BUTTERFIELD – KEENAN GENERAL PLAN AMENDMENT ENVIRONMENTAL NOISE ASSESSMENT MORGAN HILL, CALIFORNIA

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INTRODUCTION

The Butterfield – Keenan General Plan Amendment Project (GPA) would facilitate the development of residential uses on the site. The 19.5 acre site is located at the southwest corner of Butterfield Boulevard and Jarvis Drive (North) and extends west along Jarvis Drive (North) to Monterey Road. The General Plan designation would shift from *Industrial* to *Multi-family Medium* and the site could accommodate about 410 multi-family units.

This report evaluates the potential significance of noise impacts that could result from the Project, including the noise and land use compatibility of proposed uses, as well as the potential for temporary or permanent noise level increases at nearby sensitive receptors. The Setting Section of this report presents the fundamentals of environmental noise and vibration, describes the applicable regulatory criteria, and describes the existing noise environment at the project site and land uses in the project's vicinity. The Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts, provides a discussion of each project impact, and presents measures designed to provide a compatible project in relation to surrounding noise sources and land uses.

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (frequency) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

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

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA).* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. Because sound levels can vary 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* (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.

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One is the Peak Particle Velocity (PPV) and another is the Root Mean Square (RMS) velocity. The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. The RMS velocity is defined as the average of the squared amplitude of the signal. The PPV and RMS vibration velocity amplitudes are used to evaluate human response to vibration. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous vibration levels produce. The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at much 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. In high noise environments, which are more prevalent where groundborne vibration approaches perceptible levels, this rattling phenomenon may also be produced by loud airborne environmental noise causing induced vibration in exterior doors and windows.

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

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Studies have shown that the threshold of perception for average persons is in the range of 0.008 to 0.012 in/sec PPV. 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 minor cracking of building elements, or may threaten the integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher and there is no general consensus as to what amount of vibration may pose a threat for structural damage to the building. 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.

Railroad and light-rail operations are potential sources of substantial ground vibration depending on distance, the type and the speed of trains, and the type of railroad track. People's response to ground vibration has been correlated best with the 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 (60 to 70 VdB). Perceptible vibration levels inside residences are attributed to the operation of heating and air conditioning systems, door slams and foot traffic. 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 concert
Jet fly-over at 1,000 feet		
Locomotive horn at 100 feet	100 dBA	
Gas lawn mower at 3 feet	90 dBA	Loud stereo
Diesel truck at 50 feet at 50 mph		Food blender
	80 dBA	Garbage disposal
Noisy urban area, daytime		
Gas lawn mower, 30 feet	70 dBA	Vacuum cleaner
Commercial area		Normal speech face to face
Heavy traffic at 300 feet	60 dBA	
		Large business office
Quiet urban daytime	50 dBA	Dishwasher in next room
Quiet urban nighttime	40 dBA	Theater, large conference room
Quiet suburban nighttime		
	30 dBA	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20 dBA	
		Broadcast/recording studio
Threshold of hearing	10 dBA	

Source: Technical Noise Supplement (TeNS), Caltrans, November 2009.

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	Virtually no risk of damage to normal buildings
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential dwellings such as plastered walls or ceilings
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to newer residential structures

Source: Transportation- and Construction-Induced Vibration Guidance Manual, California Department of Transportation, June 2004.

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, US Department of Transportation Federal Transit Administration, May 2006.

Regulatory Background - Noise

The future development on the project site would be subject to noise-related regulations, plans, and policies established within documents prepared by the State of California and the City of Morgan Hill. These documents are implemented during the environmental review process to limit noise exposure at existing and proposed noise sensitive land uses. Applicable planning documents include: (1) the California Environmental Quality Act (CEQA) Guidelines, Appendix G, (2) the City of Morgan Hill General Plan, and (3) the City of Morgan Hill Code of Ordinances. Regulations, plans, and policies presented within these documents form the basis of the significance criteria used to assess project impacts.

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:

- 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?

- Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?

- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?

- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

- 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?

- For a project within the vicinity of a private airstrip, exposure of people residing or working in the project area to excessive noise levels?

Public Health and Safety Element of the City of Morgan Hill General Plan. The Public Health and Safety Element of the General Plan sets forth noise and land use compatibility standards to guide development, and noise goals and policies to protect citizens from the harmful and annoying effects of excessive noise. Policies established in the Noise Element of the General Plan that are applicable to the proposed project include:

7a. New development projects shall be designated and constructed to meet acceptable exterior noise level standards, as follows:

- The maximum exterior noise level of 60 dBA L_{dn} shall be applied in residential areas where outdoor noise is a major consideration (e.g., backyards in single family housing developments and recreation areas in multi-family housing projects.) Where the city determines that providing an L_{dn} of 60 dBA or lower cannot be achieved after the application of reasonable and feasible mitigation, an L_{dn} of 65 dBA may be permitted.

- Indoor noise levels should not exceed an L_{dn} of 45 dBA in new residential housing units.

- Noise levels in new residential development exposed to an exterior L_{dn} 60 dBA or greater should be limited to a maximum instantaneous noise level (e.g., trucks on busy streets, train warning whistles) in bedrooms of 50 dBA. Maximum instantaneous noise levels in all other habitable rooms should not exceed 55 dBA. The maximum outdoor noise level for new residences near the railroad shall be 70 dBA L_{dn}, recognizing that train noise is characterized by relatively few loud events.

7b. The impact of a proposed development project on existing land uses should be evaluated in terms of the potential for adverse community response based on significant increase in existing noise levels, regardless of compatibility guidelines.

7e. Noise level increases resulting from traffic associated with new projects shall be considered significant if: a) the noise level increase is 5 dBA L_{dn} or greater, with a future noise level of less than 60 dBA L_{dn}, or b) the noise level increase is 3 dBA L_{dn} or greater, with a future noise level of 60 dBA L_{dn} or greater.

City of Morgan Hill Code of Ordinances. Chapter 8.28, Section 8.28.040 of the Health and Safety section of the Municipal Code prohibits construction activities between the hours of eight p.m. and seven a.m., Monday through Friday, and between the hours of six p.m. and nine a.m. on Saturday. Construction activities may not occur on Sundays or federal holidays.

Regulatory Background - Vibration

The City of Morgan Hill 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 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 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).

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

TABLE 5 Groundborne Vibration Impact Criteria

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

Notes:

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

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

Existing Noise Environment

The 19.5 acre site is located at the southwest corner of Butterfield Boulevard and Jarvis Drive and extends west along Jarvis Drive to Monterey Road. The site is currently undeveloped. There is a residential development across Jarvis Drive from the site. An office/light industrial use is located across Butterfield Boulevard from the site, undeveloped land is located to the south, and undeveloped land and the Union Pacific Railroad (UPRR) tracks are located to the west across Monterey Road. The El Toro Fire Station is located further to the west across the UPRR tracks.

The existing noise environment on the project site results primarily from vehicular traffic along Butterfield Boulevard and Monterey Road. The UPRR rail corridor is used intermittently (about 12 to 15 trains per day) and generates relatively high noise levels during train passby events. The duration of these high noise level events is normally less than a few minutes during any hour. The office/light industrial use to the east has offices facing Butterfield Boulevard and does not affect the noise environment on the site.

Noise levels were measured along Butterfield Boulevard near Jarvis Drive (south) by *Illingworth & Rodkin, Inc.* in June 2012.[2] The measurement location was approximately 95 feet east from the center of the nearest travel lane. This measurement quantified the daily trend in noise levels attributable to traffic along the roadway. Hourly average noise levels typically ranged from 57 to 63 dBA L_{eq} during the day, and from 46 to 58 dBA L_{eq} at night. Calculated day-night average noise levels ranged from 62 to 63 dBA $L_{dn.}$ During the same survey, noise levels were also measured at a location approximately 50 feet from the center of the UPRR train tracks. Hourly average noise levels typically ranged from 49 to 75 dBA L_{eq} during the day, and from 43 to 75 dBA L_{eq} at night. The loudest hourly averages were heavily influenced by train events during both daytime and nighttime hours. Calculated day-night average noise levels at this location ranged from 72 to 76 dBA L_{dn} with an average of 75 dBA L_{dn}. Maximum instantaneous noise levels typically ranged from 90 dBA L_{max} to 100 dBA L_{max}, and the highest noise level during the three days of measurements reached 107 dBA L_{max}. Noise levels were monitored using Larson-Davis Laboratories Model 820 integrating sound level meters fitted with precision microphones and windscreens. The railroad tracks are located, at the closest point, about 175 feet from the western boundary of the project site. Sounds levels drop off with distance from a railroad train at a rate of 3 - 4 dBA per doubling of distance from the tracks. The noise level along the western boundary of the Site resulting from rail operations is calculated to be 68 dBA L_{dn}, with typical maximum noise levels ranging from 83 – 93 dBA L_{max}.

A noise monitoring survey consisting of two short-term noise measurements was performed on Tuesday, June 24, 2014 to supplement existing noise conditions on the project site and at nearby sensitive receptors. The measurement sites are shown on Figure 1. Table 6 summarizes the noise data collected at the noise monitoring sites. Daily average noise levels at the noise monitoring sites were estimated based on long-term noise data described above.

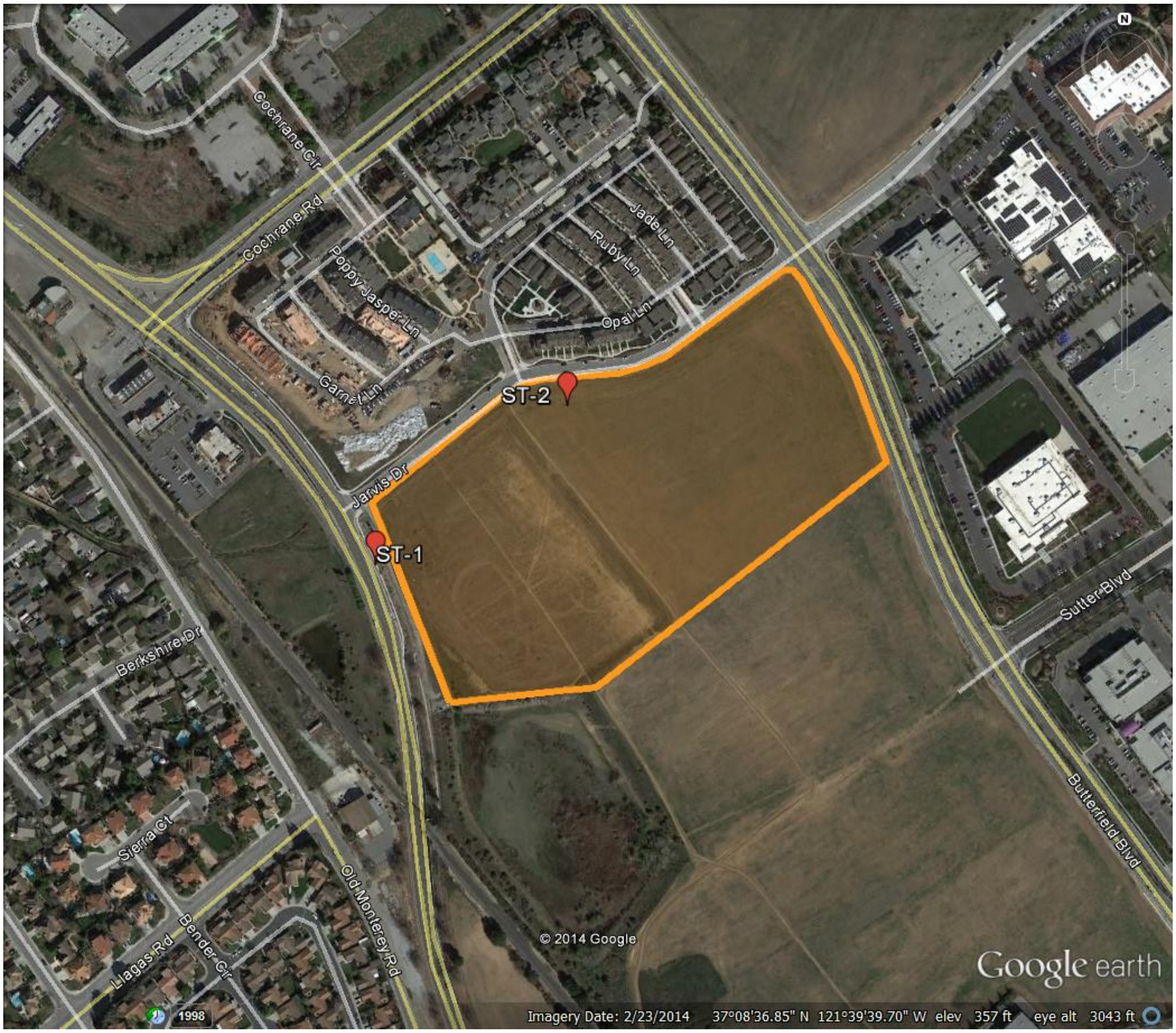
TABLE 6 - Summary of Short-Term Noise Measurements (dBA)

Noise Measurement Location	Date Time	L_{eq}	L_{max}	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	Est. L_{dn}
ST-1: 50 feet from the center of Monterey Road, westernmost corner of the Site.	6/24/2014 1110-1120	65	80	70	62	60	67
ST-2: 50 feet from the center of Jarvis Drive, northernmost portion of the Site near center.	6/24/2014 1210-1220	46	61	48	44	42	60

*No train pass-bys occurred during short-term measurements. L_{dn} levels were estimated based on noise levels measured in 2012 and adjusted for distance from the roadways and railroad.

[2] Butterfield Boulevard Residential Projects General Plan Amendment, Environmental Noise Assessment, Illingworth & Rodkin, Inc., August 15, 2012.

FIGURE 1 Aerial Photo Showing Noise Monitoring Locations



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 receptors 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:

- 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.

- A significant impact would be identified if the project would expose persons to vibration levels that would exceed the FTA criteria for groundborne vibration.

- A significant impact would be identified if the construction of the project would expose persons to excessive vibration levels. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in "architectural" damage to normal buildings.

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

- 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 greater than one year would constitute a significant temporary noise increase at adjacent residential land uses.

Impact 1: **Noise and Land Use Compatibility.** Future residential uses developed at the project site would be exposed to exterior noise levels greater than 60 dBA L_{dn}, which exceeds the exterior noise and land use compatibility standard presented in the City of Morgan Hill's General Plan. Interior noise levels would be expected to exceed 45 dBA L_{dn} assuming standard residential construction methods. **This is a significant impact.**

Future Exterior Noise Environment

The future noise environment at the project site would continue to result from traffic along Butterfield Boulevard, intermittent UPRR train pass-bys, and possible high-speed rail trains. Currently, the California High-Speed Rail Authority is proposing a High-Speed Train (HST) project between the Bay Area and the Central Valley, and the HST alignment is envisioned along the UPRR right-of-way.[3] There are numerous uncertainties regarding this potential project, therefore, making the prediction of future day-night average noise levels from conventional trains and high-speed rail trains very difficult. The calculation of daily average noise levels is highly dependant on the number and type of trains planned per day and the timing of the train passbys over the course of the day, whether during the daytime or at night.

Noise levels in outdoor use areas that are affected by transportation noise are required to be maintained at or below 60 dBA L_{dn} to be considered acceptable for residential development. Per the City's General Plan, noise levels in outdoor use areas that are affected by railroad noise are required to be maintained at or below 70 dBA L_{dn} to be considered acceptable for residential development. Future L_{dn} noise levels at typical setbacks of residential properties (100 feet) along Butterfield Boulevard and Monterey Road are predicted to be up to 70 dBA L_{dn} based on data from previous projects within the vicinity.[4] Where exterior noise levels as a result of automobile traffic exceed the City's noise level goal of 60 dBA L_{dn}, mitigation is normally required to provide a compatible exterior noise environment. Achieving the City's noise level goal of 60 dBA L_{dn} may not be possible in all situations, and a somewhat higher acceptability threshold is allowed by the City provided that the noise level in at least one of the outdoor use areas provided at a development is reduced to 65 dBA L_{dn}, consistent with the residential land use guidelines of the U.S. Department of Housing and Urban Development (HUD) and the U.S. Department of Transportation, Federal Aviation Administration (FAA).[5] Rail traffic along the conventional railroad line is anticipated to increase slightly assuming a moderate growth in rail service. The L_{dn} noise level at 175 feet from UPRR tracks would be 69 dBA $L_{dn,}$ below the 70 dBA L_{dn} threshold considered "acceptable" by local guidelines for rail operations. The overall noise level resulting from Monterey Road traffic and the railroad is calculated to reach 70 dBA L_{dn}.

Measures to be Considered at the Time of Future Development

Mitigation methods available to reduce exterior noise levels in private or shared outdoor use areas would include site planning alternatives (e.g., increased setbacks and using the proposed buildings as noise barriers), the construction of traditional noise barriers or earth berms, or a combination of the above. The final recommendations for mitigation would be determined on a project-specific basis when detailed site plans and grading plans are available. Setbacks of about 320 feet would reduce future noise levels at houses along Butterfield Boulevard or Monterey Road to less than 60 dBA L_{dn}.

Future Interior Noise Environment

The City of Morgan Hill requires that interior noise levels within new residential units not exceed 45 dBA L_{dn}. Interior noise levels in new residential development exposed to an exterior

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[3] Bay Area to Central Valley High-Speed Train Partially Revised DRAFT Program Environmental Impact Report, January 2012.

[4] Morgan Hill Downtown Specific Plan, Illingworth & Rodkin, Inc., July 16, 2009.

[5] U.S. Department of Housing and Urban Development, 24 CFR Part 51. U.S. Department of Transportation, Federal Aviation Administration, 14 CFR Part 150.

L_{dn} 60 dBA or greater should also be limited to a maximum instantaneous noise level (e.g., trucks on busy streets, train warning whistles) in bedrooms of 50 dBA, and 55 dBA in all other habitable rooms. Some residential units along Butterfield Boulevard could be exposed to exterior noise levels of approximately 70 dBA L_{dn}. In buildings of typical construction, with the windows partially open, interior noise levels are approximately 15 dBA lower than exterior noise levels. With the windows closed, standard residential construction typically provides 20 to 25 decibels of exterior to interior noise reduction.

In exterior noise environments of 60 dBA L_{dn} or less, standard construction methods are normally sufficient to reduce noise levels within residential units to 45 dBA L_{dn}. Where exterior noise levels range from 60 to 65 dBA L_{dn}, the inclusion of adequate forced air mechanical ventilation is often the method selected to reduce interior noise levels to acceptable levels by closing the windows to control noise. Where noise levels exceed 65 dBA L_{dn}, forced-air mechanical ventilation systems and sound-rated construction methods are normally required. Such methods or materials may include a combination of smaller window and door sizes as a percentage of the total building façade facing the noise source, sound-rated windows and doors, sound rated exterior wall assemblies, and mechanical ventilation so windows may be kept closed at the occupant's discretion. Where the exterior noise environment does not exceed 75 dBA L_{dn}, attaining the necessary noise reduction from exterior to interior spaces is readily achievable with proper wall construction techniques, the selections of proper windows and doors, and the incorporation of forced-air mechanical ventilation systems to allow occupants to control noise by closing the windows. Noise insulation becomes more costly and difficult to implement in noise environments exceeding 75 dBA L_{dn}.

Noise sensitive land uses affected by the rail corridor would be exposed to high maximum instantaneous noise during high-speed pass-bys or when warning whistles are sounded. Noise sensitive land uses proposed in the vicinity of the UPRR would likely require forced-air mechanical ventilation systems and sound-rated construction methods to reduce interior average and maximum noise levels to acceptable levels. In some cases, high-performance noise insulation features such as stucco-sided staggered-stud or double-stud walls and high performance sound rated windows and doors may be required to maintain interior maximum instantaneous noise levels below 50 dBA in bedrooms and 55 dBA in other rooms.

As described above, the City's noise policies can be feasibly implemented at the project site to reduce anticipated noise and land use compatibility impacts to a less than significant level.

Measures to be considered at the time of future development

Project-specific acoustical analyses shall be completed for residential land uses exposed to noise levels exceeding 60 dBA L_{dn}. The specific determination of what 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. The analyses should meet the following noise reduction requirements:

- Interior noise levels shall be reduced to 45 dBA L_{dn} or lower. Sound insulation requirements would likely need to include the provision of forced-air mechanical ventilation for all units, so that windows could be kept closed at the occupant's discretion to control noise. Special building construction techniques (e.g., sound-rated windows and building facade treatments) may be required for new residential uses affected by the UPRR, Monterey Road, and Butterfield Boulevard.

- Maximum instantaneous noise levels (L_{max}) should be reduced to 50 dBA in bedrooms and 55 dBA in other habitable rooms. The design of mitigation measures for the railroad shall consider the best available methods. These treatments include, but are not limited to, sound rated windows and doors, sound rated wall construction, acoustical caulking, insulation, acoustical vents, etc. Large windows and doors should be oriented away from the railroad where possible.

The implementation of these mitigation measures at the time of future development would reduce the impact to a *less-than-significant level*.

Impact 2: **Groundborne Vibration.** The Site would be subject to vibration from railroad trains, but the buffer distance is large enough so that vibration levels would not exceed the FTA guidelines for vibration compatibility. **This is a less than significant impact.**

Rail traffic along the conventional railroad line is anticipated to increase to 30 trains or more per day with the planned Caltrain expansion project and other growth in rail service, but would not exceed 70 trains per day. Train activity would be considered "occasional" with respect to the FTA vibration impact criteria. Data gathered along the UPRR indicate that vibration levels are 70 VdB or less at a distance of 100 feet from the center of the near track. The Site is located at a distance of 175 feet or more from the UPRR tracks. At this distance ground vibration levels would be below the FTA impact thresholds.

The Draft Bay Area to Central Valley High-Speed Train Program EIR/EIS states that, "…vibration of the ground caused by the pass-by of the HST is similar to that caused by conventional steel wheel/steel rail trains. However, vibration levels associated with the HST are relatively lower than conventional passenger and freight trains due to advanced track technology, smooth track and wheel surfaces, and high maintenance standards required for high-speed operation." Based on these data, vibration levels resulting from the HST are anticipated to be at or below ambient vibration levels from conventional railroad trains.

Measures to be considered at the time of future development – None Required

Impact 3: **Exposure to Excessive Groundborne Vibration.** Construction related vibration would not be excessive at nearby residential land uses. **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, hoe rams) are used. Construction activities would likely include site preparation work, foundation work, and new building framing and finishing. Pile driving, which can cause excessive vibration, is typically not used in the construction of residential buildings.

For structural damage, the California Department of Transportation uses a vibration limit of 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a conservative limit of 0.08 in/sec PPV for ancient buildings or buildings that are documented to be structurally weakened.

Table 7 presents typical vibration levels that could be expected from construction equipment at a distance of 25 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. 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. The nearest residential buildings are located across Jarvis Drive from the Site at a distance of about 75 feet from the property boundary. Vibration levels would be expected to be 0.1 in/sec PPV or less, below the 0.3 in/sec PPV significance threshold. Vibration generated by construction activities near Jarvis Drive would at times be perceptible, however, would not be expected to result in “architectural” damage to these buildings. This is a *less-than-significant impact*.

In areas where vibration would not be expected to cause structural damage, vibration levels may still be perceptible. However, as with any type of construction, this would be anticipated and it would not be considered significant given the intermittent and short duration of the phases that have the highest potential of producing vibration (demolition and use of jackhammers and other high power tools). By use of administrative controls such as notifying nearby residents of scheduled construction activities and scheduling construction activities with the highest potential to produce perceptible vibration to hours with the least potential to affect these uses, perceptible vibration can be kept to a minimum and as such would not result in a significant impact with respect to perception.

TABLE 7 Vibration Source Levels for Construction Equipment[6]

Equipment		**PPV at 25 ft. (in/sec)**	**Approximate L_v at 25 ft. (VdB)**
Pile Driver (Impact)	upper range	1.158	112
	typical	0.644	104
Pile Driver (Sonic)	upper range	0.734	105
	typical	0.170	93
Clam shovel drop		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Vibratory Roller		0.210	94
Hoe Ram		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

Impact 4: **Project-Generated and Cumulative Traffic Noise.** The proposed project would not result in a substantial permanent noise level increase or make a cumulatively considerable contribution to future noise levels at residential land uses in the vicinity. **This is a less-than-significant impact.**

Traffic along Butterfield Boulevard and Monterey Road dominates the noise environment in the area. *Hexagon Transportation Consultants* supplied peak hour traffic volumes for 20 intersections near the Site. Vehicular traffic generated by the project would not increase noise levels substantially along these roadways because the project traffic makes up a small percentage of the total traffic. Vehicular traffic noise levels would not be expected to increase measurably above existing levels as a result of the project (increase would be less than 1 dBA L_{dn}). If traffic accesses the Site along Jarvis Drive there would be an increase in local traffic noise, but the overall noise level increase would be less than 3 dBA L_{dn} because the major roadways would continue to be the most significant sources of traffic noise. This is a *less-than-significant impact*.

Increases in traffic noise levels above existing levels were calculated for two future cumulative scenarios, with and without the proposed GPA. Traffic noise levels are calculated to increase by 3 dBA L_{dn} along several roadway segments, but the traffic resulting from the GPA would only incrementally affect the projected increase by less than 0.5 dBA in all instances. This would not be a cumulatively considerable contribution to the projected change and is therefore a *less-than-significant impact*.

[6] Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office 87of Planning and Environment, Federal Transit Administration, May 2006.87

Impact 5: **Construction Noise.** Existing noise-sensitive land uses could be exposed to construction noise levels in excess of the significance thresholds for a period of more than one construction season. **This is a potentially significant impact.**

Future construction at the Site would generate noise, and would temporarily increase noise levels at adjacent land uses. The construction of residential units on the Site would affect the noise environment at the existing neighborhoods to the north of Jarvis Drive, depending on the timing and duration of planned construction activities.

Construction activities can generate high noise levels, especially during the construction of project infrastructure when heavy equipment is used. The highest maximum instantaneous noise levels generated by project construction would typically range from about 90 to 95 dBA L_{max} at a distance of 50 feet from the noise source. Typical hourly average construction generated noise levels are about 81 dBA to 88 dBA L_{eq} 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.). 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.

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 receptors. Construction noise impacts primarily occur when construction activities occur during noise-sensitive times of the day (early morning, evening, or nighttime hours), the construction occurs in areas immediately adjoining noise sensitive land uses, or when construction durations last over extended periods of time. Where noise from construction activities exceeds 60 dBA L_{eq} and exceeds the ambient noise environment by at least 5 dBA L_{eq} at noise-sensitive uses in the project vicinity for a period of one year or more, the impact would be considered significant.

Typically, significant noise impacts do not result when standard construction noise control measures are enforced at the project site and when the duration of the noise generating construction period is limited to one construction season (typically one year) or less. Noise generated by site improvements, grading, infrastructure improvements, and the construction of residential homes could result in noise levels exceeding 60 dBA L_{eq} and the ambient noise environment by 5 dBA L_{eq} for a period greater than one year.

The following standard controls are assumed to be included in the project:

- Construction activities shall be limited to the hours between 7:00 a.m. and 8:00 p.m., Monday through Friday, and between the hours of 9:00 a.m. and 6:00 p.m. on Saturdays. No construction activities should occur on Sundays or federal holidays (Consistent with Section 8.28.040 of the Morgan Hill Municipal Code).

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

- Locate stationary noise generating equipment (e.g. rock crushers, compressors) as far as possible from adjacent residential receptors.

- Acoustically shield stationary equipment located near residential receptors with temporary noise barriers or recycled demolition materials.

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

- The contractor shall prepare a detailed construction plan identifying the schedule for major noise-generating construction activities. The construction plan shall identify a procedure for coordination with adjacent residential land uses so that construction activities can be scheduled to minimize noise disturbance.

- Designate a "disturbance coordinator" who would be responsible for responding to any complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., bad muffler, etc.) and will require that reasonable measures be implemented to correct the problem.

Implementation of the above measures would reduce construction noise levels emanating from the site, limit construction hours, and minimize disruption and annoyance. With the implementation of these measures, and recognizing that noise generated by each project phase would only affect the sensitive land uses adjoining that particular phase, and that construction of the remaining phases would typically occur at increased distances from those same sensitive land uses, the substantial temporary increase in ambient noise levels would be *less-than-significant*.