11 NOISE

INTRODUCTION

This chapter addresses impacts related to noise and vibration, both noise generated by project construction and operation, as well as external noise sources' impacts on future residents of the project.

NOISE FUNDAMENTALS AND TERMINOLOGY

Noise is simply described as unwanted sound, and thus is a subjective reaction to the physical phenomenon of sound. Sound consists of variations in air pressure that the ear can detect. Sound levels are measured and expressed in decibels (dB), the unit for describing the *amplitude* of sound. Sound pressure levels are expressed in logarithmic numbers; accordingly, 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* (not amplitude) of one source, which results in a 3 dB increase in noise levels. Decibels and other technical terms are defined in **Table NO-1**.

Most environmental sounds consist of several frequencies, with each frequency differing in sound level. The intensities of each frequency combine to generate sound. Acoustical professionals quantify sounds by "weighting" frequencies based on how sensitive humans are to that particular frequency. Using this method, low and extremely high frequency sounds are given less weight, or importance, while mid-range frequencies are given more weight, because humans can hear mid-range frequencies much better than low or very high frequencies. This method is called "A" weighting, and the units of measurement are dBA (A-weighted decibel level). The threshold for the human ear's ability to hear sound is zero (0) dBA, and the range of sound in normal human experience is 0 to 140 dBA. **Table NO-2** shows common noise sources and the sound level those sources typically generate.

Community Noise: Community noise is commonly described in terms of the "ambient" noise level, which is defined as the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (Leq), over a given time period (usually one hour). The Leq is the foundation of the day-night average noise descriptor, and shows very good correlation with community response to noise for the average person.

The Ldn is based upon the average noise level over a 24-hour day, with a +10 dB weighting applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime "penalty" is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because Ldn represents a 24-hour average, it tends to disguise short-term variations in the noise

environment. Where short-term noise sources are an issue, noise impacts may be assessed in terms of maximum noise levels, hourly averages, or other statistical descriptors.

Perception of Loudness: The perceived loudness of sounds and corresponding reactions to noise are dependent upon many factors, including sound pressure level, duration of intrusive sound, frequency of occurrence, time of occurrence, and frequency content. As mentioned above; however, within the usual range of environmental noise levels, perception of loudness is relatively predictable, and can be approximated by weighing the frequency response of a sound level meter by means of the standardized A-weighing network. **Table NO-2** shows examples of noise levels for several common noise sources and environments.

Sound Propagation: Sound decreases with distance, but sound propagation depends on more variables than distance. Those variables include the type of noise source (point, moving point, or line sources, such as roadways), the directionality of the noise source, the frequency content of the source (low frequency sound is absorbed in the atmosphere at a slower rate than high-frequency sound and therefore "carries" farther), atmospheric conditions (wind, temperature, humidity, gradients), ground type (dirt, grass fields, concrete, etc.), shielding (structures, noise barriers, topography), and vegetation. At short distances between a source and receptor, the effects of the atmosphere on sound propagation are diminished, as those effects become more pronounced at distances in excess of 300 feet.

Perception of Changes in Noise Levels: **Table NO-3** is based upon recommendations made in August 1992 by the Federal lnteragency Committee on Noise (FICON) for assessing changes in ambient noise levels resulting from aircraft operations. The recommendations are based upon studies that relate aircraft noise levels to the percentage of persons highly annoyed by noise. Although the FICON recommendations were specifically developed to assess aircraft noise impacts, these criteria have been applied to other sources of noise similarly described in terms of cumulative noise exposure metrics such as the Ldn.

The FICON recommendations indicate that an increase in noise from similar sources of five dB or more would be noticeable where the ambient level is less than 60 dB. Where the ambient level is between 60 and 65 dB, an increase in noise of 3 dB or more would be noticeable. An increase of 1.5 dB or more would be noticeable where the ambient noise level exceeds 65 dB Ldn. Generally, as ambient noise levels increase, a smaller increase in noise resulting from a project is sufficient to cause annoyance.

Sound Measurement: Sound is measured with an electronic meter that includes an electrical filter that converts the sound to dBA. “Ambient noise level” means the noise from all sources at a given location, and in the context of a noise analysis, refers to the noise level that is present before a new noise source is introduced, i.e. the “pre-project” noise level.

NOISE MITIGATION FUNDAMENTALS

Any noise issue may be considered as being composed of three basic elements: the noise source, a transmission path, and a receiver. The appropriate acoustical treatment for a given project should consider the nature of the noise source and the sensitivity of the receiver. The issue should be defined in terms of appropriate criteria (Ldn, L_{50}, or L_{max}), the location of the sensitive receiver (inside or outside), and when the issue occurs (daytime, nighttime, or 24-hour average). Noise control techniques should then be selected to provide an acceptable noise environment for the receiving property while remaining consistent with local aesthetic standards and practical structural and economic limits.

Noise control techniques include:

Setbacks: Noise exposure may be reduced by increasing the distance between the noise source and the receptor. Attenuation from this technique is limited by the characteristics of the noise source, but is generally about four to six dB per doubling of distance from the source.

Barriers: Walls, berms or other structures between the noise source and the receiver can shield receptors from excessive noise. A barrier's effectiveness depends upon blocking the line-of-sight between the source and receiver, and is improved by increasing the distance sound must travel to pass over the barrier. Barrier effectiveness also depends upon the relative heights of the source, barrier and receiver. Generally, barriers work best when they are placed close to either the receiver or the source.

Barriers typically are made of concrete-block walls, earthen berms, or berm/wall combinations. The use of an earth berm in lieu of a solid wall may provide additional attenuation over that attained by a solid wall alone due to the absorption provided by the earth. Berm/wall combinations offer slightly better acoustical performance than solid walls, and are often preferred for aesthetic reasons over solid barrier walls alone. Barriers should be continuous and relatively airtight along their length and height. To ensure that sound transmission through the barrier is insignificant, barrier mass should be about three to four pounds per square foot, although a lesser mass may be acceptable if the barrier material can provide sufficient attenuation.

There are practical limits to the noise reduction that barriers can provide. For traffic noise, a five to 10 dB noise reduction can be attained. A 15 dB noise reduction is usually difficult but sometimes possible to achieve, and a 20 dB noise reduction is extremely difficult.

Site Design: Buildings can be located to shield other structures or areas and to minimize reflected sounds. For example, carports or garages can be used to form or complement a barrier shielding adjacent dwellings or an outdoor activity area. Placement of outdoor activity areas within the shielded portion of a building complex, such as a central courtyard, can be an effective method of providing a quiet retreat in an otherwise noisy environment. Patios or balconies should be placed on the side of a

building opposite the noise source, and "wing walls" can be added to buildings or patios to help shield sensitive uses.

Building Design: Strategic placement of noise-sensitive portions of buildings can be effective means of reducing interior noise. Bedrooms, living rooms, family rooms and other noise-sensitive portions of a dwelling can be located on the side of the unit farthest from the noise source. Additionally, bathrooms, closets, stairwells and food preparation areas are relatively insensitive to exterior noise sources, and can be placed on the noisy side of a unit. When such techniques are employed, noise reduction requirements for the building facade can be significantly reduced.

Noise Reduction by Building Façades: Building façade design can reduce interior noise - standard residential construction practices generally provide 10 to 15 dB noise reduction for building facades with open windows, and approximately 25 to 30 dB reduction when windows are closed. Simply requiring adequate ventilation systems can achieve a 25 dB exterior- to-interior noise reduction so that windows may remain closed under any weather condition. Where greater noise reduction is required, acoustical treatment of the building facade with upgraded windows that have higher Sound Transmission Class (STC) ratings.

Noise transmitted through walls can be reduced by increasing wall mass (using stucco or brick in lieu of wood siding), isolating wall members by the use of double- or staggered-stud walls, or mounting interior walls on resilient channels. Noise control for exterior doorways is provided by reducing door area, using solid-core doors, and by acoustically sealing door perimeters with suitable gaskets. Using plywood sheathing under roofing materials also helps to reduce noise.

Vegetation: Trees and other vegetation provide very limited noise attenuation and should not be considered as a primary noise-reduction solution. An approximately 100-foot deep band of dense foliage (so that no visual path extends through the foliage) is required to reduce traffic noise by five dB. However, vegetation *can* be used to acoustically "soften" the area between a noise source and receiver, increasing ground absorption of sound and thus increasing sound attenuation with distance. Trees and shrubs also provide aesthetic and psychological value, and may reduce adverse public reaction to a noise source by shielding the source from view, even though noise levels would be largely unaffected.

Noise-Reducing Paving Materials (Rubberized Asphalt): Rubberized asphalt can slightly reduce traffic noise. Studies conducted for the Sacramento County Planning and Environmental Review Department and Transportation Department indicate that rubberized asphalt used on two County roadways appears to have resulted in an average traffic noise level reduction of approximately 4 dB over that provided by conventional asphalt.

Table NO-1: Acoustics Terminology

TERM	DEFINITION
Ambient Noise Level	The composite of noise from all sources near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.
Intrusive Noise	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.
Decibel (dB)	A unit for 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, which is 20 micropascals (20 micronewtons per square meter).
Frequency (Hz)	The number of complete pressure fluctuations per second above and below atmospheric pressure.
Community Noise Equivalent Level (CNEL)	The average equivalent sound level during a 24-hour day, obtained after addition of approximately five decibels to sound levels in the evening form 7:00 p.m. to 10:00 p.m. And ten decibels to sound levels in the night before 7:00 a.m. and after 10:00 p.m.
Equivalent Noise Level (Leq)	The average noise level during the measurement or sample period. Leq is typically computed over 1, 8 and 24-hour sample periods.
Day/Night Noise Level (Ldn)	The average equivalent sound level (Leq) during a 24-hour day, obtained after addition of ten decibels to sound levels in the night after 10:00 p.m. And before 7:00 a.m.
Lmax, Lmin	The maximum or minimum sound level recorded during a noise event.
Ln	The sound level exceeded “n” per percent of the time during a sample interval. L10 equals the level exceeded 10 percent of the time (L90, L50, etc.).
Noise Exposure Contours	Lines drawn about a noise source indicating constant levels of noise exposure. CNEL and Ldn contours are frequently utilized to describe community exposure to noise.
Sound Exposure Level, (SEL) Single Event Noise Exposure Level (SENEL)	The level of noise accumulated during a single noise event, such as an aircraft overflight, with reference to a duration of one second. More specifically, it is the time integrated A-weighted squared sound pressure level for a stated time interval or event, based on a reference pressure of 20 micropascals and a reference duration of one second.
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 response of the human ear and gives good correlation with subjective reactions to noise.

Table NO-2: Examples of Common Noise Levels

Loudness Ratio Level		A-weighted Sound Level (dBA)		
128		130		Threshold of pain
64		120		Jet aircraft takeoff at 100 feet
32		110		Riveting machine at operators position
16		100		Cut-off saw at operators position
8		90		Bulldozer at 50 feet
4		80		Diesel locomotive at 300 feet
2		70		Commercial jet aircraft interior during flight
1		60		Normal conversation speech at 5-10 feet
0.5		50		Open office background level
0.25		40		Background level within a residence
0.13		30		Soft whisper at 2 feet
0.06		20		Interior of recording studio

Table NO-3: Significance of Changes in Cumulative Noise Exposure

Ambient Noise Level Without Project (Ldn)	Increase Required for Significant Impact
<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)

ENVIRONMENTAL SETTING

The project site is a 128.1-acre property surrounded by low-intensity commercial and residential development at elevations ranging from approximately 120 to 155 feet above sea level. The project site consists of gently hilly to undulating terrain. Don Julio Boulevard traverses the property across the easternmost section of the survey area from north to south.

The existing noise environment within the overall project area varies by location and is defined by a combination of noise sources. The most pervasive noise source affecting the project area is surface traffic on Don Julio Boulevard, Antelope Road, and other local and distant roadways. In addition, the project area is potentially affected by noise levels generated from playground activity noise at Barrett Ranch Elementary School, and athletic events at Antelope High School.

No appreciable sources of vibration were identified during field surveys of the project area and existing ambient vibration levels were subjectively evaluated as being below the threshold of perception.

The processes used for quantifying the existing noise levels on the project site and the surrounding area follow in the Methodology section below.

REGULATORY SETTING

STATE OF CALIFORNIA

The California Department of Health Services (DHS) office of Noise Control has studied the relationship between noise levels and different land uses. As a result, the DHS has established four categories for judging the severity of noise intrusion on specified land use. Noise in the "normally acceptable" category places no undue burden on affected receptors and would need no mitigation. As noise rises into the "conditionally acceptable" range, some mitigation of exposure (as established by an acoustical study) would be warranted. At the next level, noise intrusion is so severe that it is classified "normally unacceptable" and would require extraordinary noise reduction measures to avoid disruption. Finally, noise in the "clearly unacceptable" category is so severe that it cannot be mitigated.

Title 24 of the California Administrative Code establishes standards governing interior noise levels that apply to all new multifamily residential units in California. The standards require that acoustical studies be performed prior to construction at building locations where the existing L_{dn} exceeds 60 dBA. Such acoustical studies are required to establish mitigation measures that will limit maximum L_{dn} noise levels to 45 dBA in any inhabitable room. The U.S. Department of Housing and Urban Development (HUD) has set an L_{dn} of 45 as its goal for interior noise in residential units built with HUD funding.

SACRAMENTO COUNTY GENERAL PLAN NOISE ELEMENT

The goals of the Sacramento County General Plan Noise Element are to: (1) protect the citizens of Sacramento County from exposure to excess noise and (2) protect the economic base of Sacramento County by preventing incompatible land uses from encroaching upon existing planned noise-producing uses. The General Plan defines a noise sensitive outdoor area as the primary activity area associated with any given land use at which noise sensitivity exists. Noise sensitivity generally occurs in locations where there is an expectation of relative quiet, or where noise could interfere with the activity that takes place in the outdoor area. An example is a backyard, where loud noise could interfere with the ability to engage in normal conversation.

The Noise Element establishes noise exposure criteria to aid in determining land use compatibility by defining the limits of noise exposure for sensitive land uses. There are

policies for noise receptors and noise sources, transportation or non-transportation noise, and interior and exterior noise.

NO-1: The noise level standards for noise-sensitive areas of *new* uses affected by traffic or railroad noise sources in Sacramento County are shown by Table 1. Where the noise level standards of Table 1 are predicted to be exceeded at new uses proposed within Sacramento County which are affected by traffic or railroad noise, appropriate noise mitigation measures shall be included in the project design to reduce projected noise levels to a state of compliance with the Table 1 standards (see **Table NO-4**).

Table NO-4: General Plan Noise Element, Table 1
Noise Standards for New Uses Affected by Traffic and Railroad Noise

New Land Use	Sensitive Outdoor Area – L_{dn}	Sensitive Interior Area – L_{dn}
All Residential[5]	65	45
Transient lodging[3,5]	65	45
Hospitals and nursing homes[3,4,5]	65	45
Theaters and auditoriums[3]	None	35
Churches, meeting halls, schools, libraries, etc.[3]	65	40
Office buildings[3]	65	45
Commercial buildings[3]	None	50
Playgrounds, parks, etc.	70	None
Industry[3]	65	50

1. Sensitive areas are defined in acoustical terminology section.
2. Interior noise level standards are applied within noise-sensitive areas of the various land uses, with windows and doors in the closed positions.
3. Where there are no sensitive exterior spaces proposed for these uses, only the interior noise level standard shall apply.
4. Hospitals are often noise-generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation either by hospital staff or patients.
5. If this use is affected by railroad noise, a maximum (L_{max}) noise level standard of 70 dB shall be applied to all sleeping rooms to reduce the potential for sleep disturbance during nighttime train passages.

NO-5: The interior and exterior noise level standards for noise-sensitive areas of new uses affected by existing non-transportation noise sources in Sacramento County are shown by Table 2. Where the noise level standards of Table 2 are predicted to be exceeded at a proposed noise-sensitive area due to existing non- transportation noise sources, appropriate noise mitigation measures shall be included in the project design to reduce projected noise levels to a state of compliance with the Table 2 standards within sensitive areas (see **Table NO-5**).

Table NO-5: General Plan Noise Element Table 2
Non-Transportation Noise Standards Median (L_{50})/Maximum (L_{max})

New Land Use	Outdoor Area		Interior
	Daytime	Nighttime	Day and Night
All Residential	55 / 75	50 / 70	35 / 55
Transient lodging[4]	55 / 75	---	35 / 55
Hospitals and nursing homes[5,6]	55 / 75	---	35 / 55
Theaters and auditoriums[6]	---	---	30 / 50
Churches, meeting halls, schools,[6]	55 / 75	---	35 / 60
Office buildings[6]	60 / 75	---	45 / 65
Commercial buildings[6]	---	---	45 / 65
Playgrounds, parks, etc[6]	65 / 75	---	---
Industry[6]	60 / 80	---	50 / 70

1. The Table 2 standards shall be reduced by 5 dB for sounds consisting primarily of speech or music, and for recurring impulsive sounds. If the existing ambient noise level exceeds the standards of Table 2, then the noise level standards shall be increased at 5 dB increments to encompass the ambient.
2. Sensitive areas are defined in the acoustic terminology section.
3. Interior noise level standards are applied within noise-sensitive areas of the various land uses, with windows and doors in the closed positions.
4. Outdoor activity areas of transient lodging facilities are not commonly used during nighttime hours.
5. Hospitals are often noise-generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation by either hospital staff or patients.
6. The outdoor activity areas of these uses (if any), are not typically utilized during nighttime hours.
7. Where median (L50) noise level data is not available for a particular noise source, average (Leq) values may be substituted for the standards of this table provided the noise source in question operates for at least 30 minutes of an hour. If the source in question operates less than 30 minutes per hour, then the maximum noise level standards shown would apply.

NO-6: Where a project would consist of or include non-transportation noise sources, the noise generation of those sources shall be mitigated so as not exceed the interior and exterior noise level standards of Table 2 at existing noise-sensitive areas in the project vicinity.

NO-7: The “last use there” shall be responsible for noise mitigation. However, if a noise-generating use is proposed adjacent to lands zoned for uses which may have sensitivity to noise, then the noise generating use shall be responsible for mitigating its noise generation to a state of compliance with the Table 2 standards at the property line of the generating use in anticipation of the future neighboring development.

NO-8: Noise associated with construction activities shall adhere to County Code requirements (§ 6.68.090(e)).

NO-9: For capacity enhancing roadway or rail projects, or the construction of new roadways or railways, a noise analysis shall be prepared in accordance with the Table 3 requirements. If projected post-project traffic noise levels at existing uses exceed the

noise standards of Table 1, then feasible methods of reducing noise to levels consistent with the Table 1 standards shall be analyzed as part of the noise analysis. In the case of existing residential uses, sensitive outdoor areas shall be mitigated to 60 dB, when possible, through the application of feasible methods to reduce noise. If 60 dB cannot be achieved after the application of all feasible methods of reducing noise, then noise levels up to 65 dB are allowed.

If pre-project traffic noise levels for existing uses already exceed the noise standards of Table 1 and the increase is significant as defined below, feasible methods of reducing noise to levels consistent with the Table 1 standards should be applied. In no case shall the long-term noise exposure for non-industrial uses be greater than 75 dB; long-term noise exposure above this level has the potential to result in hearing loss.

A significant increase is defined as follows:

Pre-Project Noise Environment (Ldn)	Significant Increase
Less than 60 dB	5+ dB
60 – 65 dB	3+ dB
Greater than 65 dB	1.5+ dB

NO-13: Where noise mitigation measures are required to satisfy the noise level standards of this Noise Element, emphasis shall be placed on the use of setbacks and site design to the extent feasible, prior to consideration of the use of noise barriers.

N0-14: Noise analyses prepared for multi-family residential projects, town homes, mixed- use, condominiums, or other residential projects where floor ceiling assemblies or party-walls shall be common to different owners/occupants shall be consistent with the State of California Noise Insulation standards.

N0-15: The County shall have the flexibility to consider the application of 5 dB less restrictive exterior noise standards than those prescribed in Tables 3 and 4 in cases where it is impractical or infeasible to reduce exterior noise levels within infill projects to a state of compliance with the Table 3 or 4 standards. In such cases, the rational for such consideration shall be clearly presented and disclosure statements and noise easements should be included as conditions of project approval. The interior noise level standards of Tables 3 and 4 would still apply. The maximum allowable long-term noise exposure permissible for non-industrial uses is 75 dB.

SACRAMENTO COUNTY NOISE CONTROL ORDINANCE

The County's Noise Control Ordinance sets limits for exterior noise levels on some designated agricultural-residential and all residential properties. The standards found in the County's Noise Control Ordinance are based on the duration of noise on private property over one-hour periods. The ordinance is primarily concerned with regulating noise other than noise generated by transportation noise sources (e.g., other than passing cars or aircraft flyovers). The ordinance limits the duration of noise based on many factors, including the type of source, tonal characteristics of the source, ambient

noise levels, time of day, etc., by utilizing a system of noise criteria not to be exceeded based on the duration of noise over any given hour. **Table NO-6** summarizes the Noise Ordinance standards.

In recognition of ambient noise, the ordinance allows the standards set forth in **Table NO-6** to be adjusted in 5 dBA increments to encompass the ambient noise level. For example, if the ambient noise level for a given hour was 57 dBA, the daytime L_{50} noise standard would be increased to 60 dBA. The Noise Control Ordinance also states that each of the standards identified in **Table NO-6** should be reduced by 5 dBA for impulsive or simple tone noises,[1] or for noises consisting of speech or music.

Various uses and activities are exempt from the Noise Ordinance. In particular, construction noise is expressly exempt provided that construction activities do not take place between eight p.m. and six a.m. from Mondays through Thursdays, and from eight p.m. to seven a.m. on Fridays, Saturdays and Sundays (County Code § 6.68.090).

The noise analysis prepared for the project (cited below) comprehensively sets forth all County noise regulations.

Table NO-6: Sacramento County Noise Ordinance

Cumulative Duration of the Intrusive Sound	Descriptor	Exterior Noise Standard, dB	
		Daytime (7am – 10pm)	Nighttime (10pm – 7am)
30 – 60 minutes per hour	L_{50}	55	50
15 – 30 minutes per hour	L_{25}	60	55
5 – 15 minutes per hour	L_{08}	65	60
1 – 5 minutes per hour	L_{02}	70	65
Level not to be exceeded at any time	L_{max}	75	70

Source: Sacramento County, Noise Control Ordinance (County Code § 6.68.070)

NON-REGULATORY SETTING

SUBJECTIVE REACTIONS TO CHANGES IN NOISE LEVELS

Another means of assessing noise impacts is to estimate public reaction to the change in noise levels which result from a given project; this is, in fact, how the General Plan has established significance for roadway projects (refer to Policy NO-9). Expected

[1] "Impulsive noise" means a noise characterized by brief excursions of sound pressures whose peak levels are very much greater than the ambient noise level, such as might be produced by the impact of a pile driver, punch press or a drop hammer, typically with duration of one second or less. "Simple tone noise" or "pure tone noise" means a noise characterized by the presence of a predominant frequency or frequencies such as might be produced by a whistle or hum.

human reactions to changes in ambient noise levels have been quantified by metrics that define short-term exposure (e.g., hourly L_{eq}, L_{max} and L_n). These metrics are usually used to describe noise impacts due to industrial operations, machinery and other sources that are not associated with transportation. An increase of at least 3 dB is usually required before most people will perceive a change in noise levels, and an increase of 5 dB is required before the change will be clearly noticeable.

Table NO-7 shows expected public reaction to changes in environmental noise levels. This table was developed on the basis of test subjects' reactions to changes in the levels of steady-state pure tones or broad-band noise and to changes in levels of a given noise source.

Some additional guidance as to the significance of changes in ambient noise levels is provided by the 1992 findings of the Federal Interagency Committee of 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 L_{dn} or CNEL. The changes in noise exposure that are shown in **Table NO-8** are expected to result in equal changes in annoyance at sensitive land uses. The rational for the criteria shown in **Table NO-8** is that, as ambient noise levels increase, a smaller increase in noise resulting from a project is sufficient to cause significant annoyance. Although the FICON findings were specifically developed to address aircraft noise impacts, they are considered as measures of potential noise impacts in the analysis of traffic noise.

Table NO-7: Subjective Reaction to Changes in Noise Levels

Change in Level	Subjective Reaction	Factor Change in Acoustical Energy
1 dB	Imperceptible (Except for tones)	1.3
3 dB	Just Barely Perceptible	2.0
5 dB	Clearly Noticeable	3.2
10 dB	About Twice (or Half) as loud	10.0

Source: Architectural Acoustics, M. David Egan, 1988.

Table NO-8: Significance of Changes in Noise Exposure

Ambient Noise Level Without the Project, Ldn	Significant Impact
<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)

METHODOLOGY

A noise analysis was prepared for this project by Bollard Acoustical Consultants, Inc. (Appendix G: *Bollard Acoustical Consultants, Inc., Environmental Noise Analysis, Barrett Ranch East Development EIR, February 2015*). The Federal Highway Administration Highway Traffic Noise Prediction Model (FHWA RD-77-108) was used to predict the traffic noise levels on the project site. Baseline FHWA Model traffic volume inputs were obtained from the traffic impact analysis prepared for the project by Kimley-Horn and Associates (October 14, 2014). The FHWA model is based upon the Calveno reference noise factors for automobiles, medium trucks and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The site plan that was used for the noise analysis has been revised since preparation of the noise analysis. The following is an analysis of the currently proposed site plan based on the information provided in the noise analysis.

Table NO-9 shows the predicted existing traffic noise levels at a reference distance of 100 feet from the roadway centerlines, as well as the distances to the unshielded Ldn contours.

Table NO-9: Existing (Baseline) Traffic Noise Levels at 100-feet and Distance to Traffic Noise Contours

Segment	Roadway	Segment Description	Ldn at 100 feet, (dB)	Distance to Ldn Contour (feet)		
				70 dB	65 dB	60 dB
1	Titan Dr.	Elverta Rd. - Antelope HS Dwy.	52	7	14	31
2	Palmerson Dr.	N Loop Blvd. - Elverta Rd.	55	9	20	44
3	Elverta Rd.	Walerga Rd. - Palmerson Dr.	63	35	76	164
4		Palmerson Dr. - Titan Dr.	61	27	57	123
5		Titan Dr. - Pismo Beach Dr.	60	21	45	96
6		Pismo Beach Dr. - Sand City Dr.	60	20	43	93
7	Antelope Rd.	Watt Ave. - Walerga Rd.	66	53	114	246
8		Walerga Rd. - Esteem Dr.	68	69	149	320
9		Esteem Dr. - Elverta Rd.	59	19	40	87
10		Don Julio Blvd. - Roseville Rd.	69	85	184	396
11	Elkhorn Blvd.	Walerga Rd. - Don Julio Blvd.	68	75	162	349
12		Don Julio Blvd. - Roseville Rd.	70	102	220	474
13		Roseville Rd. - 180 WB Ramps	70	99	214	462
14	Don Julio Blvd.	N Loop Blvd. - Poker Ln.	65	44	95	204
15		Poker Ln. - Antelope Rd.	66	53	115	247
16		Antelope Rd. - Elkhorn Blvd.	66	56	121	262
17	Watt Ave.	Antelope Rd. - Elkhorn Blvd.	68	71	152	327
18	Walerga Rd.	Elverta Rd. - Antelope Rd.	69	80	173	372
19		Antelope Rd. - Elkhorn Blvd.	68	71	153	330

Source: FHWA-RD-77-108 with traffic inputs provided by Kimley-Horn and Associates.

EXISTING GENERAL AMBIENT NOISE ENVIRONMENT

To quantify the existing ambient noise environment, short-term (continuous) ambient noise level measurements were conducted on December 1, 2014 at five locations within and adjacent to the proposed project area (**Plate NO-1**). As detailed in **Table NO-10**, existing noise levels within the project area vary, with locations nearest Don Julio Boulevard and Poker Lane recording the highest noise levels.

Table NO-10: Short-term Ambient Noise Level Monitoring Summary

Measured Noise Levels, dBA2,3						
Site[1]	**Time**	**L_{eq}**	**L_{max}**	**L_{50}**	**L_{90}**	**Notes/Source**
1	1:46 PM	49	62	46	43	High School dominant source
2	2:15 PM	60	67	59	56	Don Julio Blvd. dominant source
3	2:38 PM	58	65	57	52	Don Julio Blvd/Poker Ln dominant source
4	3:02 PM	71	84	69	56	Don Julio Blvd. dominant source
5	3:28 PM	51	57	48	45	Elementary School/distant traffic

Notes:
1 Noise monitoring locations illustrated on Figure 1.
2 Noise level descriptors (Leq, Lmax, L50, and L90) defined in Appendix G of this EIR.
3 Noise level measurements were 15 minutes in duration.

Source: Bollard Acoustical Consultants, Inc.

SIGNIFICANCE CRITERIA

Sacramento County uses the following criteria, which are based on Appendix G of the CEQA Guidelines, to determine whether an impact is significant:

1. Expose people to, or generate noise levels in excess of standards established in the Sacramento County General Plan, Zoning Code and Noise Ordinance, or applicable standards of other agencies.

2. Expose people to a substantial *permanent* increase in ambient noise levels in the project vicinity above levels existing without the project.

3. Result in a substantial *temporary* or *periodic* increase in ambient noise levels in the project vicinity above levels existing without the project.

The CEQA Guidelines list two additional thresholds relating to airport noise. As noted in the Initial Study Checklist, the project site is not near a public or private airport, and would not be significantly affected by airport noise. Accordingly, airport noise impacts are not discussed in this document.

Plate NO-1: Ambient Noise Monitoring Locations

IMPACTS AND ANALYSIS

IMPACT: EXPOSURE OF PEOPLE TO NOISE LEVELS IN EXCESS OF APPLICABLE STANDARDS ESTABLISHED IN THE SACRAMENTO COUNTY GENERAL PLAN, ZONING CODE AND NOISE ORDINANCE, OR APPLICABLE STANDARDS OF OTHER AGENCIES

LEVEL OF IMPACT: LESS THAN SIGNIFICANT WITH MITIGATION

TRANSPORTATION NOISE

SENSITIVE RECEPTORS WITHIN THE PROJECT AREA

The cumulative and cumulative plus project traffic noise levels were predicted using the FHWA model and traffic volume inputs from the traffic impact analysis prepared for the project (Appendix J of this EIR). Noise levels in excess of County standards are anticipated along three roadway segments within the project site, two segments along Don Julio Boulevard and one along Elverta Road. For these roadway segments the noise level at 100 feet from the roadway centerline and the distance at which the noise level meets County standards was determined (**Table NO-11**).

Table NO-11: Future Traffic Noise Levels

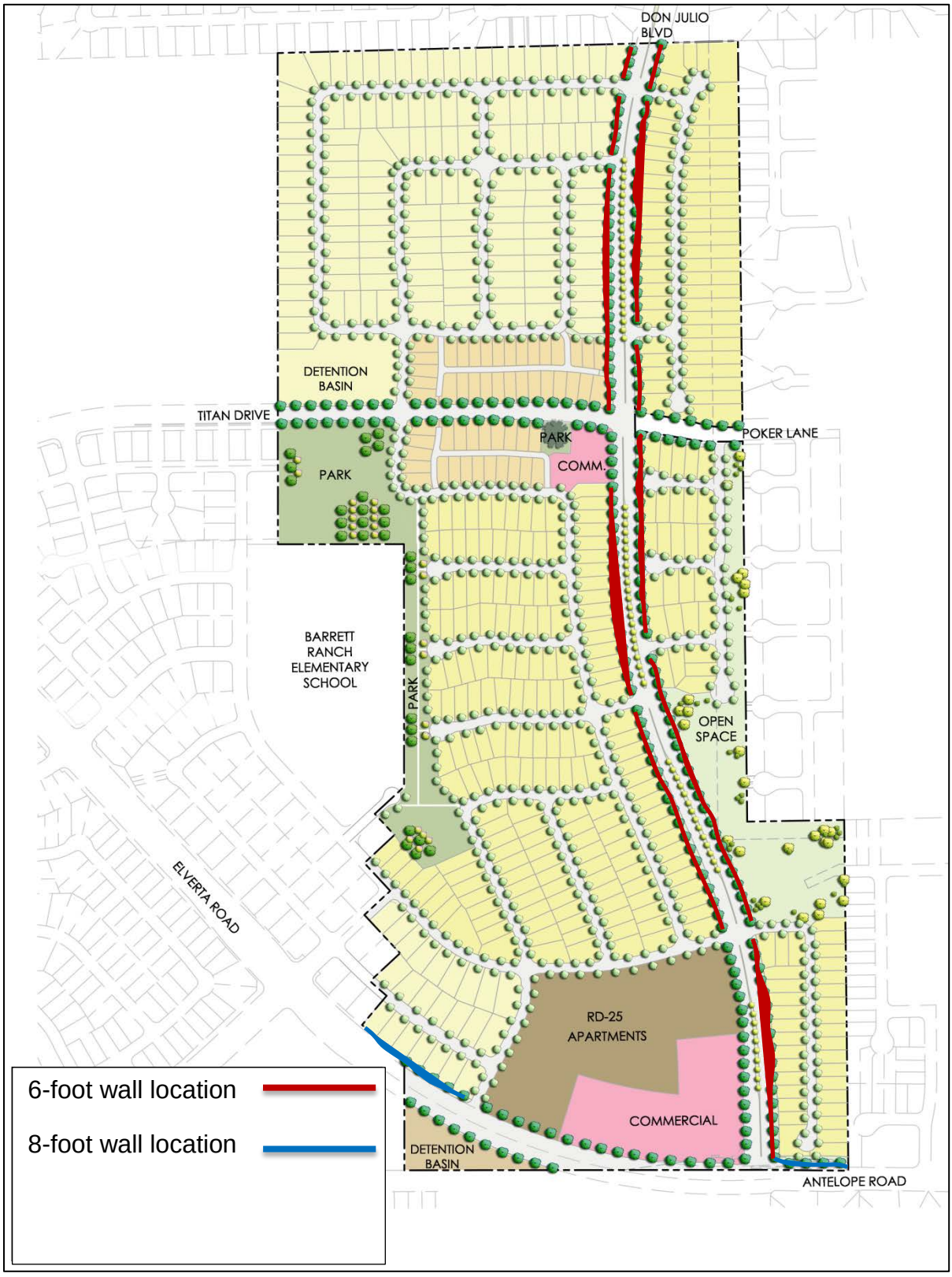
Segment	Roadway	Segment Description	L_{dn} at 100 ft.	Distance to 65 dB L_{dn} Contour (feet)
14	Don Julio Blvd	N Loop Blvd.- Poker Ln	66	119
15		Poker Ln - Antelope Rd	67	145
n/a[1]	Elverta Road	Sand City Dr.- Don Julio Blvd	71	236

Notes:
[1]Connector does not currently exist.

Source: FHWA-RD-77-108 with traffic inputs provided by Kimley-Horn and Associates.

New residential uses are planned along Don Julio Boulevard and Elverta Road with primary outdoor activity areas backing on to these roadways. Barriers will be required at these sensitive receptor locations in order to reduce the noise level to within County standards. The noise analysis concluded that construction of a six foot tall solid noise barrier along Don Julio Boulevard and an eight foot tall solid noise barrier along Elverta Road would reduce the noise levels within the backyards of the lots backing on to these roadways to below 65 dB, thereby bringing the noise level into compliance with County standards. The location of these barriers is shown on **Plate NO-2**; because the tentative map was revised after the noise study was prepared, **Plate NO-2** has been updated to reflect the currently proposed project. The revised barrier locations are substantially the same as those proposed in the noise study. With mitigation requiring that noise barriers be constructed in these locations, impacts are less than significant.

Plate NO-2: Recommended Noise Barrier Locations



The maximum interior noise level for residential uses is 45 dB. Standard residential construction generally provides interior noise reduction of 25 dB, which means that exterior noise volumes must exceed 70 dB before interior volumes will exceed the 45 dB standard. With the installation of barriers, the exterior noise volumes will not exceed 65 dB and standard construction will reduce the interior noise level by 25 dB bringing the maximum interior noise levels to no more than 40 dB. To further ensure that interior noise levels are within County standards, installation of second floor windows with a minimum sound transmission rating of 32 was recommended by the noise consultant. With standard residential construction and installation windows with a sound transmission rating of 32, impacts are less than significant.

NON-TRANSPORTATION NOISE

OFFSITE PLAYGROUND/SPORTS FIELD NOISE

Barrett Ranch Elementary School is located on the western boundary of the project area, near the corner of Ocean Park Drive and Sand City Drive. The school playgrounds and a sports field are located on the north/northeast side of the facility, bordering Ocean Park Drive and Olberoing Way. There is an existing residential development adjacent to the playgrounds, with residential structures located approximately 100 feet away.

Prior playground monitoring conducted by Bollard Acoustical Consultants, Inc. (BAC) found that a group of approximately 100 children spread out over various playground locations generated noise levels of approximately 60 dB L_{eq} and 75 dB L_{max} at a distance of 100 feet from the playground. The nearest proposed residential structures (east of the playgrounds) would be located at least 300 feet from the existing playgrounds and separated from the playground by a passive park. With the consideration of noise attenuation over distance, BAC concluded that the noise generated from the playgrounds would not exceed the County's exterior noise standard for residential structures (55 L_{50} or L_{eq} and 75 L_{max}, or 55 dB L_{dn}). Impacts are considered less than significant.

Antelope High School is located adjacent to the northwestern boundary of the project site, and on the north side of Titan Way. The existing baseball field is located on the eastern boundary of the facility, and borders outdoor areas of proposed residences on the northwest side of the project area baseball fence. Prior data collected by BAC for similar-sized baseball facilities indicate that the average noise levels produced during games would be approximately 55 dB Leq and 70 dB Lmax at a distance of 100 feet from the center of the pitcher's mound. The estimated distance from home plate to the nearest proposed residence exceeds 600 feet. With the consideration for noise attenuation over distance, BAC concluded that the noise generated from the Antelope High School baseball field would not exceed the County's exterior noise standard for residential structures. Impacts are less than significant.

ONSITE COMMERCIAL DEVELOPMENT

Commercial and other non-residential uses along Antelope Road and at the intersection of Poker Lane and Don Julio Boulevard could generate noise affecting nearby

residences. Such noise generators would likely include commercial delivery vehicles and mechanical equipment, such as high-powered heating and ventilation (HVAC) units. According to BAC, depending on the size of the equipment, HVAC units can produce sound levels in the range of 70 to 75 dBA at 50 feet. Because the project calls for commercial uses to be located adjacent to residential uses, stationary sources associated with commercial uses could result in noise that exceeds the County's compatibility standards. These developments are required to comply with the Sacramento County Noise Ordinance Section 6.68.120 for machinery, equipment, fans, and air conditioning which dictates that operation of these types of equipment in excess of 60 dB at any point within a residential property is unlawful. This requirement will ensure that noise from machinery will not exceed acceptable levels.

Furthermore, standard design practices and compliance with Zoning Code requirements for commercial uses adjacent to residential uses are expected to ensure that significant noise exposure due to loading docks and commercial delivery vehicles and is avoided. Impacts are less than significant.

MITIGATION MEASURES:

NO-1. A 6-foot tall solid noise barrier shall be constructed along Don Julio Boulevard and a 7-foot tall solid noise barrier shall be constructed along the extension of Antelope Road such that the noise level at all residential development exposed to greater than 65 dB L_{dn} at the property line is reduced to within General Plan Noise Element standards for exterior activity areas. Alternatives for achieving compliance with noise standards include, but are not limited to, increased setbacks, and/or strategic placement of structures. An acoustical analysis substantiating the required noise level reduction, prepared by a qualified acoustical consultant shall be submitted to and verified by the Environmental Coordinator prior to the issuance of any building permits for affected sites.

NO-2. The second floor windows of all residential development adjacent to Don Julio Boulevard and the extension of Antelope Road shall have a minimum Sound Transmission Class Rating of 32.

IMPACT: EXPOSE PEOPLE TO A SUBSTANTIAL PERMANENT INCREASE IN AMBIENT NOISE LEVELS

LEVEL OF IMPACT: LESS THAN SIGNIFICANT

EXISTING ADJACENT RESIDENTIAL USES

While there are General Plan noise standards applicable to *new* development affected by transportation noise, and for existing development affected by *new* transportation projects (new roadways, or roadway widening), there are no General Plan standards which apply to existing development affected by increases in traffic associated with new land uses. That impact is assessed not through General Plan standards, but the general CEQA guidelines criteria that an increase in noise which is substantial is significant. For this analysis, a substantial increase in noise is defined by the FICON

noise study – which is the same basis on which new roadway project impacts are assessed according to General Plan policy NO-9.

According to the FICON noise study (refer to **Table NO-8**), an increase in the ambient noise level by 5 dB or more is substantial when existing ambient noise levels are less than 60 dB, a change in 3 dB or more is substantial when existing noise levels are between 61 and 64 dB, and a change of 1.5 dB or more is substantial when existing ambient noise levels are above 65 dB.

Because project development would raise traffic volumes on the local roadway network, the noise analysis for the project compared existing and future traffic noise levels for 19 local roadways, both with and without project-generated traffic (**Table NO-12**). The project related increases in daily traffic volumes would result in a corresponding increase in traffic noise levels at existing off-site, noise sensitive land uses in the immediate project vicinity.

Table NO-12: Existing Versus Existing Plus Project Traffic Noise Levels

			Ldn, dB @ 100 feet			
Roadway	**Segment**	**Segment Description**	**Existing**	**Existing Plus Project**	**Change**	**Substantial Increase**
Titan Dr.	1	Elverta Rd. - Antelope HS Dwy.	52	54	+2	No
Palmerson Dr.	2	N Loop Blvd. - Elverta Rd.	55	55	0	No
Elverta Rd.	3	Walerga Rd. - Palmerson Dr.	63	65	+2	No
	4	Palmerson Dr. - Titan Dr.	61	63	+2	No
	5	Titan Dr.- Pismo Beach Dr.	60	62	+2	No
	6	Pismo Beach Dr.- Sand City Dr.	60	61	+1	No
Antelope Rd.	7	Watt Ave - Walerga Rd.	66	66	0	No
	8	Walerga Rd.- Esteem Dr.	68	68	0	No
	9	Esteem Dr.- Elverta Rd.	59	66	+7	**YES**
	10	Don Julio Blvd.- Roseville Rd.	69	69	0	No
Elkhorn Blvd.	11	Walerga Rd.- Don Julio Blvd.	68	68	0	No
	12	Don Julio Blvd.- Roseville Rd.	70	70	0	No
	13	Roseville Rd.- 180 WB Ramps	70	70	0	No
Don Julio Blvd.	14	N Loop Blvd.- Poker Ln.	65	65	0	No
	15	Poker Ln - Antelope Rd.	66	66	0	No
	16	Antelope Rd.- Elkhorn Blvd.	66	66	0	No
Watt Ave.	17	Antelope Rd.- Elkhorn Blvd.	68	68	0	No
Walerga Rd.	18	Elverta Rd.- Antelope Rd.	69	69	0	No
	19	Antelope Rd.- Elkhorn Blvd.	68	68	0	No

Source: FHWA-RD-77-108 with traffic inputs provided by Kimley-Horn and Associates.

Of the 19 existing roadway segments that were evaluated 18 had noise level increases that ranged from zero to two dB except the segment of Antelope Road between Esteem

Drive and Elverta Road. At this location, project-related traffic noise was predicted to increase by seven dB, from 59 dB to 66 dB. This increase is largely due to the reconfiguration of Antelope Road because existing traffic does not pass the residences that are located on this segment. Once the roadway is reconfigured, there will be a considerable increase in traffic along this segment when compared to the existing condition, which contributes to a higher dB increase in this area than in other parts of the site.

Although this increase is greater than five dB, the existing residences along this segment of Antelope Road are currently shielded from traffic noise by an 8-foot tall masonry wall, which provides attenuation. This masonry wall was built in anticipation of the realignment of Antelope Road, and the associated increase in traffic noise, and will reduce the noise level in the primary outdoor activity area of these residences to 60 dB L_{dn} or less. An increase of seven dB is considered a significant impact however, this impact has already been mitigated by the existing masonry wall; therefore, this impact is less than significant.

BARRETT RANCH ELEMENTARY

The nearest school the proposed project is Barrett Ranch Elementary School, which is located on the western boundary of the project area, near the corner of Ocean Park Drive and Sand City Drive. Because the noise analysis did not evaluate this roadway the results from the nearby Titan Drive segment (Elverta Road – Antelope High School Driveway) were used to predict the noise level at the Barrett Ranch Elementary. As presented in **Table NO-12**, the ambient noise level for the Titan Drive segment is expected to increase by 2 dB, from 52 dB to 54 dB. This is not considered a substantial increase. Furthermore, the predicted noise level 100 feet from the middle of Ocean Park Drive is 65 Ldn. The distance from the middle of Ocean Park Drive to the closest school building exceeds 300 feet. Based on this information, and the fact that noise attenuates over distance, impacts from future traffic noise levels from the project area would not exceed the County's exterior or interior noise standards for any nearby school structures (65 dB Ldn and 40 dB Ldn, respectively). Accordingly, noise impacts to Barrett Ranch Elementary School are less than significant.

MITIGATION MEASURES:

None required.

IMPACT: CONSTRUCTION WOULD TEMPORARILY INCREASE NOISE LEVELS

LEVEL OF IMPACT: LESS THAN SIGNIFICANT

During the construction phases of the project, noise from on-site construction activities, including grading, infrastructure and building construction, as well as noise produced from truck traffic on area roadways, would temporarily add to the ambient noise environment on and around the project site. Noise sensitive land uses located in the vicinity of construction could be subjected to noise from construction activities.

The Sacramento County Noise Ordinance specifically exempts construction-related noise from meeting noise limitations, subject to the following provisions:

> Noise sources associated with construction, repair, remodeling, demolition, paving or grading of any real property, provided said activities do not take place between the hours of eight p.m. through six a.m. on weekdays and Friday commencing at eight p.m. through and including seven a.m. on Saturday; Saturdays commencing at eight p.m. through and including seven a.m. on the next following Sunday and on each Sunday after the hour of eight p.m. Provided however, when an unforeseen or unavoidable condition occurs during a construction project, and the nature of the project necessitates that work in process be continued until a specific phase is completed, the constructor or owner shall be allowed to continue work after eight p.m. and to operate machinery and equipment necessary until completion of the specific work in progress can be brought to conclusion under conditions which will not jeopardize inspection acceptance or create undue financial hardships for the contractor or owner. [Sacramento County Code, Section 6.68.090 (e)]

Construction noise impacts associated with buildout of the proposed project fall under this exemption. It is acknowledged that construction related noise could be a nuisance to sensitive receptors; however, this increase in noise is short-term, and noise standards within the General Plan are generally intended to address long-term sources of noise. Construction-related noise would not result in a permanent increase in ambient noise. Though noise volumes would undergo short-term increases, the existing construction ordinance is designed to avoid significant community effects through the restriction of nighttime and weekend disturbance, and thus impacts are less than significant.

MITIGATION MEASURES:

None required.

COMMERCIAL ALTERNATIVE

IMPACT: EXPOSURE OF PEOPLE TO NOISE LEVELS IN EXCESS OF APPLICABLE STANDARDS ESTABLISHED IN THE SACRAMENTO COUNTY GENERAL PLAN, ZONING CODE AND NOISE ORDINANCE, OR APPLICABLE STANDARDS OF OTHER AGENCIES

LEVEL OF IMPACT: LESS THAN SIGNIFICANT WITH MITIGATION

TRANSPORTATION NOISE

The commercial alternative would result in the conversion of undeveloped land to developed land consistent with the preferred project as described above; however, the commercial development at the northwest corner of the intersection of Don Julio

Boulevard and Antelope Road would be expanded and the multifamily portion would be eliminated.

No additional noise impacts that were not already discussed for the preferred project will occur for the commercial project alternative. As discussed in the Transportation and Circulation Chapter, the commercial alternative will result in a reduction in trips when compared to the preferred project. These trips will be distributed to the surrounding roadway network similar to the preferred project. Noise impacts would be substantially the same as with the preferred project. Traffic noise in excess of County standards will occur at the residences located adjacent to Don Julio Boulevard, Elverta Road, and Antelope Road. The measures recommended for the preferred project are applicable to the commercial alternative and will ensure that impacts are less than significant.

Non-Transportation Noise

Offsite Playground/Sports Field Noise

Under the commercial project alternative impacts due to noise from Barrett Ranch Elementary and Antelope High School are the same as those described in the preferred project scenario. Noise from these uses will not exceed County standards at the new residences, and impacts are less than significant.

Onsite Commercial Development

Under the commercial project alternative, the commercial development at the northwest corner of the intersection of Don Julio Boulevard and Antelope Road would be expanded and the multifamily portion would be eliminated. This would eliminate the direct commercial/residential interface that occurs in the preferred scenario between the commercial use and the multifamily use and bring the commercial development closer to the single family residences in Village 2 and Village 4.

As discussed in the preferred project scenario there is potential for those residents to be exposed to noise from commercial delivery vehicles and mechanical equipment, such as high-powered heating and ventilation (HVAC) units. Similar to the preferred scenario, this commercial development will be subject to the County's Noise Ordinance, Zoning Code, and Design Standards. With standard design practices and compliance with County regulations impacts are considered less than significant.

Mitigation Measures:

See NO-1 and NO-2.

Impact: Expose People to a Substantial Permanent Increase in Ambient Noise Levels

Level of Impact: Less than Significant

No additional impacts related to ambient noise, which were not already discussed for the preferred project will occur for the commercial project alternative. As discussed in the Transportation and Circulation Chapter, the commercial alternative will result in a

reduction in trips when compared to the preferred project. These trips will be distributed to the surrounding roadway network as described for the preferred project. The increase in the ambient noise level would be substantially the same as with the proposed project. As with the preferred project, an increase of more than five dB is expected along the segment of Antelope Road between Esteem Drive and Elverta Road, largely due to the reconfiguration of Antelope Road. Because the existing residences along this roadway are currently shielding by an eight foot tall masonry wall, the noise level within the backyards of these residences will be below 60 dB and impacts are less than significant.

MITIGATION MEASURES:

None required.

IMPACT: CONSTRUCTION WOULD TEMPORARILY INCREASE NOISE LEVELS

LEVEL OF IMPACT: LESS THAN SIGNIFICANT

As with the preferred project, construction will temporarily add to the ambient noise environment on and around the project site. Construction noise impacts are exempt from meeting noise limitations under Section 6.68.090(e) of the Sacramento County Noise Ordinance. Though noise levels in the vicinity would increase in the short-term, the existing construction ordinance is designed to avoid significant community effects through the restriction of nighttime and weekend disturbance; therefore, impacts are less than significant.

MITIGATION MEASURES:

None required.