TRAFFIC NOISE LAND USE COMPATIBILITY ASSESSMENT

FOR

EAST DUNNE PARK PROJECT

MORGAN HILL, CA

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

This report describes the existing noise environment in the project vicinity and evaluates the compatibility of the proposed project with predicted future traffic noise levels. Land use compatibility is evaluated relative to the City of Morgan Hills's applicable noise criteria.

ACOUSTIC FUNDAMENTALS

Noise is generally defined as sound that is loud, disagreeable, or unexpected. Sound, as described in more detail below, is mechanical energy transmitted in the form of a wave because of a disturbance or vibration.

AMPLITUDE

Amplitude is the difference between ambient air pressure and the peak pressure of the sound wave. Amplitude is measured in decibels (dB) on a logarithmic scale. For example, a 65 dB source of sound, such as a truck, when joined by another 65 dB source results in a sound amplitude of 68 dB, not 130 dB (i.e., doubling the source strength increases the sound pressure by 3 dB). Amplitude is interpreted by the ear as corresponding to different degrees of loudness. Laboratory measurements correlate a 10 dB increase in amplitude with a perceived doubling of loudness and establish a 3 dB change in amplitude as the minimum audible difference perceptible to the average person.

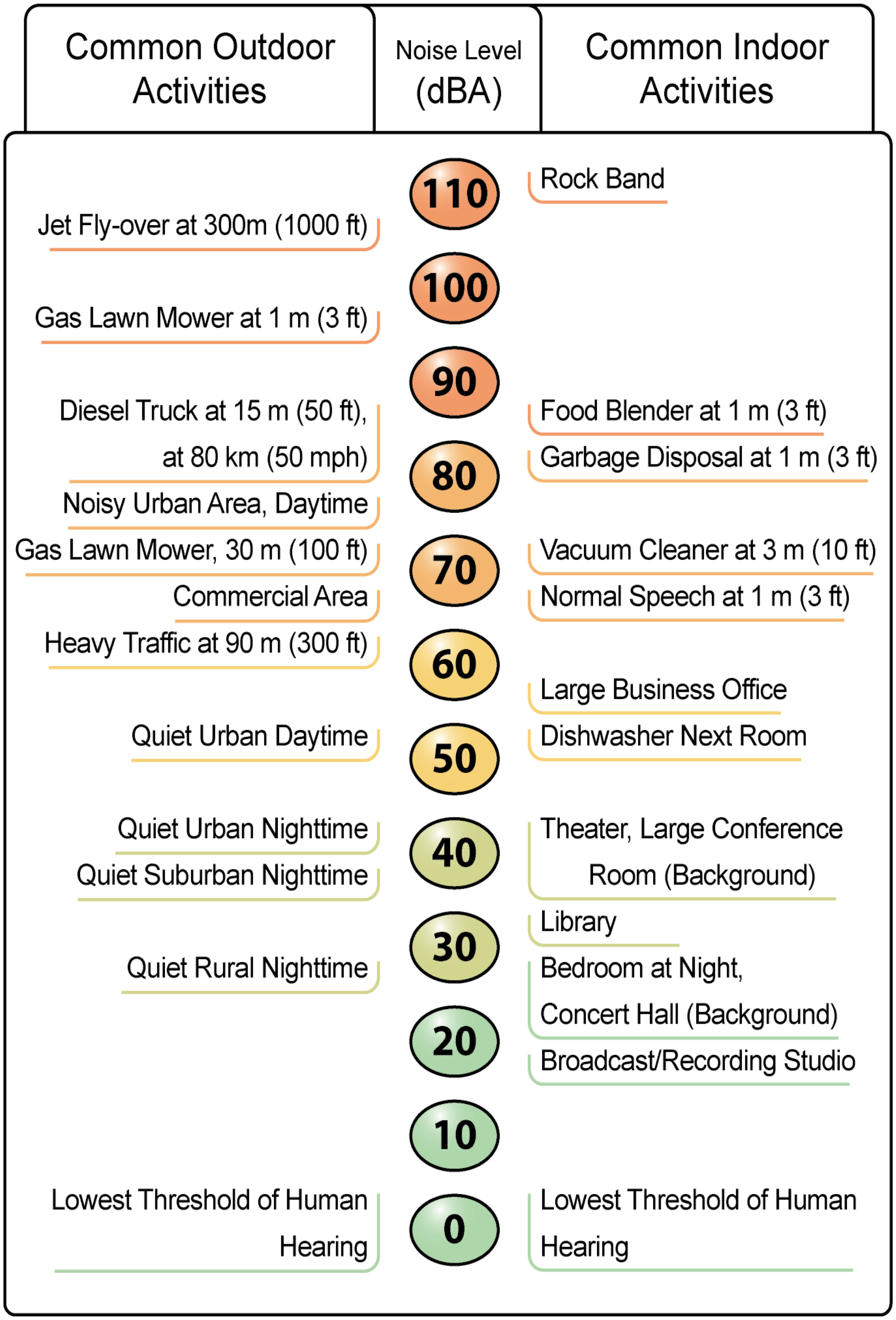
FREQUENCY

Frequency is the number of fluctuations of the pressure wave per second. The unit of frequency is the Hertz (Hz). One Hz equals one cycle per second. The human ear is not equally sensitive to sound of different frequencies. Sound waves below 16 Hz or above 20,000 Hz cannot be heard at all, and the ear is more sensitive to sound in the higher portion of this range than in the lower. To approximate this sensitivity, environmental sound is usually measured in A-weighted decibels (dBA). On this scale, the normal range of human hearing extends from about 10 dBA to about 140 dBA. Common community noise sources and associated noise levels, in dBA, are depicted in Figure 1.

ADDITION OF DECIBELS

Because decibels are logarithmic units, sound levels cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dB higher than one source under the same conditions. For example, if one automobile produces a sound level of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB; rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together would produce an increase of 5 dB.

FIGURE 1
TYPICAL COMMUNITY NOISE LEVELS



Source: Caltrans 2009

Sound Propagation & Attenuation

Geometric Spreading

Sound from a localized source (i.e., a point source) propagates uniformly outward in a spherical pattern. The sound level decreases (attenuates) at a rate of approximately 6 decibels for each doubling of distance from a point source. Highways consist of several localized noise sources on a defined path, and hence can be treated as a line source, which approximates the effect of several point sources. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of approximately 3 decibels for each doubling of distance from a line source, depending on ground surface characteristics. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receiver, such as a parking lot or body of water,), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface between a line source and the receiver, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 decibels per doubling of distance is normally assumed. When added to the cylindrical spreading, the excess ground attenuation for soft surfaces results in an overall attenuation rate of 4.5 decibels per doubling of distance from a line source.

Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receiver can substantially attenuate noise levels at the receiver. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver specifically to reduce noise. A barrier that breaks the line of sight between a source and a receiver will typically result in an approximate 5 dB of noise reduction. Taller barriers provide increased noise reduction.

Noise Descriptors

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Although the intensity (energy per unit area) of the sound is a purely physical quantity, the loudness or human response is determined by the characteristics of the human ear.

Human hearing is limited in the range of audible frequencies as well as in the way it perceives the sound-pressure level in that range. In general, people are most sensitive to the frequency range of 1,000–8,000 Hz, and perceive sounds within that range better than sounds of the same amplitude in higher or lower frequencies. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending on the human sensitivity to those frequencies, which is referred to as the "A-weighted" sound level. The A-weighting network approximates the frequency response of the average young ear when listening to most ordinary sounds. When people make judgments of the relative loudness or annoyance of a sound, their judgments correlate well with the A-weighted noise scale. Other weighting networks have been devised to address high noise levels or other special problems (e.g., B-, C-, and D-scales), but these scales are rarely used in conjunction with the evaluation of environmental and transportation noise.

The intensity of environmental noise fluctuates over time, and several descriptors of time-averaged noise levels are typically used. For the evaluation of noise, the most commonly used descriptors are L_{eq}, L_{dn}, and CNEL. The energy-equivalent noise level, L_{eq}, is a measure of the average energy content (intensity) of noise over any given period. Many communities use 24-hour descriptors of noise levels to regulate noise. The day-night average noise level, L_{dn}, is the 24-hour average of the noise intensity, with a 10-dBA "penalty" added for nighttime noise (10 p.m. to 7 a.m.) to account for the greater sensitivity to noise during this period. CNEL, the community equivalent noise level, is similar to L_{dn} but adds an additional 5-dBA penalty for evening noise (7 p.m. to 10 p.m.) Common noise descriptors are summarized in Table 1.

TABLE 1
COMMON ACOUSTICAL TERMS AND DESCRIPTORS

Descriptor	Definition
Decibel (dB)	A unit-less measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to referenced sound pressure amplitude. The reference pressure is 20 micro-pascals.
A-Weighted Decibel (dBA)	An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.
Energy Equivalent Noise Level (L_{eq})	The energy mean (average) noise level. The instantaneous noise levels during a specific period of time in dBA are converted to relative energy values. From the sum of the relative energy values, an average energy value (in dBA) is calculated.
Day-Night Average Noise Level (DNL or L_{dn})	The 24-hour L_{eq} with a 10 dBA "penalty" for noise events that occur during the noise-sensitive hours between 10:00 p.m. and 7:00 a.m. In other words, 10 dBA is "added" to noise events that occur in the nighttime hours to account for increases sensitivity to noise during these hours.
Community Noise Equivalent Level (CNEL)	The CNEL is similar to the L_{dn} described above, but with an additional 5 dBA "penalty" added to noise events that occur between the hours of 7:00 p.m. to 10:00 p.m. The calculated CNEL is typically approximately 0.5 dBA higher than the calculated Ldn.

HUMAN RESPONSE TO NOISE

The human response to environmental noise is subjective and varies considerably from individual to individual. Noise in the community has often been cited as a health problem, not in terms of actual physiological damage, such as hearing impairment, but in terms of inhibiting general well-being and contributing to undue stress and annoyance. The health effects of noise in the community arise from interference with human activities, including sleep, speech, recreation, and tasks that demand concentration or coordination. Hearing loss can occur at the highest noise intensity levels. When community noise interferes with human activities or contributes to stress, public annoyance with the noise source increases. The acceptability of noise and the threat to public well-being are the basis for land use planning policies preventing exposure to excessive community noise levels.

Project Area Setting

Noise sources in the project area consist predominantly of vehicle traffic along East Dunne Avenue. To document existing traffic noise levels in the project area, ambient noise measurements were conducted on March 26-27, 2013. Ambient noise levels were measured using a Larson Davis Laboratories Model 820 integrating sound-level meter. Measurements were conducted in the vicinity of the project site at a distance of approximately 67 feet from the centerline of East Dunne Avenue and at a height of approximately 4.5 feet above ground level. Based on the measurements conducted, average-hourly noise levels ranged from a low of approximately 50 dBA L_{eq} during the nighttime hours to a high of approximately 65 dBA L_{eq} during the daytime hours. Maximum instantaneous noise levels measured approximately 79 dBA L_{max}. Average-daily noise levels at this same location measured approximately 65 dBA CNEL.

Regulatory Framework

City of Morgan Hill General Plan

The *City of Morgan Hill General Plan* identifies normally acceptable exterior average-daily noise levels (in L_{dn}) for determination of land use compatibility. For new residential development, the City's General Plan identifies a normally acceptable noise level of 60 dBA L_{dn} for areas where outdoor use is a major consideration (e.g., rear yard areas). Where the City determines that providing an exterior noise level within these areas of 60 dBA L_{dn}, or lower, cannot be achieved after the application of reasonable and feasible mitigation, an exterior noise level of 65 dBA L_{dn} may be permissible. For new residential housing units, interior noise levels should not exceed an average-daily noise level of 45 dBA L_{dn}. For new residential development exposed to exterior noise levels of 60 dBA L_{dn}, or greater, interior maximum instantaneous noise levels in bedrooms should be limited to 50 dBA. Maximum instantaneous noise levels in all other habitable rooms should not exceed 55 dBA (City of Morgan Hill 2010).

Traffic Noise & Barrier Assessment

Land Use Compatibility

The compatibility of proposed residential land uses was determined based on a comparison of predicted future (year 2030) traffic noise levels with the City's applicable noise standards. In accordance with the City's General Plan noise criteria for land use compatibility, residential land uses are considered normally acceptable within exterior noise environments up to 60 dBA L_{dn}.

Traffic Noise Modeling

Methodology & Model Verification

Traffic noise levels at onsite receptor locations were calculated using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM). The TNM model is the most current traffic noise prediction model recommended for use by the FHWA and the California Department of Transportation. Input data used in the modeling of traffic noise included roadway traffic volumes, elevations, vehicle speeds, and day/night percentages of vehicles. Traffic volumes for East Dunne Avenue were obtained from the *City of Morgan Hill General Plan Circulation Element Network and Policy Revisions, Transportation Impact Analysis Draft Report* (2009). The accuracy of the TNM model was verified by comparing the measured average daily traffic noise level with the modeled existing traffic noise level. In comparison to the measured data, the

FHWA TNM model over predicted traffic noise levels at the measurement location by approximately 1.4 dB. To be conservative, an adjustment factor was not applied to predicted future (year 2030) traffic noise levels. Predicted future traffic noise levels were calculated along the northern property line of primarily affected proposed residential lots (i.e., Lots 1, 2, 3, and 23). Modeled receptor locations are depicted in Figure 2.

Predicted Traffic Noise Levels

Predicted future (year 2030) traffic noise levels are summarized in Table 2. As depicted, without construction of a sound barrier, predicted future traffic noise levels at the nearest proposed residential lots (i.e., Lot 1-3, and Lot 23) would range from 55 to 65 dBA L_{dn}. Predicted future traffic noise levels at Lot 1 would exceed the City of Morgan Hill's normally acceptable exterior noise level of 60 dBA L_{dn}.

TABLE 2
PREDICTED FUTURE (YEAR 2030) AVERAGE-DAILY TRAFFIC NOISE LEVELS

Receptor Location(1)	Predicted Traffic Noise Level (dBA CNEL/L_{dn})(2) Without Construction of a Sound Barrier		Predicted Interior Instantaneous Traffic Noise Level (L_{max})
	Exterior	Interior	
Lot 1	**65**	40	48
Lot 2	59	34	42
Lot 3	55	30	38
Lot 23	55	30	38
Noise Standard:	60	45	50/55[3]
Exceeds Noise Standard?:	Yes	No	No

Bold*=Predicted Noise Level Exceeds City's General Plan Noise Standard*

1. *Refer to Figure 2 for corresponding receptor locations.*
2. *Based on predicted future (year 2030) traffic noise levels. Assume an average vehicle speed of 40 mph and predicted future traffic volume of 13,900 ADT for East Dunne Avenue (City of Morgan Hill 2009).*
3. *The City's General Plan noise standard for interior instantaneous traffic noise within interior rooms is 50 dB for bedrooms and 55 dB for all other habitable rooms.*

Noise Reduction Measures

A sound barrier analysis was conducted utilizing the FHWA TNM computer program to determine the minimum sound barrier height required to achieve the City of Morgan Hill's normally acceptable exterior noise level of 60 dBA L_{dn} at Lot 1. The barrier analysis was conducted for future (year 2030) traffic noise conditions. Based on the modeling conducted, a 6-foot sound barrier would be required to reduce predicted noise levels to below the City's noise standard of 60 dBA L_{dn} at ground-floor locations.

Based on the calculated reductions provided by sound barrier and assuming an average exterior-to-interior noise reduction of 25 dB, predicted maximum instantaneous noise levels within the interior of the proposed dwelling would be approximately 48 dBA L_{max}.

Based on the modeling conducted, a sound barrier construction to a minimum height of 6 feet would be sufficient to reduce predicted noise levels to below the City's normally acceptable levels. The proposed sound barrier would not, however, provide shielding of traffic noise for upper-floor locations. In the event that multi-floor dwellings are proposed for Lot 1, predicted exterior noise levels at the upper-floor of the dwelling could reach levels in excess of the City's exterior noise standard of 60 dBA L_{dn}.

Recommended Noise-Reduction Measures

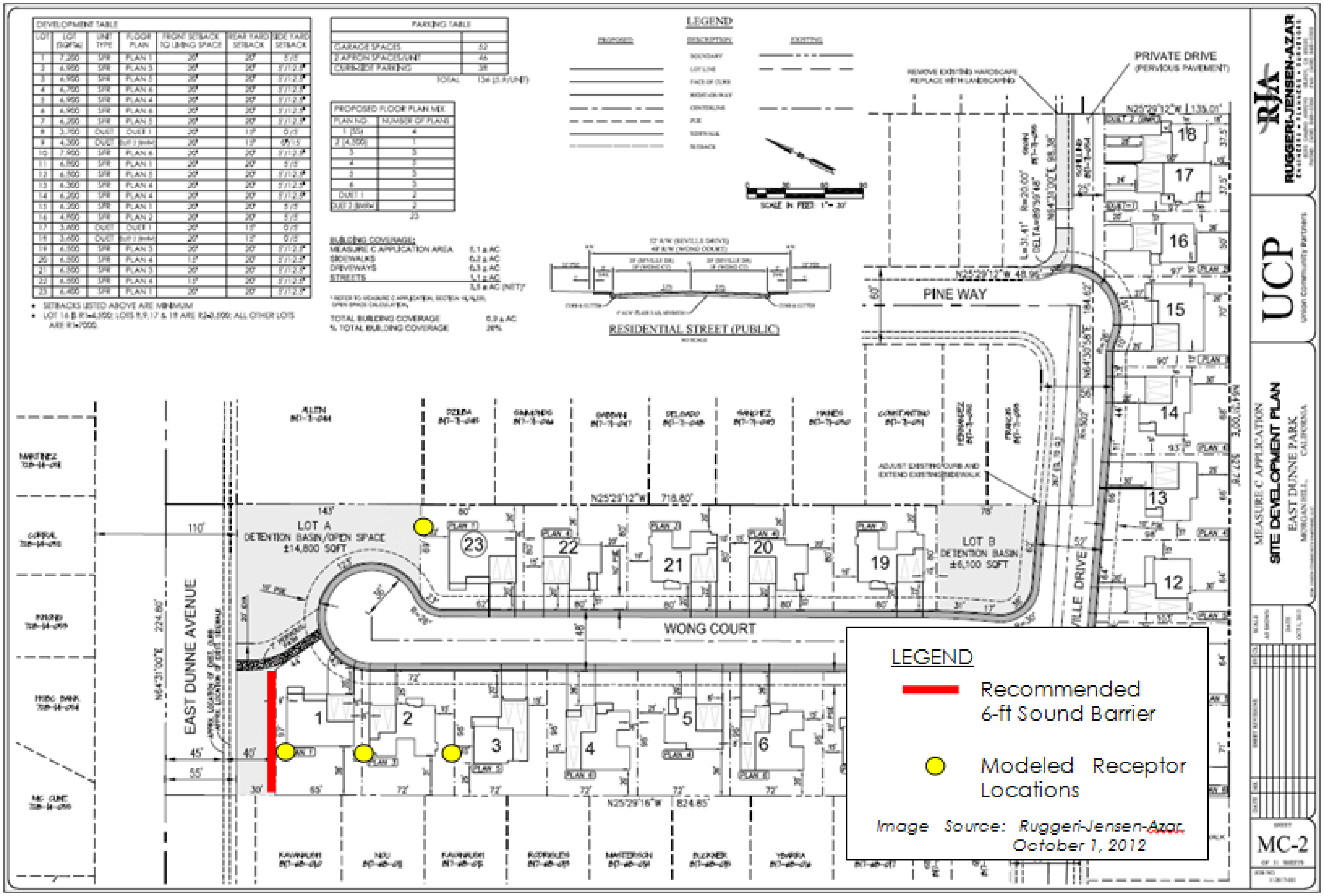
To achieve the City's exterior noise standard of 60 dBA L_{dn} at Lot 1, the following noise-reduction measures are recommended:

- A sound barrier should be constructed along the northern property line of the nearest residential lot (i.e., Lot 1), as depicted in Figure 2. The sound barrier should be constructed to a minimum of height of 6 feet above the proposed residential pad elevations. The sound barriers should be constructed of masonry block, or material of similar density and usage, with no visible air gaps along the barrier alignments or at the base of the barriers.
- Install air circulation systems to allow windows to remain closed during inclement weather conditions.
- The installation of balconies along the northern façade of the dwelling structure should be prohibited.

In addition to the above measures, the following additional mitigation measure is recommended, though not required:

- If a multi-floor dwelling is proposed for Lot 1, the northern façade of the dwelling should be designed to achieve a minimum composite sound-transmission-class (STC) rating of 35 dB. Stucco/framed exterior walls constructed and insulated in compliance with current building standards with the use of windows meeting a minimum STC rating of 28 dB, is typically sufficient to meet this standard. Use of higher STC-rated windows should be included where practical. It is also recommended that the number and size of windows along the northern building façade be minimized, to the extent possible.

FIGURE 2
MODELED RECEPTOR & BARRIER LOCATIONS



References

California Governor's Office of Planning and Research. 2003. *State of California General Plan Guidelines*.

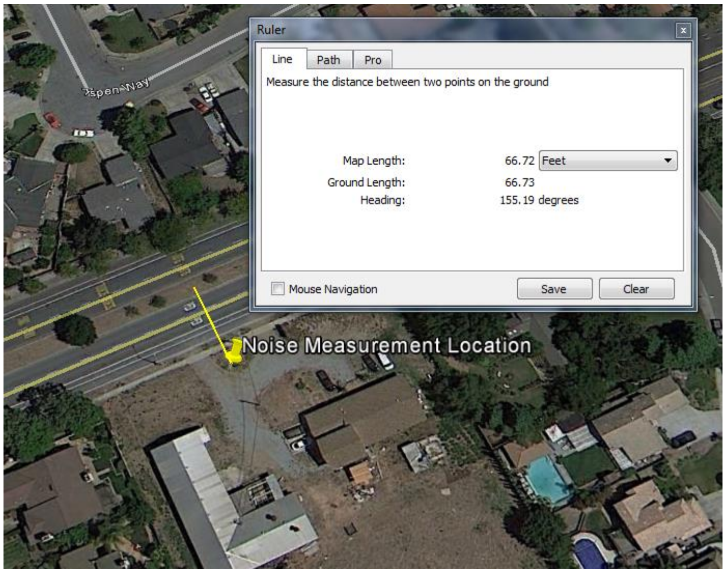
California Department of Transportation (Caltrans). Accessed June 2, 2009. *IS/EA Annotated Outline*. URL: http://www.dot.ca.gov/ser/vol1/sec4/ch31ea/chap31ea.htm.

City of Morgan Hill. July 2001 (Updated February 2010. *Morgan Hill General Plan*.

Ruggeri-Jensen-Azar. October 1, 2012. *Site Development Plan, East Dunne Park, Morgan Hill, California.*

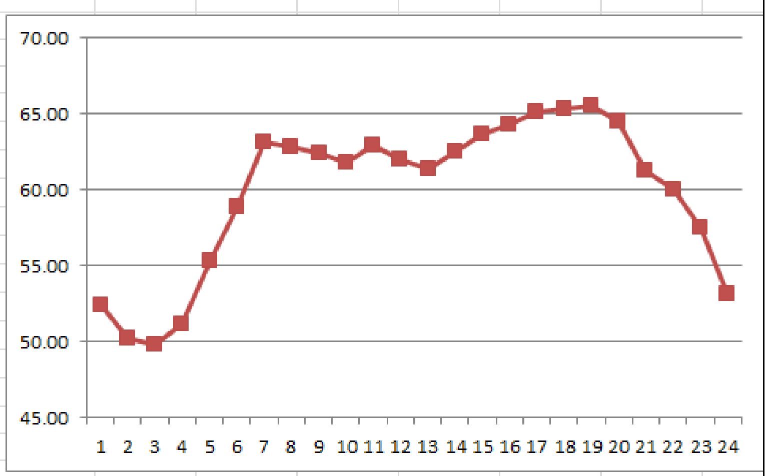
APPENDIX A

SUMMARY OF AMBIENT NOISE MEASUREMENTS



Date: March 26-27, 2013
Distance from Roadway Centerline: ~67 feet
Temp: 47-70°F, Humidity: ≤40%, Wind:5-10 mph
Equipment: Larson Davis Type I Sound Meter

Hours	Leq
1	52.40
2	50.20
3	49.80
4	51.20
5	55.30
6	58.90
7	63.20
8	62.80
9	62.40
10	61.80
11	62.90
12	62.00
13	61.40
14	62.50
15	63.70
16	64.30
17	65.10
18	65.30
19	65.60
20	64.50
21	61.30
22	60.00
23	57.50
24	53.10
Average Daily L_{dn}/CNEL:	**64.48**
Highest Lmax:	**78.80**



TRAFFIC NOISE MODELING

RESULTS: SOUND LEVELS								
PROJECT/CONTR		Dunne Ave						
RUN:		Future Year 2030 Current General Plan Volumes (12,040 ADT)						
BARRIER DESIGN		6 ft						
ATMOSPHERICS:		20 deg C, 50% RH						
Receiver								
Name	No.	#DUs		No Barrier		With Barrier*		
			Existing	Ldn		Calculated	Noise Reduction	
			Ldn	Calculated	Crit'n	Ldn	Calculated	
			dBA	dBA	dBA	dBA	dB	
Lot 23	4	1	0	55.1	60	52.6	2.5	
Lot 3	3	1	0	54.7	60	52.3	2.4	
Lot 2	2	1	0	59.1	60	55.4	3.7	
Lot 1	1	1	0	**64.8**	60	**58.5**	6.3	
						*6-foot barrier		
RESULTS: SOUND LEVELS								
PROJECT/CONTR		Dunne Ave						
RUN:		Existing						
BARRIER DESIGN		INPUT HEIGHTS						
ATMOSPHERICS:		20 deg C, 50% RH						
Receiver								
Name	No.	#DUs	Measured	No Barrier				
			Ldn	Ldn				
				Calculated				
			dBA	dBA	K	Acceptable?	Applied?	
cal	1	1	65.4	66.8	1.4	Yes	No	