regulations and policies to protect citizens from potential hearing damage and various other adverse physiological and social effects associated with noise and ground-borne vibration. The City of San Jose has adopted the Noise Element of the General Plan, which is based in part on federal and State regulations and is intended to control, minimize or mitigate environmental noise effects. The City policy that relates to ground-borne vibration indicates no activity on any site should cause ground vibration that is perceptible without instruments at the property line of the site. Therefore, the ground-borne vibration standards and guidelines for perceptibility and annoyance from the Federal Transit Administration (FTA) are used for this analysis, as well as the FTA construction vibration impact criteria for building damage. The regulations and policies that are relevant to PROJECT construction and operation noise are discussed below.

Applicable Plans and Policies

(1) Applicable State Noise Standards

The State of California has adopted noise compatibility guidelines for general land use planning. The types of land uses addressed by the State standards and the acceptable noise categories for each land use are included in the State of California General Plan Guidelines, which is published and updated by the Governor's Office of Planning and Research. The level of acceptability of the noise environment is dependent upon the activity associated with the particular land use. According to the State, an exterior noise environment up to 65 dBA CNEL is "normally acceptable" for single and multi-family residential uses, up to 75 dBA CNEL is "conditionally acceptable" with special noise insulation requirements, while 75 dBA CNEL and above is identified as "clearly unacceptable" noise levels for residential and hotel uses, respectively.[4] The maximum allowable interior noise level for residential structures is 45 dBA CNEL.

The California Environmental Quality Act (CEQA) Guidelines establishes guidelines for the evaluation of significant impacts of environmental noise attributable to a proposed project. The guidelines ask whether the project would result in:

- The generation of or exposure of persons to noise levels in excess of standards established in the local General Plan or Noise Ordinance or applicable standards of other agencies.
- The generation of or exposure of persons to excessive groundborne vibration or groundborne noise levels.

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[4] – State of California, Governor's Office of Planning and Research, *General Plan Guidelines*, (Sacramento, CA: State of California, Governor's Office of Planning and Research, October 2003), p. 250.

- A substantial permanent increase in ambient noise levels.
- A substantial temporary increase in ambient noise levels.
- If the project is located within an airport land use plan (ALUP) or within two miles of a public airport or public-use airport where an ALUP has not been adopted, the exposure of people residing or working within the project area to excessive noise levels.

Typically, in high noise environments, if the CNEL due to the project would increase by 3 dBA at noise sensitive receptors, the impact is considered significant.

(2) City of San Jose General Plan - Noise

The Noise Element of the General Plan identifies noise and land use compatibility standards for various land uses. The City's goal is to "minimize the impact of noise on people through noise reduction and suppression techniques, and through appropriate land use policies." Noise and vibration policy EC-1.1 specifies the standard for interior noise levels in residences, hotels, motels, residential care facilities and hospitals is 45 dBA DNL. EC-1.1 also indicates residential and most institutional land uses are considered "Normally Acceptable" for exterior noise levels up to 60 dBA DNL. This exterior noise level also provides "usable outdoor activity areas" for new multi-family and single family residences.

Noise and vibration policy EC-1.2 specifies 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 Unacceptable" noise level.

Other noise and vibration policies require:

- EC-1.3 – the mitigation of noise generation of new nonresidential land uses to 55 dBA DNL at adjacent existing or planned residential property lines,
- EC-1.7 – construction operations to use best available noise suppression devices and techniques, and limit construction hours near residential uses. 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 use would involve substantial noise generating activities continuing for more than 12 months. This policy requires large or complex projects to provide a construction noise logistics plan that:

- Specifies hours of construction
- Incorporates noise and vibration minimization measures
- Provides posting or notification of construction schedules
- A noise disturbance coordinator who responds to neighborhood complaints to reduce noise impacts on neighboring residents and other uses.

- EC-1.9 – residential development affected by noise from rail or other single-event noise sources to implement mitigation so recurring maximum instantaneous noise levels do not exceed 50 dBA maximum noise level (Lmax) in bedrooms and 55 dBA Lmax in other rooms.

(3) City of San Jose General Plan - Ground-Borne Vibration

The City policy indicates the goal to "minimize vibration impacts on people, residences, and business operations." The policies enacted to achieve this goal include:

- EC-2.1 – new development within 100 feet of rail lines to demonstrate project design features minimize vibration impacts on people, residences, and businesses to vibration levels at or below the guidelines of the Federal Transit Administration (FTA).
- EC-2.3 – new development to minimize construction and demolition vibration impacts to adjacent uses to 0.08 in/sec PPV for historic structures and 0.20 in/sec PPV for conventional construction.

The Federal Transit Administration (FTA) provides standards and guidelines for perceptibility and annoyance for ground-borne vibration as well as construction vibration impact criteria for building damage. As discussed in the *Characteristics of Vibration* section above, in most circumstances common ground-induced vibrations related to roadway traffic and construction activities pose no threat to buildings or structures, and for smooth roadways, the ground-borne vibration from traffic is barely perceptible.

The FTA has published a technical manual titled, "Transit Noise and Vibration Impacts Assessment," that provides ground-borne vibration impact criteria with respect to building damage and human response during construction activities. As discussed above, building vibration damage is measured in peak particle velocity described in the unit of inches per second. Table 2, below, provides the Federal Transit Administration vibration criteria applicable to construction activities. According to Federal Transit Administration guidelines, a vibration criterion of 0.20 inch per second should be considered as the significant impact level for non-engineered timber and masonry buildings. Furthermore, structures or buildings constructed of reinforced-concrete, steel, or timber, have vibration damage criteria of 0.50 inch per second pursuant to the FTA guidelines.

Table 2
Federal Transit Administration Construction Vibration Impact Criteria for Building Damage

Building Category	Peak Particle Velocity (inch per second)
I. Reinforced-concrete, steel or timber (no plaster)	0.5
II. Engineered concrete and masonry (no plaster)	0.3
III. Non-engineered timber and masonry buildings	0.2
IV. Buildings extremely susceptible to vibration damage	0.12

Source: Federal Transit Administration, 2006.

Impacts for the human response to vibration levels are given in VdB by the FTA in Table 8-1 of the *Transit Noise and Vibration Impact Assessment* manual[5], as shown in Table 3 below. The FTA Land Use Category 1 impact criteria is intended for vibration-sensitive research and manufacturing facilities, hospitals with vibration-sensitive equipment, and university research operations. These Category 1 impact criteria vibration levels are well below those associated with human annoyance, but are equal to the threshold of perceptibility. The FTA vibration criteria for Category 2, residential impact, indicate impacts occur at a 72 VdB vibration level for frequent events occurring more than 70 times per day, at 75 VdB for occasional events occurring between 30 and 70 times per day, and at 80 VdB for infrequent events occurring less than 30 times per day.

5 U.S. Department of Transportation, Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, (Washington, DC: U.S. Department of Transportation, Federal Transit Administration, May 2006), p. 8-3

Table 3
Federal Transit Administration Ground-Borne Vibration Impact Criteria for General Assessment

Land Use Category	**GBV Impact Levels** (VdB re 1 micro-inch /sec)		
	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 will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

Source: Federal Transit Administration, 2006.

ENVIRONMENTAL IMPACTS

Significance Thresholds

The following significance thresholds are used in this report to evaluate the significance of the PROJECT noise impacts:

- Proposed use of PROJECT is exposed to DNL in excess of the City's noise and land use compatibility guidelines
- PROJECT causes the DNL at noise sensitive receptors to increase by five dBA or more where the noise levels would remain "Normally Acceptable" or cause an increase by three dBA or more where noise levels would equal or exceed the "Normally Unacceptable" level.
- Nonresidential land uses generate noise levels in excess of 55 dBA DNL at adjacent residential property lines.
- Construction continuing for more than 12 months occurs within 500 feet of residential uses or 200 feet of commercial or office use.
- Noise levels within residential development due to noise from rail or other single-event noise sources exceeds 50 dBA maximum noise level (Lmax) in bedrooms and 55 dBA Lmax in other rooms.
- Groundborne vibrations at residences within 100 feet of rail lines exceed the FTA guidelines
- Construction and demolition vibration levels at adjacent land uses exceed 0.08 in/sec PPV for historic structures and 0.20 in/sec PPV for conventional construction.

ANALYSIS METHODOLOGY

Analysis of potential noise impacts associated with construction and operation of the PROJECT is based on noise monitoring and computer noise modeling. The noise levels generated by the PROJECT from construction and operations are determined from reference source noise levels or noise measurements and using the computer noise model Predictor, described below, to predict the noise levels at the receptor locations. These predicted noise levels are compared to the existing ambient noise levels to determine whether such noise levels would result in significant impacts. The existing ambient noise levels are also determined via noise monitoring and computer noise modeling.

Traffic noise modeling procedures for evaluating potential traffic noise impacts involved the calculation of the expected increase in noise caused by the traffic volume increase due to the PROJECT. Traffic volumes utilized were based on information provided by Hexagon Transportation Consultants, Inc., the PROJECT traffic engineer. The off-site traffic noise is analyzed on an increase in CNEL basis to determine the PROJECT's impact.

Construction noise analysis follows the procedures of the Federal Highway Administration Roadway Construction Noise Model, utilizing acoustic factors such as the construction equipment reference noise levels, the usage factor of the equipment, the site conditions and the distance to each receptor.

Predicted vibration impacts resulting from the implementation of the proposed PROJECT were determined using data from the Federal Transit Administration, and estimating the level of vibration at neighboring structures and comparing these vibration levels to the perceptibility and significance thresholds.

Each of these analyses is described in the ***Impact Analysis*** section of this report.

Description of Computer Model – Predictor

Sound from a point source propagates similar to the waves caused by throwing a stone into a pond. At the initial point of the disturbance the energy is dissipated over a small surface area. As the wave moves outward away from the initial point of disturbance, the circumference of the wave increases. Neglecting friction, the total energy remains the same but it is distributed over a greater surface area. Therefore, for any specific point at the wave, even though the total energy has not changed, the energy is less as the distance from the source increases. Under typical conditions the reduction in noise level is 6 dB per doubling of distance when evaluating the sound pressure level in the far field from a point source.

In the real world there are additional factors that will have an effect on how much sound energy reaches a particular receptor location: obstructions between the source and receptor, the directionality of the sound, absorption by the air, the type of terrain between the source and receptor, and climatic factors such as temperature and wind gradients in the atmosphere. The effects of these factors have been well documented and are defined in an International Standard ISO 9613-1 "Attenuation of Sound During Propagation Outdoors." Using the methods documented in this standard it can be predicted how much sound will radiate from a source to a receptor if all of the conditions are known with a reasonable degree of accuracy. Because of the number of variables for outdoor sound propagation, calculating the noise manually becomes impractical when there are numerous sound sources and many barriers or obstructions.

Computer software has been developed for acoustical calculations. Brüel & Kjaer developed acoustical software, Predictor, with the cooperation of Stapelfeldt Ingenieurgesellschaft mbH. The Predictor software models building structures, terrain, sound sources, etc., and it uses the calculation methods documented in ISO 9613-1 to calculate noise at defined receptor locations. The program can also be used to generate noise contours, showing predicted noise levels at defined intervals. The Predictor computer model has been used for the construction and operation noise analyses to model each noise source and predict the noise impacts at the sensitive receptors, taking into account all site conditions, including existing structures that provide noise shielding, air absorption of the noise, and the terrain and ground absorption effects.

Input to the Computer Model – Predictor Existing Conditions

A three dimensional replica of the PROJECT Site area was constructed in Predictor. The terrain of the area including the surrounding neighborhood was entered from data obtained from a topographical survey produced by HMH and the U.S. Geological Survey. The heights, footprints and locations of buildings on and around the PROJECT were determined based on field observations and aerial photographs. However, only structures that provided measureable noise shielding were included in the 3-D model.

Input to the Computer Model – Predicted Future Conditions

The intended modifications to the future conditions were provided by HMH. This file was imported into the Predictor model. Modifications to the PROJECT Site, as indicated on the architectural site plan, were included in the model.

ENVIRONMENTAL SETTING

Existing Conditions

Noise Environment

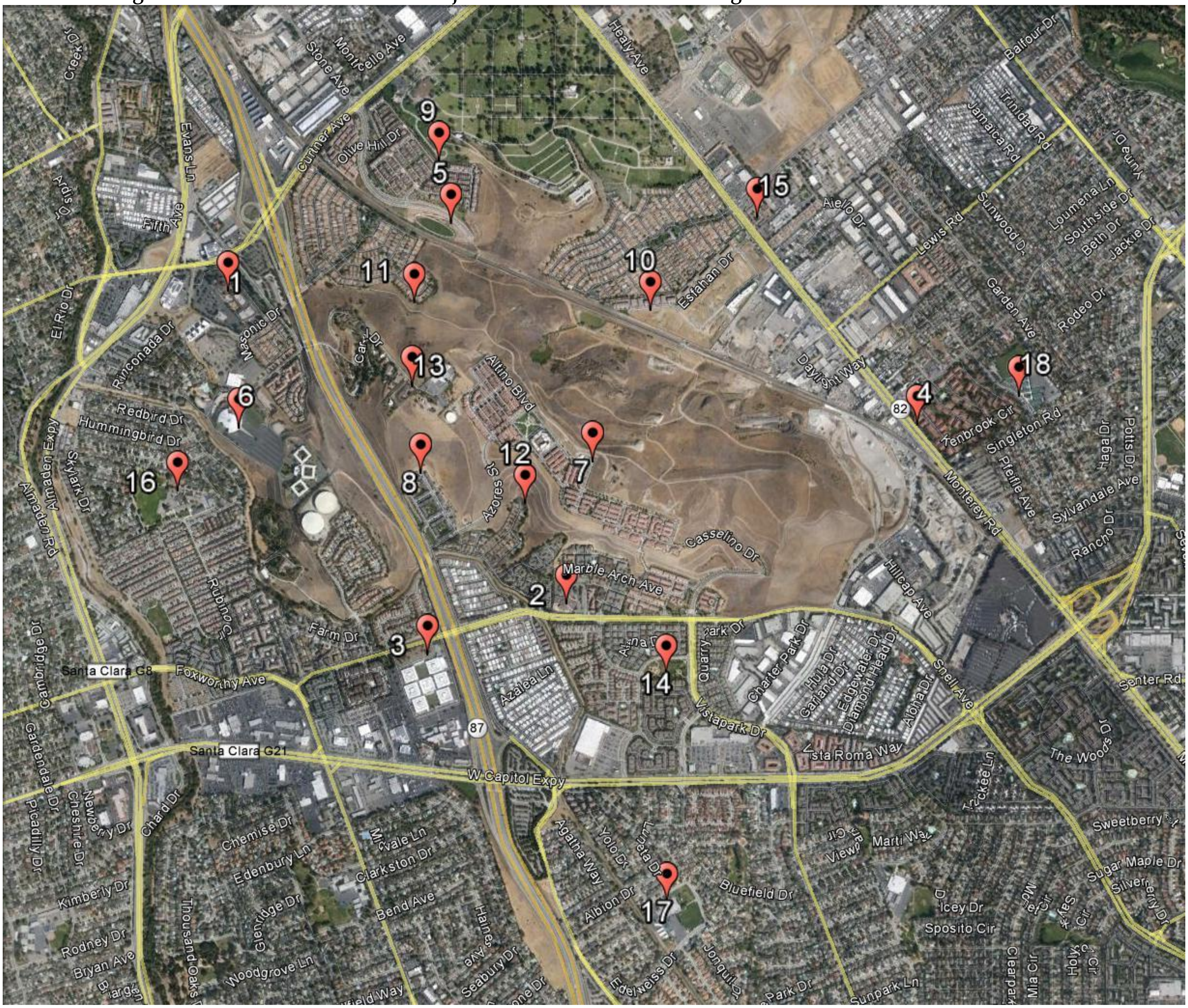
The proposed project site is generally bounded by the Caltrain/Union Pacific railroad tracks on the north, Old Hillsdale Avenue to the east, the Tuscany Hills development to the south, and the Millpond and Dairy Hill neighborhoods to the west. The Oak Hill Cemetery is located adjacent to the northeastern boundary of the Plan area. **Figure 2** shows the present site of the plan area and various land uses surrounding the PROJECT. Land uses to the north, south, east, and west of the site are mainly residential, with some commercial/industrial use. Traffic from Highway 87, Monterey Road, Curtner Avenue and the W. Capitol Expressway is the primary source of noise in the general area of the site.

Existing Ambient Monitored Noise Levels

To establish existing ambient noise levels in areas surrounding the PROJECT Site, a field monitoring study was conducted. Long term noise measurements were performed in and around the PROJECT site for documenting the ambient conditions. Larsen Davis Model 820 and Bruel & Kjaer Model 2250 and Model 2260 Sound Level Meters, which satisfy the American National Standards Institute (ANSI) for general environmental noise measurement instrumentation, were used for this purpose. Vehicular traffic is the predominant noise source around the PROJECT site. Long term noise measurements were performed at 18 locations as shown on **Figure 2**. The measurements occurred at these locations throughout the period of August 12 to August 15, 2013. Noise readings were measured over 1-minute intervals with "A" frequency fast time weighting. The resulting 1-minute Leq noise levels were energy-averaged to determine both the hourly Leq noise levels and the overall average Leq noise level for the referenced time period. Vibration measurements were performed on August 12 and August 13, 2013 at 65 feet from the railroad tracks. The weather conditions were normal and no anomalies were present during the survey periods.

Table 4, Existing Ambient Monitored Noise Levels, provides the noise level data associated with each monitoring period for each location. As shown, noise levels ranged from 53.5 dBA CNEL at the Mountain Springs measurement location to 76.6 dBA CNEL at the Kenwood Residences location. The high noise level measured at the Kenwood Residences location was due to the high volume of traffic along Monterey road. An additional measurement was performed 65 feet from the railroad tracks to determine the maximum noise level (Lmax) of passing trains. Nine passing trains were measured and the average Lmax measured 85.3 dBA.

Figure 2 – Communications Hill Project Site and Noise Monitoring Locations



Number	Location Name	Location Description
1	Cathedral of Faith	2315 Canoas Garden Ave
2	Hillside Evangelical	545 Hillsdale Ave
3	Metropolitan Educational Center	60 Hillsdale Ave
4	Kenwood Residences	Monterey & Southside Dr.
5	Kurte Park	Communications Hill Blvd
6	Church on the Hill	500 Sands Dr.
7	Tuscany Hills Residences	2933 Saint Florian Way
8	Helzer Residences	101 Nagel Way
9	Oak Hill Memorial Park	300 Curtner Ave

Number	Location Name	Location Description
10	Esfahan Drive Residences	Esfahan Ct.
11	Millpond Community	335 Millpond Dr.
12	Mountain Springs	336 Mountain Springs Dr.
13	Carol Residences	Carol Dr. near tower
14	Waterford Park	Vistapark & Sandpebble
15	Palm Tree Inn Motel	2724 Monterey Hwy.
16	Canoas Elementary School	880 Wren Dr
17	Carson Elementary School	4245 Meg Dr
18	Captain Jason Dahl School	3200 Water St

Table 4 - Existing Weekday Ambient Monitored Noise Levels

Location	Noise Sources	Noise Levels - CNEL	Noise Levels – Leq Range (dBA)
Cathedral of Faith	Traffic (Hwy 87, Curtner)	67	55 – 68
Hillside Evangelical	Traffic (Hillsdale)	65	49 – 64
Metropolitan Educational Center	Traffic (Hwy 87, Hillsdale)	60	46 – 58
Kenwood Residences	Rail, Traffic (Monterey,	77	61 – 77
Kurte Park	Rail, Traffic (Curtner)	61	41 – 57
Church on the Hill	Traffic (Hwy 87)	58	44 – 57
Tuscany Hills Residences	Rail, Traffic (Hwy 87)	54	38 – 52
Helzer Residences	Traffic (Hwy 87)	58	45 – 56
Oak Hill Memorial Park	Traffic (Curtner, Monterey)	61	49 – 63
Esfahan Drive Residences	Rail	63	35 – 58
Millpond Community	Rail, Traffic (Hwy 87, Curtner)	54	40 – 52
Mountain Springs	Traffic (Hwy 87)	54	42 – 51
Carol Residences	Traffic (Hwy 87)	61	48 – 58
Waterford Park	Traffic (Vistapark)	60	45 – 58
Palm Tree Inn Motel	Traffic (Monterey)	64	49 – 66
Canoas Elementary School	Traffic (Local)	59	45 – 58
Carson Elementary School	Traffic (Local)	59	46 – 65
Captain Jason Dahl School	Traffic (Local)	59	46 – 57

Note: Ambient noise levels measured over 1-minute intervals were energy-averaged to determine hourly and overall average Leq noise levels

Ground-Borne Vibration Environment

Rail vehicles utilizing the adjacent railway and vehicular traffic are the sources of ground-borne vibration in the PROJECT vicinity. The rail vibrations measured between 72.9 and 83.6 VdB at a distance of 65 feet from the railway. The existing vehicular traffic vibration levels within the PROJECT vicinity are negligible, except for trucks driving over potholes and bumps within 25 feet of existing structures where the vibration may be perceived and may be annoying.

Impact Analysis and Mitigation Measures

The PROJECT would involve the grading of the site and construction of new buildings. The PROJECT would introduce new residential and commercial land uses with new noise sources, including traffic generated by the project, onsite activity, mechanical equipment associated with the commercial activity, and construction noise.

The various measurement locations indicated previously in Figure 2 were utilized as sensitive receptors for the impact analysis, as well as residential land use adjacent to the site. The PROJECT noise impact for construction and future operations were analyzed at each of these sensitive receptors.

Impact 1: The site is exposed to noise levels exceeding those normally considered satisfactory with the PROJECT intended use. This is potentially a significant impact.

The existing DNL on the site measured as high as 63 DNL along the railway near the Esfahan Drive Residences location and 62 DNL at the Carol Residences location, and are calculated to be approximately 61 DNL at the northwest corner of the site near Monterey Road. Residential land uses are proposed in these areas where the noise exposure exceeds the City's goal of 60 DNL. Mitigation measures are therefore required to achieve an acceptable outdoor noise level of 60 DNL or less, where possible, and interior noise levels of 45 DNL or less. These noise levels are readily achievable through the incorporation of sound walls and the construction elements utilized for the residences. As these exterior noise levels are at most 3 dBA above the 60 DNL goal, standard five-foot masonry walls or solid wood fencing will reduce the outdoor activity area noise level to 60 DNL. Standard exterior construction will provide 25 dB of noise attenuation of the exterior noise level per Table 1, *Outside to Inside Noise Attenuation*, providing an interior noise level of 38 DNL, complying with the interior noise goal.

Mitigation 1: Provide minimum five foot masonry walls or solid wood fencing along the PROJECT perimeter of residential land uses near Highway 87, Monterey Road, and Hillsdale Avenue/Snell Avenue.

Impact 2: Project-generated traffic due to PROJECT-generated residential and commercial traffic would not cause a substantial increase in noise levels in the area. This is a less-than-significant impact.

Vehicular traffic on the street network surrounding the project site will increase in the future due to background growth and due to the residential plus commercial uses proposed in the PROJECT. Traffic data prepared by the transportation consultant, Hexagon Transportation Consultants, Inc., projected traffic increases due to background growth and due to the PROJECT for 83 intersections and roadway sections. The maximum predicted noise increase due to PROJECT-generated residential and commercial traffic is 2.9 dBA, less than the 3 dBA considered a significant impact for land uses with "Normally

Unacceptable" noise levels and less than the 5 dBA significance impact for land uses with "Normally Acceptable" noise levels. Therefore this is a less-than-significant impact.

Impact 3: Project-generated traffic due to PROJECT-generated industrial, residential and commercial traffic would not cause a substantial increase in noise levels in the area. This is a less-than-significant impact.

The 83 intersections and roadway sections were analyzed with PROJECT-generated industrial-use traffic in addition to the residential and commercial use traffic. The noise levels due to PROJECT-related traffic at the intersection of Hillsdale Avenue and Snell Avenue is predicted to increase 4.4 dBA Leq, the only intersection with a predicted increase of greater than 3 dBA. The industrial-use traffic accounts for the majority of the noise increase, as without the industrial traffic, the projected noise increases are 1.4 dBA. The ambient noise level is 60 CNEL, and with a 4.4 dBA Leq increase in traffic noise during daytime hours, the increase in CNEL is 2 dBA. Therefore the predicted noise increase is less than the significance threshold of 3 dBA and is a less-than-significant impact.

Impact 4: Noise generated by activity on the site, including the proposed retail and commercial facilities, may generate a DNL of 55 dBA at any existing land use. This is potentially a significant impact.

The PROJECT design for the proposed retail and commercial facilities incorporates features to minimize noise impacts to the existing land use. The new facilities are strategically placed to shield noise impacts from activities in parking lots and outdoor areas. As final designs are completed for these facilities, acoustical analysis of the mechanical systems will be required to ensure compliance.

Mitigation 4: An acoustical study should be completed by a qualified acoustical consultant at final design of the PROJECT to confirm compliance.

Impact 5: Noise-generating activities associated with the construction of the PROJECT would temporarily elevate noise levels adjacent to the site. This is a significant impact.

The construction of the proposed buildings would increase noise levels in the area. The construction noise impacts were analyzed for long-term noise exposure due to all proposed construction equipment operating during each phase of construction as well as for short term noise exposure from construction equipment operating along the PROJECT site property line. The proposed construction equipment to be utilized for each type of on-site construction activity is indicated in Table 5 below. The construction equipment noise level for all equipment listed for each construction activity was predicted for each construction phase in the proposed construction schedule at each location on the site. The noise levels predicted include the maximum long-term noise levels and the maximum short-term noise levels while construction activity occurs along the PROJECT site boundaries.

Table 5 - Proposed Construction Equipment

Grading/Rock/Paving	**Dry Utilities**	**Landscaping**
10 Scrapers	6 Backhoes	2 Backhoes
4 Bulldozers	10 Trucks	1 Bobcat
2 Compactors	3 Loaders	1 Flatbed Truck
2 Loaders	2 Water Trucks	2 Dump Trucks
20 Dump Trucks	6 Pickup Trucks	2 Pickup Trucks
3 Water Truck		
2 Graders	**Vertical Construction**	
2 Pavers/2 Rollers	5 Forklifts	**Bridge Construction**
	5 Skip Loaders	1 Scraper
Underground Wet Utilities	7 Cranes	1 Grader
8 Excavators	5 Backhoes	2 Crawler Tractors
4 Tractors/4 Backhoes	25 Concrete Trucks	2 Plate Compactors
3 Water Trucks	30 Delivery Trucks	1 Rubber Tire Loader
10 Trucks	6 Concrete Pump Trucks	2 Cranes
	5 Conveyor Belts	2 Excavators
Concrete		1 Bore/Drill Rigs
20 Concrete Trucks		4 Other Construction Equipment
4 Pickup Trucks		2 Tractor/Loader/Backhoes

The maximum predicted long-term average noise levels at each sensitive receptor location due to all of the proposed construction equipment for the entire construction schedule are shown in Table 6 below. Table 7 indicates the predicted short-term noise exposure due to construction equipment operating along the site property line. Both tables indicate the measured existing ambient CNEL and the lowest hourly Leq measured during the construction hours of 7:00 am to 7:00 pm.

Table 6 – Predicted Maximum Long-Term Construction Noise Levels

Location	Construction Leq Noise Levels (dBA)	Measured CNEL	Lowest Measured Hourly Leq During Construction Hours (dBA)
Cathedral of Faith	36	67	61
Hillside Evangelical	38	65	61
Metropolitan Educational Center	39	60	56
Kenwood Residences	51	77	72
Kurte Park	63	61	50
Church on the Hill	37	58	53
Tuscany Hills Residences	53	54	49
Helzer Residences	37	58	50
Oak Hill Memorial Park	42	61	56
Esfahan Drive Residences	52	63	53
Millpond Community	47	54	48
Mountain Springs	40	54	45
Carol Residences	47	61	55
Waterford Park	44	60	56
Palm Tree Inn Motel	49	64	60
Canoas Elementary School	33	59	53
Carson Elementary School	36	59	52
Captain Jason Dahl School	41	59	53

It is evident from Table 6 that the only two sensitive locations impacted by long-term construction noise are Kurte Park and the Tuscany Hills Residences, and the construction activity causing the impacts at each site are the bridge construction and the initial grading, respectively. The predicted hourly Leq is 63 at Kurte Park and 53 at Tuscany Hills Resiences, increases of 13 and 4 dBA, respectively. The CNEL for the predicted construction noise levels is estimated to remain approximately 63 CNEL at Kurte Park and to increase by 1 dBA to 55 CNEL at the Tuscany Hills Residences. The CNEL increase of 1 dBA at Tuscan Hills is less than the 5 dBA significance impact for land uses with "Normally Acceptable" noise levels of 60 CNEL or less.

Table 7 – Predicted Short-Term Maximum Construction Noise Levels

Location	Construction Leq Noise Levels (dBA)	Measured CNEL	Lowest Measured Hourly Leq During Construction Hours (dBA)
Cathedral of Faith	37	67	61
Hillside Evangelical	39	65	61
Metropolitan Educational Center	39	60	56
Kenwood Residences	54	77	72
Kurte Park	67	61	50
Church on the Hill	40	58	53
Tuscany Hills Residences	77	54	49
Helzer Residences	40	58	50
Oak Hill Memorial Park	43	61	56
Esfahan Drive Residences	64	63	53
Millpond Community	77	54	48
Mountain Springs	43	54	45
Carol Residences	77	61	55
Waterford Park	47	60	56
Palm Tree Inn Motel	52	64	60
Canoas Elementary School	35	59	53
Carson Elementary School	39	59	52
Captain Jason Dahl School	44	59	53

Table 7 indicates that sensitive receptors at Kurte Park, the Tuscany Hills Residences, the Esfahan Drive residences, the Millpond Community, and the Carol Residences will experience short-term construction noise impacts. The predicted construction noise levels are as high as 77 dBA. These short-term noise impacts only occur while construction equipment proposed to work along the PROJECT site boundaries is operating nearest these sites.

Mitigation 5: Construction Noise Reduction Measures – The following standard measures are identified to minimize the potential effects of construction noise on adjacent land uses:

- **Limit construction activity to 7:00 am to 7:00 pm on weekdays, 9:00 am to 5:00 pm on Saturdays, and no construction activity on Sundays or holidays.**
- **Schedule highest noise-generating activity and construction activity along the PROJECT site boundaries near Kurte Park, Tuscany Hills Residences, Esfahan Drive Residences, Millpond Community, and Carol Residences between 9:00 am and 3:00 pm wherever feasible.**
- **Equip all internal combustion engine-driven equipment with original factory (or equivalent) intake and exhaust mufflers which are maintained in good condition.**

- **Prohibit and post signs prohibiting unnecessary idling of internal combustion engines.**
- **Locate all stationary noise-generating equipment such as air compressors and portable generators as far as practicable from noise-sensitive land uses.**
- **Utilize "quiet" air compressors and other stationary equipment where feasible and available.**
- **Designate a noise disturbance coordinator who would respond to neighborhood complaints about construction noise by determining the cause of the noise complaints and require implementation of reasonable measures to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site.**

Impact 6: Noise-generating activities associated with the off-site roadway improvement construction due to the PROJECT would temporarily elevate noise levels adjacent to the construction. This is a significant impact.

The construction for the roadway improvements would increase noise levels in the area. The construction noise impacts were analyzed for the noise exposure due to all proposed construction equipment operating during the noisiest phase of roadway construction. The proposed construction equipment to be utilized for each type of roadway improvement construction activity was analyzed and the loudest phase, the grading phase, included 1 scraper, 1 bulldozer, 1 loader, 1 dump truck, and 1 water truck simultaneously in use. The construction equipment noise level was predicted for the closest sensitive receiver located near the site. The noise levels predicted include the maximum noise levels while construction activity occurs.

Table 8 – Predicted Maximum Construction Noise Levels (Leq)

Location	Location 1	Construction Leq Noise Levels (dBA)	Location 2	Construction Leq Noise Levels (dBA)
Route 87/Narvaez On-Ramp and Pedestrian/Bike Trail	Pre-school	75	Residential	65
Curtner Corridor Improvements	Residential	74	Commercial	72
Monterey Curtner	Commercial 1	75	Commercial 2	77
Alamedan Expressway/Foxworthy	Commercial	81	Residential	69
Capital Expressway/Snell Avenue	Residential	64	Commercial	75
Route 87/Curtner	Residential	56	Residential	52

Table 8 indicates that sensitive receptors near the roadway improvement construction will experience short-term construction noise impacts. The predicted construction noise levels are as high as 74 dBA for residential sites, 75 dBA for a pre-school, and 81 for commercial sites.

Mitigation 6: Construction Noise Reduction Measures – The following standard measures are identified to minimize the potential effects of construction noise on adjacent land uses:

- **Limit construction activity to 7:00 am to 7:00 pm on weekdays, 9:00 am to 5:00 pm on Saturdays, and no construction activity on Sundays or holidays.**
- **Schedule highest noise-generating activity and construction activity between 9:00 am and 3:00 pm wherever feasible.**
- **Equip all internal combustion engine-driven equipment with original factory (or equivalent) intake and exhaust mufflers which are maintained in good condition.**
- **Prohibit and post signs prohibiting unnecessary idling of internal combustion engines.**
- **Locate all stationary noise-generating equipment such as air compressors and portable generators as far as practicable from noise-sensitive land uses.**
- **Utilize "quiet" air compressors and other stationary equipment where feasible and available.**

Designate a noise disturbance coordinator who would respond to neighborhood complaints about construction noise by determining the cause of the noise complaints and require implementation of reasonable measures to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site.

Impact 7: Noise levels within residential development due to rail noise would not exceed 50 dBA Lmax in bedrooms and 55 dBA Lmax in other rooms. This is a less-than-significant impact.

The maximum noise levels of trains measured 60 feet from the railway averaged 85.3 dBA. Adjusting this measured value to determine the noise exposure at the closest proposed structure at 200 feet from the railway yields 75 dBA. Standard exterior construction will provide 25 dB of noise attenuation of the exterior noise level per Table 1, *Outside to Inside Noise Attenuation*, providing an interior noise level of 50 dBA DNL, complying with the interior noise goal for all rooms.

Mitigation 7: An acoustical study should be completed by a qualified acoustical consultant at final design of the PROJECT to confirm compliance.

Impact 8: Groundborne vibrations at residences near rail lines will not exceed FTA guidelines. This is a less-than-significant impact.

The maximum train vibration measured 83.6 VdB at 60 feet from the railway. With the nearest structure 200 feet from the railway, the estimated vibration level will be 69 VdB. This is below the significance criteria of 72 VdB as stated in the FTA guidelines.

Mitigation 8: An acoustical study should be completed by a qualified acoustical consultant at final design of the PROJECT to confirm compliance.

Impact 9: Vibration associated with the construction of the PROJECT will not generate vibration impacts for existing structures but may generate perceptible and/or annoying vibration impacts at sensitive receptors. This may be a significant impact.

A review of the proposed construction equipment and the FTA vibration source levels indicates that at the proposed minimum distance between the construction equipment and the sensitive receptors of 60 feet, vibration levels are less than the FTA construction vibration impact criteria of 0.20 in/sec PPV for building damage. However, vibrations from construction equipment may be perceptible and even annoying, depending on the location of the activity. Table 8 below indicates the distances to maintain between equipment and sensitive receptors in order to eliminate perceptibility or annoyance.

Table 8 – Construction Equipment Vibration Distances for Perceptibility and Annoyance

Equipment	Vibration Source Levels at 25' (PPV)	Perceptible Distance	Annoyance Distance
Typical Pile Driver	0.644 **in/sec**	500 feet	300 feet
Vibratory Roller	0.210 **in/sec**	250 feet	150 feet
Large Bulldozer	0.089 **in/sec**	150 feet	100 feet
Hoe Ram	0.089 **in/sec**	150 feet	100 feet

Mitigation 9: Maintain the "Perceptible Distance" shown in Table 7 between the specified construction equipment and sensitive receptors (existing structures) wherever feasible to eliminate perceptible vibrations. Alternatively, maintain the "Annoyance Distance" shown in the table or utilize alternate equipment with lower vibration levels.

APPENDIX A

Table A.1 – Definitions of Noise-Related Terms

Term	Definition
Decibel, dB	A unit describing the amplitude of sound equivalent to 20 times the logarithm, to the base 10, of the ratio of the pressure of the sound to the reference pressure of 20 μPa.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured in an A-weighting filter network. The A-weighting de-emphasizes the very low 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. All sound levels in this report are in the A-weighted scale.
L_0 (L_{max}), L_2, L_8, L_{25}, L_{50}	The A-weighted noise levels that are exceeded 0 percent (maximum noise level), 2 percent, 8 percent, 25 percent, and 50 percent of the time during the measurement period.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the stated measurement period.
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 P.M. to 10:00 P.M., and after addition of 10 decibels to noise levels in the night between 10:00 P.M. and 7:00 A.M.
Day-Night Noise Level, DNL, Ldn	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 P.M. and 7:00 A.M.
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.
Impulsive Noise	Sound of short duration. Typically associated with an abrupt onset and rapid decay (i.e., gun-shots, etc.).
Pure Tones	A sound wave, residing over a small range of frequencies, which has a sinusoidal behavior over time.
VdB	Unit of measurement used by FHWA to describe ground-borne vibration. Equivalent to 20 times the logarithm, to the base 10, of the ratio of the root mean square ground-borne velocity to the reference of reference of $1x10^{-6}$ in/sec.