APPENDIX I

Acoustics Assessment for the Froom Ranch Project

I.1 – Acoustic Assessment for the Froom Ranch Project 2017

I.2 – Acoustic Assessment for the Froom Ranch Project 2020

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APPENDIX I.1

Acoustics Assessment for the Froom Ranch Project 2017

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June 7, 2017

Project 1721-1

RE:
Acoustics Assessment
Froom Ranch Project
San Luis Obispo, CA 93401

Client:
John Madonna
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1 Summary

This is a report on the existing and future noise impacts on the proposed Froom Ranch Project located on the southwest side of Los Osos Valley Road (LOVR), between Froom Ranch Road and Calle Joaquin. All noise sources are considered, including occasional air traffic from San Luis Obispo County Regional Airport, and vehicular traffic noise from adjacent Los Osos Valley Road and Calle Joaquin, as well as U.S. Highway 101 to the southeast of the project. The intent of this assessment is to determine noise levels that may potentially impact the proposed residential units at the eastern edge and elsewhere throughout the site.

Several sound level measurement data sets were collected at different locations on site. Existing sound levels were correlated for each of the measurement locations, for use in "calibrating" noise modeling software. The objective is to generate existing sound level contours, which may be compared with generalized sound level contours published by the City of San Luis Obispo in the 1996 Noise Element (Figures 5 and 6).

This report shows the results of an initial sound level survey to establish existing and future sound level contours resulting from transportation noise.

Two sound level 'portraits' for the overall site are shown in addition:

1. Existing sound levels with no development on the site, i.e., no project.

2. Potential future sound levels once the proposed project is built.

Contents

2 Location

The project is located west of the intersection of Los Osos Valley Road and Calle Joaquin, near the U.S. Highway 101 interchange. The project site is shown in Figure 1. Vicinity of Site, currently open land separated from Los Osos Valley Road by shrubbery and trees and a barbed wire fence.

The measurement stations on the site were chosen to be near potential future residential building elevations exposed to Los Osos Valley Road, Calle Joaquin, and U.S. Highway 101 in the distance.

During the sound level survey, occasional overflight of small aircraft was observed, departing from San Luis Obispo County Regional Airport and over 1,000 feet above the project area.

Figure 1. Vicinity of Site,
southwest of Los Osos Valley Road and west of Calle Joaquin.
U.S. Highway 101 is further in the distance toward the southeast of the site.

Figure 2. Sources of traffic noise: Los Osos Valley Road, Calle Joaquin and U.S. Highway 101, two lanes.

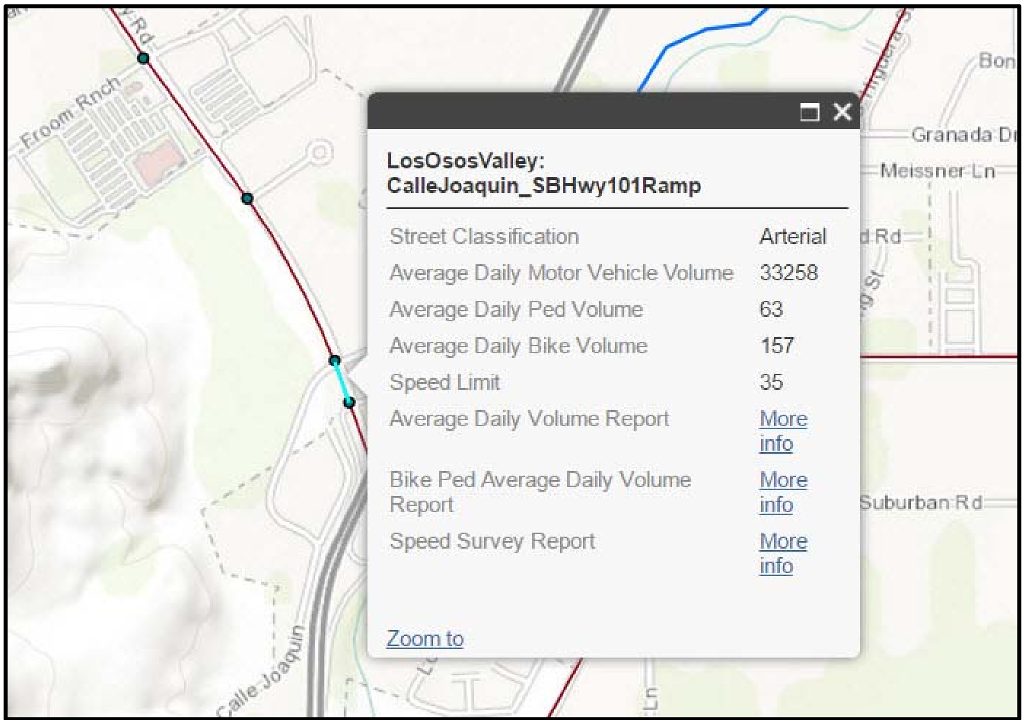
Location of the three transportation noise sources is shown in Figure 2.

Toward the southeast of the site, U.S. Highway 101 is a significant transportation noise source with an Average Annual Daily Traffic Flow between 62,000 to 69,000.

Figure 3. 2015 Traffic Volumes, U.S. Highway 101, from Caltrans data

Dist	Rte	CO	Post Mile	Description	Back Peak Hour	Back Peak Month	Back AADT	Ahead Peak Hour	Ahead Peak Month	Ahead AADT
05	101	SLO	25.911	SAN LUIS OBISPO, LOS OSOS ROAD	6900	76000	69300	5900	67000	61900
05	101	SLO	27.501	SAN LUIS OBISPO, MADONNA ROAD	5800	66000	63700	6300	70000	65000

Figure 4. Los Osos Valley Road, Calle Joaquin Average Daily Traffic



2.1 Sound Level Measurements

Six sound level measurement sites are shown in *Figure 6. Plan showing measurement stations and sound levels*, Leq = dBA, at each station. Two measurement sites are stationary; four sites are spot check locations. In addition to the six sites, synchronized duplicate measurements were made at the two stationary sites for a total of eight data sets. The sound level data was compared with nearby data. The fixed measurement stations were then used to calibrate the noise modeling software, in order to generate sound level contours based on precision measurements of existing sound. Future sound level is projected using future growth assumptions for average daily traffic flow.

2.2 Sound Level Contours

A Sound Level Contour is a line on a map that represents equal levels of noise exposure. SoundPlan is an acoustics modeling software program used to calculate noise contours, based on topographic relationships of noise sources and noise receivers. The standard calculation software for modeling traffic noise is the Federal Highway Administration program, Transportation Noise Model, TNM. SoundPlan, used for this report, implements TNM in its calculation.

On-site measured sound level values are used to calibrate and to validate the SoundPlan - generated sound level contours. The graphic sound level contours depict sound level on the site from a composite of three transportation noise sources: Los Osos Valley Road, Calle Joaquin and U.S. Highway 101.

Figure 5. Site Plan, proposed project

Figure 6. Plan showing measurement stations and sound levels, Leq = dBA, at each station. There were two stationary measurement stations, one next to LOVR and the other next to Calle Joaquin. There were four 'spot-check' stations near future potential building elevations.

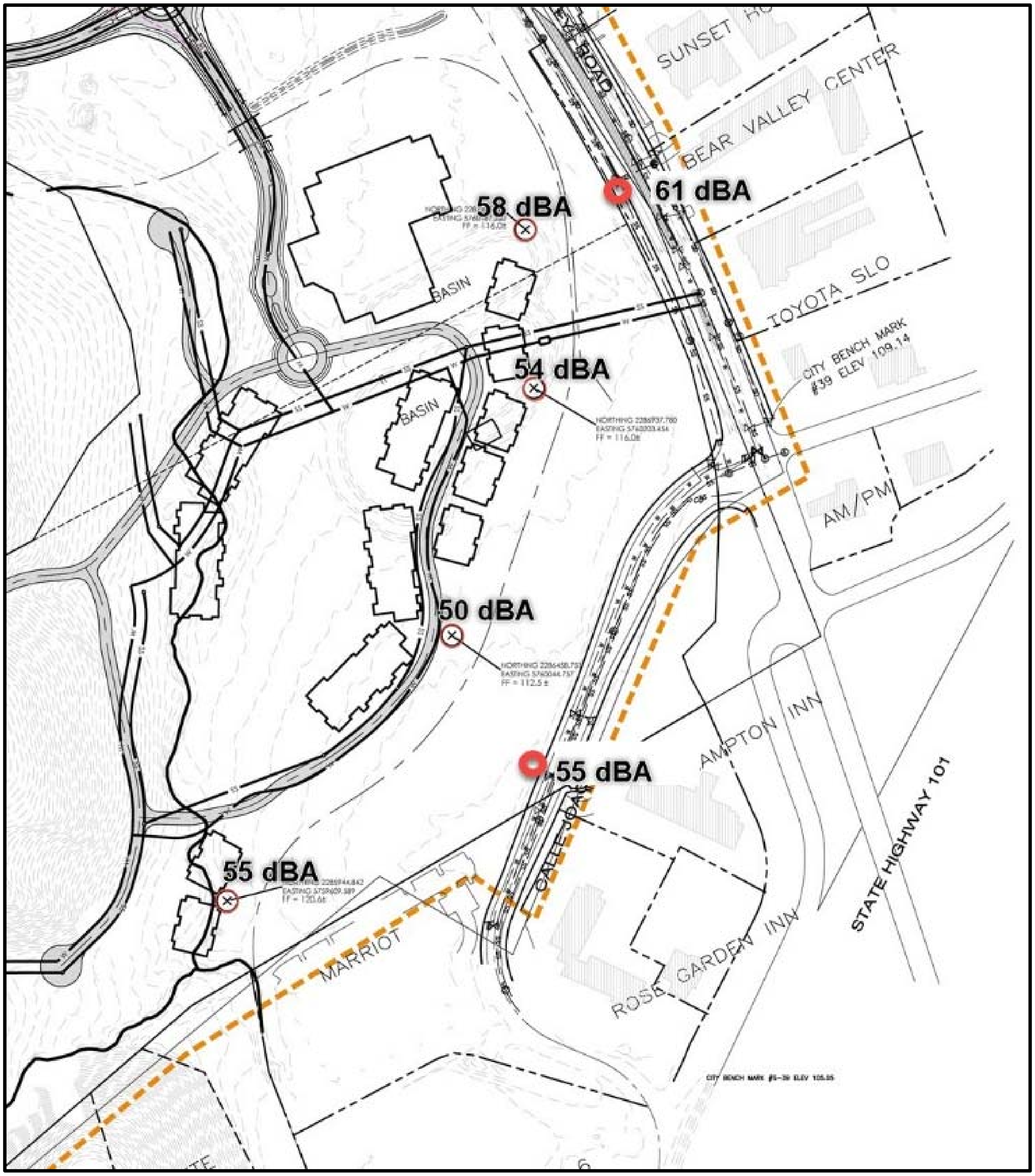
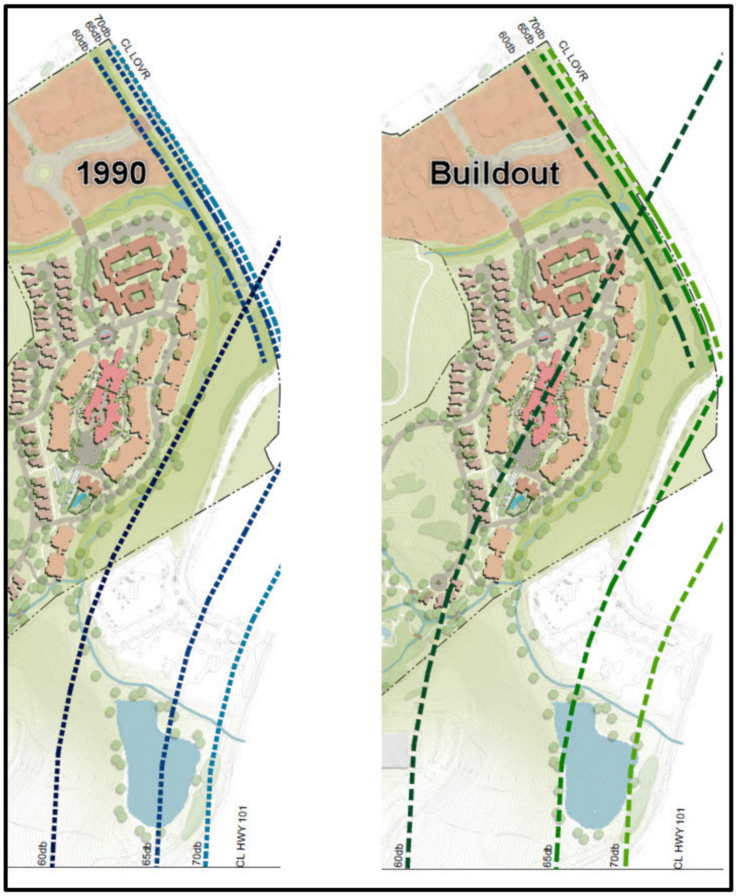


Figure 7. City of San Luis Obispo Sound Level Contours, based on a study by Brown Buntin, 1991. Results appear in City of San Luis Obispo Noise Element, last revised 1996.



2.3 Contour Disparities

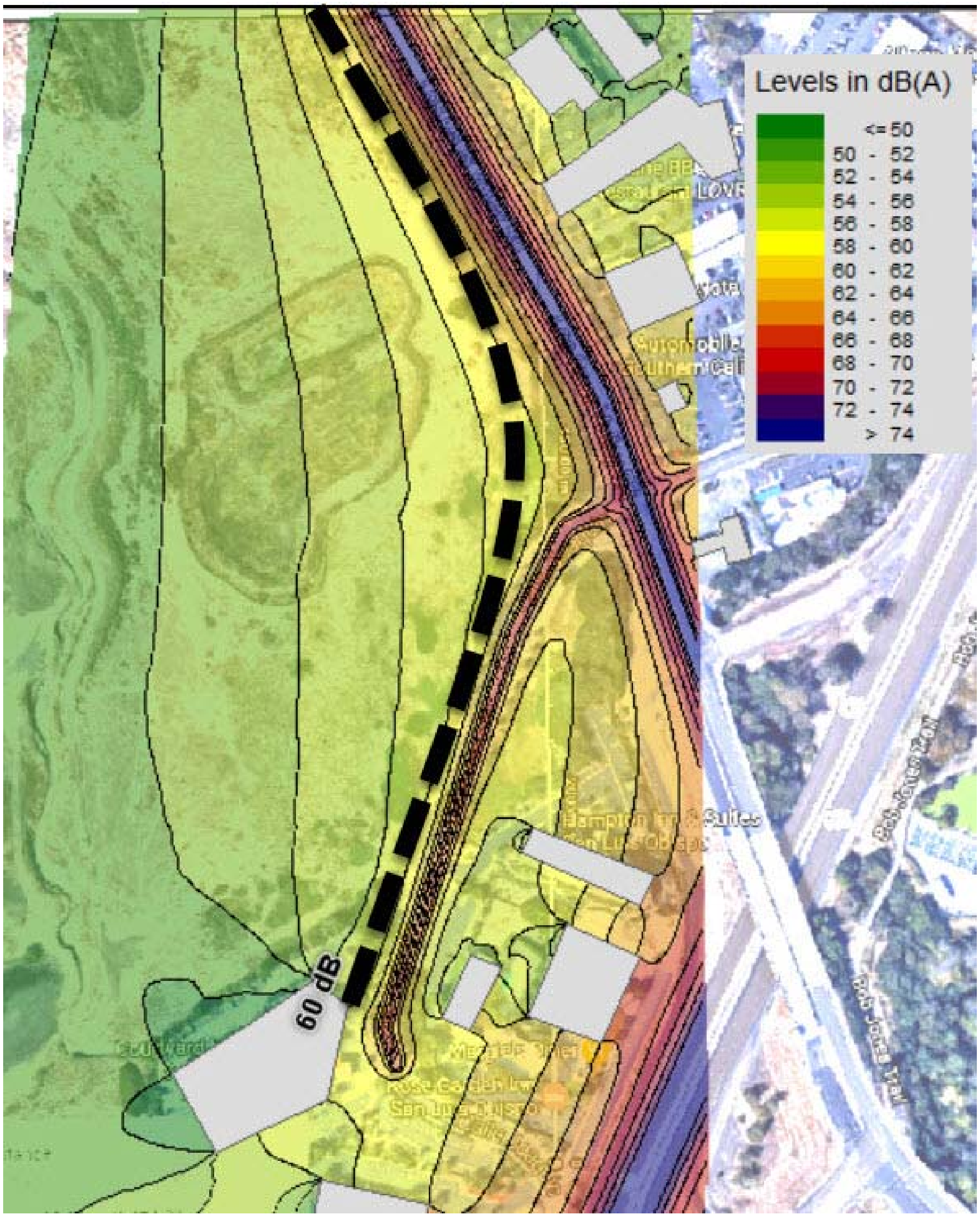
The difference between the sound level contours shown by the City in its 1996 Noise Element exhibit and the measured and modeled contemporaneous sound level contours presented in this report can be attributed to the difference in technology utilized in the 1990s and that used today.

In 1990, when the City's commissioned noise study was completed by Brown-Buntin Associates, the method for drawing sound level contours was based on a mathematical calculation of sound level at fixed and specific distances from the centerline of the roadway. The calculations ignored the effects of topography, shielding by buildings, ground surface variations, absorption and reflection. In 1990, sound level contours were drawn at a constant distance along major roads in the city and ended at the city limits. The calculations accommodated three vehicle types, autos, heavy trucks and medium trucks at constant speeds. Described at the time, "the noise contour information prepared by the consultants and staff generally reflects conservative (worst case) assumptions, so significant noise exposure concerns are not likely to be omitted or understated." (See Reference 9.)

Today, using contemporary sound level mapping, there are noticeable effects and multiple variations due to terrain, ground absorption, reflection and blocking of sound by the built environment. Noise contours change as urban density and traffic patterns change. Today's sound level contours are a more realistic representation of actual conditions.

2.4 Graphic Results

Figure 8. This is the *measured, existing* 60 dBA Sound Level Contour, based on measured values from the six stations shown previously.



2.5 Future Sound Level

The calculated future Ldn/CNEL (year 2037) along the east and south side of the site will depend on growth of traffic, generally accepted to be about one percent per year growth rate.

Figure 9. Future, calculated, 60 dBA Sound Level Contour at Buildout or year 2037

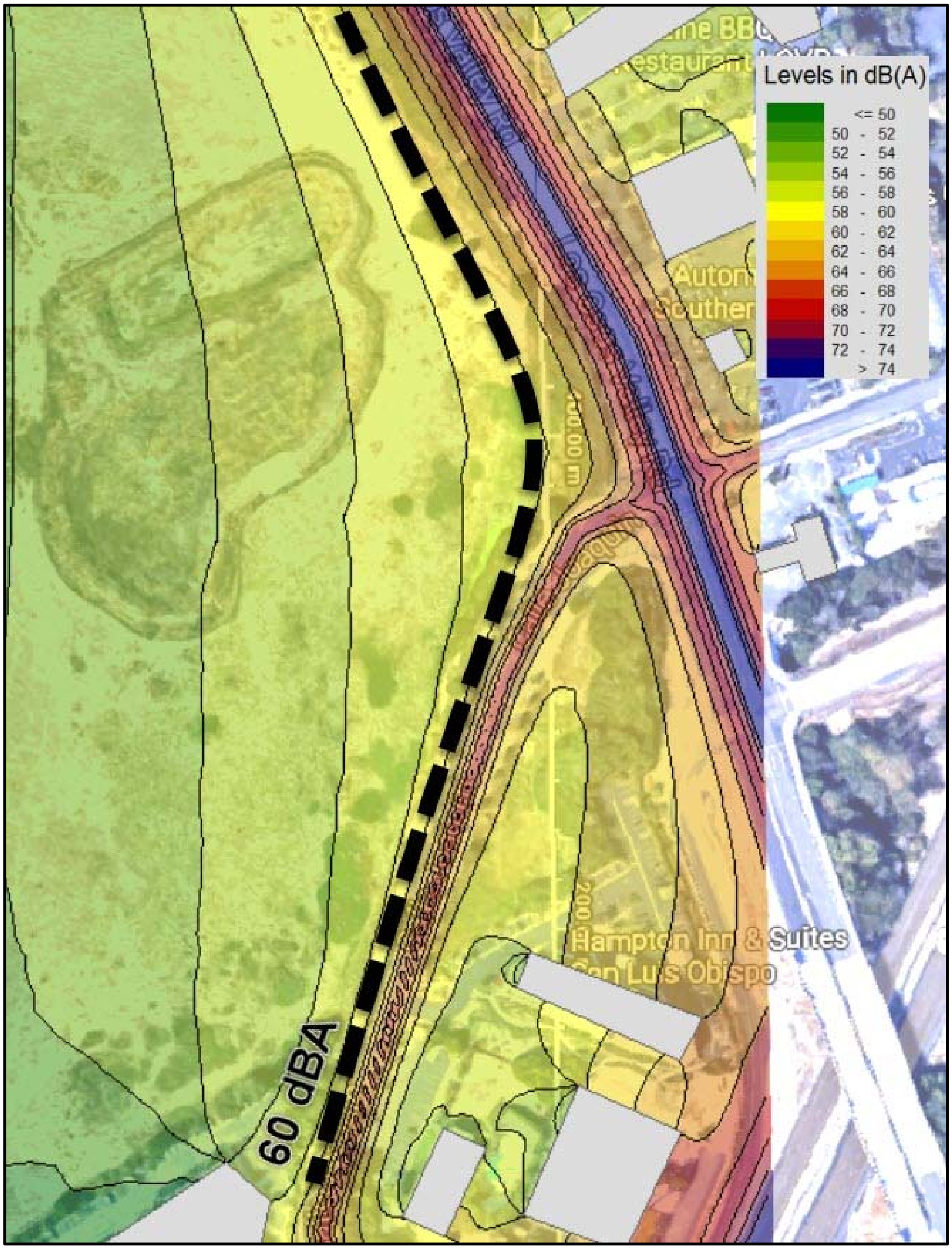


Figure 10. No Project, Sound Level Contours Across the Site

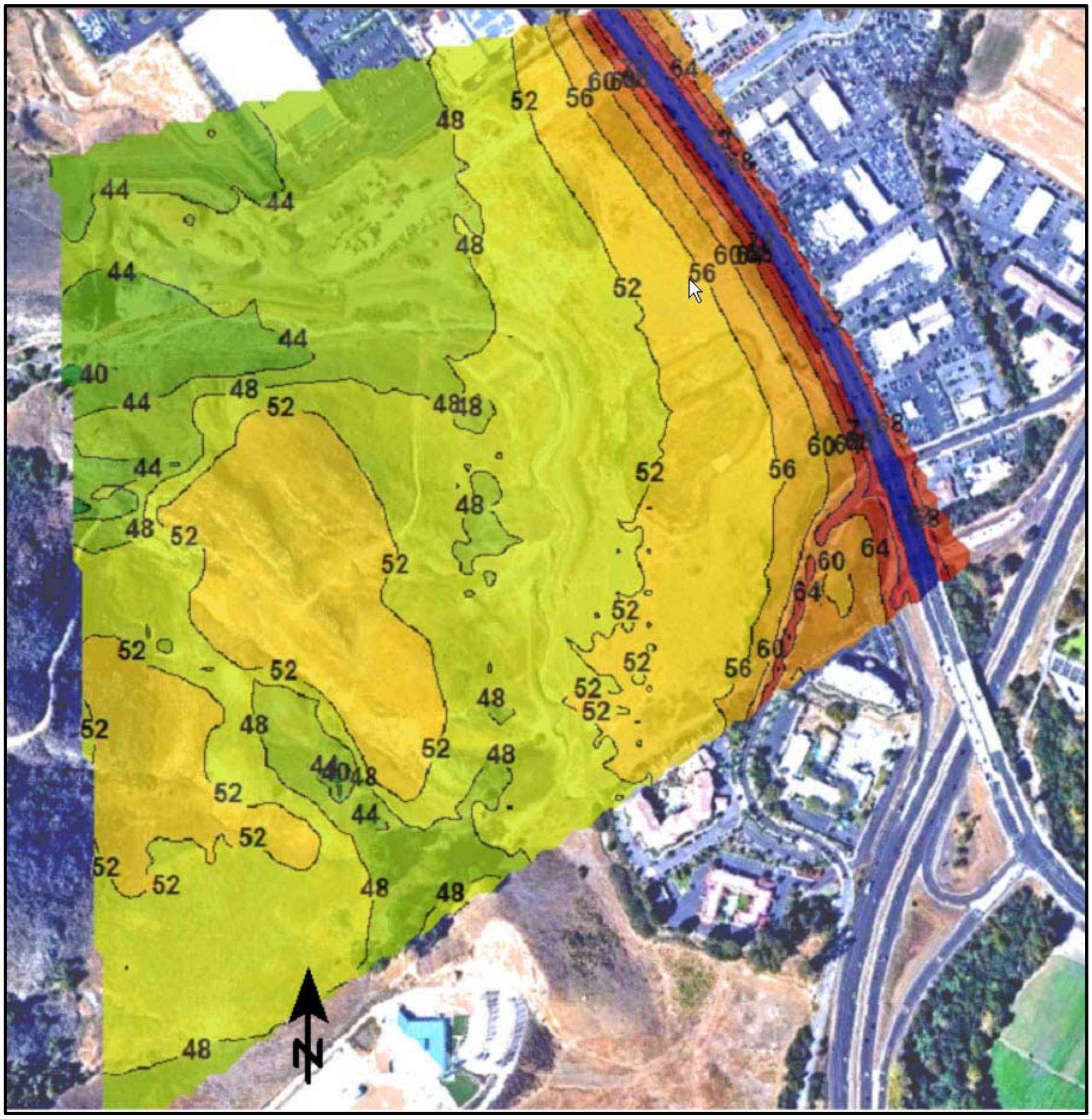
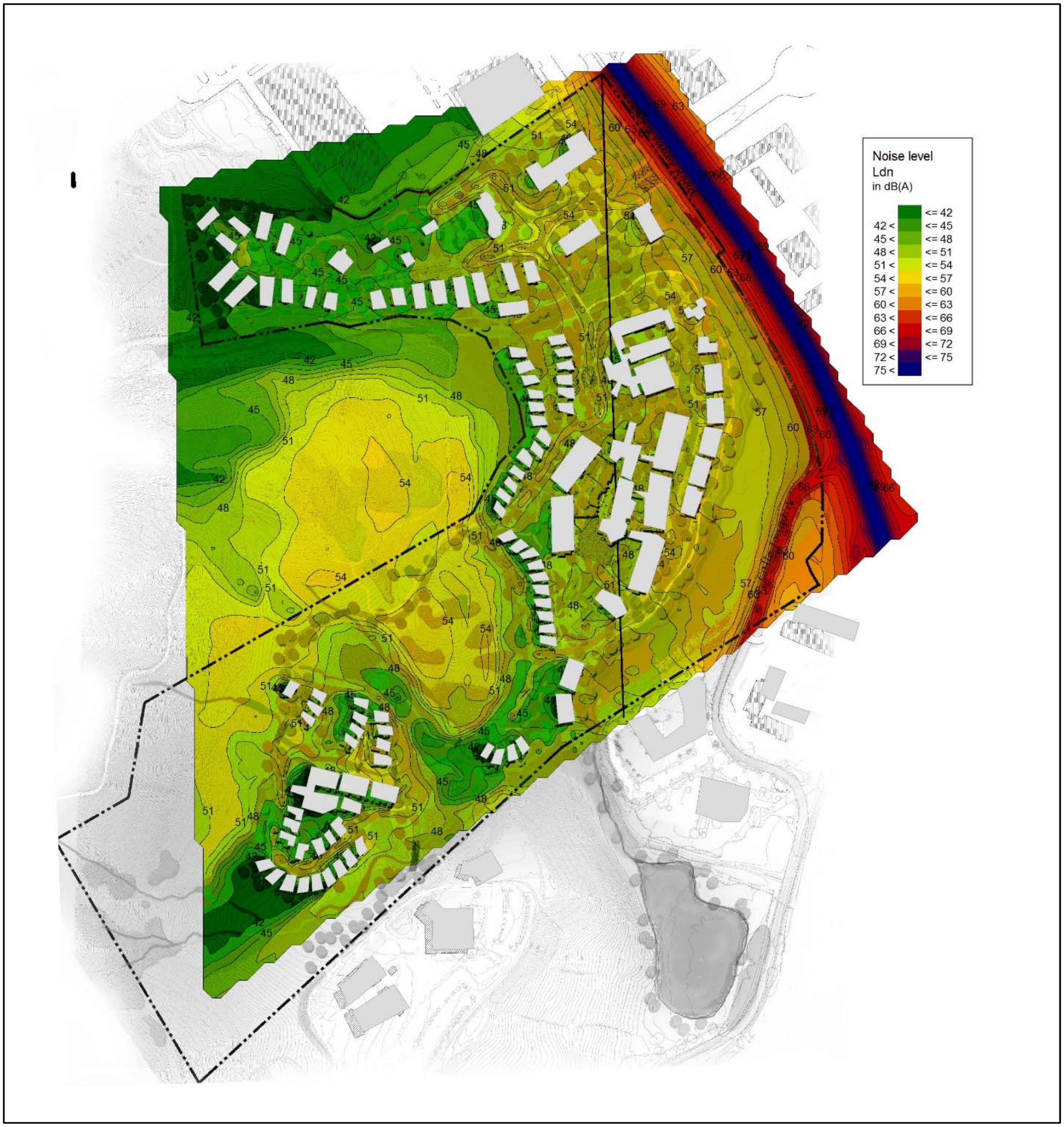


Figure 11. Future Sound Level Contours with Proposed Project (year 2037)



3 Regulatory Setting

Noise is regulated at the federal, state and local levels through regulations, policies and/or local ordinances. Local policies are generally adaptations of federal and state guidelines, adjusted to prevailing local condition.

3.1 State Regulation

The State of California's *Guidelines for the Preparation and Content of Noise Element of the General Plan (1987)* make reference to land use compatibility standards for community noise environments as developed by the California Department of Health Services, Office of Noise Control. Sound levels up to 65 Ldn or CNEL are determined to be normally acceptable for multi-family residential land uses. Sound levels up to 70 CNEL are normally acceptable for buildings containing professional offices or defined as business commercial.

All new Multi-Family housing must comply with California Code of Regulations (CCR) Title 24. This is included in the California Building Code (CBC), Section 1207, "Sound Transmission" – which specifies the maximum level of interior noise due to exterior sources allowable for new residential developments.

3.2 Local Regulation

CCR Title 24 also defers to local requirements if applicable. The Noise Element of the City of San Luis Obispo General Plan specifies a maximum allowable interior noise level of 45 dBA Ldn for multi-family projects which is consistent with the above policies for interior noise and also extends this requirement to new single-family dwellings. The City of San Luis Obispo Noise Element also states that 60 dBA Ldn or less is the exterior noise goal for outdoor common areas, defined as areas intended for the use and enjoyment of residents.

Guidelines for transportation noise exposure are contained in City of San Luis Obispo, General Plan Noise Element and Noise Guidebook (1996). The maximum noise exposure standards for noise-sensitive land uses are shown in Figure 12. The maximum noise exposure standards for noise-sensitive land uses due to traffic are shown in Figure 13.

Figure 12. Community Noise Exposure Ldn / CNEL

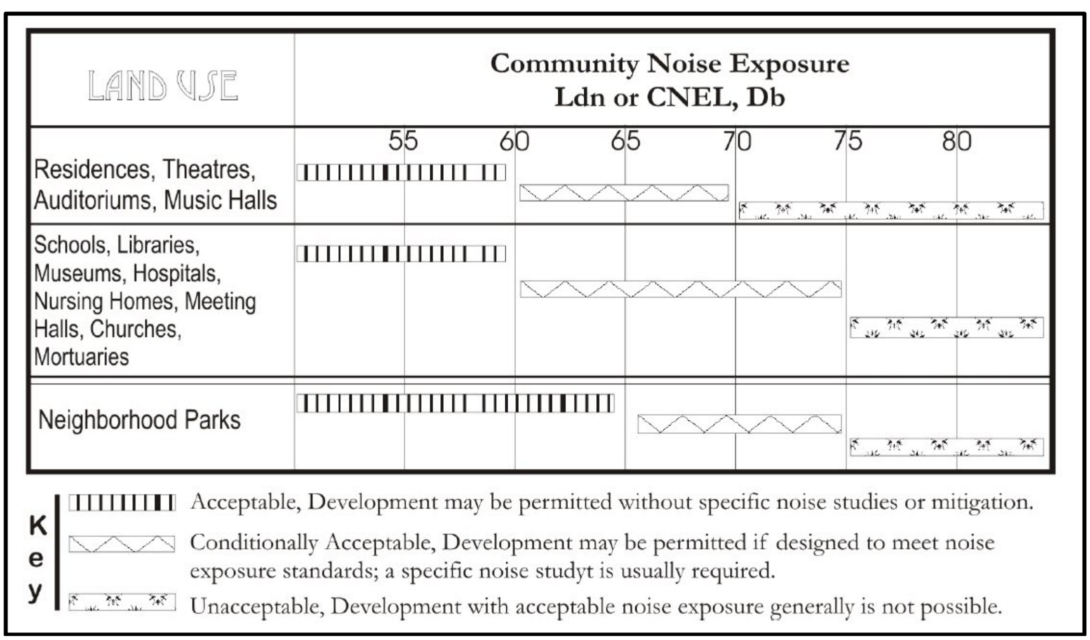


Figure 13. Maximum Exposure for Noise Sensitive Uses due to Traffic

	Outdoor Activity Areas[1]	Indoor Spaces		
Land Use	**L_{dn} or CNEL, in dB**	**L_{dn} or CNEL, in dB**	**L_{eg} in db[2]**	**L_{max} in db[3]**
Residences, hotels, motels, hospitals, nursing homes	60	45	-	60
Neighborhood parks	65	-	-	-

[1] *If the location of outdoor activity areas is not shown, the outdoor noise standard shall apply at the property line of the receiving land use.*

[2] *As determined for a typical worst-case hour during periods of use.*

[3] *L_{max} indoor standard applies only to railroad noise at locations south of Orcutt Road.*

4 Traffic Characteristics

This section examines the effects of traffic growth over time on the sound level contours of the site, and the relationship of traffic flow to sound levels on site.

4.1 Traffic Growth

Federally funded projects and environmental reviews typically require the projection of traffic volumes 10–30 years in the future, typically assuming a 1–2% annual growth in vehicle volume. In this report, we have assumed a 20-year period of growth to year 2037, at an annual growth rate of 1 percent (0.01). The calculation in Figure 14 shows the result for Los Osos Valley Road.

Figure 14. Growth of Noise from Average Daily Traffic

Growth of Noise from Average Daily Traffic

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Froom Ranch

Scenario 2

Calculation of added noise sources

		((10^-16)*10^(D9/10))
Present Noise Level (LDN)	60 dBA	intensity= 1E-10 W/cm2
present traffic flow	33258 ADT	(average daily traffic)
future traffic flow	40581 ADT	0.864275 dBA additional
Future Noise Level (LDN)	**60.9** dBA	10*LOG10(D13/D12)

	scenario 2
33258	present traffic ADT
0.01	**Growth Rate / Year**
20	number of years
40581	future traffic ADT

Future = present x (1+i)^n

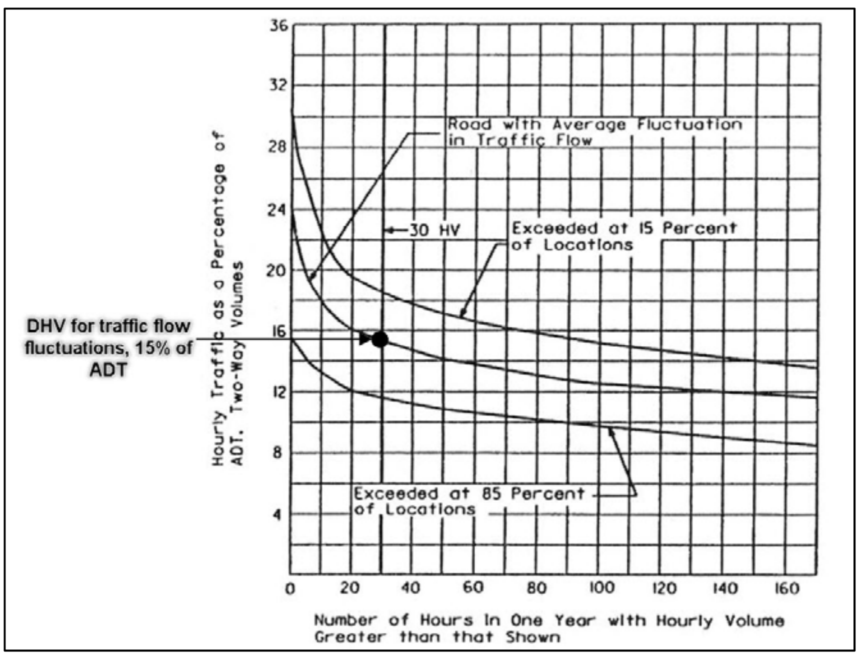
4.2 Traffic Flow and Sound Level

Consulting the Highway Traffic Manual (reference 15) helps to understand the issues in measuring sound level resulting from traffic flow. There are several descriptors of traffic flow from Average Daily Traffic (ADT) to Design Hourly Volume (DHV) of traffic on a road or highway. DHV is sometimes used as a benchmark for sound level measurements. However, the DHV is defined as the 30th highest hourly volume in the "design" year, whereas the Peak Hour Volume (PHV) is defined as the highest hourly volume during an average day.

Depending on the type of roadway, the PHV may be from 5 to 45 percent lower than the DHV.

The definition infers that if a highway or street is to adequately serve throughout its life, its physical capacity will only be exceeded for about 30 hours out of the total 8,760 hours in the "design" year. The choice of the 30th highest hourly volume is a long-held concept which stems from research published in *A Policy on Geometric Design of Rural Highways* (Reference 1.)

Figure 15. Relationship Between Peak-Hour and Average Daily Traffic Volumes.



Visually comparing the traffic flow trend lines above indicates that significant traffic flow changes occur at the inflection point of the 30th highest volume hour of the year. The difference in volume of traffic between the 1st highest hourly volume and the 30^{th} increases rapidly. For the remainder of the hours between the 30th and the 170th, there is very little change in the slope of the curves. This indicates that designing for that 30th hour would cover the expected traffic volume at almost any given hour in a given day of a given week in a given month of a given year.

Noise impacts are measured during the one-hour period when the worst-case noise levels are expected to occur. This may or may not be the peak hour of traffic. That is, higher traffic volumes can lead to higher congestion and lower operating speeds. Since higher speeds lead to higher noise emissions from motor vehicles, the worst-case noise levels may occur in hours with lower volumes and higher speeds. In addition, vehicle mix may also change hourly. On many highways, the percentage of heavy trucks is reduced during peak hour. Since heavy trucks have greater sound emissions than passenger cars, vehicle mix is an important component in determining the peak hour of noise impact.

During the sound level measurement for this project, Level of Service (LOS) was observable and gives us confidence that we are measuring during a busy-but-not-congested time period.

The LOS during the measurements was generally Level B to Level C and at one time became Level of Service D.

Figure 16. Level of Service vs General Operating Conditions

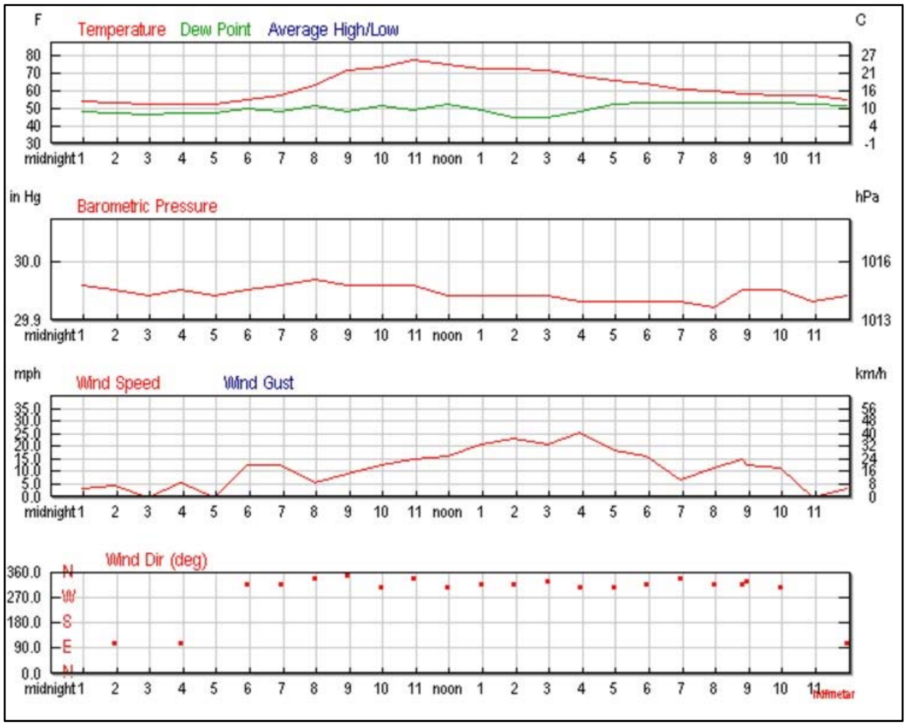
Level of Service	General Operating Conditions
A	Free flow
B	Reasonably free flow
C	Stable flow
D	Approaching unstable flow
E	Unstable flow
F	Forced or breakdown flow

5 Meteorological Conditions

During the measurement period from 10 am to 12 noon on Saturday, April 22, 2017, the sky was essentially clear and the wind speed was less than 10 mph from the west and north. Wind speed and direction data was taken from San Luis Obispo County Regional Airport weather station.

Wind speed above 12 mph has an increasing adverse effect on the accuracy of sound level measurements (reference: Federal Highway Administration, Noise Measurement).

Figure 17. Weather conditions at SBP San Luis Obispo Airport, 3.2 km SE of the project site.



6 Sound Level Data

Figure 18. Location Name, Coordinates and Sound Level, LAeq

Location Name	Coordinates	LAeq (
SC1	35.245107, -120.684473	54.9
SC2	35.244282, -120.686455	54.9
SC3	35.247990, -120.684612	58
SC4	35.247065, -120.684385	53.8
SC5	35.248028, -120.684247	61.6
SC6	35.245840, -120.685085	49.9
LT1	35.245107, -120.684473	54.4
LT2	35.248028, -120.684247	61.1

Figure 19. Spectral quality of sound, Third Octave Bands at LT1, near Calle Joaquin.

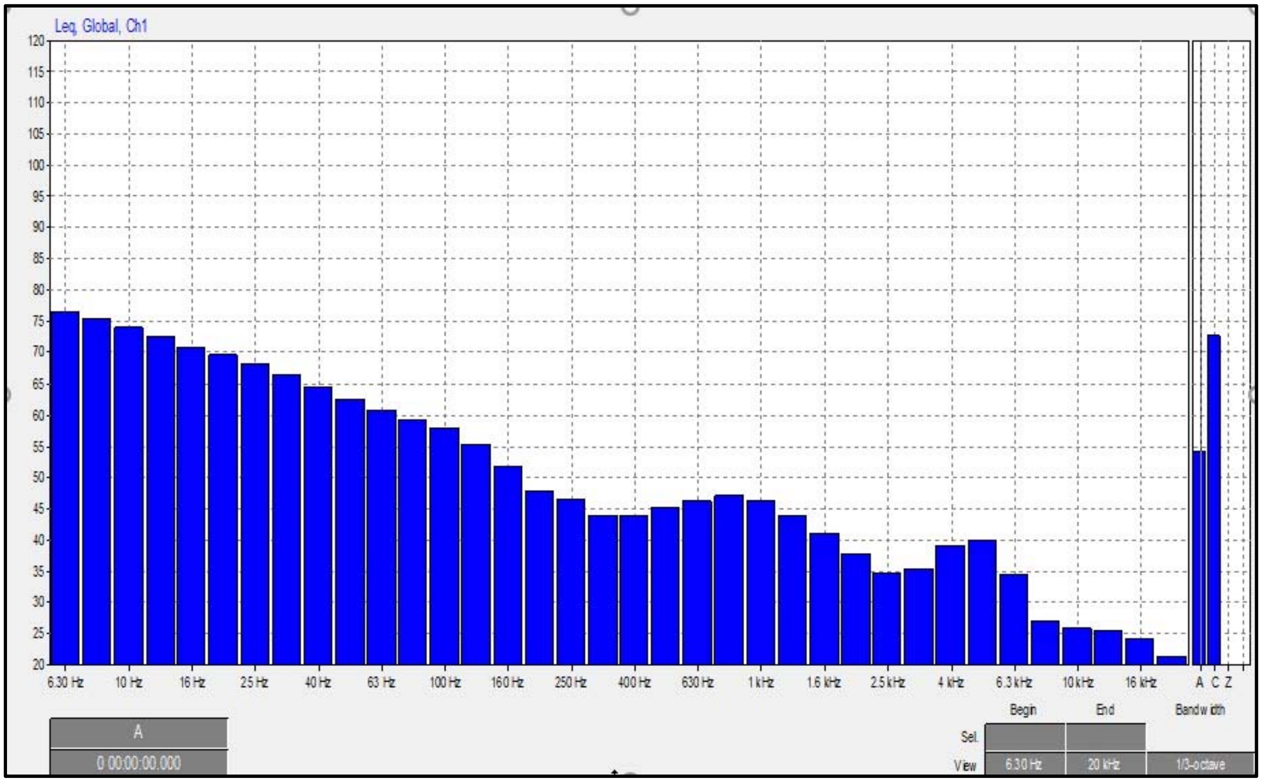
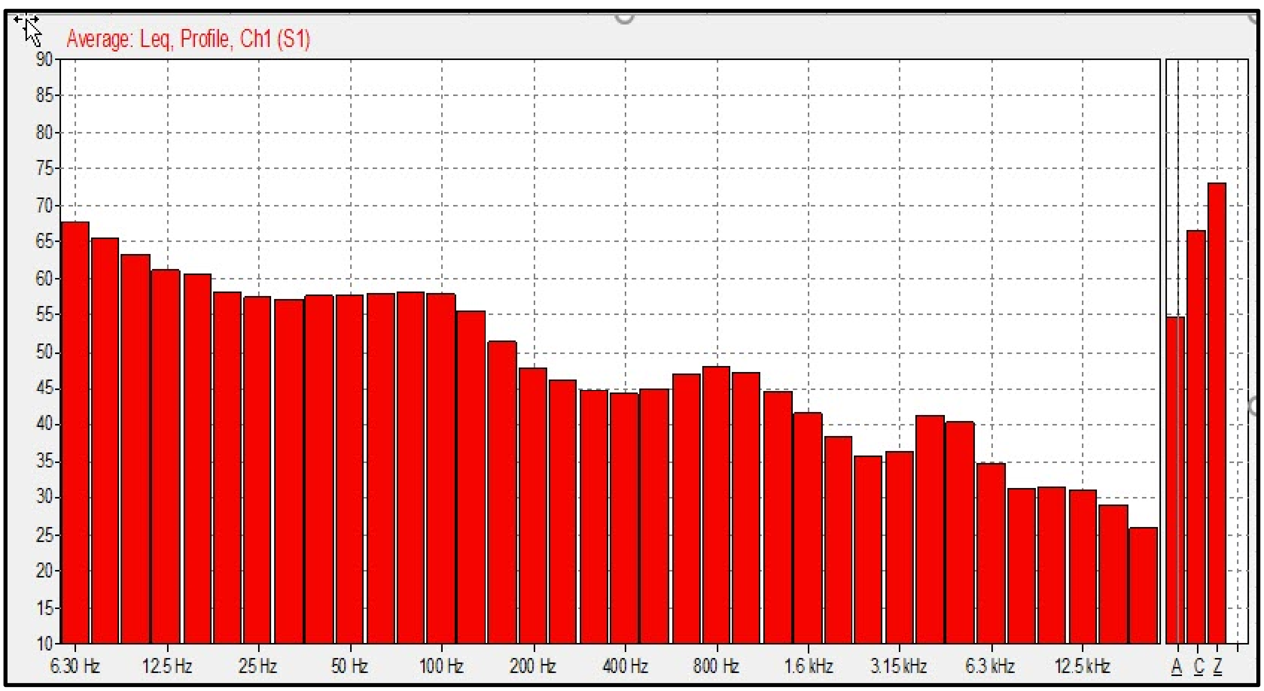


Figure 20. Spectral Quality of Sound, Third Octave Bands at LT2 near Los Osos Valley Road



7 Conclusion

The measured and predicted sound levels impacting the proposed Villaggio project are a mix of transportation noise along Los Osos Valley Road, the Calle Joaquin interchange with Highway 101, and to a lesser extent, Calle Joaquin west of Los Osos Valley Road. Future noise level from transportation sources at buildout are predicted to result in an increase in sound level of about one decibel in 20 years' time.

Perceived sound level studies reveal the subjective interpretation of sound differences. A one dBA increase in sound level is barely noticeable to the most sensitive subjects. Sound level must increase by five (5) dBA before most listeners report a noticeable or significant change in sound level.

for 45dB Acoustics, LLC
David Lord

8 Glossary of Acoustical Terms

A-Weighted Sound Level (dBA)
The sound pressure level in decibels as measured on a sound level meter using the internationally standardized A-weighting filter or as computed from sound spectral data to which A-weighting adjustments have been made. A-weighting de-emphasizes the low and very high frequency components of the sound in a manner similar to the response of the average human ear. A-weighted sound levels correlate well with subjective reactions of people to noise and are universally used for community noise evaluations.

Air-borne Sound
Sound that travels through the air, differentiated from structure-borne sound.

Ambient Sound Level
The prevailing general sound level existing at a location or in a space, which usually consists of a composite of sounds from many sources near and far. The ambient level is typically defined by the Leq level.

Background Sound Level
The underlying, ever-present lower level noise that remains in the absence of intrusive or intermittent sounds. Distant sources, such as Traffic, typically make up the background. The background level is generally defined by the L90 percentile noise level.

Community Noise Equivalent Level (CNEL)
The Leq of the A-weighted noise level over a 24-hour period with a 5 dB penalty applied to noise levels between 7 p.m. and 10 p.m. and a 10 dB penalty applied to noise levels between 10 p.m. and 7 a.m. CNEL is similar to Ldn.

Day-Night Sound Level (Ldn)
The Leq of the A-weighted noise level over a 24-hour period with a 10 dB penalty applied to noise levels between 10 p.m. and 7 a.m. Ldn is similar to CNEL.

Decibel (dB)
The decibel is a measure on a logarithmic scale of the magnitude of a particular quantity (such as sound pressure, sound power, sound intensity) with respect to a reference quantity.

DBA or dB(A)
A-weighted sound level. The ear does not respond equally to all frequencies, but is less sensitive at low and high frequencies than it is at medium or speech range frequencies. Thus, to obtain a single number representing the sound level of a noise containing a wide range of frequencies in a manner representative of the ear’s response, it is necessary to reduce the effects of the low and high frequencies with respect to the medium frequencies. The resultant sound level is said to be A-weighted, and the units are dBA. The A-weighted sound level is also called the noise level.

Energy Equivalent Level (Leq)
Because sound levels can vary markedly in intensity over a short period of time, some method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, one describes ambient sounds in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-equivalent sound/noise descriptor is called Leq. In this report, an hourly period is used.

Field Sound Transmission Class (FSTC)
A single number rating similar to STC, except that the transmission loss values used to derive the FSTC are measured in the field. All sound transmitted from the source room to the receiving room is assumed to be through the separating wall or floor-ceiling assembly.

Outdoor-Indoor Transmission Class (OITC)
A single number classification, specified by the American Society for Testing and Materials (ASTM E 1332 issued 1994), that establishes the A-weighted sound level reduction provided by building facade components (walls, doors, windows, and combinations thereof), based upon a reference sound spectra that is an average of typical air, road, and rail transportation sources. The OITC is the preferred rating when exterior façade components are exposed to a noise environment dominated by transportation sources.

Single Event Noise Exposure Level (SENEL)
The time-integrated A-weighted sound pressure level of a single aircraft flyover (which exceeds a threshold noise level) which is expressed by the level of an equivalent one-second duration reference signal.

Sound Transmission Class (STC)
STC is a single number rating, specified by the American Society for Testing and Materials, which can be used to measure the sound insulation properties for comparing the sound transmission capability, in decibels, of interior building partitions for noise sources such as speech, radio, and television. It is used extensively for rating sound insulation characteristics of building materials and products.

Structure-Borne Sound
Sound propagating through building structure. Rapidly fluctuating elastic waves in gypsum board, joists, studs, etc.

Subjective Loudness Level
In addition to precision measurement of sound level changes, there is a subjective characteristic which describes how most people respond to sound:

- A change in sound level of 3 dBA is *barely perceptible* by most listeners.
- A change in level of 6 dBA is *clearly perceptible*.
- A change of 10 dBA is perceived as being *twice* (or *half*) as loud.

9 Sound Level Modeling and Measurement

9.1 Sound level modeling

Sound level contours compared to the measured sound level values were generated for assessment using *SoundPlan* noise simulation software. The software calculates sound attenuation of environmental noise around buildings. For this project, the land between the sources (road and airport operations) and receiver project boundary, is generally flat and partially paved. The modeling software calculates the sound field in accordance with ISO 9613-2 "Acoustics - Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation." This standard states that "this part of ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favorable to propagation from sources of known sound emissions."

9.2 Sound Level Measurement

The protocol used for the sound level measurements is prescribed in detail by the American Society for Testing and Materials (ASTM) in their E 1014 publication. The procedures and standards in that document were met or exceeded for sound level measurements shown in this report. The standards of ASTM E 1014 are exceeded by using Type 1 (Class 1) sound level meters for all measurements in this report instead of less accurate Type 2 meters. Therefore, the precision of the measurements in this report is likely to be better than +/- 1 dB. The sound level meters used for measurements shown in this report are Norsonic Nor140 Sound Analyzers, with synchronized time settings. These sound level meters meet all requirements of ANSI s1.4, IEC 651 for Class 1 accuracy. The sound level meters were calibrated before and after each sound level measurement. The measurement results from both sound level meters running simultaneously were compared and found to be in close agreement.

10 References

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APPENDIX I.2

Acoustics Assessment for the Froom Ranch Project 2020

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April 9, 2020
Project 20031

Acoustics Assessment:	**Requestor/Client:**	**Owner:**
Froom Ranch Specific Plan **City of San Luis Obispo, CA**	**RRM Design Group** Attn.: Victor Montgomery 3765 S. Higuera St., Suite 102 San Luis Obispo, CA 93401	**John Madonna Construction** PO Box 5310 San Luis Obispo, CA 93403

1 Executive Summary

The proposed Froom Ranch Specific Plan has been analyzed for potential noise impact from stationary and transportation noise associated with commercial activity to the north of Froom Ranch. Predictive noise modeling was used to evaluate existing and future land use for compliance with the City of San Luis Obispo General Plan Noise Element.

Traffic counts from the City's published Average Daily Traffic levels were used to predict traffic noise levels from Los Osos Valley Road (LOVR) to the east of the Specific Plan area, which agreed with previous measurements. Utilizing industry-standard calculation methods within SoundPLAN® software and reference noise emission data, the noise levels from activities such as trucks maneuvering in and out of loading docks, trucks passing through the alley, forklifts, HVAC noise and passenger vehicle parking lot activities were calculated for the potential noise-sensitive receiver locations on the northern portion of the Froom Ranch Specific Plan.

Under the above conditions and assumptions, the land uses adjacent to Irish Hills Plaza commercial zone along the north boundary are anticipated to comply with the Noise Element requirements of the City of San Luis Obispo.

for 45dB Acoustics, LLC

Sarah Taubitz, MSME

David Lord, Ph.D.

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2 Introduction

This predictive noise modeling study of the Froom Ranch Specific Plan is intended to determine the potential impact of noise associated with commercial operations in Irish Hills Plaza to the north of the proposed Specific Plan. The following topics are presented:

- The topographical relationship of transportation noise sources in relation to the existing and proposed built environment
- Identification of project-related noise sources and their characteristics, including commercial noise from existing businesses to the north of Froom Ranch
- Determination of existing ambient sound levels as well as predicted sound level contours predicted noise levels for proposed zoning of the Froom Ranch Specific Plan
- Basis for the sound level prediction, the noise attenuation measures to be applied, and an analysis of results in comparison to applicable project requirements

Information on fundamentals of noise and vibration to aid in interpreting the report

3 Project Location

The proposed Froom Ranch Specific Plan is located west of Los Osos Valley Road. A commercial zone of businesses including Home Depot, Whole Foods Market, and TJ Maxx lie directly to the north in the Irish Hills Plaza (Figure 1). Calle Joaquin creates the southern border for the project, with Highway 101 further to the south.

Our previous reports included road traffic noise for the entire Froom Ranch area. This report adds commercial noise related to business operations to the immediate north of Froom Ranch. Figure 2 identifies the areas of commercial activity areas of the businesses to the north of the project. This report focuses on the northern portion of Froom Ranch, as the southern portion of the project is not affected by noise from these businesses.

Figure 1: Project location

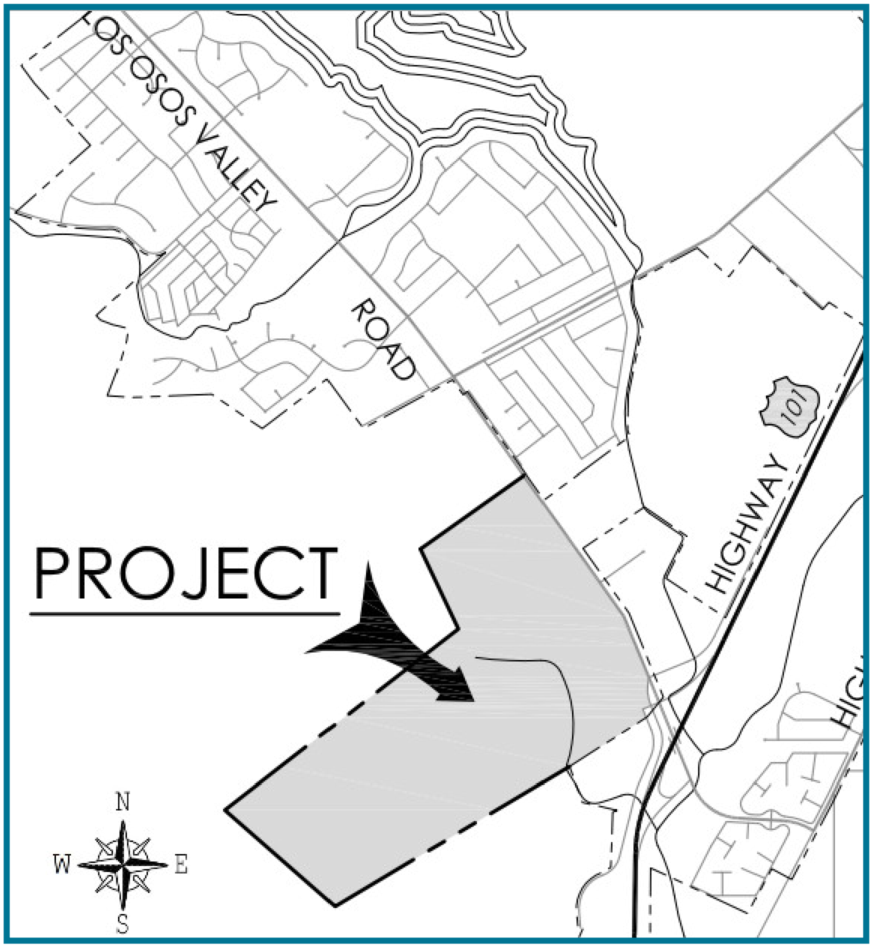


Figure 2: Identified noise sources at businesses to the north of Froom Ranch

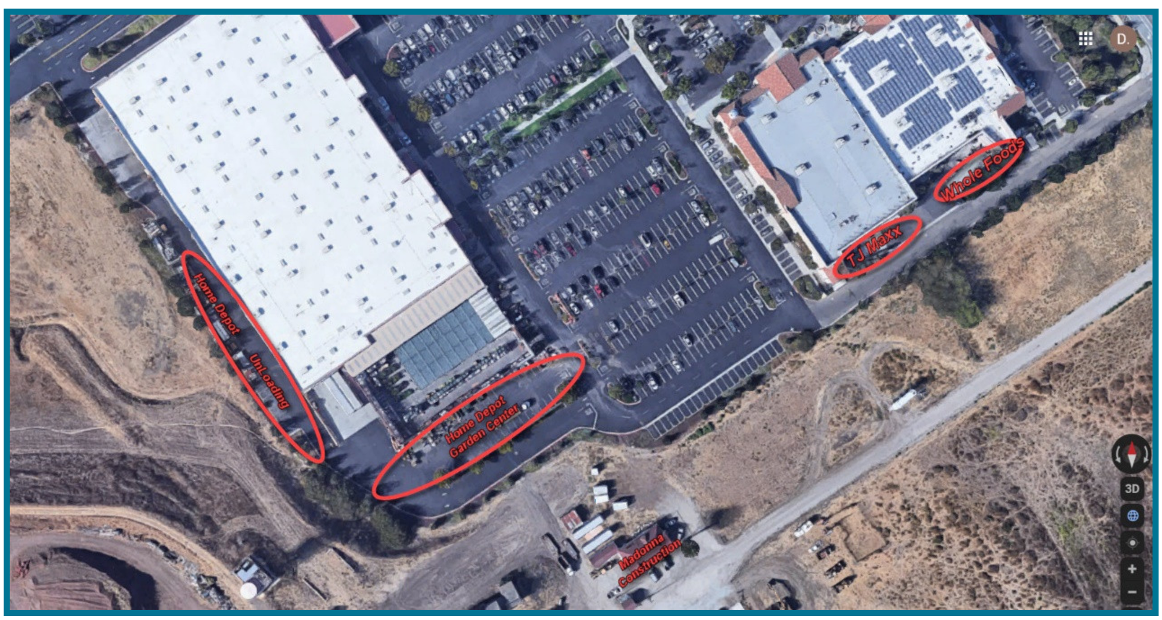
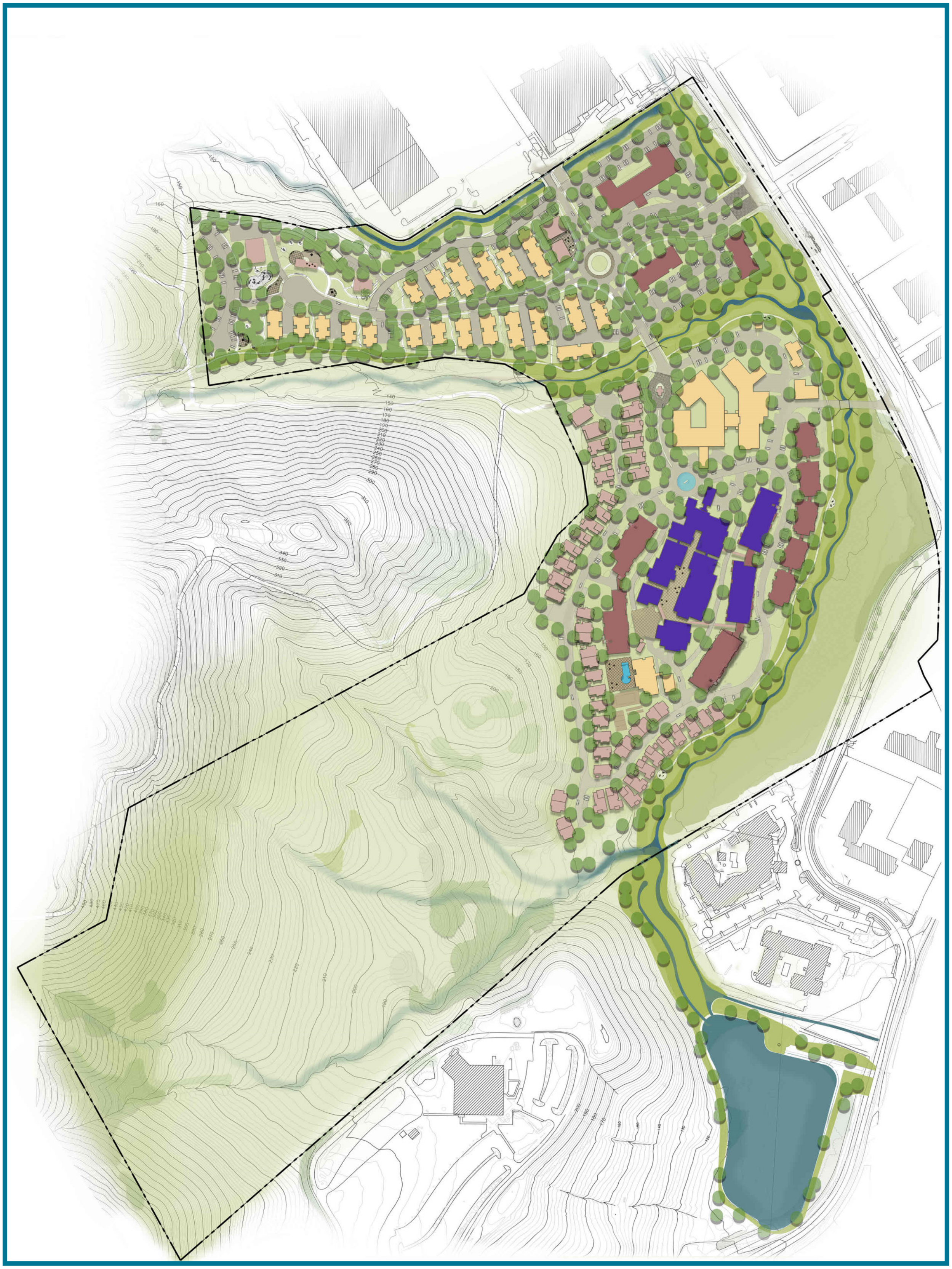


Figure 3: Froom Ranch site plan concept (RRM Design Group)



4 City Noise Element

City of San Luis Obispo's General Plan, Noise Element provides regulation and guidelines regarding noise. The Noise Element provides the conclusions, recommendations, and strategies necessary to ensure an appropriately quiet and pleasurable interior environment for all. The regulation of transportation noise sources such as roadway and train traffic primarily falls under either State or Federal jurisdiction. Local jurisdiction may use land use and planning decisions to limit locations or volumes of transportation noise sources to avoid development within potential noise impact zones, or to shield impacted receivers or sensitive receptors.

This project is evaluated against the City's Noise Element Table 1, Maximum noise Exposure for Noise-Sensitive Uses Due to Transportation Noise Sources, reprinted in Figure 4. This table is also reprinted in the Froom Ranch Specific Plan EIR as Table 3.10-5. CNEL and L_{dn} are typically within 1 dB of each other and can be considered to be equivalent here.

Figure 4: Noise Element's Maximum Noise Exposure for Transportation Sources

Table 1. Maximum Noise Exposure for Noise-Sensitive Uses Due to Transportation Noise Sources

	Outdoor Activity Areas[1]	Indoor Spaces		
Land Use	**L_{dn} or CNEL, in dB**	**L_{dn} or CNEL, in dB**	**L_{eq} in db[2]**	**L_{max} in db[3]**
Residences, hotels, motels, hospitals, nursing homes	60	45	-	60
Theaters, auditoriums, music halls	-	-	35	60
Churches, meeting halls, office building, mortuaries	60	-	45	-
Schools, libraries, museums	-	-	45	60
Neighborhood parks	65	-	-	-
Playgrounds	70	-	-	-

1 *If the location of outdoor activity areas is not shown, the outdoor noise standard shall apply at the property line of the receiving land use.*

2 *As determined for a typical worst-case hour during periods of use.*

3 *L_{max} indoor standard applies only to railroad noise at locations south of Orcutt Road.*

Our analysis will provide modeled noise levels based upon existing traffic counts as well as commercial delivery activities, parking lot sweeping, forklifts and stationary rooftop HVAC noise for commercial businesses in Irish Hills Plaza to the north of Froom Ranch. Existing and proposed noise levels based on these assumptions using the SoundPLAN® software along with our underlying assumptions and model inputs are reported here. Observations on compatibility of the proposed project with reference to these previously cited regulations is provided.

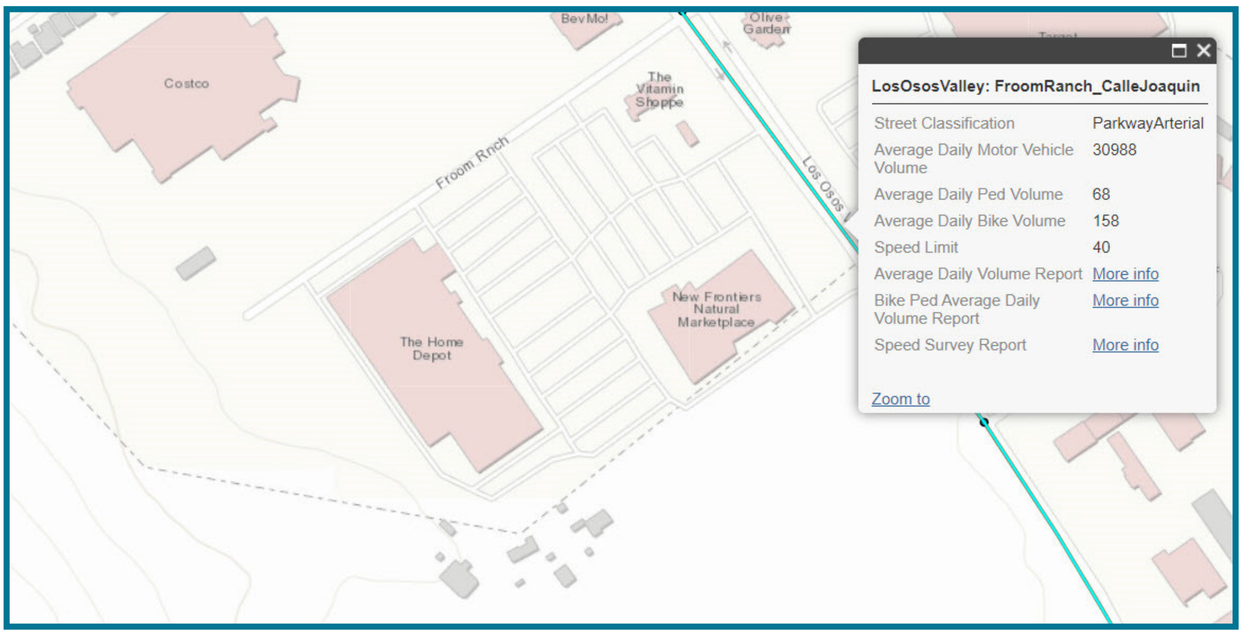
5 Sound Level Modeling

5.1 Noise Sources

5.1.1 Traffic Noise

The SoundPLAN® noise model utilizes ADT traffic volume and the FHWA's Traffic Noise Model (TNM) to calculate / predict day ("Ld"), evening ("Le"), and nighttime ("Ln"), and composite day-evening-night levels "Lden" as desired. Lden and Community Noise Equivalent ("CNEL") noise levels are equivalents. The City of San Luis Obispo has published traffic counts for Los Osos Valley Road from 2011 through 2015 (Figure 5). These figures are adjusted upward to present year levels assuming a 1% per year growth rate. A linear noise source is used to accurately represent traffic noise at the southern boundary of Irish Hills Plaza in our acoustic model.

Figure 5: City of San Luis Obispo traffic volume for Los Osos Valley Road.



5.1.2 Rooftop and other Mechanical Equipment

The heating, ventilating and air conditioning (HVAC) systems for maintaining comfortable shopping temperatures within the Home Depot, TJ Maxx and Whole Foods stores consist of packaged rooftop air conditioning systems. We included noise from all the rooftop units (RTU) identified from Google Maps in our analysis. The contribution of RTUs are not significant when compared to truck delivery and alley traffic noise.

5.1.3 Parking Lot Noise

The north boundary of Froom Ranch Specific Plan area faces adjacent on-grade parking near Home Depot and TJ Maxx retail sales stores. Various noise events, including noise related to automobile movement near driveways, infrequent alarms, car horns, door slams, and tire squeals, may occur infrequently within the proposed parking areas and may be individually / instantaneously audible from the Froom Ranch project areas. However, the averaged (CNEL or hourly) noise levels over time are relatively low when compared to the sources previously described. The incremental increase in *average* noise level would be less than the 3-dBA perceptibility threshold (see "Subjective Loudness Level" in Section 7.1) and therefore from the standpoint of the Noise Element these noise sources are less-than-significant.

5.1.4 Parking Lot Sweeping Noise (Less than Significant)

The parking lot area requires a sweeping truck for routine cleaning during night and early morning hours. As a means of determining the noise levels associated with sweeper truck activities, field measurements have been conducted by Bollard Associates of a typical sweeper vehicle during normal operation at a Home Depot store on Howe Avenue in Sacramento, California. Sweeper truck noise levels were measured to be up to 75 dB Lmax at a reference distance of 50 feet. However, due to the infrequency of this noise source, and comparing to the sound levels already produced from the other sources as described, this also does not significantly add to the existing noise levels produced by the alley and trucks themselves as modeled.

5.1.5 Intermittent Delivery Truck and Loading Dock Noise

Local carrier vehicles, vendor vehicles, and Home Depot, TJ Maxx and Whole Foods distribution center trucks accessing the project site have the potential to increase ambient noise levels on the project site and in its vicinity. This is a noncontinuous sound level that does not define an associated instantaneous maximum level that may occur from backup beeping, honking, slamming doors, etc.

This condition is helpful only in attempting to address the Municipal Code requirements adapted by the Froom Ranch EIR within Table 3.10-5 of that document, reprinted in Table 1. The Municipal Code requirement states that the Maximum Acceptable Noise Level is not to be exceeded more than 30 minutes in an hour (L50 or L_{50} in acoustic terminology). To use an extreme example, a very loud, impulsive noise source such as a firing range would still be compliant with this L50 requirement, as long as firearm shots are only present less than half the time in a given hour.

Because environmental noise such as this—with random backup beeping, truck brakes, and other instantaneous or "maximum" noises—is inherently stochastic in nature, there are theoretically an infinite number of noise scenarios with varying instantaneous noise peaks all having the same equivalent hourly Leq or daily CNEL. For this reason, it is impossible to guarantee without exception that an instantaneous or short-duration sound level limit will not be exceeded in the future, at any location. Given the maximum noise levels estimated within the EIR (reprinted in Table 2), and on the condition that these noises would not occur more than 6 minutes per hour even in the nighttime hours between 10pm and 7pm for the R-3-SP residences where these noises will be loudest (per Table 2), then the resulting L50 with an otherwise quiet background noise level will not exceed even the City's nighttime Exterior Noise Limit of 50dBA.

However, in this scenario the additional 1-minute-per-hour (L08 or L_{08}) limit of 75 dBA shown in Table 2 may be exceeded at the R3-SP location if more than 1 total minute of intermittent noise occurs. This L08 level would require at least 60 or more intermittent noises—beeps, honks, banging, or other such noises—and we anticipate that will not be the case. We conclude that the

EIR limits as derived from the Municipal Code are not anticipated to be exceeded under any foreseeable conditions or for any locations within the Froom Ranch site plan.

Having said that, we do recommend that prospective residents be forewarned of the possibility of audible noise from the commercial zone which will inevitably occur from time to time, as the Froom Ranch EIR has previously stated. Additionally, it may be prudent to design exterior window-wall assemblies facing the commercial zone to the north to a higher degree of noise isolation (Outdoor-Indoor Transmission Class, or "OITC") to further mitigate against these short-duration sounds for interior habitable spaces for resident comfort, although it is not required.

Table 1: City Municipal Code Exterior Noise Limits

Table 3.10-7. City of San Luis Obispo Exterior Noise Limits

Zoning Designation[1]	Time Period	Maximum Acceptable Noise Level (dBA[2])[3]
Low- and Medium-Density Residential (R-1 and R-2); Conservation/Open Space (C/OS)	10:00 PM – 7:00 AM	50
	7:00 AM – 10:00 PM	55
Medium- and High-Density Residential (R-3 and R-4)	10:00 PM – 7:00 AM	50
	7:00 AM – 10:00 PM	55
Office and Public Facility (O and PF)	10:00 PM – 7:00 AM	55
	7:00 AM – 10:00 PM	60
Neighborhood, Retail, Community, Downtown and Tourist Commercial (C-N, C-R, C-C, C-D, C-T)	10:00 PM – 7:00 AM	60
	7:00 AM – 10:00 PM	65
Service Commercial (C-S)	Any Time	70
Manufacturing (M)	Any Time	75

[1] The classification of different areas of the community in terms of environmental noise zones shall be determined by the Noise Control Office(r) based upon community noise survey data. Additional area classifications should be used as appropriate to reflect both lower and higher existing ambient levels than those shown. Industrial noise limits are intended primarily for use at the boundary of industrial zones rather than for noise reduction within the zone (Ord. 1032 § 2 [part] 1985)
[2] dBA (A-weighted decibel scale) emphasizes the range of sound frequencies that are most audible to the human ear (between 1,000 and 8,000 Hertz).
[3] Levels not to be exceeded more than 30 minutes in any hour.
Source: City of San Luis Obispo 2008.

Table 2: Estimated Maximum Noises from Nearby Commercial Activities (Wood)

Table 3.10-18. Maximum Noise Level Estimates and Thresholds Resulting from Nearby Commercial Activities

	Park	Hotel	MFR R-3-SP Residences	MFR R-4-SP Housing	Health Care Facilities	Retail/ Office
Maximum Noise Level (dB)	85	77	76	72	68	74
City Exterior Noise Limit – 30 minutes or more[1] (dBA)	60	65	60	55	55	60
City Exterior Noise Limit – 1 minute[2] (dBA)	75	80	75	70	70	75

[1] Noise Standard for Land Use within Section 9.12.060 of the City Municipal Code. Levels not to be exceeded more than 30 minutes in any hour.
[2] Noise Standard for Land Use within Section 9.12.060 of the City Municipal Code. Levels not to be exceeded for more than one minute in any hour.
MFR - Madonna Froom Ranch

5.2 CNEL Sound Level Contours for Commercial and Traffic Sources

The previous section discussed short duration/instantaneous/maximum noise levels as compared to the Municipal Code. In this section, a 24-hour equivalent (CNEL) sound level map is presented for the area, to compare with the primary applicable guidance document, the Noise Element of the General Plan.

A linear noise source in the alleyway was modeled for deliveries to the back side of the existing commercial businesses. The starting assumption from the Froom Ranch Specific Plan Draft EIR is 82 truck trips per week. If a worst-case/maximum of 15 trips per day exists, then assuming the noise exists during all 15 hours per day along the entire line source is conservative and can be considered a "worst case" situation, providing a desirable safety factor for exterior noise level on the design development for the project's buildings. Figure 6 shows a vertical cross section of sound level contours passing through an RTU on top of Home Depot and the alley line source.

Figure 6: Vertical cross-section of line-source truck noise

Additionally, Home Depot Garden Center and parking lot area noise source were added to the model to include the lower-level noise. However, these noise sources are a less-than-significant contribution.

The resulting CNEL sound level contours in Figure 7 depict a realistic 24-hour scenario with a maximum amount of activity and noise from these businesses. A conceptual future zoning map has been underlaid in the image to assist in evaluation of compatibility. The 60-dBA contour line is highlighted in red here, to aid in the compatibility assessment in the next section.

The future CNEL sound pressure levels (year 2040) across the site are expected remain within 1 dB of current predictions, assuming a 1% per year growth rate of combustion engine cars and trucks.

6 Compatibility and Recommendations

The PF-SP (Public Spaces), C/OS-SP (Conservation – Open Space), and R3-SP (Medium-Density Residential) zones of the specific plan do exceed 60 dBA in some locations toward the commercial areas to the north of Froom Ranch. Per the City's Noise Element, neighborhood parks and playgrounds would be compliant with these levels, but (private) residential outdoor activity areas would not be compliant in the areas that exceed 60 dBA CNEL. So, the C/OS-SP area is compliant. The PF-SP and R3-SP zones should be designed to locate residential outdoor activity areas—i.e., patios, balconies, etc.—on elevations that do not face the commercial areas to the north, using the residential buildings themselves as an effective mitigating noise barriers.

Commercial zones labeled "CR-SP" are in compliance with these predicted noise levels.

The Noise Element requires that indoor spaces not exceed 45 dBA CNEL. Given a maximum exterior level of 66 dBA for the northernmost corner of the R-3-SP zone facing the commercial businesses to the north, industry-standard exterior wall-window assemblies can readily be designed to render the interior sound levels to less than 45 dBA CNEL.

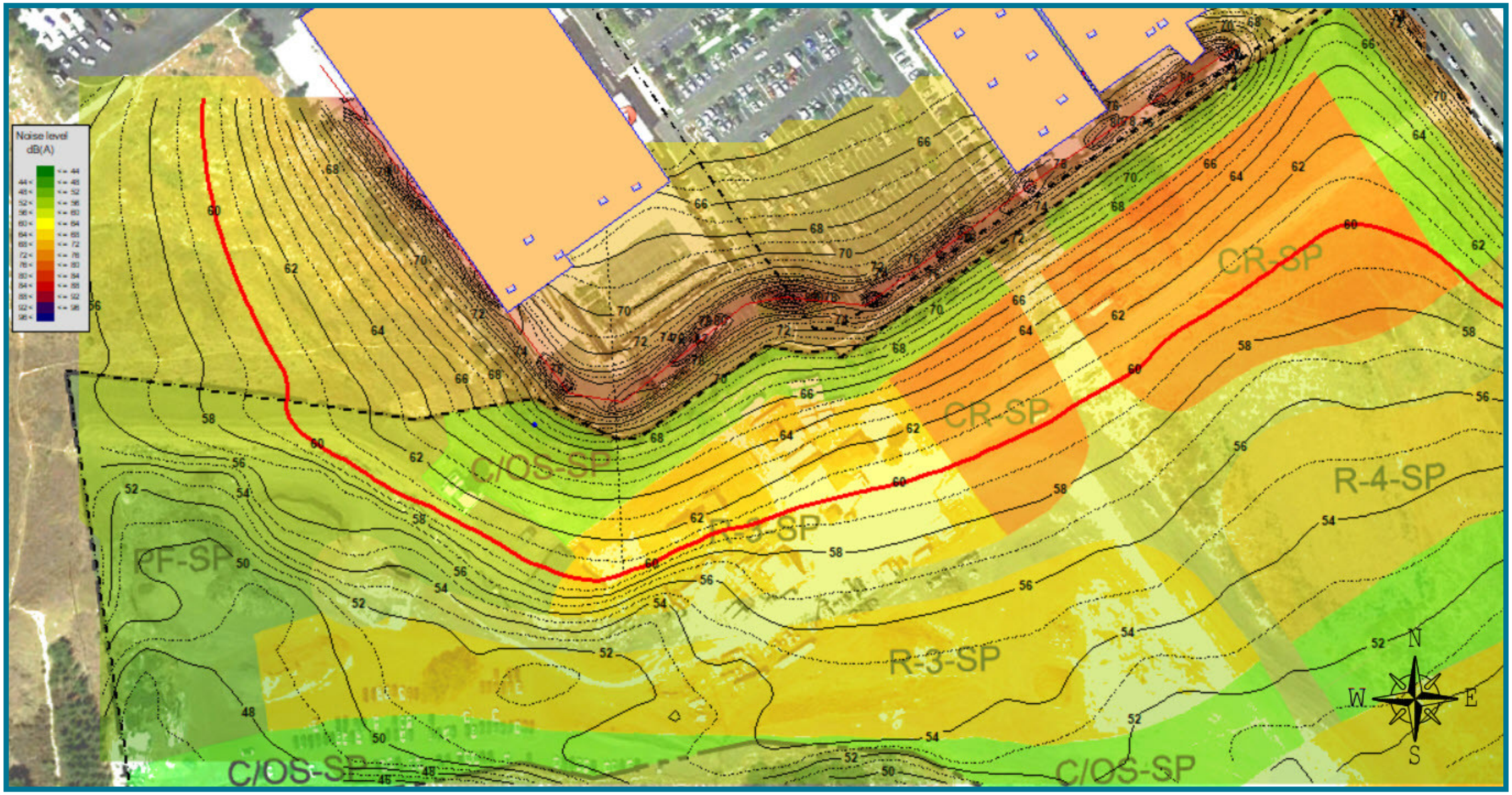
The calculation to verify outdoor-to-indoor transmission class (OITC) is complex, requiring known receiving room volume, exact wall design detail, and respective areas of glazing and walls comprising the composite assembly. However, we can state that dual glazing will be sufficient. A thick or complex wall design is not anticipated to be required in order to successfully mitigate against an exterior noise level of up to 66 dBA CNEL per the Noise Element.

Commercial and public space zones of the Froom Ranch Specific Plan are compatible with predicted sound levels. Other outdoor activity areas for the individual residential housing buildings in the R-3-SP and R-4-SP areas are recommended to be shielded from the commercial area to the north by locating them to the south and out of line-of-sight of the commercial area.

Alternatively, although not required, an earth berm or noise barrier wall could be constructed that not only *slightly* reduces these propagated levels onto Froom Ranch, but also blunts instantaneous sound levels arising from individual truck and car pass-byes, vehicle horns, or any other such sounds which, however compliant they may be, could be considered annoying to future Froom Ranch residents. The psychoacoustic effect of not having direct line-of-sight to noise sources is well-documented and not to be ignored—if a listener cannot see the noise source, the probability of annoyance and audibility is decreased somewhat. A berm or wall may also be desired for aesthetic reasons. However, it must be noted noise barriers are most effective either very near the source or the receiver—the CNEL levels are not anticipated to be reduced by more than approximately 3dB since the parking lot, the RTUs, and the shipping docks will be located away from the barrier, essentially allowing the noise to "jump" the barrier.

The exterior noise levels for this project are considered to be reasonable for a residential land use, and exterior window-wall building assemblies can be designed such that interior spaces will meet the State Building Code.

Figure 7: CNEL Sound Level Contours from all sources with 60 dB contour in red



7 Appendix

7.1 Terminology/Glossary

A-Weighted Sound Level (dBA)
The sound pressure level in decibels as measured on a sound level meter using the internationally standardized A-weighting filter or as computed from sound spectral data to which A-weighting adjustments have been made. A-weighting de-emphasizes the low and very high frequency components of the sound in a manner similar to the response of the average human ear. A-weighted sound levels correlate well with subjective reactions of people to noise and are universally used for community noise evaluations.

Air-borne Sound
Sound that travels through the air, differentiated from structure-borne sound.

Ambient Sound Level
The prevailing general sound level existing at a location or in a space, which usually consists of a composite of sounds from many sources near and far. The ambient level is typically defined by the Leq level.

Background Sound Level
The underlying, ever-present lower level noise that remains in the absence of intrusive or intermittent sounds. Distant sources, such as Traffic, typically make up the background. The background level is generally defined by the L90 percentile noise level.

Community Noise Equivalent Level (CNEL)
The Leq of the A-weighted noise level over a 24-hour period with a 5 dB penalty applied to noise levels between 7 p.m. and 10 p.m. and a 10 dB penalty applied to noise levels between 10 p.m. and 7 a.m. CNEL is similar to Ldn.

Day-Night Sound Level (Ldn)
The Leq of the A-weighted noise level over a 24-hour period with a 10 dB penalty applied to noise levels between 10 p.m. and 7 a.m. Ldn is similar to CNEL.

Decibel (dB)
The decibel is a measure on a logarithmic scale of the magnitude of a particular quantity (such as sound pressure, sound power, sound intensity) with respect to a reference quantity.

DBA or dB(A)
A-weighted sound level. The ear does not respond equally to all frequencies, but is less sensitive at low and high frequencies than it is at medium or speech range frequencies. Thus, to obtain a single number representing the sound level of a noise containing a wide range of frequencies in a manner representative of the ear's response, it is necessary to reduce the effects of the low and high frequencies with respect to the medium frequencies. The resultant sound level is said to be A-weighted, and the units are dBA. The A-weighted sound level is also called the noise level.

Energy Equivalent Level (Leq)
Because sound levels can vary markedly in intensity over a short period of time, some method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, one describes ambient sounds in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-equivalent sound/noise descriptor is called Leq. In this report, an hourly period is used.

Field Sound Transmission Class (FSTC)
A single number rating similar to STC, except that the transmission loss values used to derive the FSTC are measured in the field. All sound transmitted from the source room to the receiving room is assumed to be through the separating wall or floor-ceiling assembly.

Outdoor-Indoor Transmission Class (OITC)
A single number classification, specified by the American Society for Testing and Materials (ASTM E 1332 issued 1994), that establishes the A-weighted sound level reduction provided by building facade components (walls, doors, windows, and combinations thereof), based upon a reference sound spectra that is an average of typical air, road, and rail transportation sources. The OITC is the preferred rating when exterior façade components are exposed to a noise environment dominated by transportation sources.

Percentile Sound Level, Ln
The noise level exceeded during *n* percent of the measurement period, where *n* is a number between 0 and 100 (e.g., L10 or L90)

Sound Transmission Class (STC)
STC is a single number rating, specified by the American Society for Testing and Materials, which can be used to measure the sound insulation properties for comparing the sound transmission capability, in decibels, of interior building partitions for noise sources such as speech, radio, and television. It is used extensively for rating sound insulation characteristics of building materials and products.

Structure-Borne Sound
Sound propagating through building structure. Rapidly fluctuating elastic waves in gypsum board, joists, studs, etc.

Sound Exposure Level (SEL)
SEL is the sound exposure level, defined as a single number rating indicating the total energy of a discrete noise-generating event (e.g., an aircraft flyover) compressed into a 1-second time duration. This level is handy as a consistent rating method that may be combined with other SEL and Leq readings to provide a complete noise scenario for measurements and predictions. However, care must be taken in the use of these values since they may be misleading because their numeric value is higher than any sound level which existed during the measurement period.

Subjective Loudness Level
In addition to precision measurement of sound level changes, there is a subjective characteristic which describes how most people respond to sound:

- A change in sound level of 3 dBA is *barely perceptible* by most listeners.
- A change in level of 6 dBA is *clearly perceptible*.
- A change of 10 dBA is subjectively perceived as being *twice* (or *half*) as loud.

7.2 Calculating CNEL

Housing and Urban Development (HUD) Code of Federal Regulations (CFR), Part 51 Environmental Criteria and Standards, along with Federal Highway Administration (FHWA) guidelines are used for estimating CNEL values based on "design hour" traffic flow measurement.

Highway projects receiving Federal aid are subject to noise analyses under the procedures of the FHWA. Where such analyses are available, they may be used to assess sites subject to the requirements of this standard. The Federal Highway Administration employs two alternate sound level descriptors (23 CFR 772.12):

> (i) The A-weighted sound level not exceeded more than 10 percent of the time for the highway design hour traffic flow, symbolized as L10; or
> (ii) The equivalent sound level for the design hour, symbolized as Leq. The day-night average sound level may be estimated from the design hour L10 or Leq values by the following relationships, provided heavy trucks do not exceed 10 percent of the total traffic flow in vehicles per 24 hours and the traffic flow between 10 p.m. and 7 a.m. does not exceed 15 percent of the average daily traffic flow in vehicles per 24 hours:
>
> (a) CNEL ≈ L10 (design hour) - 3 decibels
>
> (b) CNEL≈ Leq (design hour) decibels

Existing highway traffic noise measurements are made to represent an hourly equivalent sound level, Leq. Statistical accuracy requires a minimum measurement of approximately eight minutes. Most highway agencies have automated measurement equipment and typically measure 15-minute time periods to represent the Leq. This is acceptable if unusual events do not occur during the noisiest hour.

Measurements along low-volume highways may require longer measurement periods (e.g., 30-60 minutes) to attain desirable statistical accuracy. If information is not available to identify the noisiest hour of the day or if there is public controversy at a specific location, 24-hour measurements may be necessary.

The FHWA stipulates the use of noise meters with sufficient accuracy to yield valid data for the particular project (ANSI S1.4-1983, TYPE II or better). The measurement procedure shall ensure measurements have consistent and supportable validity. Traffic conditions, climatic conditions, and land uses at the time of measurement shall be noted.

7.3 Traffic Noise Model (TNM)

The Federal Highway Administration Traffic Noise Model (TNM) used for the sound level analysis in this study, contains the following components:

1. Modeling of five standard vehicle types, including automobiles, medium trucks, heavy trucks, buses, and motorcycles, as well as user-defined vehicles.
2. Modeling both constant- and interrupted-flow traffic using a field-measured data base.
3. Modeling effects of different pavement types, as well as the effects of graded roadways.
4. Sound level computations based on a one-third octave-band data base and algorithms.
5. Graphically-interactive noise barrier design and optimization.
6. Attenuation over/through rows of buildings and dense vegetation.
7. Multiple diffraction analysis.
8. Parallel barrier analysis.
9. Contour analysis, including sound level contours, barrier insertion loss contours, and sound-level difference contours.

These components are supported by a scientifically founded and experimentally calibrated acoustic computation methodology.

7.4 SoundPLAN® Acoustics Software

SoundPLAN, the software used for this acoustic analysis, is an acoustic ray-tracing program dedicated to the prediction of noise in the environment. Noise emitted by various sources propagates and disperses over a given terrain in accordance with the laws of physics. Worldwide, governments and engineering associations have created algorithms to calculate acoustical phenomena to standardize the assessment of physical scenarios. Accuracy has been validated in wide-ranging schenairos to be + / - 2.7 dBA with an 85% confidence level. At close-in distances and simpler geometries, the accuracy may be as high as +/- 1 dB. SoundPLAN is compliant with TNM standards described above.

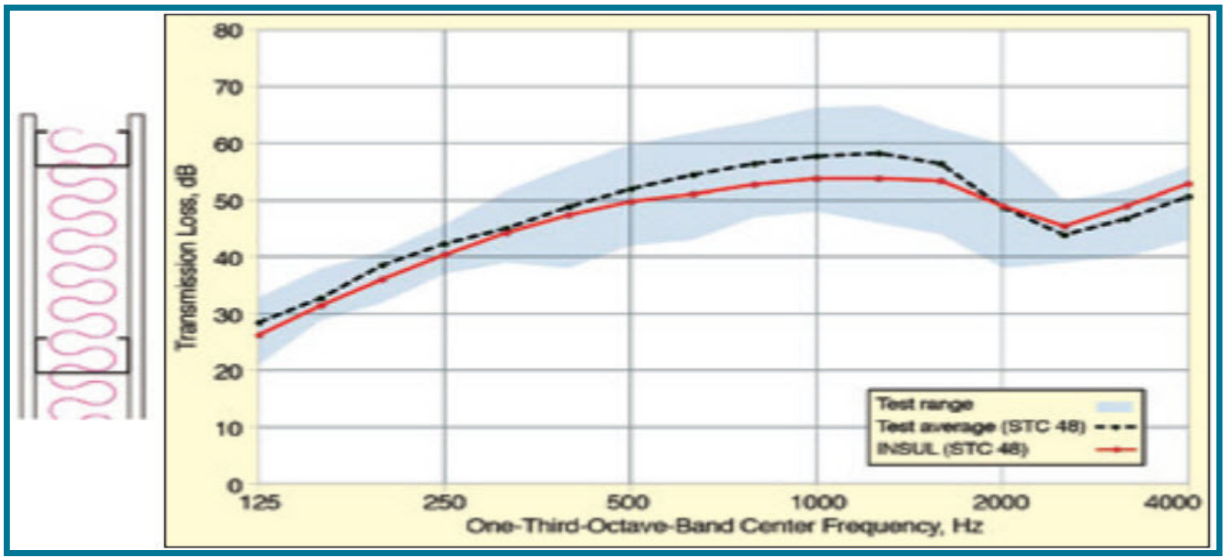
The software calculates sound attenuation of environmental noise, even over complex terrain, uneven ground conditions, and with complex obstacles. The modeling software calculates the sound field in accordance with ISO 9613-2 "*Acoustics - Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation*." This standard states that "this part of ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors, in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favorable to propagation from sources of known sound emissions. These conditions are for downwind propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night."

7.1 Computer Modeling of Transmission Class (STC)

The use of computer modeling to estimate sound transmission class (STC) and outdoor-to-indoor transmission class (OITC) ratings has become increasingly common. There are several factors to consider when using software to estimate the sound insulation of architectural elements and assemblies. One of the most important factors is the question of real-world accuracy. Others include the use of analytical vs. empirical models, the complexity of assemblies that can be modeled and the level of user experience and knowledge necessary to yield valid or useful results.

Computational results using INSUL software yield octave or third-octave-band transmission loss values as well as providing an estimated single-number STC rating. Modeled results are compared to published laboratory test data for several representative assemblies in Figure 8.

Figure 8: Comparison of INSUL and Laboratory Testing:



7.2 Characteristics of Sound

When an object vibrates, it radiates part of its energy as acoustical pressure in the form of a sound wave. Sound can be described in terms of amplitude (loudness), frequency (pitch), or duration (time). The human hearing system is not equally sensitive to sound at all frequencies. Therefore, to approximate this human, frequency-dependent response, the A-weighted filter system is used to adjust measured sound levels. The normal range of human hearing extends from approximately 0 to 140 dBA. Unlike linear units such as inches or pounds, decibels are measured on a logarithmic scale, representing points on a sharply rising curve. Because of the physical characteristics of noise transmission and of noise perception, the relative loudness of sound does not closely match the actual amounts of sound energy. Table 3 below presents the subjective effect of changes in sound pressure levels.

Table 3: Sound Level Change Relative Loudness/Acoustic Energy Loss

0 dBA	Reference 0%
-3 dBA	Barely Perceptible Change 50%
-5 dBA	Readily Perceptible Change 67%
-10 dBA	Half as Loud 90%
-20 dBA	1/4 as Loud 99%
-30 dBA	1/8 as Loud 99.9%
Source: Highway Traffic Noise Analysis and Abatement Policy and Guidance, U.S. Department of Transportation, Federal Highway Administration, Office of Environment and Planning, Noise and Air Quality Branch, June 1995.	

Sound levels are generated from a source and their decibel level decreases as the distance from that source increases. Sound dissipates exponentially with distance from the noise source. This phenomenon is known as spreading loss. Generally, sound levels from a point source will decrease by 6 dBA for each doubling of distance. Sound levels for a highway line source vary differently with distance because sound pressure waves propagate along the line and overlap at the point of measurement. A closely spaced, continuous line of vehicles along a roadway becomes a line source and produces a 3 dBA decrease in sound level for each doubling of distance. However, experimental evidence has shown that where sound from a highway propagates close to "soft" ground (e.g., plowed farmland, grass, crops, etc.), a more suitable drop-off rate to use is not 3.0 dBA but rather 4.5 dBA per distance doubling (FHWA 2010).

When sound is measured for distinct time intervals, the statistical distribution of the overall sound level during that period can be obtained. The Leq is the most common parameter associated with such measurements. The Leq metric is a single-number noise descriptor that represents the average sound level over a given period of time. For example, the L50 noise level is the level that is exceeded 50 percent of the time. This level is also the level that is exceeded 30 minutes in an hour. Similarly, the L02, L08 and L25 values are the noise levels that are exceeded 2, 8, and 25 percent of the time or 1, 5, and 15 minutes per hour. Other values typically noted during a noise survey are the Lmin and Lmax. These values represent the minimum and maximum root-mean-square noise levels obtained over the measurement period.
Because community receptors are more sensitive to unwanted noise intrusion during the evening and at night, State law requires that, for planning purposes, an artificial dB increment be added to quiet-time noise levels in a 24-hour noise descriptor called the CNEL or Ldn. This increment is incorporated in the calculation of CNEL or Ldn, described earlier.

7.3 Evidence of Compliance

Evidence of compliance shall consist of submittal of an acoustical analysis report, prepared under the supervision of a person experienced in the field of acoustical engineering, with the application for building permit. The report shall show topographical relationship of noise sources and dwelling site, identification of noise sources and their characteristics, predicted noise spectra at the exterior of the proposed dwelling structure considering present and future land usage, basis for the prediction (measured or obtained from published data), noise attenuation measures to be applied, and an analysis of the noise insulation effectiveness of the proposed construction showing that the prescribed interior noise level requirements are met. If interior allowable noise levels are met by requiring that windows be unopenable or closed, the design for the structure must also specify the means that will be employed to provide ventilation and cooling, if necessary, to provide a habitable interior environment.

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