TRAFFIC NOISE ANALYSIS

CALIFORNIA STATE UNIVERSITY STANISLAUS PHYSICAL MASTER PLAN UPDATE

Turlock, California

BBA Project No. 08-214

Prepared For

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INTRODUCTION

This document analyzes the potential short-term and cumulative traffic noise impacts resulting from the implementation of the proposed California State University, Stanislaus Physical Master Plan Update (the Proposed Project).

The Proposed Project could result in increases in traffic on adjacent local streets, which could affect existing noise sensitive land uses in nearby neighborhoods.

FUNDAMENTALS OF ACOUSTICS

Noise is often described as unwanted sound, and thus is a subjective reaction to the physical phenomenon of sound. Sound is variations in air pressure that the ear can detect.

The ear responds to pressure changes over a range of one to 10^{14}(100,000,000,000,000). This is roughly equivalent to the range of 1 second as compared to 3.2 million years, or 1 square yard compared to the entire surface area of the earth. To deal with the extreme range of pressures which the ear can detect, researchers express the amount of acoustical energy of a sound by comparing the measured sound pressure to a reference pressure, then taking the logarithm (base 10) of the square of that number. This original unit of sound measurement, named the bel after Alexander Graham Bell, corresponded well to human hearing characteristics if it was divided by a factor of 10. The resulting unit, one tenth of a bel, is called the decibel, and is abbreviated as dB.

The threshold of hearing is considered to be zero (0) dB, and the range of sounds in normal human experience is 0 to 140 dB.

Because sound pressure levels are defined as logarithmic numbers, the values cannot be directly added or subtracted. For example, two sound sources, each producing 50 dB, will produce 53 dB when combined, not 100 dB. This is because two sources have two times the energy of one source, and 10 times the logarithm of 2 equals 3. Similarly, ten sources produce a 10 dB higher sound pressure level than one source, as ten times the logarithm of 10 equals 10.

The ear responds to pressure variations in the air from about 20 times per second to about 20,000 times per second. The frequency of the variations is described in terms of hertz (Hz), formerly called cycles per second. The ear does not respond equally to all frequencies. For example, we do not hear very low frequency sounds as well as we hear higher frequency sounds, nor do we hear very high frequency sounds very well. This difference in perceived loudness varies with the sound pressure level of the sound. In general, the maximum sensitivity of the ear occurs at frequencies between about 500 and 8000 Hz.

To compensate for the fact that the ear is not as sensitive at some frequencies and sound pressure levels as at others, a number of frequency weighting scales have been developed. The "A" weighting scale is most commonly used for environmental noise assessment, as sound pressure levels measured using an A-weighting filter correlate well with community response to noise sources such as aircraft and traffic.

When an A-weighting filter is used to measure sound pressure levels, the results may be expressed as *sound levels*, in decibels (dB). It is sufficient to use the abbreviation "dB" if these terms are well defined, but many people prefer to use the expressions dBA or dB(A) for clarity. For convenience, many people use the term "noise level" interchangeably with "sound level." Table 1 shows typical sound levels and relative loudness for various types of noise environments.

The ambient noise level is defined as the noise from all sources near and far. A similar term is background noise level. This term usually refers the ambient noise level that is present before a noise source being studied is introduced. A synonymous term is pre-project noise level.

Noise exposure contours or noise contours are lines drawn about a noise source representing constant levels of noise exposure. CNEL or L_{dn} (DNL) contours are frequently utilized to graphically portray community noise exposure. The terms CNEL and L_{dn} (DNL) are defined in the following section.

Most environmental noise sources produce varying amounts of noise over time, so the measured sound levels also vary. For example, noise produced during a train passage will vary from relatively quiet background levels before the event to a maximum value when the train passes by, then returning down to background levels as the train leaves the observer's vicinity. Similarly, noise from traffic varies with the number and types of vehicles, speed and proximity to the observer.

Variations in sound levels may be addressed by statistical methods. The simplest of these are the maximum (L_{max}) and minimum (L_{min}) noise levels, which are the highest and lowest levels observed. To describe less extreme variations in sound levels, other statistical descriptors may be used, such as the L_{10} and L_{50} and L_{90}. The L_{10} is the A-weighted sound level equaled or exceeded during 10 percent of a time period. Similarly, the L_{50} and L_{90} are the sound levels equaled or exceeded during 50 and 90 percent of a time period. The most common time period used with these statistical descriptors is 1 hour, although any time period could be used so long as it is stated.

Because statistical descriptors such as L_{10}, L_{50}, etc. are sometimes cumbersome to calculate, the equivalent sound level (L_{eq}) or energy average sound level is often used to describe the "average" sound level during stated time period, usually 1 hour.

The Community Noise Equivalent Level (CNEL) is calculated from hourly L_{eq} values, after adding a "penalty" to the noise levels measured during the evening (7 p.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) periods. The penalty for evening hours is a factor of 3, which is equivalent to 4.77 dB. The penalty for nighttime hours is a factor of 10, which is equivalent to 10 dB. To calculate L_{dn} (also called DNL), the evening penalty is omitted.

TABLE 1
EXAMPLES OF A-WEIGHTED SOUND LEVELS AND RELATIVE LOUDNESS

Sound Source	Sound Level (dBA)	Relative Loudness (approximate)	Relative Sound Energy
Jet aircraft, 100 feet	130	128	10,000,000
Rock music with amplifier	120	64	1,000,000
Thunder, snowmobile (operator)	110	32	100,000
Boiler shop, power mower	100	16	10,000
Orchestral crescendo at 25 feet, noisy kitchen	90	8	1,000
Busy street	80	4	100
Interior of department store	70	2	10
Ordinary conversation, 3 feet away	60	1	1
Quiet automobile at low speed	50	½	.1
Average office	40	1/4	.01
City residence	30	1/8	.001
Quiet country residence	20	1/16	.0001
Rustle of leaves	10	1/32	.00001
Threshold of hearing	0	1/64	.000001

Source: U.S. Department of Housing and Urban Development, "Aircraft Noise Impact -- Planning Guidelines for Local Agencies," 1972.

ENVIRONMENTAL SETTING

Traffic Noise

The Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA-RD-77-108) was used for the prediction of traffic noise levels. The model is based upon the CALVENO noise emission factors for automobiles, medium trucks and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to receiver, and the acoustical characteristics of the site.

The FHWA model was developed to predict hourly L_{eq} values for free-flowing traffic conditions, and is considered to be accurate within 1.5 dB. To predict L_{dn} values, it is necessary to determine the day/night distribution of traffic and to adjust traffic volume input data to yield an equivalent hourly traffic volume.

Inputs to the FHWA model include the Average Daily Traffic volume (ADT), daytime/nighttime traffic distribution, medium and heavy truck percentages, and vehicle speed. The existing daily traffic volumes were based upon data supplied by the project traffic consultant. Truck mix was estimated from traffic observations and BBA's experience with traffic counts on local roadways.

The day/night traffic distribution was assumed to be 87%/13%, consistent with BBA ambient noise measurements in typical residential and commercial areas. An acoustically soft site was assumed. Based upon field experience, traffic noise levels at upper story building facades are expected to be at least 3 dB higher than the noise levels reported below.

Table 2 shows the predicted worst-case traffic noise levels for existing traffic volumes at a reference distance of 50-feet from the centerlines of the roadways in the vicinity of the Proposed Project. This distance represents the possible location of a typical first-floor building facade, and may be used to approximate the noise exposure for typical noise sensitive uses.

TABLE 2 EXISTING TRAFFIC NOISE LEVELS		
Roadway Name	**Segment Description**	**Predicted Ldn, dB, at 50 Feet**
Taylor Road	East of Golden State Blvd	68.0
Taylor Road	Walnut Ave to Geer Road	64.4
Taylor Road	East of Geer Road	63.1
Christoffersen Road	East of Golden State Blvd	65.3
Christoffersen Road	Mountain View Road to Kilroy Road	67.3
Christoffersen Road	Kilroy Road to Walnut Avenue	67.0
Christoffersen Road	Walnut Ave to Crowell Road	67.9
Christoffersen Road	Crowell Road to McKenna Drive	68.1
Christoffersen Road	McKenna Drive to Picadilly Lane	67.9
Christoffersen Road	Picadilly Lane to Geer Road	67.3
Christoffersen Road	East of Geer Road	66.4
Monte Vista Avenue	SR 99 to Country Side Drive	71.7
Monte Vista Avenue	Country Side Drive to Golden State Blvd	71.0
Monte Vista Avenue	Golden State Blvd to Walnut Avenue	71.4
Monte Vista Avenue	Walnut Avenue to Crowell Road	71.1
Monte Vista Avenue	Crowell Road to Dels Lane	70.8
Monte Vista Avenue	Dels Lane to Andre Lane	69.9
Monte Vista Avenue	Andre Lane to Geer Road	70.2
Monte Vista Avenue	East of Geer Road	68.6
Walnut Avenue	Taylor Road to Christoffersen Road	62.6
Walnut Avenue	Christoffersen Road to Monte Vista Avenue	63.7
Walnut Avenue	South of Monte Vista Avenue	61.5
Crowell Road	North of Christoffersen Road	57.0
Crowell Road	Christoffersen Road to Monte Vista Avenue	60.2
Crowell Road	South of Monte Vista Avenue	56.4
McKenna Drive	North of Christoffersen Road	50.6
Picadilly Lane	North of Christoffersen Road	50.8
Dels Lane	South of Monte Vista Avenue	61.0
Andre Lane	South of Monte Vista Avenue	50.8
Geer Road	Taylor Road to Christoffersen Road	68.1
Geer Road	Christoffersen Road to Monte Vista Avenue	69.3
Geer Road	South of Monte Vista Avenue	67.4
Countryside Drive	South of Monte Vista Avenue	69.0
Source: Brown-Buntin Associates, Inc., 2008		

REGULATORY SETTING

City of Turlock

Noise Element of the General Plan

Criteria for evaluating noise impacts in the City of Turlock are set forth in the Noise Element of the General Plan. The policies of the Noise Element include compatible land use guidelines in Figure 8-2, as presented below. The relevant Noise Element policies are listed below:

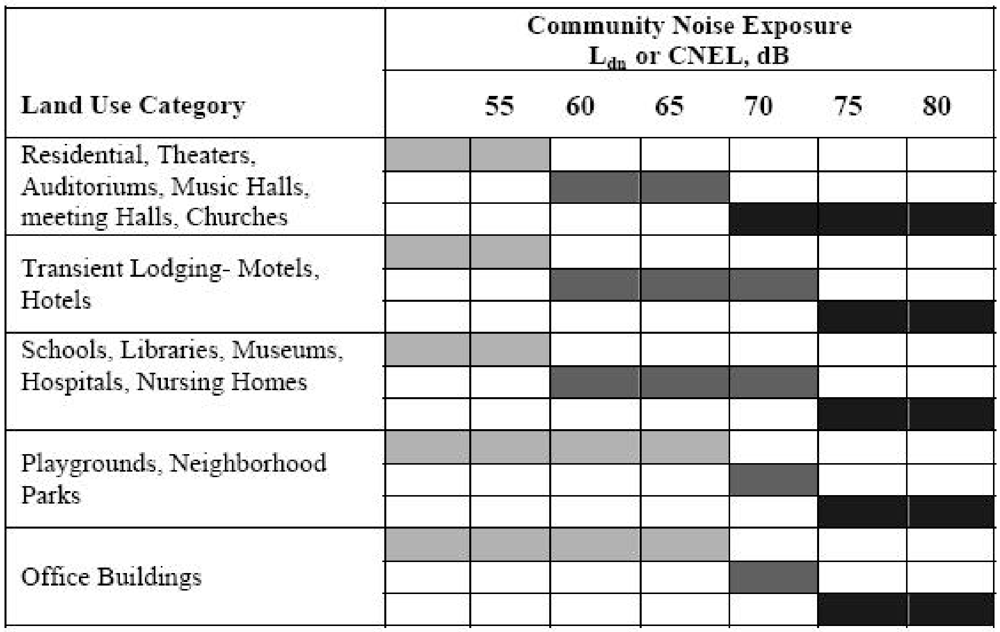
8.4-f Require all major development projects and noise-sensitive receptors (major residential developments, schools, hospitals, nursing homes, parks, and playgrounds) to comply with the land use compatibility guidelines indicated by Figure 8-2. Compliance shall be based upon projected noise levels at General Plan build out.

8.4-g New residential, transient lodging, school, library, church, hospital, and convalescent home development should be designed to provide a suitable interior noise environment of no greater than 45 dB CNEL or L_{dn}.

Although Policies 8.4-f and 8.4-g do not apply directly to this Project, the land use compatibility guidelines in Figure 8-2, and the interior noise standard for noise sensitive uses, provide measures of significance for the purposes of this EIR.

Land Use Compatibility Guidelines for Development

Figure 8-2



(light grey)	ACCEPTABLE	Specified land use is satisfactory. No noise mitigation measures are required.
(dark grey)	CONDITIONALLY ACCEPTABLE	Use should be permitted only after careful study and inclusion of protective measures as needed to satisfy the policies of the Noise Element.
(black)	UNACCEPTABLE	Development is usually not feasible in accordance with the goals of the Noise Element.

SIGNIFICANCE CRITERIA

The California Environmental Quality Act (CEQA) requires that significant environmental impacts be identified, and that such impacts be eliminated or mitigated to the extent feasible. A significant effect from noise may exist if a project would 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 ground-borne vibration or ground-borne noise levels;
- a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project; or
- a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

Absolute Noise Level Criteria

Based upon Figure 8-2, for transportation noise sources affecting residential, transient lodging, and other noise-sensitive land uses, the exterior noise threshold of significance for the Proposed Project is 60 dB L_{dn} or CNEL. An exterior noise level of up to 70 dB L_{dn} or CNEL may be allowed, provided that practical exterior noise level reduction measures have been implemented and that an interior noise level standard of 45 dB L_{dn} or CNEL is achieved.

Criteria for Increases in Noise Exposure

Guidance as to the significance of changes in ambient noise levels is provided by the 1992 findings of the Federal Interagency Committee on Noise (FICON), which assessed the annoyance effects of changes in ambient noise levels resulting from aircraft operations. The FICON findings are based upon studies that relate aircraft and traffic noise levels to the percentage of persons highly annoyed by the noise. Annoyance is a summary measure of the general adverse reaction of people to noise that generates speech interference, sleep disturbance, or interference with the desire for a tranquil environment.

The rationale for the FICON findings is that it is possible to consistently describe the annoyance of people exposed to transportation noise in terms of Ldn or CNEL. The changes in noise exposure that are shown in Table 3 are expected to result in equal changes in annoyance at sensitive land uses. Although the FICON findings were specifically developed to address aircraft noise impacts, they are considered in this analysis as the thresholds of noise impacts for traffic noise.

TABLE 3 POTENTIALLY SIGNIFICANT INCREASES IN CUMULATIVE NOISE EXPOSURE FOR TRANSPORTATION NOISE SOURCES	
Ambient Noise Level Without Project (L_{dn} or CNEL)	**Change in Ambient Noise Level Due to Project**
<60 dB	+5.0 dB or more
60-65 dB	+3.0 dB or more
>65 dB	+1.5 dB or more
Source: Federal Interagency Committee on Noise (FICON), 1992, as applied by Brown-Buntin Associates, Inc.	

NOISE IMPACT ASSESSMENT

The FHWA Highway Traffic Noise Prediction Model was used to predict traffic noise levels for future conditions. The reference distance is 50 feet from the centerline of the major roadways in the vicinity of the Proposed Project. This distance represents the possible location of a typical first-floor building facade facing each roadway, and may be used to approximate the noise exposure for typical noise sensitive uses.

Table 4 shows the predicted traffic noise levels for existing and projected traffic volumes at the reference distance cited above.

TABLE 4 PREDICTED FUTURE TRAFFIC NOISE LEVELS						
Roadway Name	Segment Description	Predicted Ldn, dB at 50 Feet by Scenario				
		Existing	Short Term with No Master Plan	Short Term With Master Plan	2027 with No Master Plan	2027 With Master Plan
Taylor Road	East of Golden State Blvd	68.0	68.4	68.4	70.0	70.0
Taylor Road	Walnut Ave to Geer Road	64.4	67.0	67.0	67.9	67.9
Taylor Road	East of Geer Road	63.1	64.9	64.9	65.1	65.3
Christoffersen Road	East of Golden State Blvd	65.3	67.3	67.5	67.8	68.1
Christoffersen Road	Mountain View Road to Kilroy Road	67.3	68.9	69.1	69.3	69.6
Christoffersen Road	Kilroy Road to Walnut Avenue	67.0	68.7	68.9	69.1	69.5
Christoffersen Road	Walnut Ave to Crowell Road	67.9	70.2	70.4	70.6	71.1
Christoffersen Road	Crowell Road to McKenna Drive	68.1	70.3	70.5	70.7	71.3
Christoffersen Road	McKenna Drive to Picadilly Lane	67.9	69.7	70.3	70.5	71.1
Christoffersen Road	Picadilly Lane to Geer Road	67.3	69.8	70.0	70.2	70.7
Christoffersen Road	East of Geer Road	66.4	68.9	69.0	69.6	69.9
Monte Vista Avenue	SR 99 to Country Side Drive	71.7	73.3	73.4	73.3	73.5
Monte Vista Avenue	Country Side Drive to Golden State Blvd	71.0	73.3	73.4	73.2	73.4
Monte Vista Avenue	Golden State Blvd to Walnut Avenue	71.4	72.4	72.6	72.5	72.8
Monte Vista Avenue	Walnut Avenue to Crowell Road	71.1	71.9	72.2	72.1	72.4
Monte Vista Avenue	Crowell Road to Dels Lane	70.8	71.7	71.9	71.9	72.2
Monte Vista Avenue	Dels Lane to Andre Lane	69.9	71.0	71.3	71.2	71.6
Monte Vista Avenue	Andre Lane to Geer Road	70.2	71.1	71.4	71.3	71.7
Monte Vista Avenue	East of Geer Road	68.6	69.6	69.6	69.9	70.0
Walnut Avenue	Taylor Road to Christoffersen Road	62.6	63.9	63.9	65.9	65.9
Walnut Avenue	Christoffersen Road to Monte Vista Avenue	63.7	67.5	67.5	68.1	68.3
Walnut Avenue	South of Monte Vista Avenue	61.5	63.9	64.0	64.5	64.8

TABLE 4 PREDICTED FUTURE TRAFFIC NOISE LEVELS						
Roadway Name	**Segment Description**	**Predicted Ldn, dB at 50 Feet by Scenario**				
		Existing	**Short Term with No Master Plan**	**Short Term With Master Plan**	**2027 with No Master Plan**	**2027 With Master Plan**
Crowell Road	North of Christoffersen Road	57.0	58.7	58.7	59.0	59.1
Crowell Road	Christoffersen Road to Monte Vista Avenue	60.2	60.8	61.1	61.0	61.8
Crowell Road	South of Monte Vista Avenue	56.4	57.4	57.8	58.2	58.7
McKenna Drive	North of Christoffersen Road	50.6	53.1	53.3	53.1	53.5
Picadilly Lane	North of Christoffersen Road	50.8	53.8	54.0	54.0	54.3
Dels Lane	South of Monte Vista Avenue	61.0	61.1	61.5	61.6	61.9
Andre Lane	South of Monte Vista Avenue	50.8	51.4	51.7	51.9	52.4
Geer Road	Taylor Road to Christoffersen Road	68.1	68.7	68.8	69.4	69.6
Geer Road	Christoffersen Road to Monte Vista Avenue	69.3	69.6	70.0	69.9	70.5
Geer Road	South of Monte Vista Avenue	67.4	67.8	68.0	68.0	68.4
Countryside Drive	South of Monte Vista Avenue	69.0	69.8	69.8	69.7	69.8
Source: Brown-Buntin Associates, Inc., 2008						

Based on Table 4, the predicted short term (10 year) and 2027 No Project traffic noise levels at 50 feet from the major roadway centerlines would exceed the City standards for new residential and other noise sensitive uses. This condition would occur with or without the project, and would not be an effect of the project.

Table 5 shows the differences between predicted noise levels for the future scenarios, comparing the noise levels with and without the Project.

TABLE 5 CHANGES IN PREDICTED FUTURE TRAFFIC NOISE LEVELS					
Roadway Name	Segment Description	Difference, dB at Reference Distance by Scenario			
		Short Term with No Master Plan Minus Existing	Short Term With Master Plan Minus Short Term No Project	2027 with No Master Plan Minus Existing	2027 With Master Plan Minus 2027 No Project
Taylor Road	East of Golden State Blvd	0.3	0.0	2.0	0.0
Taylor Road	Walnut Ave to Geer Road	2.6	0.0	3.5	0.0
Taylor Road	East of Geer Road	1.7	0.0	2.0	0.2
Christoffersen Road	East of Golden State Blvd	2.0	0.2	2.5	0.3
Christoffersen Road	Mountain View Road to Kilroy Road	1.6	0.2	1.9	0.3
Christoffersen Road	Kilroy Road to Walnut Avenue	1.8	0.2	2.2	0.4
Christoffersen Road	Walnut Ave to Crowell Road	2.3	0.2	2.7	0.5
Christoffersen Road	Crowell Road to McKenna Drive	2.2	0.2	2.6	0.6
Christoffersen Road	McKenna Drive to Picadilly Lane	1.9	0.6	2.6	0.6
Christoffersen Road	Picadilly Lane to Geer Road	2.4	0.2	2.8	0.5
Christoffersen Road	East of Geer Road	2.5	0.2	3.2	0.3
Monte Vista Avenue	SR 99 to Country Side Drive	1.7	0.1	1.7	0.2
Monte Vista Avenue	Country Side Drive to Golden State Blvd	2.3	0.1	2.2	0.2
Monte Vista Avenue	Golden State Blvd to Walnut Avenue	1.0	0.2	1.1	0.3
Monte Vista Avenue	Walnut Avenue to Crowell Road	0.8	0.2	1.0	0.3
Monte Vista Avenue	Crowell Road to Dels Lane	0.9	0.2	1.1	0.4
Monte Vista Avenue	Dels Lane to Andre Lane	1.1	0.3	1.3	0.4
Monte Vista Avenue	Andre Lane to Geer Road	0.9	0.3	1.1	0.4
Monte Vista Avenue	East of Geer Road	1.0	0.1	1.4	0.0
Walnut Avenue	Taylor Road to Christoffersen Road	1.3	0.0	3.3	0.1

TABLE 5 CHANGES IN PREDICTED FUTURE TRAFFIC NOISE LEVELS					
Roadway Name	**Segment Description**	**Difference, dB at Reference Distance by Scenario**			
		Short Term with No Master Plan Minus Existing	**Short Term With Master Plan Minus Short Term No Project**	**2027 with No Master Plan Minus Existing**	**2027 With Master Plan Minus 2027 No Project**
Walnut Avenue	Christoffersen Road to Monte Vista Avenue	3.8	0.0	4.4	0.2
Walnut Avenue	South of Monte Vista Avenue	2.4	0.2	3.0	0.3
Crowell Road	North of Christoffersen Road	1.7	0.0	2.0	0.1
Crowell Road	Christoffersen Road to Monte Vista Avenue	0.5	0.4	0.8	0.8
Crowell Road	South of Monte Vista Avenue	1.0	0.4	1.8	0.5
McKenna Drive	North of Christoffersen Road	2.6	0.2	2.6	0.3
Picadilly Lane	North of Christoffersen Road	3.0	0.2	3.3	0.3
Dels Lane	South of Monte Vista Avenue	0.1	0.4	0.6	0.3
Andre Lane	South of Monte Vista Avenue	0.6	0.3	1.1	0.5
Geer Road	Taylor Road to Christoffersen Road	0.5	0.1	1.2	0.2
Geer Road	Christoffersen Road to Monte Vista Avenue	0.3	0.4	0.6	0.6
Geer Road	South of Monte Vista Avenue	0.4	0.2	0.7	0.4
Countryside Drive	South of Monte Vista Avenue	0.8	0.0	0.8	0.0
Note: Shaded cells would indicate a significant change in traffic noise levels due to project-related traffic.					
Source: Brown-Buntin Associates, Inc., 2008					

Based upon Table 5, traffic noise levels along the roadways selected for this analysis would increase by significant amounts in the future in both the short term (10 years) and 2027 scenarios, regardless of whether the Physical Master Plan Update were implemented. However, the Proposed Project would not result in any significant increases in traffic noise levels.

Interior Traffic Noise

Typical facade construction in accordance with the Uniform Building Code will provide an exterior to interior traffic noise reduction of 20 to 25 dB. Compliance with the interior noise standard of 45 dB Ldn can therefore be expected with standard energy-conserving construction practices where the affected buildings are outside the 65 dB Ldn contour. It is usually feasible to attain the interior noise level standard of 45 dB Ldn where the exterior traffic noise level is 75 dB Ldn or less, using acoustically-rated glazing and doors, and other practical acoustical design features.

Therefore, compliance with the interior noise standard of 45 dB L_{eq} can therefore be expected with standard energy conserving construction practices where the traffic noise exposure is 65 dB L_{dn} or less. Existing noise sensitive uses along the roadways near the Project may be exposed to traffic noise levels exceeding that value. However, this condition would exist with or without the project and would not be considered a project-related impact.

CONCLUSIONS

Traffic associated with the Proposed Project is not expected to result in significant noise impacts.

Respectfully submitted,
Brown-Buntin Associates, Inc.

Jim Buntin
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