

**APPENDIX J**  
**ENVIRONMENTAL NOISE ASSESSMENT**

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# Environmental Noise Assessment

## Robla Estates Subdivision

City of Sacramento, California

BAC Job # 2022-013

Prepared For:

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## Introduction

The Robla Estates Subdivision (project) is located between Rio Linda Boulevard and Rose Street in Sacramento, California. The project consists of the construction of approximately 178 single-family residential lots on land currently undeveloped. The project area with aerial imagery is shown on Figure 1. The project site plan is presented as Figure 2.

Due to the potential for elevated Rio Linda Boulevard traffic noise levels at the project site, the City of Sacramento Community Development Department has requested that an acoustical assessment be prepared. In response to the City's request, Bollard Acoustical Consultants, Inc. (BAC) was retained to prepare this acoustical assessment. Specifically, the purposes of this assessment are to quantify noise levels associated with future Rio Linda Boulevard traffic noise levels at the project site, to assess the state of compliance of those noise levels with applicable City of Sacramento noise criteria, and if necessary, to recommend measures to reduce those noise levels to acceptable limits.

## Noise Fundamentals and Terminology

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. If the pressure variations occur frequently enough (at least 20 times per second), they can be heard, and thus are called sound. Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB. Another useful aspect of the decibel scale is that changes in levels (dB) correspond closely to human perception of relative loudness. Appendix A contains definitions of Acoustical Terminology. Figure 3 shows common noise levels associated with various sources.

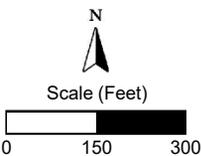
The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable, and can be approximated by weighing the frequency response of a sound level meter by means of the standardized A-weighting network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels in decibels.

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 ( $L_{eq}$ ) over a given time period (usually one hour). The  $L_{eq}$  is the foundation of the day-night average level noise descriptor,  $L_{dn}$  or DNL, and shows very good correlation with community response to noise.



**Legend**

- - - Project Border (Approximate)
- ▲ Traffic Calibration Measurement Location

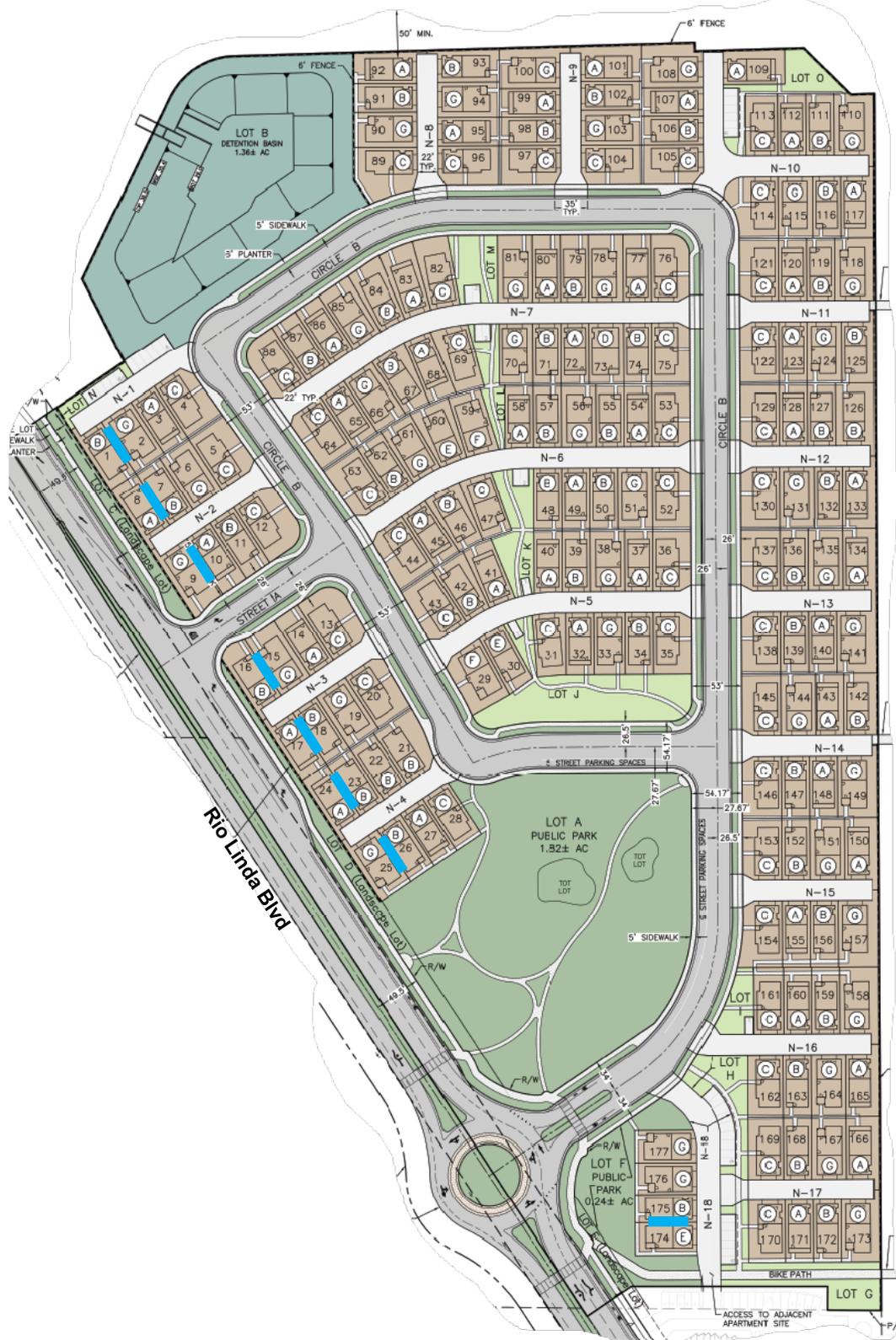


Robla Estates Subdivision  
Sacramento, California

Project Area

Figure 1





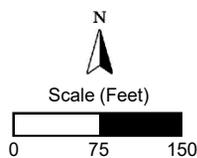
**Legend**

Proposed Primary Open Spaces (Residential Side Yards)

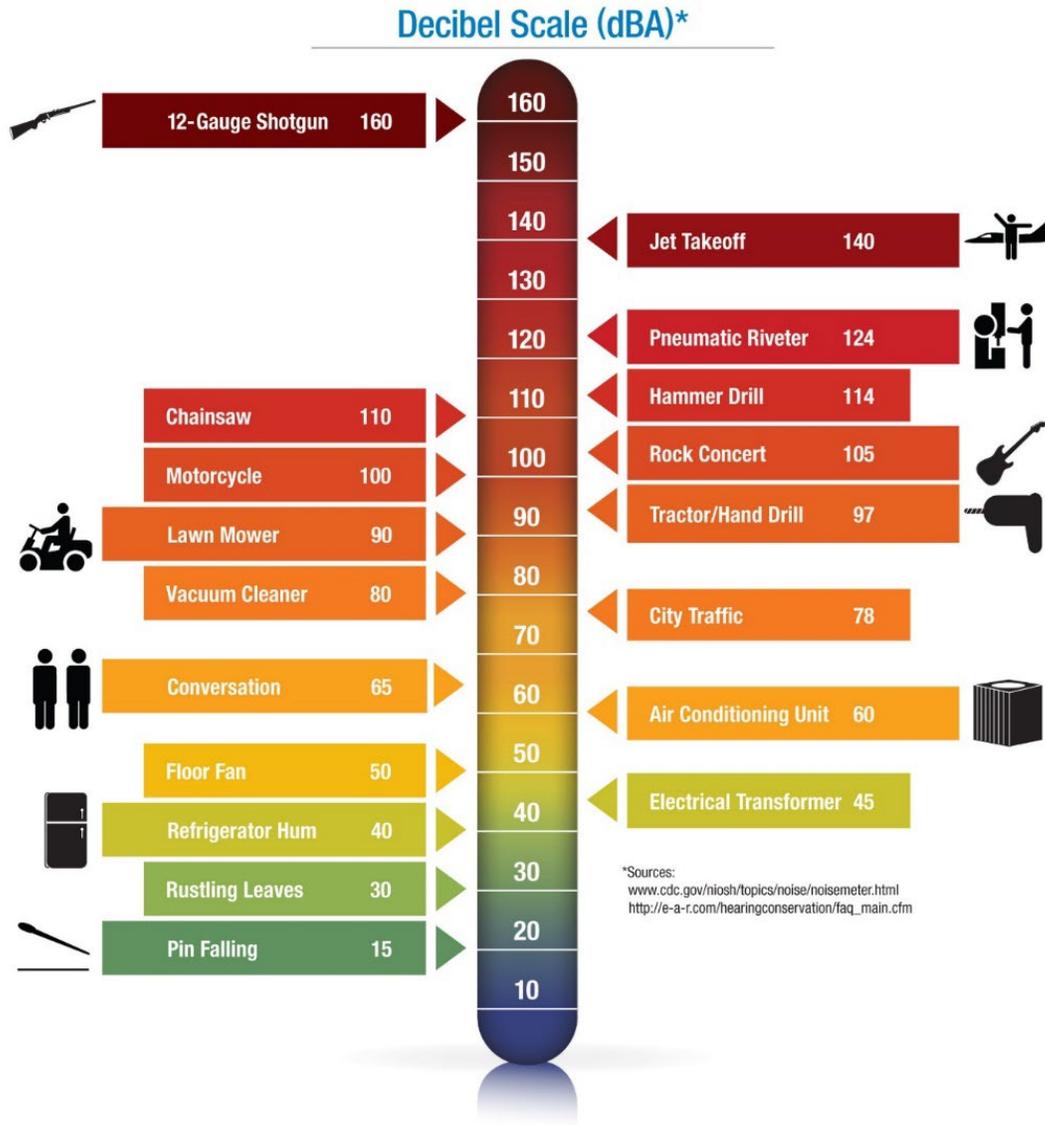
**Robla Estates Subdivision  
Sacramento, California**

Project Site Plan

**Figure 2**



**Figure 3**  
**Typical A-Weighted Sound Levels of Common Noise Sources**



DNL is based upon the average noise level over a 24-hour day, with a +10-decibel 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 DNL represents a 24-hour average, it tends to disguise short-term variations in the noise environment. DNL-based noise standards are commonly used to assess noise impacts associated with traffic, railroad, and aircraft noise sources.

## Criteria for Acceptable Noise Exposure

### Sacramento 2035 General Plan

The Environmental Constraints chapter (EC-3) of the Sacramento 2035 General Plan establishes an exterior and interior noise level standards for various land uses. The General Plan policies applicable to the project are included below.

- EC 3.1.1 Exterior Noise Standards.** The City shall require noise mitigation for all development where the projected exterior noise levels exceed those shown in Table 1 (General Plan Table EC 1), to the extent feasible.
- EC 3.1.3 Interior Noise Standards.** The City shall require new development to include noise mitigation to assure acceptable interior noise levels appropriate to the land use type: 45 dBA DNL for residential, transient lodgings, hospitals, nursing homes and other uses where people normally sleep; and 45 dBA  $L_{eq}$  (peak hour) for office buildings and similar uses.
- EC 3.1.4 Interior Noise Review for Multiple, Loud Short-Term Events.** In cases where new development is proposed in areas subject to frequent, high-noise events (such as aircraft over-flights, or train and truck passbys), the City shall evaluate substantiated noise impacts on any sensitive receptors from such events when considering whether to approve the development proposal, taking into account potential for sleep disturbance, undue annoyance, and interruption in conversation, to ensure that the proposed development is compatible within the context of its surroundings.
- EC 3.1.11 Alternatives to Sound Walls.** The City shall encourage the use of design strategies and other noise reduction methods along transportation corridors in lieu of sound walls to mitigate noise impacts and enhance aesthetics.

**Table 1  
Exterior Noise Compatibility Standards for Various Land Uses**

Land Use Type	Highest Level of Noise Exposure that is Regarded as “Normally Acceptable” <sup>a</sup> (DNL <sup>b</sup> or CNEL <sup>c</sup> )
Residential – Low Density Single Family, Duplex, Mobile Homes	60 dBA <sup>d,e</sup>
Residential – Multi-Family <sup>g</sup>	65 dBA
Urban Residential Infill <sup>h</sup> and Mixed-Use Projects <sup>i,j</sup>	70 dBA
Transient Lodging – Motels, Hotels	65 dBA
Schools, Libraries, Churches, Hospitals, Nursing Homes	70 dBA
Auditoriums, Concert Halls, Amphitheaters	Mitigation based on site – specific study
Sports Arena, Outdoor Spectator Sports	Mitigation based on site – specific study
Playgrounds, Neighborhood Parks	70 dBA
Golf Courses, Riding Stables, Water Recreation, Cemeteries	75 dBA
Office Buildings – Interstate, Commercial, and Professional	70 dBA
Industrial, Manufacturing, Utilities, Agriculture	75 dBA

a. As defined in the Guidelines, “Normally Acceptable” means that the “specified land use is satisfactory, based upon the assumption that any building involved is of normal conventional construction, without any special noise insulation requirements.”

b. Ldn or Day Night Average Level is an average 24-hour noise measurement that factors in day and night noise levels.

c. CNEL or Community Noise Equivalent Level measurements are a weighted average of sound levels gathered throughout a 24-hour period.

d. Applies to the primary open space area of a detached single-family home, duplex, or mobile home, which is typically the backyard or fenced side yard, as measured from the center of the primary open space area (not the property line). This standard does not apply to secondary open space areas, such as front yards, balconies, stoops, and porches.

e. dBA or A-weighted decibel scale is a measurement of noise levels.

f. The exterior noise standard for the residential area west of McClellan Airport (McClellan Heights/Parker Homes) is 65 dBA.

g. Applies to the primary open space areas of townhomes and multi-family apartments or condominiums (private rear yards for townhomes; common courtyards, roof gardens, or gathering spaces for multi-family developments). These standards shall not apply to balconies or small attached patios in multistoried multi-family structures.

h. With land use designations of Central Interstate District, Urban Neighborhood (Low, Medium, or High) Urban Center (Low or High), Urban Corridor (Low or High).

i. All mixed-use projects located anywhere in the City of Sacramento

j. See notes d and g above for definition of primary open space areas for single-family and multi-family developments.

*Source: Sacramento 2035 General Plan, Table EC 1*

## Evaluation of Future Traffic Noise Levels at the Project Site

### Traffic Noise Prediction Methodology

The Federal Highway Administration Highway Traffic Noise Prediction Model (FHWA-RD-77-108) was used to predict traffic noise levels at the project site. The FHWA 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 the 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 in most situations.

## **Traffic Noise Prediction Model Calibration**

To calibrate the FHWA Model to accurately reflect local Rio Linda Boulevard traffic conditions at the project site, BAC conducted short-term noise level measurements and traffic counts on the project site on January 18, 2022. The traffic calibration location is shown on Figure 1. Photographs from the traffic calibration survey are provided in Appendix B.

A Larson Davis Laboratories (LDL) Model LxT precision integrating sound level meter was used for the traffic calibration. The meter was calibrated before and after use with an LDL Model CAL200 acoustical calibrator to ensure the accuracy of the measurements. The equipment used meets all pertinent specifications of the American National Standards Institute for Type 1 sound level meters (ANSI S1.4).

The results of the FHWA Model calibration procedure, which are shown in Appendix C, indicate that the FHWA Model was found to accurately predict Rio Linda Boulevard traffic noise levels at the project site (within 1 dB). As a result, no calibration offset was warranted for the prediction of future Rio Linda Boulevard traffic noise levels at the development.

## **Predicted Future Exterior Traffic Noise Levels**

The FHWA Model was used with future traffic data to predict future traffic noise levels at the project site. The future Average Daily Traffic (ADT) for Rio Linda Boulevard was conservatively estimated by increasing the existing ADT volume by a factor of 50%. The existing (2019) ADT volume for Rio Linda Boulevard was obtained from data published by the Sacramento County Department of Transportation. The day/night distribution and truck percentages were derived from BAC file data for similar roadways. Estimated future traffic speed assumptions were based on posted speed limits and field observations. The FHWA Model inputs and predicted future Rio Linda Boulevard traffic noise levels at the proposed development are presented in Appendix D and are summarized in Table 2.

As stated in footnote d of Table 1, the General Plan's exterior noise level standard is to be applied at primary open space areas of detached single-family homes, such as those proposed by the project. The General Plan defines primary open space areas for single-family detached homes as backyards or side yards and does not apply to secondary open space areas such as front yards, balconies, stoops, or porches. It is the understanding of BAC that the primary open space areas for the proposed residences of the development will be side yards located between residential buildings. The locations of the side yards proposed nearest to Rio Linda Boulevard are illustrated on Figure 2. Based on the proposed site design, the residential side yards located nearest to Rio Linda Boulevard would receive a reduced view of the roadway provided by proposed intervening building envelopes. To account for this screening, predicted Rio Linda Boulevard traffic noise levels at the nearest residential side yards include an offset of -5 dB.

**Table 2**  
**Predicted Future Exterior Traffic Noise Levels at the Project Site<sup>1</sup>**

<b>Roadway</b>	<b>Receiver Description<sup>2</sup></b>	<b>Predicted Future Exterior DNL (dB)<sup>3,4</sup></b>
Rio Linda Boulevard	Nearest Public Park – Lot F	65
	Nearest Primary Open Spaces – Side Yards	60
	Nearest First-Floor Building Facades	67
	Nearest Upper-Floor Building Facades	69
<sup>1</sup> A complete listing of FHWA Model Inputs and results for Rio Linda Boulevard are provided as Appendix D. <sup>2</sup> The locations of the nearest public park and primary open spaces (side yards) are shown on Figure 2. <sup>3</sup> Predicted noise level at residential side yards include an offset of -5 dB to account for a reduced view of the roadway that would be provided by proposed intervening buildings (residences). <sup>4</sup> Predicted noise levels at upper-floor building facades include a +2 dB offset to account for reduced ground absorption of sound at elevation positions. Source: BAC (2022)		

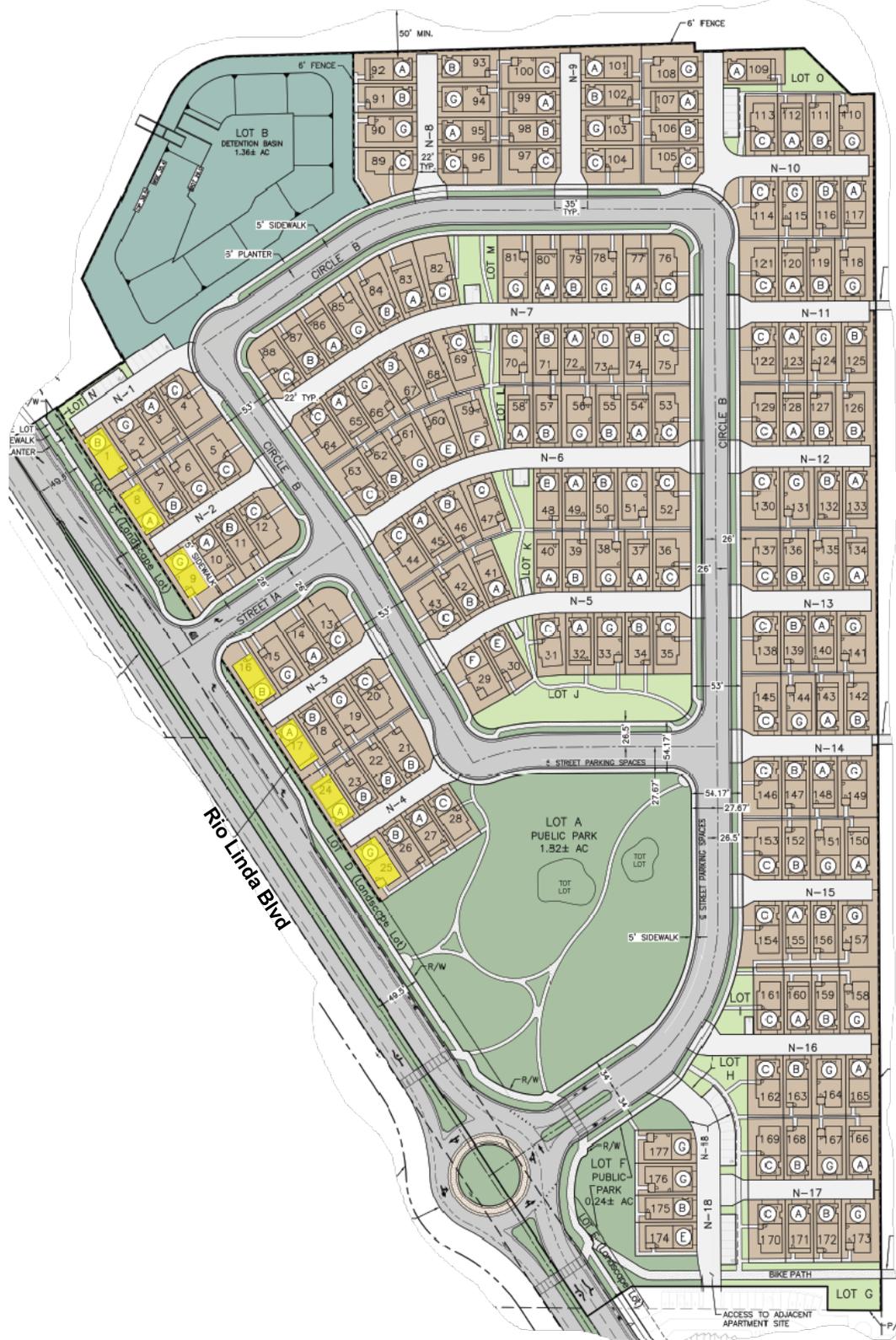
### Exterior Noise Compliance Evaluation

As indicated in Table 2, predicted future Rio Linda Boulevard traffic noise level exposure at the nearest proposed public park (Lot F) would satisfy the Sacramento General Plan 70 dB DNL exterior noise level standard applicable to neighborhood parks. The Table 2 data also indicate that future Rio Linda Boulevard traffic noise exposure is predicted to satisfy the General Plan 60 dB DNL exterior noise level standard at the primary open spaces (side yards) of the nearest residences to the roadway. As a result, no further consideration of exterior noise mitigation measures would be warranted for future Rio Linda Boulevard traffic noise at the project site.

### Interior Traffic Noise Compliance Evaluation

Standard residential construction (stucco siding, STC-27 windows, door weather-stripping, exterior wall insulation, composition plywood roof), *typically* results in an exterior to interior noise reduction of approximately 25 dB with windows closed and approximately 15 dB with windows open. Therefore, provided future traffic noise levels do not exceed 70 dB DNL at exterior building facades, standard construction practices would be adequate to ensure compliance with the Sacramento General Plan 45 dB DNL interior noise level standard.

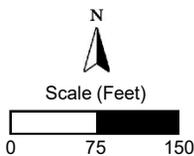
As indicated in Table 2, future exterior Rio Linda Boulevard traffic noise level exposure is predicted to be 67 dB DNL at the first-floor building facades of residences constructed nearest to the roadway. Due to reduced ground absorption at elevated positions, future exterior traffic noise levels at the upper-floor facades of those buildings are predicted to approach 69 dB DNL. Based on the above-identified exterior to interior noise reduction typically achieved with standard residential construction, window and door construction upgrades would not be warranted for satisfaction of the General Plan 45 dB DNL interior noise level standard at the project site. However, if a greater margin of safety is desired, the window construction upgrades identified on Figure 4 could be integrated into the project design. Finally, mechanical ventilation (air conditioning) should be provided for all residences within this development to allow the occupants to close doors and windows as desired for additional acoustical isolation.



**Legend**

Window Assembly Upgrades: STC 32 (All Floors)\*

*\*Recommended STC rating of 32 for greater margin of safety. Applies to all floors of windows from which a view of Rio Linda Boulevard would be present (i.e., north-, west- and south-facing windows).*



**Robla Estates Subdivision  
Sacramento, California**

Window Assembly Upgrades

**Figure 4**



## Conclusions

The Robla Estates Subdivision is predicted to be exposed to future Rio Linda Boulevard traffic noise levels in compliance with the applicable Sacramento General Plan exterior noise level criteria. In addition, standard residential construction (stucco siding, STC-27 windows, door weather-stripping, exterior wall insulation, composition plywood roof) is expected to be adequate to reduce future Rio Linda Boulevard traffic noise levels within all floors of residences constructed adjacent to the roadway to a state of compliance with the applicable General Plan interior noise level standard for residential uses. However, if a greater margin of safety is desired, the window construction upgrades identified on Figure 4 could be integrated into the project design. Finally, mechanical ventilation (air conditioning) should be provided for all residences within this development to allow the occupants to close doors and windows as desired for additional acoustical isolation.

These conclusions are based on the results from the BAC traffic calibration survey (Appendix C), the FHWA Model traffic inputs and assumptions contained in Appendix D, the proposed site design shown in Figures 2 and 4, and on noise reduction data for standard residential dwellings and for typical STC rated window data. Deviations from the resources cited herein could cause future traffic noise levels to differ from those predicted in this assessment. In addition, Bollard Acoustical Consultants, Inc. is not responsible for degradation in acoustic performance of the residential construction due to poor construction practices, failure to comply with applicable building code requirements, or for failure to adhere to the minimum building practices cited in this report.

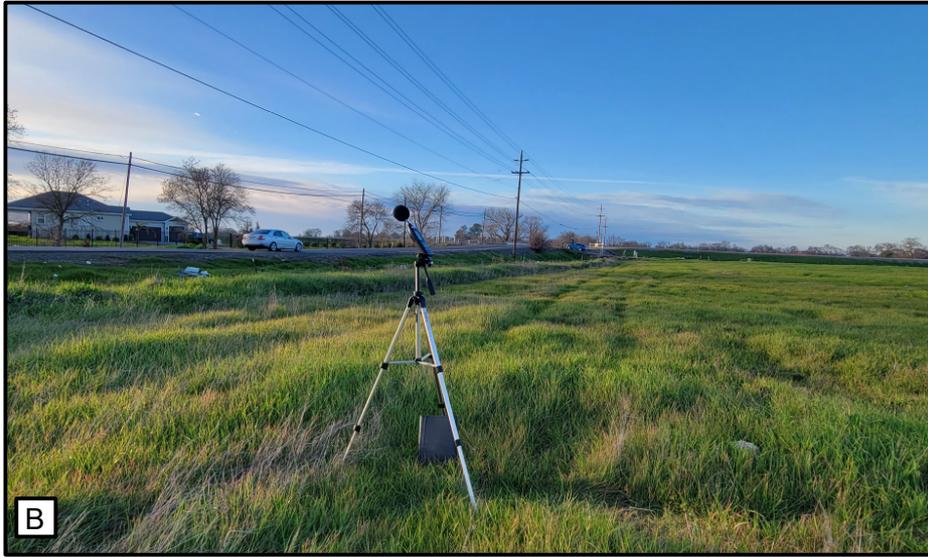
This concludes BAC's environmental noise assessment for the Robla Estates Subdivision in Sacramento, California. Please contact BAC at (530) 537-2328 or [dariog@bacnoise.com](mailto:dariog@bacnoise.com) with any questions regarding this assessment.

## Appendix A Acoustical Terminology

<b>Acoustics</b>	The science of sound.
<b>Ambient Noise</b>	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
<b>Attenuation</b>	The reduction of an acoustic signal.
<b>A-Weighting</b>	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
<b>Decibel or dB</b>	Fundamental unit of sound. A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.
<b>CNEL</b>	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
<b>Frequency</b>	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.
<b>IIC</b>	Impact Insulation Class (IIC): A single-number representation of a floor/ceiling partition's impact generated noise insulation performance. The field-measured version of this number is the FIIC.
<b>L<sub>dn</sub></b>	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
<b>Leq</b>	Equivalent or energy-averaged sound level.
<b>L<sub>max</sub></b>	The highest root-mean-square (RMS) sound level measured over a given period of time.
<b>Loudness</b>	A subjective term for the sensation of the magnitude of sound.
<b>Masking</b>	The amount (or the process) by which the threshold of audibility is for one sound is raised by the presence of another (masking) sound.
<b>Noise</b>	Unwanted sound.
<b>Peak Noise</b>	The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.
<b>RT<sub>60</sub></b>	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
<b>STC</b>	Sound Transmission Class (STC): A single-number representation of a partition's noise insulation performance. This number is based on laboratory-measured, 16-band (1/3-octave) transmission loss (TL) data of the subject partition. The field-measured version of this number is the FSTC.



**A**



**B**



**C**

**Legend**

- A** Facing west from traffic calibration measurement site along Rio Linda Boulevard
- B** Facing north from traffic calibration measurement site along Rio Linda Boulevard
- C** Facing south from traffic calibration measurement site along Rio Linda Boulevard

Robla Estates Subdivision  
Sacramento, California

Traffic Calibration Survey Photographs

Appendix B



**Appendix C**  
**FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)**  
**Calibration Worksheet**

**Project Information:** Job Number: 2022-013  
Project Name: Robla Estates Subdivision  
Roadway Tested: Rio Linda Boulevard  
Test Location: On project site  
Test Date: January 18, 2022

**Weather Conditions:** Temperature (Fahrenheit): 59  
Relative Humidity: 60%  
Wind Speed and Direction: Calm  
Cloud Cover: Partly Cloudy

**Sound Level Meter:** Sound Level Meter: LDL Model LXT (BAC #2)  
Calibrator: LDL Model CAL200  
Meter Calibrated: Immediately before  
Meter Settings: A-weighted, slow response

**Microphone:** Microphone Location: On project site  
Distance to Centerline (feet): 70  
Microphone Height: 5 feet above ground  
Intervening Ground (Hard or Soft): **Soft**  
Elevation Relative to Road (feet): 0

**Roadway Condition:** Pavement Type Asphalt  
Pavement Condition: Good  
Number of Lanes: 2  
Posted Maximum Speed (mph): 45

**Test Parameters:** Test Time: 4:10 PM  
Test Duration (minutes): 15  
Observed Number Automobiles: 304  
Observed Number Medium Trucks: 2  
Observed Number Heavy Trucks: 4  
Observed Average Speed (mph): 55

**Model Calibration:** Measured Average Level ( $L_{eq}$ ): 69.0  
Level Predicted by FHWA Model,  $L_{eq}$  (dB): 68.2  
**Difference (dB): -0.8**

**Conclusions:** The FHWA Model was found to predict existing Rio Linda Boulevard traffic noise levels at the project site within 1 dB. As a result, no calibration offset was applied to the FHWA Model for the prediction of future Rio Linda Boulevard traffic noise levels at the project site.

**Appendix D**  
**FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)**  
**Noise Prediction Worksheet**

**Project Information:**

Job Number: 2022-013  
 Project Name: Robla Estates Subdivision  
 Roadway Name: Rio Linda Boulevard

**Traffic Data:**

Year: Future  
 Average Daily Traffic Volume: 19,232  
 Percent Daytime Traffic: 87  
 Percent Nighttime Traffic: 13  
 Percent Medium Trucks (2 axle): 2  
 Percent Heavy Trucks (3+ axle): 1  
 Assumed Vehicle Speed (mph): 45  
 Intervening Ground Type (hard/soft): **Soft**

**Traffic Noise Levels:**

		----- DNL (dB) -----					
Location	Description	Distance	Offset (dB)	Autos	Medium Trucks	Heavy Trucks	Total
1	Nearest Public Park - Lot F	100		64	54	55	65
2	Nearest Primary Open Space Areas - Side Yards	95	-5	59	49	50	60
3	Nearest First-Floor Building Facades	70		66	56	57	67
4	Nearest Upper-Floor Building Facades	70	2	68	58	59	69

**Traffic Noise Contours (No Calibration Offset):**

DNL Contour (dB)	Distance from Centerline (ft)
75	21
70	45
65	96
60	207

- Notes:**
1. Future ADT was conservatively estimated by increasing the existing (2019) ADT volume of Rio Linda Boulevard adjacent to the site by 50% for future increases. Existing traffic data obtained from the Sacramento County of Transportation (12,821 ADT - Rio Linda Boulevard: South of Marysville Boulevard).
  2. Predicted future traffic noise levels at nearest primary open space areas (side yards) include a -5 dB offset to account for a reduced view of the roadway resulting from the construction of intervening buildings (residences).
  3. Predicted future traffic noise levels nearest upper-floor building facades include an offset of +2 dB to account for reduced absorption of sound at elevated positions.