APPENDIX O

Sound Level Assessment for Avila Ranch Development Project

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Sound Level Assessment for

Avila Ranch Project
Vachell Lane and Buckley Road
San Luis Obispo, CA

requested by
Avila Ranch, LLC
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San Luis Obispo, CA. 93401

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1.0 Description and Criteria

This sound level assessment is for the proposed development of Avila Ranch with regard to surrounding noise levels from all sources that have potential impact on noise sensitive uses. The possible noise sources examined in this study are vehicular traffic, as well as air traffic from San Luis Obispo County Regional Airport. In addition there are potential stationary noise sources from neighboring commercial activities along the north boundary. The Avila Ranch site is bordered by Vachell Lane to the west and by Buckley Road to the south. Commercial activities, including loading and aggregate mixing operations occur to the northwest of the site. The northeast of the site is closest to the San Luis Obispo County Regional Airport. The general layout and configuration of the site, along with sound level measurement locations are shown in "Figure 1. Site Plan" on page 5.

The purpose of this sound level study is to assess the exterior noise environment of the subject property and to provide recommendations on the control of exterior-to-interior noise with respect to regulations, policies and/or local ordinances. This report provides a description of the environmental noise survey methodology, a discussion of applicable noise standards, results of the noise survey, future noise level projections, and exterior-to-interior noise mitigation recommendations for the proposed residential development.

Existing sound levels were measured continuously on the proposed site at 10-second intervals over a 24-hour period on Friday and Saturday, January 23 - 24, 2015, and on Monday and Tuesday, January 26 - 27, 2015. An acoustic model with sound level contours was generated for the site based on topography, noise sources and measured sound level values.

2.0 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. Refer to "7.0 APPENDIX A: Glossary of Acoustical Terms" on page 38 for further definition of metrics and terminology.

2.1 State Regulation

The State of California's Guidelines for the Preparation and Content of Noise Element of the General Plan (1987). These guidelines reference land use compatibility standards for

Figure 1. Site Plan

The plan below shows adjacent roads, Vachell Lane to the west and Buckley Road to the south, each of which is a potential noise source. Two stations 1 and 5, measure noise from those roads. Two stations 2 and 3, are located in the relatively quiet interior of the site. Potential stationary and operating noise from AirVol Block is measrued at station 4 in the northwest corner of the site. Station 6 is located in the northeast corner of the site, which is nearest the airport, and is otherwise sheltered from stationary and transportation noise. The location of the six Sound Level 24-hour measurement stations distributed around the site is shown. The geographic coordinate of each site is listed below:

Station 1: 35.236807, -120.674414
Station 2: 35.237686, -120.671067
Station 3: 35.238978, -120.668318
Station 4: 35.241.258, -120.672064
Station 5: 35.236972, -120.669616
Station 6: 35.240476, -120.662504

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. However, a detailed analysis of noise reduction requirements is recommended when new office or commercial development is proposed in areas where existing sound levels approach 70 CNEL.

All new Multi-Family housing must comply with California Code of Regulations (CCR) Title 24 – 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. Division II of the CBC, Appendix 12 presents acoustical requirements in general terms, with more specific language provided in Division IIA of Appendix 12. 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 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.

2.2 Local Regulation

Transportation Noise: 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 2. Acceptable Noise Exposure" on page 7.

2.3 Airport Land Use Plan

The location of the Avila Ranch site is shown in "Figure 3. Airport Land Use Plan" on page 8, in relation to the Airport Land Use Plan Airport Noise Contours. The site is partially within the Projected 50 dB airport noise contour and partially within the Projected 55 dB airport noise contour. The actual 55 dB airport noise contour is off-site.

The Airport Land Use Plan (ALUP), adopted December 1973 and amended May, 2005, establishes Maximum Allowable Interior Noise Exposure from Aviation Related Noise Sources in Table 4, page 18: The maximum is judged from the "single-event interior aviation noise level," and prescribes the noise attenuation required in relation to the "single-event noise contour." The reference event for determination of required single event noise mitigation is assumed to be the straight-in arrival of a regional airline jet landing on Runway 29 and the straight-out departure of a regional airline jet from Runway 29. Measurements are to be of the maximum noise level, are to be A-weighted, and are to be obtained using a Fast response time. (It should be noted that aircraft arrivals are substantially less noisy than aircraft departures.)

For Residential Dwellings, the ALUP prescribes a maximum allowable interior noise level of 50 dBA and allows normal construction materials and methods when the residence is located at or below the 65 dB Noise Contour. At 65 dB sound level or below, "normal

Figure 2. Acceptable Noise Exposure

City of San Luis Obispo: Acceptability of new noise-sensitive uses exposed to transportation noise sources. Noise Element of the General Plan.

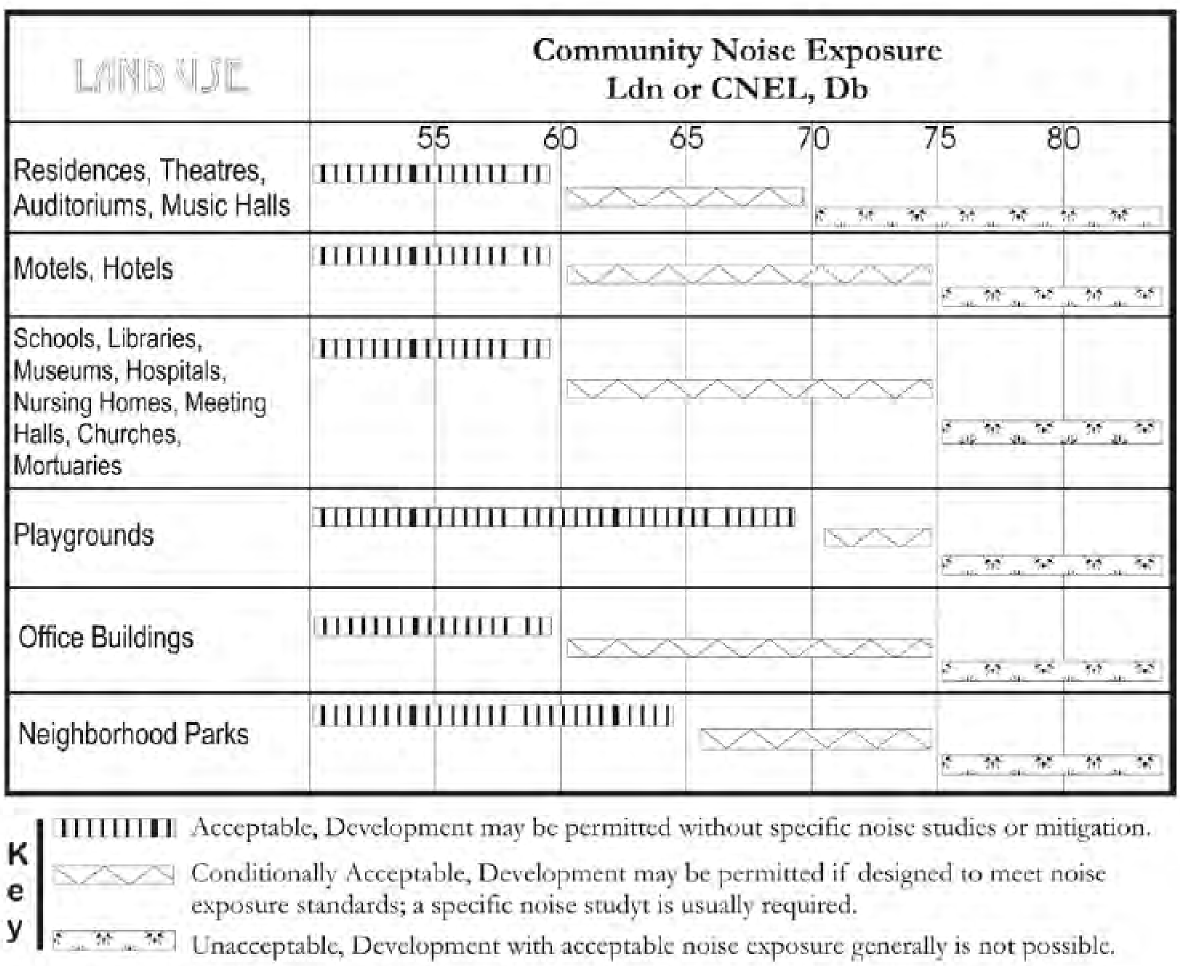


Figure 3. Airport Land Use Plan

Location of Avila Ranch site in relation to the Airport Land Use Plan Airport Noise Contours. The site is partially within the Projected 50 dB airport noise contour and the Projected 55 dB airport noise contour. The actual 55 dB contour is off-site.

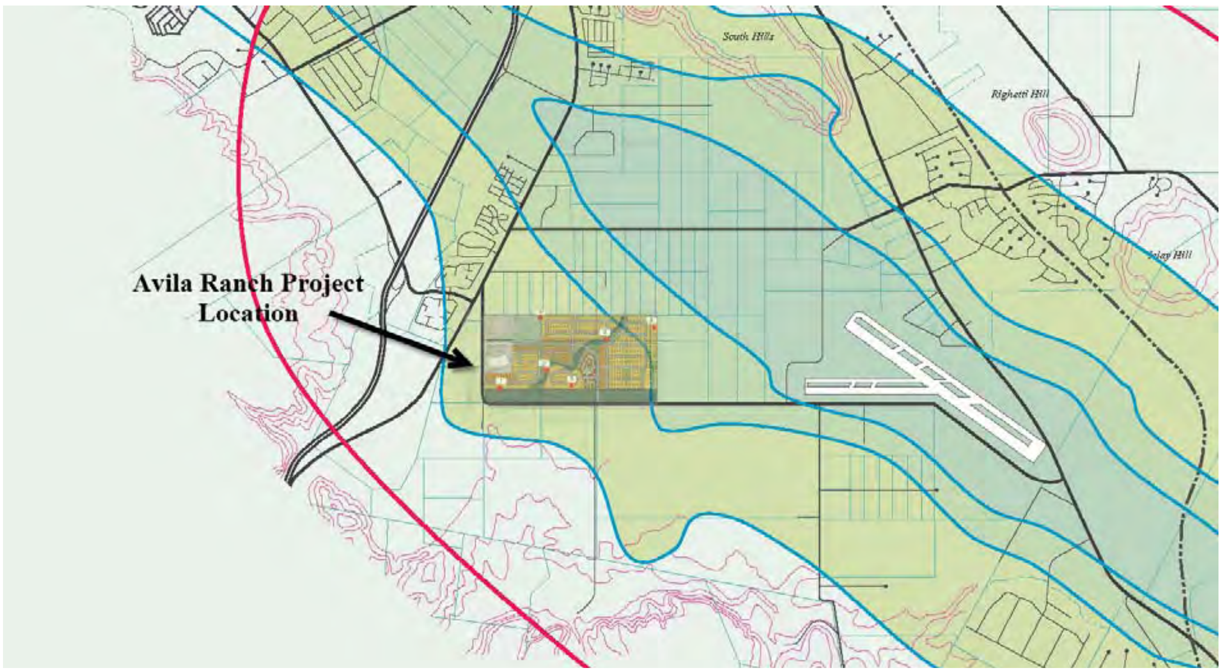
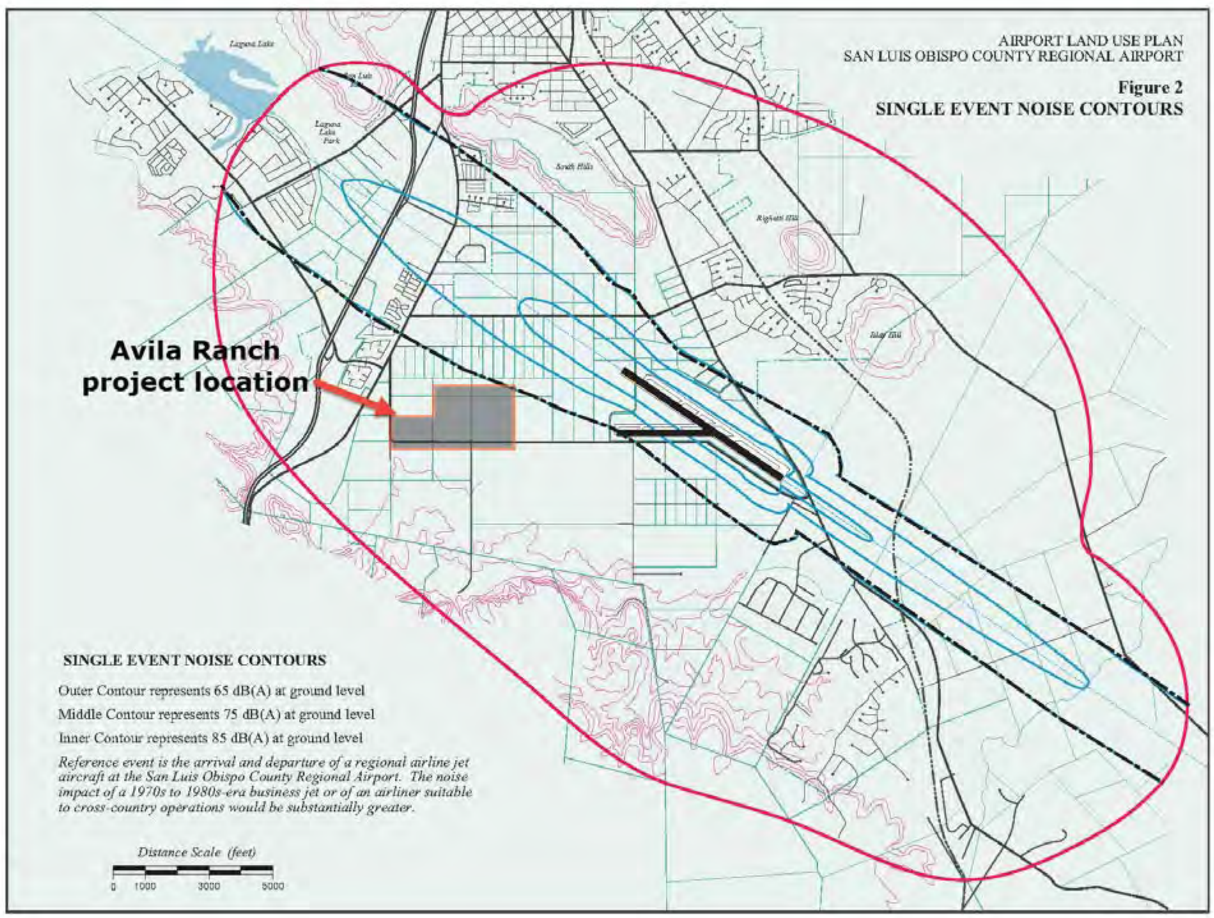


Figure 4. Airport Land Use Plan, revised

Location of Avila Ranch site in relation to the Airport Land Use Plan Airport Noise Contours, revised form, supplied by the Airport Land Use Commission.



construction techniques are assumed to provide adequate noise attenuation." The ALUP guidance for exterior to interior noise attenuation for this setting is construction with 15 dB attenuation, which is construction that uses ordinary materials and methods. However, since the ALUP was written, ordinary construction has improved sound attenuation. (see "Figure 5. CALGreen Code" on page 13.) In general, the ALUP requires that peak hour interior sound levels be reduced below Leq = 45 dBA.

3.0 Existing Sound Levels

Existing sound levels on the site were measured at six stations, located across the proposed Avila Ranch site. Sound level at each measurement station was recorded at 10-second intervals for a 24-hour period. Recorded sound level data consist of:

Average sound level, dBA,

Peak sound level, dBA, and

SEL (Sound Exposure Level) normalized to one second.

Audio recording of each event over 60 dBA.

From the measured data, existing hourly LEQ values were calculated and an overall Community Noise Equivalent Level (CNEL) was calculated for each measurement station For an explanation of technical definitions, see "7.0 APPENDIX A: Glossary of Acoustical Terms" on page 38. The six sound level measurement stations were placed in the following locations:

(a) Station 1. Located at the southwestern corner of the site and approximately 300 feet toward the interior from the intersection of Buckley Road and Vachell Lane. These two roads form a large, linear transportation noise source with potential impact on the site. See "Figure 1. Site Plan" on page 5.

(b) Station 2. Located in the quiet interior of the site. This location is subject to occasional low levels of wildlife sounds and occasional overflight noise. Other than aircraft overflight, this is a relatively quiet location on the site, not near surface transportation or major stationary noise sources. Although there are currently some agricultural operations and activities in the vicinity, those noise sources were accounted for on audio recordings made at the site, and were minimal during the noise measurement period. See "Figure 10. Station Two Sound Level" on page 20.

(c) Station 3. Located in the quiet interior of the site. This location is subject to occasional low sound levels made by wildlife and occasional overflight noise. Other than aircraft overflight, this is a relatively quiet location on the site, not near surface transportation or major stationary noise sources. Although there are currently some agricultural operations and activities in the vicinity, those noise sources were accounted for on audio recordings made at the site, and were minimal during the noise measurement period. See "Figure 12. Station Three Sound Level" on page 22.

(d) Station 4. Located next to the northwest boundary of the property, adjacent to the current AirVol Block manufacturing facility with loading and staging areas, and a potential 24-hour daily operation. Only a portion of the sampled noise was "stationary noise" such as compressors, stationary mixers, etc., separated from the overall operating noise from the AirVol operation. In total, the stationary component of the noise at the property line was lower than 50 dBA. See "Figure 15. Station Four Sound Level" on page 25.

(e) Station 5. Located in the middle of the southern boundary of the site, approximately 300 feet from Buckley Road. This location has an unobstructed 'view' of the road and is far enough away from Vachell Lane to measure only Buckley Road transportation noise. This is the measurement site with the highest sound level values. See "Figure 17. Station Five Sound Level" on page 27.

(f) Station 6. Located in the northeast corner of the site, this station is closest to the San Luis Obispo County Regional Airport, and is otherwise in a quiet location with little background noise. The primary source of noise measured at this site was aircraft overflight, which can be seen in the individually plotted results. See "Figure 19. Station Six Sound Level" on page 29.

The hourly LEQ for each of the measurement sites was derived from measured sound level data. In addition, for each measurement location the 24-hour Ldn and CNEL values were calculated (see "7.0 APPENDIX A: Glossary of Acoustical Terms" on page 38 for definitions)

4.0 Future Sound Levels

Existing measured sound levels provide a baseline from which future sound levels can be predicted. Future sound levels are related to growth of Average Daily Traffic (ADT) growth rates on the surrounding roads, and increased activity at nearby commercial operations and increases in number of flights at the San Luis Obispo County Regional Airport. The general relationship of traffic growth and sound level is that with a doubling of traffic ADT, there will be a concomitant increase of 3 dB sound level.

Therefore, if existing sound levels are 53 dBA at a certain location on the proposed site, and if transportation growth results in a doubling of ADT volume, then the sound level will increase to 56 dBA at that same location in the future:

	ADT Estimates with Avila Ranch Project		
Segment	Existing ADT	2035 ADT	Notes
Buckley east of Vachell	4189	8000	Existing ADT from 2009, County of SLO traffic counts.
Vachell north of Venture	4000	6000	Existing estimated as 10 times PM peak hour volume at intersection.
Horizon south of Suburban	200	4000	Existing estimated using ITE rate for 25,000 s.f. of Light Industrial.
Earthwood south of Suburban	0	3000	No existing uses.
Venture east of Vachell	600	3000	Existing estimated using ITE rate for 80,000 s.f. of Light Industrial.

5.0 Discussion and Conclusions

The 24-hour existing sound levels on the undeveloped site are clearly shown at each of the measurement stations and in "Figure 6. Existing Sound Level Contours" on page 16. In the area of the site along Buckley Road, sound levels may exceed CNEL = 60 dBA threshold in CCR Title 24. Residential units planned in the this area will require noise mitigation of any potential outdoor activity areas that are confirmed to be above 60 dBA, as illustrated in "Figure 22. Outdoor Activity Area Noise Mitigation" on page 32. If exterior sound level is below CNEL = 60 dBA, no additional sound attenuating construction is necessary. If windows are required to be shut to meet the interior 45 dBA requirement, then a mechanical ventilation alternative is required.

The measured sound level of air traffic for flights to and from San Luis Obispo County Regional Airport is shown for a 24-hour period in "Figure 19. Station Six Sound Level" on page 29 and in "Figure 21. Station Six hourly Leq" on page 31.

The Ldn / CNEL value of 51 dBA for Station Six represents the 24-hour average sound level at the location nearest the airport, with a minimum of surface transportation noise. The existing sound level value is lower than the projected sound level of CNEL 55, shown in "Figure 3. Airport Land Use Plan" on page 8.

Summary of disposition of regulatory requirements:

(a) City Noise Element outdoor activity area less than CNEL = 60 dBA; Mitigation may be required and is described below for area facing Buckley Road.

(b) City Stationary Noise Ordinance less than Leq = 50 dBA: This limit is not exceeded in the northwest corner of the development, near AirVol operation.

(c) Airport Land Use Plan recommendation that interior sound levels not exceed Leq 1 hr = 45 dBA in peak one hour period. (see calculation in "Figure 5. CALGreen Code" on page 13)

(d) California Energy Commission CALGREEN code requirement less than Leq = 45 dBA during peak one hour period. (see "Figure 5. CALGreen Code" on page 13)

(e) State Building Code requirement that interior noise level not exceed annual CNEL = 45 dBA: This standard is met or exceeded in above instances and with mitigations described below.

5.1 Exterior Glazing

Windows are inherently the weak link of a residential project's exterior acoustical envelope. Therefore, proper selection and installation of exterior glazing elements are paramount to achieving CCR Title 24 interior noise limits. Frames of windows and doors must be sealed with dual beads of resilient, acoustical sealant to provide an airtight seal. Also, dual beads of resilient, acoustical sealant must be applied to window casings before installation. Manufacturer's instructions for installation of acoustically rated window assemblies must be followed carefully, so that installed windows retain their rated acoustical performance.

Recommendations are presented in terms of the Outdoor-Indoor Transmission Class (OITC) and Sound Transmission Class (STC) acoustical performance ratings, both of which

Figure 5. CALGreen Code

The California Green Building Standards Code (CCR Title 24, Part 11) provides standards for acoustical transmission values in noisy environments, as shown in the table below. The proposed development meets the requirements of 5.507.4.2 Performance method, illustrated and described in the following way:

Standard construction materials and techniques used for new developments in Southern California result in a minimum exterior-to-interior noise attenuation of 12 dBA with windows open (for natural ventilation) and minimum 20 dBA with windows closed.

Therefore, the worst case resulting interior noise level (LEQ = 1 hr.) due to airport activity (refer to "Figure 21. Station Six hourly Leq" on page 31) will occur during the Station Six one-hour LEQ = 53 dBA at 16:00 to 17:00. The interior sound level during that hour would be 53 dB minus 20 dB = 33 dBA with windows closed.

5.507.4.1 Exteriors noise transmission prescriptive method.
Wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 in the following locations:

1. Within the 65 CNEL noise contour of an airport.

   Exceptions:

   1. L_{dn} or CNEL for military airports shall be determined by the facility Air Installation Compatible Land Use Zone (AICUZ) plan.
   2. L_{dn} or CNEL for other airports and heliports for which a land use plans has not been developed shall be determined by the local general plan noise element.

2. Within the 65 CNEL or L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway source as determined by the Noise Element of the General Plan.

5.507.4.1.1 Noise exposure where noise contours are not readily available.
Buildings exposed to a noise level of 65 dBL_{eq}-1-hr during any hour of operation shall have building, addition or alteration exterior wall and roof-ceiling assemblies exposed to the noise source meeting a composite STC rating of at least 45 (or OITC 35), with exterior windows of a minimum STC of 40 or (OITC 30).

5.507.4.2 Performance method.
For buildings located as defined in Section 5.507.4.1 or 5.507.4.1.1, wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level (L_{eq} -1Hr) of 50 dBA in occupied areas during any hour of operation.

should be met by the window manufacturer by providing test data for the specific window assembly types submitted for this project.

Traditionally, manufacturers of exterior doors and windows have used the single-number Sound Transmission Class (STC) metric to rate the acoustical performance of their products. However, STC is a metric optimized for the spectral shape (or tonal quality) of human speech, as it was originally developed as a means to rate the degree of sound isolation between dwelling units in the late 1950s.

The Outdoor-Indoor Transmission Class (OITC), as defined in the ASTM Standard E1332, is the preferred metric for rating the sound performance of building shell materials. OITC ratings are tied to a typical noise spectrum shape from transportation sources, which are rich in low frequency, bass-type sounds, as opposed to the frequencies of human speech or television audio. Both OITC and STC rating values are calculated from 1/3-octave band transmission loss data for specific building shell components.

Exterior window glazing recommended for residential units exposed to potential noise above Ldn = 60 dBA is a minimum OITC 24 / STC 30. If practical, glazing systems with dissimilar thickness panes are preferred to avoid the "harmonic resonance" that occurs with panes of equal thickness. However, all of this project's recommended acoustical design ratings should be achievable with commercially available window assemblies.

5.2 Exterior Doors Facing Noise Source

According to Section 1207.7 of the California Building Code, the following applies to residential unit entry doors from interior spaces:

Entrance doors together with their perimeter seals shall have STC ratings not less than 26. Such tested doors shall operate normally with commercially available seals. Solid-core wood-slab doors 1 3/8 inches (35 mm) thick minimum or 18 gage insulated steel-slab doors with compression seals all around, including the threshold, may be considered adequate without other substantiating information.

Based upon the results of the exterior noise study for this project, standard entrance doors as described above, will provide adequate acoustical insulation at exterior project entries. These should have a combined STC 28 rating for any door and frame assemblies. Any balcony and ground floor entry doors located at bedrooms should have an STC rating similar to the minimum STC window ratings. While design criteria are the same for all habitable spaces, bedrooms are the most sensitive habitable spaces in a residential unit.

In general, an STC 28 door rating can be achieved with a standard door that is supplied with improved acoustical gaskets at the jambs and threshold, although any supplier must provide an acoustical rating submittal. It is typical for an STC 30 rated exterior entry to include side and head jamb gaskets of the non-porous kind, such as Pemko™ Siliconseal (S88) or approved equal, to avoid flanking transmission of sound into the project units. The door bottom should be fitted with a fully gasketed, lap-joint type threshold or with another form of door bottom/threshold with gasket that provides a proper acoustical seal. Thresholds and frames of all exterior doors should be carefully caulked before setting.

5.3 Exterior Walls

The exterior wall assemblies for this project have not been specified at this time. Where outdoor sound levels exceed Ldn = 60 dBA, typical constructions would likely consist of a stucco or engineered building skin system over sheathing, with 4” to 6” deep metal or wood studs, fiberglass batt insulation in the stud cavity, and one or two layers of 5/8” gypsum board on the interior face of the wall. As the project design is developed and site planning is modified, sections and details for the exterior facades may require further review.

The ultimate degree of sound isolation provided by the building shell is highly dependent on the quality of workmanship and attention to detail that is followed during construction. The following recommendations are aimed at delivering the full sound isolating potential of the building shell:

(a) If possible, avoid electrical outlets in exterior walls exposed to noise. If this is not possible, apply outlet box pads such as those manufactured by Hilti to all electrical boxes. Carefully seal around all edges of electrical outlet boxes and other penetrations with non-hardening acoustical sealant.

5.4 Supplemental Ventilation

Noise levels above Ldn = 60 dBA are predicted for some of the project’s exterior facades before mitigation. A typical bedroom/living room window will allow for a reduction of approximately 12 decibels when open, as used for natural ventilation. In this instance interior sound levels are expected to be (60 - 12 = 48 dBA). Therefore, it is not expected that interior noise requirement of Ldn = 45 dBA or less can be met with open windows. The State Building Code requires that supplemental ventilation adhering to OITC/STC recommendations must be provided for the project’s residential units with habitable spaces facing noise levels exceeding Ldn = 60 dBA, so that the opening of windows is not necessary to meet ventilation requirements.

Supplemental ventilation can also be provided by passive or by fan-powered, ducted air inlets that extend from the building’s rooftop into the units. Ducted air inlets must be acoustically lined through the top-most 6 ft in length and incorporate one or more 90-degree bends between openings, so as not to compromise the noise insulating performance of the residential unit’s exterior envelope.

Figure 6. Existing Sound Level Contours

Site Plan, existing site, showing sound level contours expressed as CNEL = dBA

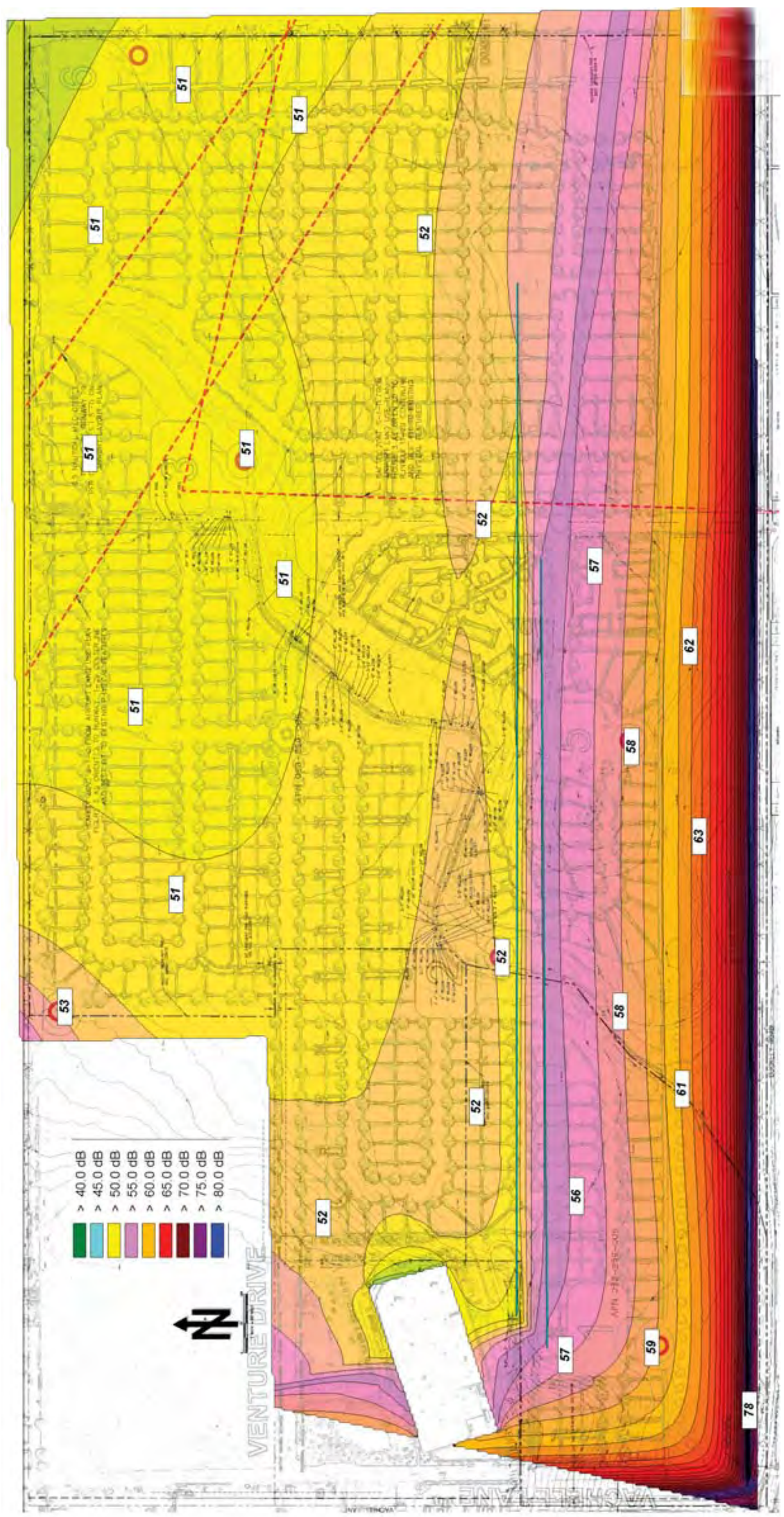


Figure 7. Future Sound Level Contours, Year 2035

Site Plan, future predicted sound level contours expressed as CNEL = dBA, based on increased traffic count (ADT) for 2035. Buildings are shown in plan only and not modeled in three dimensions, therefore ground transportation sound levels in the interior of the site may be lower than depicted here.

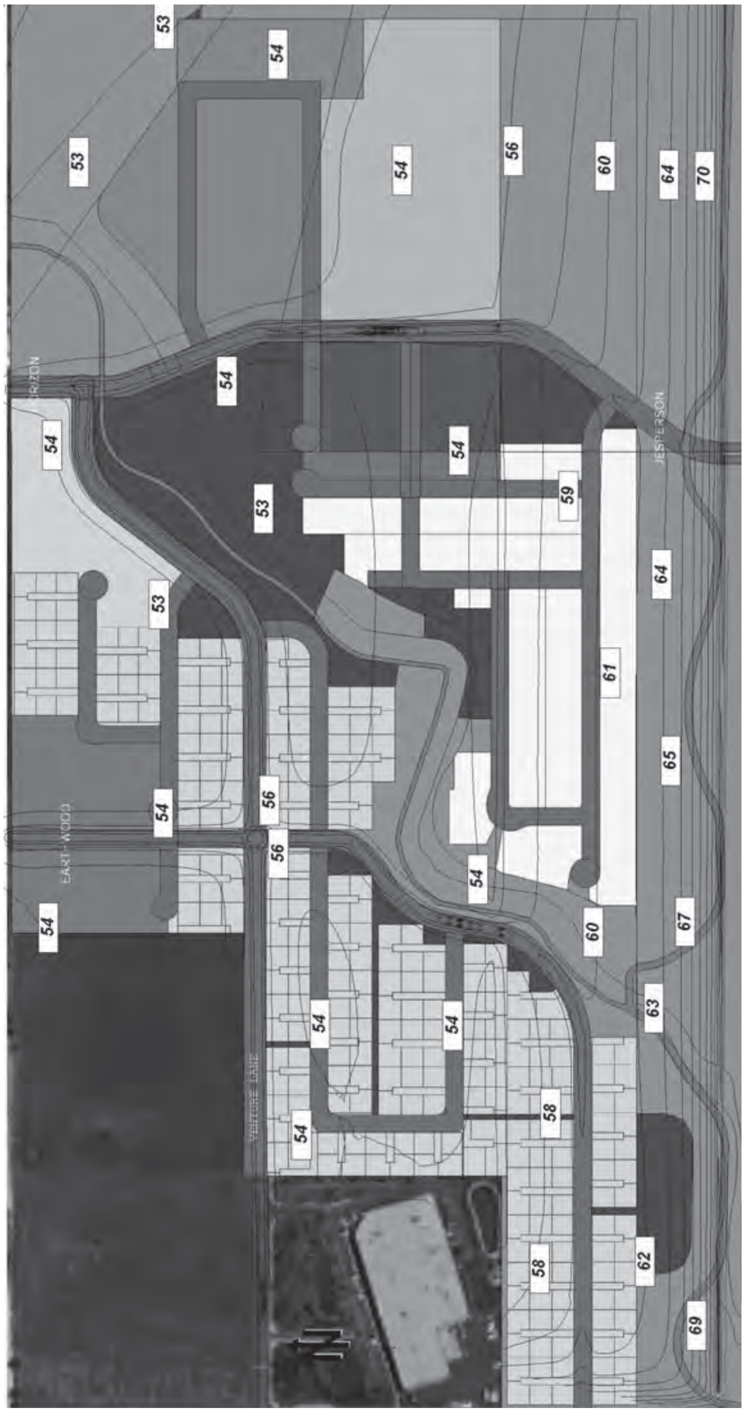


Figure 8. Station One Sound Level

Station One Sound Level, measured every 10 seconds over a 24-hour period. The sound level meter is located 75 feet west of nearest traffic lane. Peak sound levels are generally identified as motorcycles or trucks. Sound levels are dBA, slow meter setting

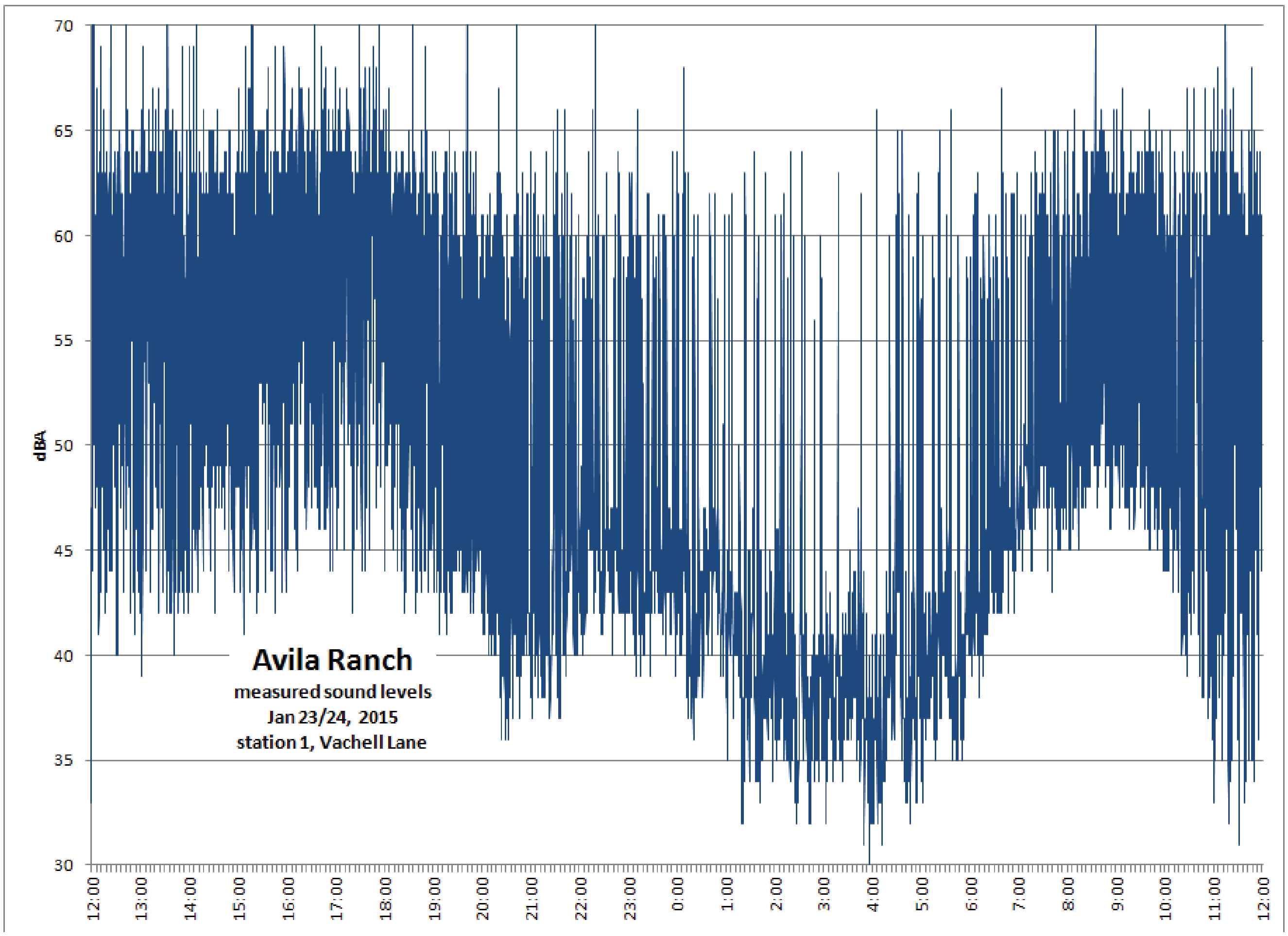


Figure 9. Station One hourly Leq

Station One Sound Levels, expressed as hourly Leq over a 24-hour period. The calculated LDN/ CNEL for the 24-hour period is 59 dBA, including calculated penalties for evening and nighttime noise.

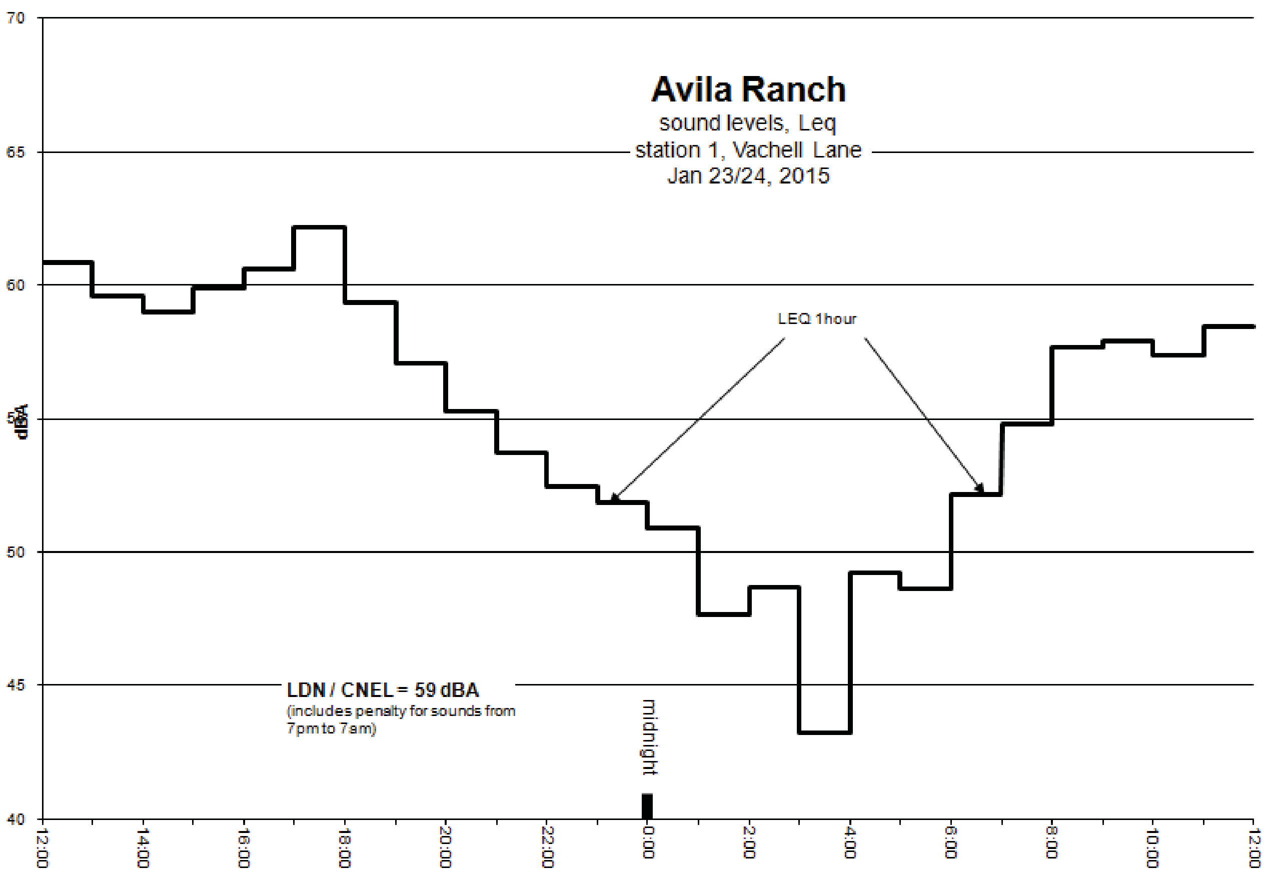


Figure 10. Station Two Sound Level

Station Two Sound Level, measured every 10 seconds over a 24-hour period. The sound level meter is located in the interior of the site, in a quiet location. The occasional peak sound levels are generally identified as aircraft overflights. Sound levels are dBA, slow meter setting

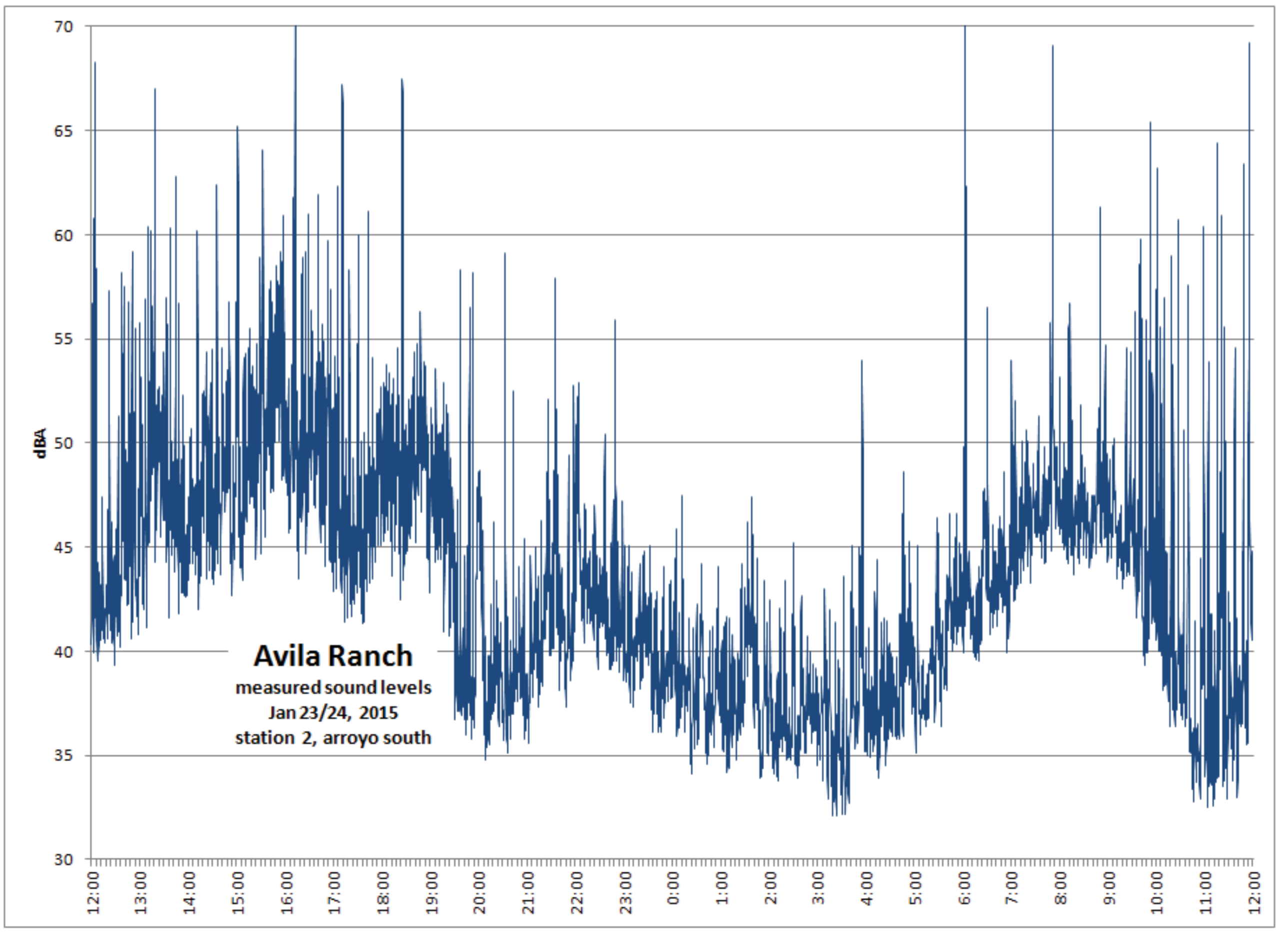


Figure 11. Station Two hourly Leq

Station Two Sound Levels, expressed as hourly Leq over a 24-hour period. The calculated LDN/CNEL for the 24-hour period is 52 dBA, including calculated penalties for evening and nighttime noise.

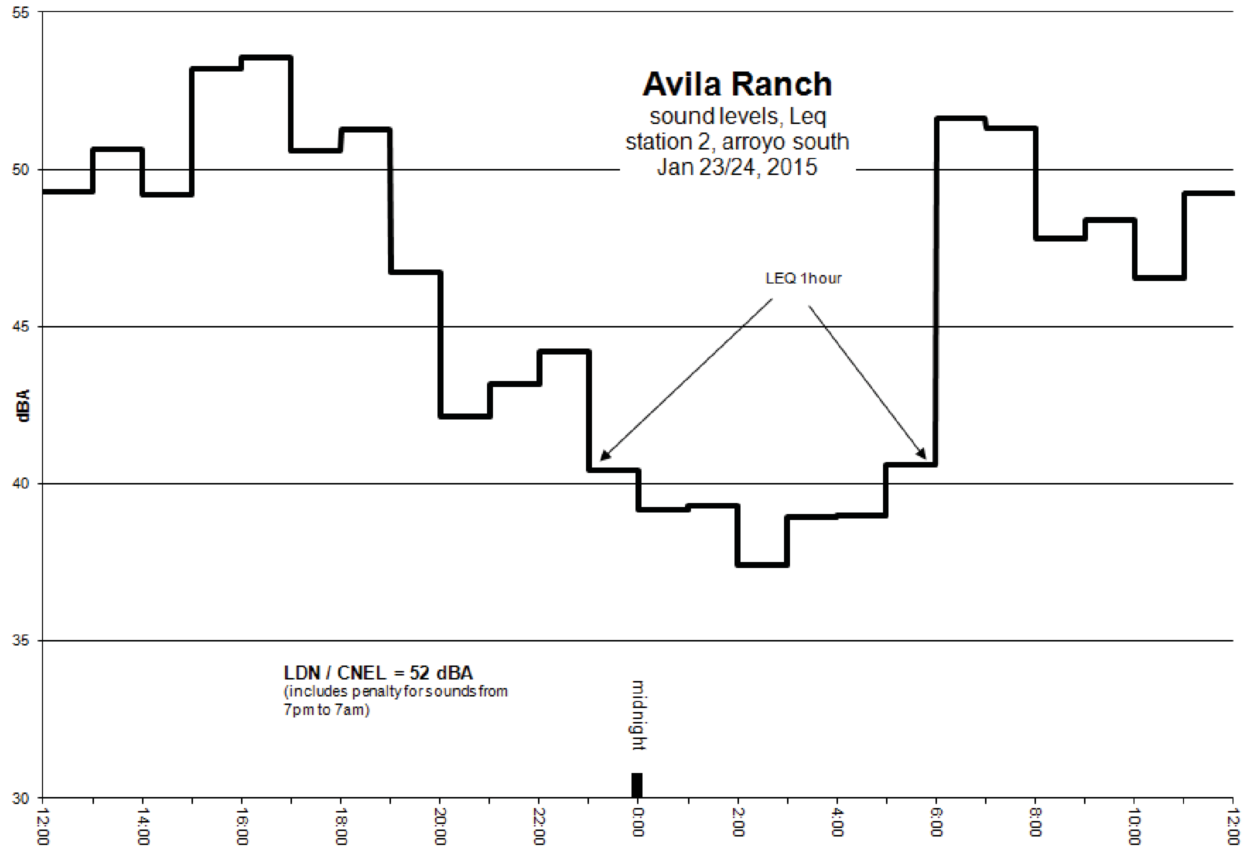


Figure 12. Station Three Sound Level

Station Three Sound Level, measured every 10 seconds over a 24-hour period. The sound level meter is located in the interior of the site, in a quiet location. The occasional peak sound levels are generally identified as aircraft overflights. Sound levels are dBA, slow meter setting

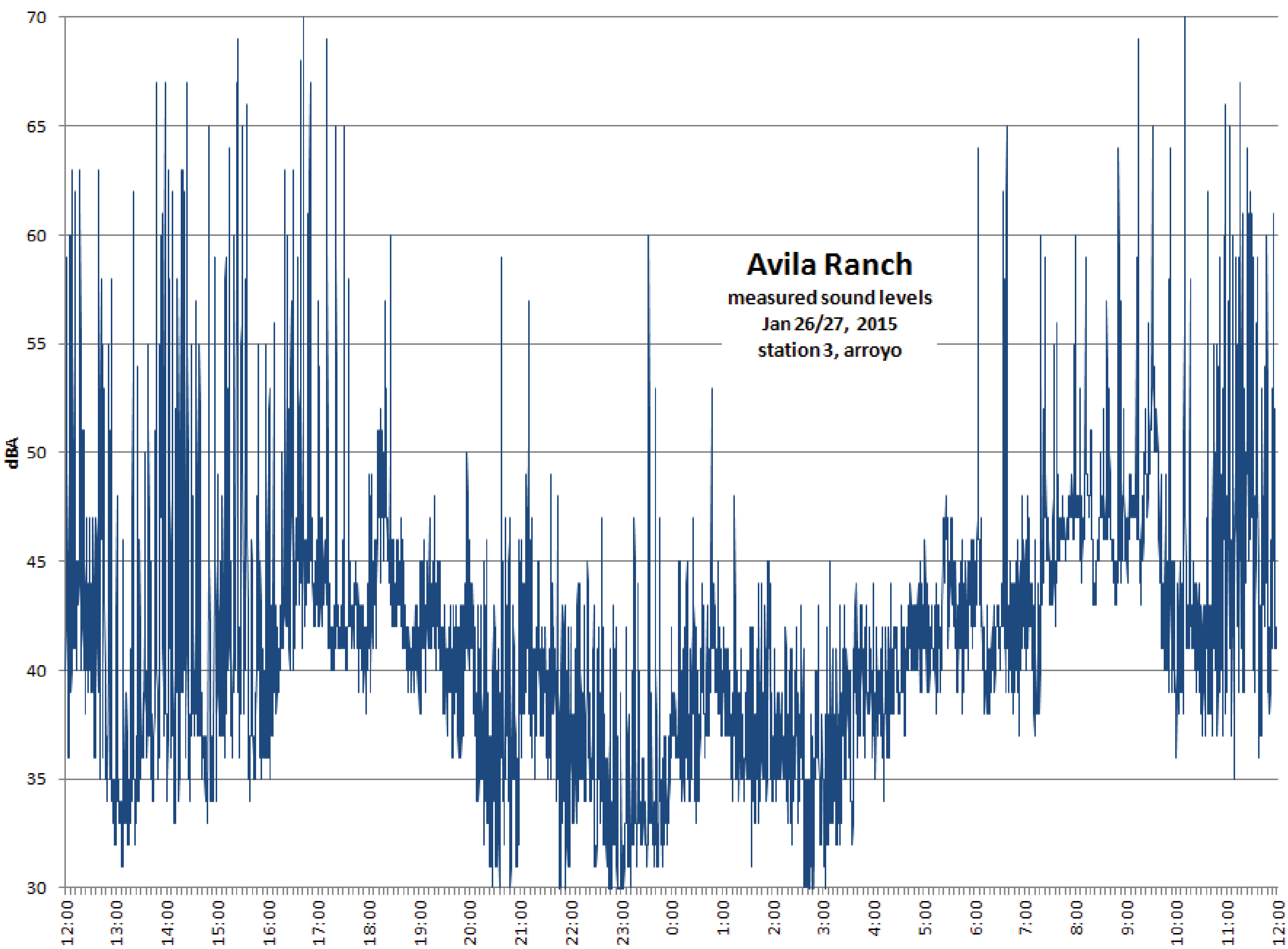


Figure 13. Station Three hourly Leq

Station Three Sound Levels, expressed as hourly Leq over a 24-hour period. The calculated LDN/CNEL for the 24-hour period is 51 dBA, including calculated penalties for evening and nighttime noise.

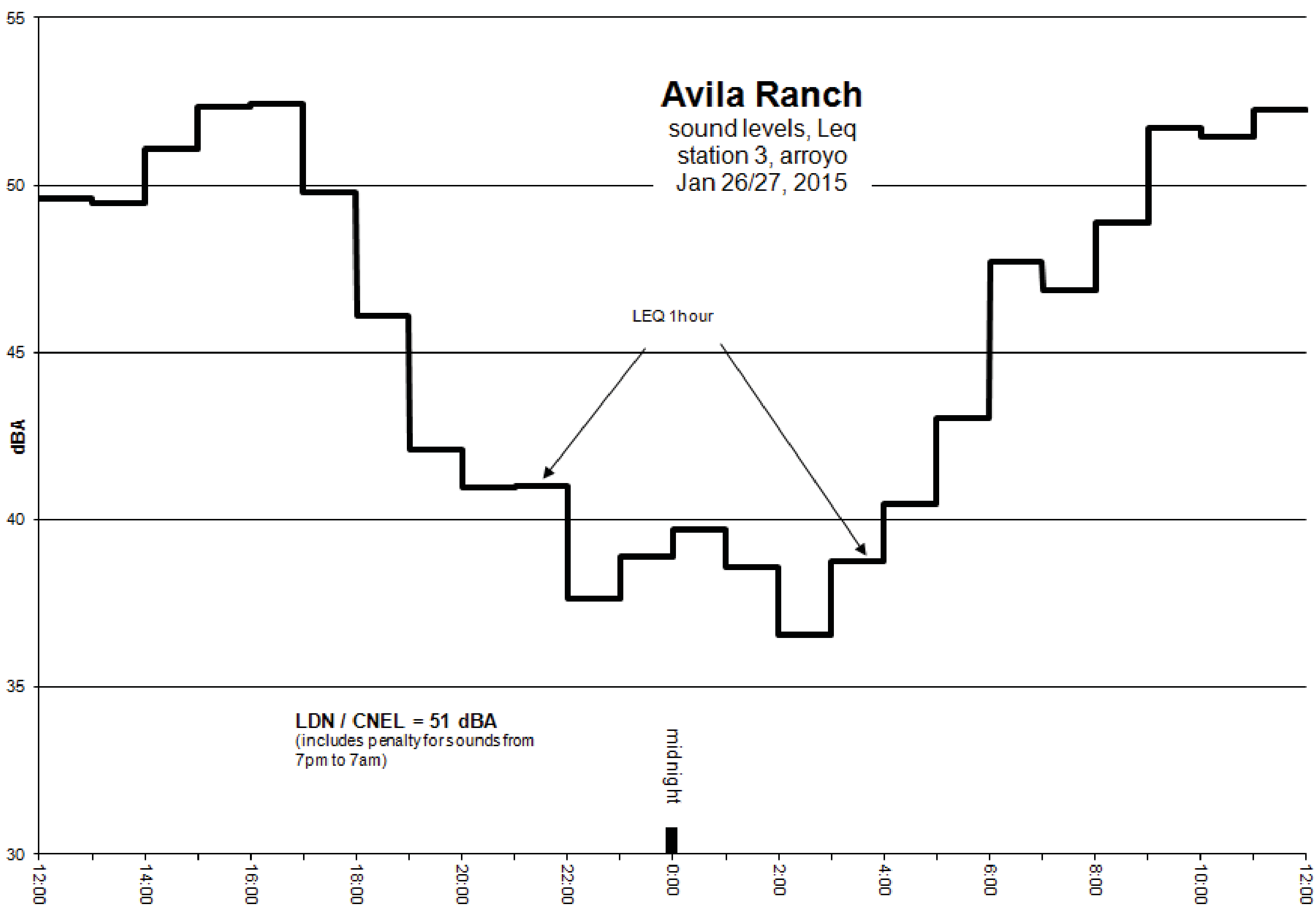


Figure 14. Station Three hourly Leq

Station Three Sound Levels: Example of data collected over a typical one-hour period for every measurement station, including Leq for each 10 sec. period, Lmax and SEL.

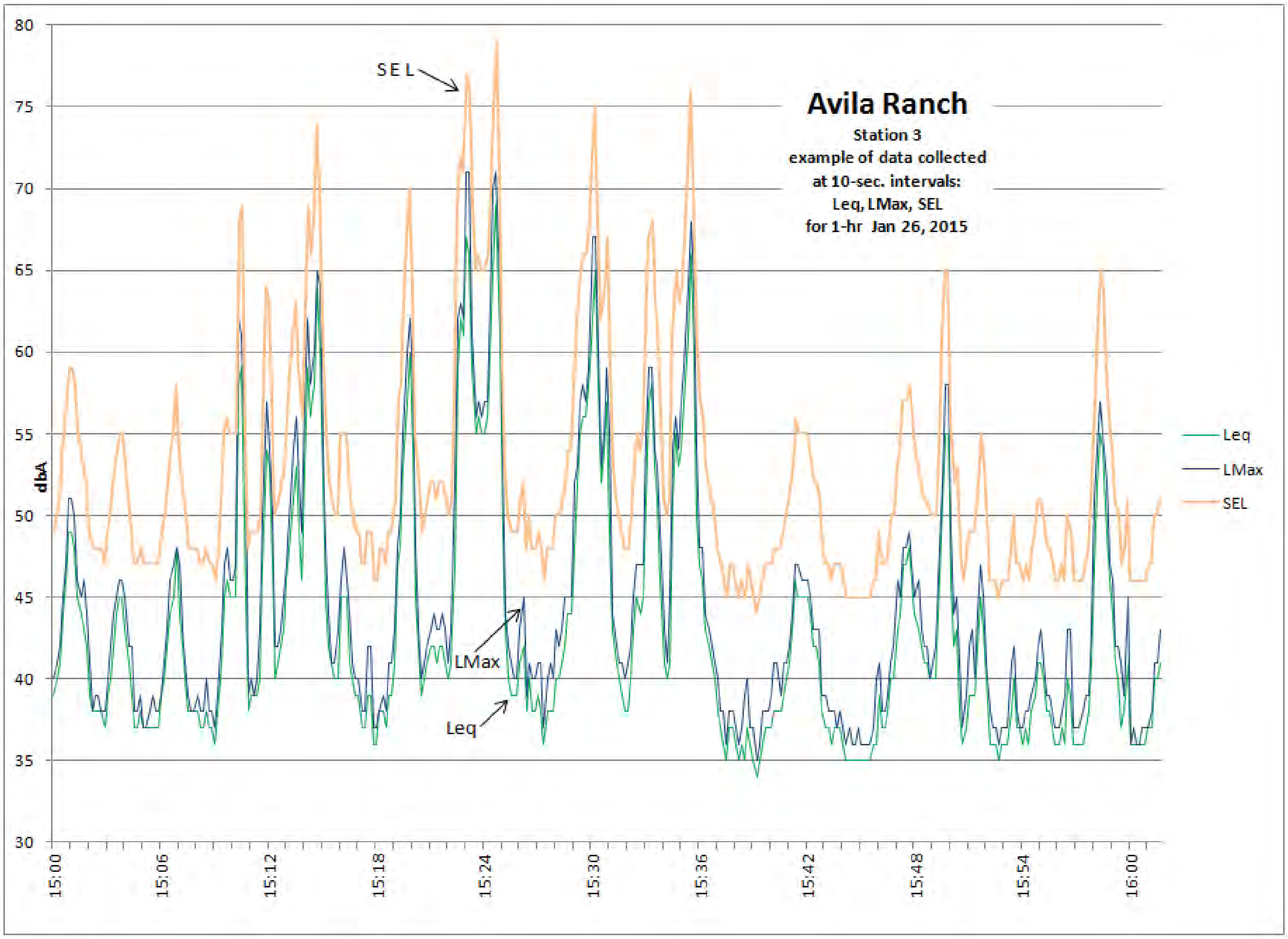


Figure 15. Station Four Sound Level

Station four Sound Levels, measured every 10 seconds over a 24-hour period. The sound level meter is located at the AirVol Block shared boundary. Peak sound levels are generally identified as industrial operations, as well as arriving and departing forklifts and delivery vehicles. Sound levels are dBA, slow meter setting.

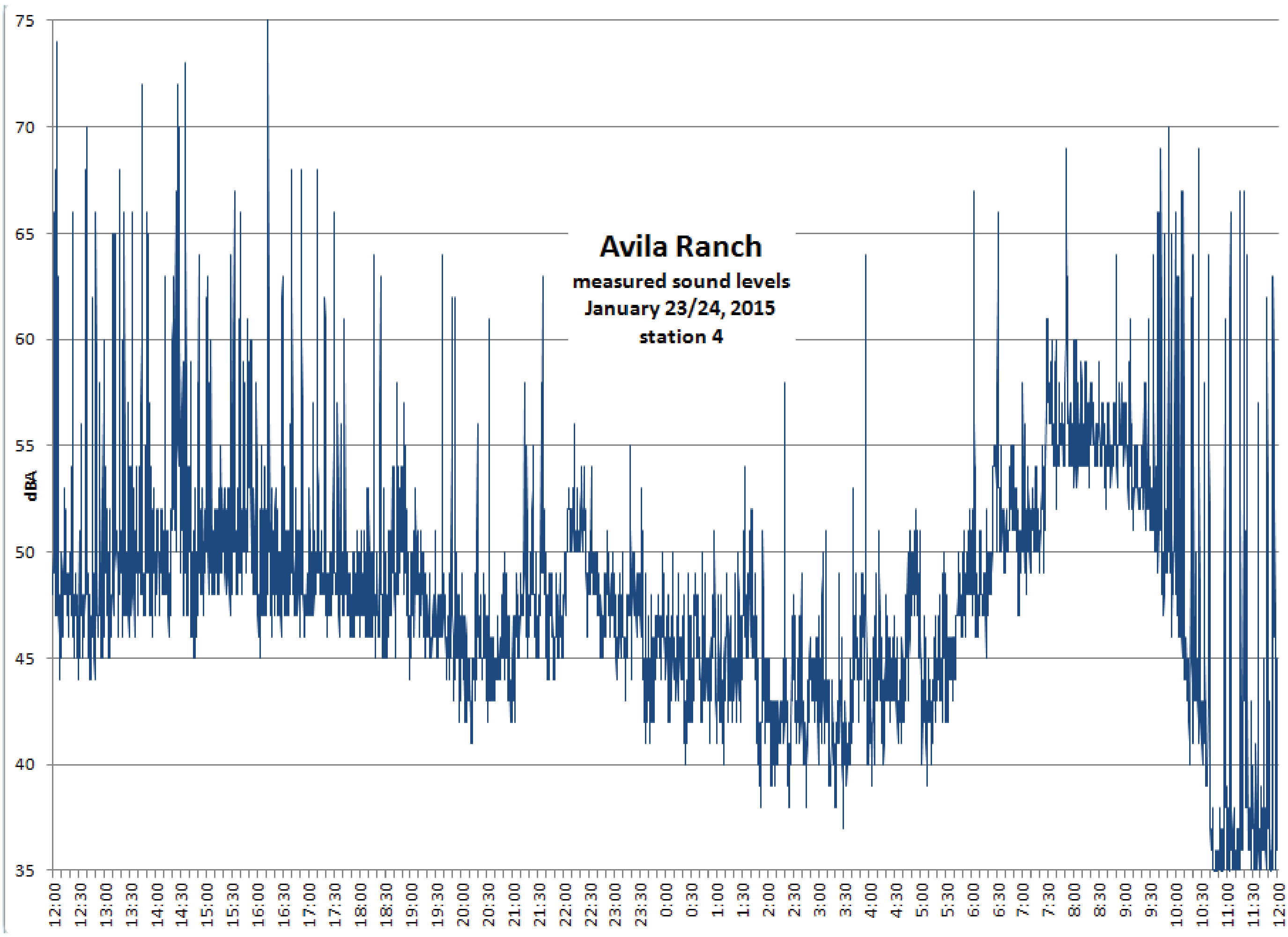


Figure 16. Station Four hourly Leq

Station Four Sound Levels, expressed as hourly Leq over a 24-hour period. The calculated LDN/CNEL for the 24-hour period is 56 dBA, including calculated penalties for evening and nighttime noise.

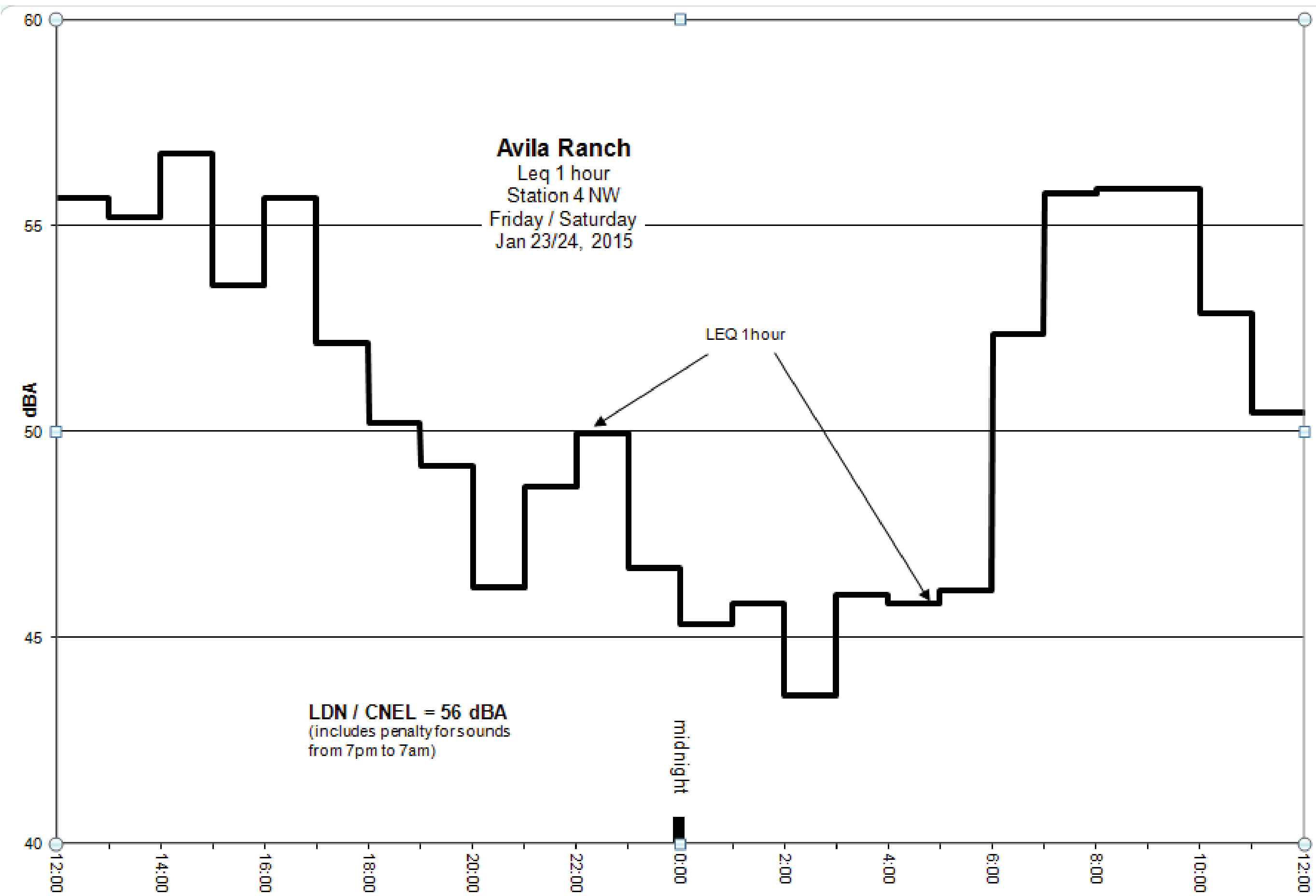


Figure 17. Station Five Sound Level

Station five Sound Levels, measured every 10 seconds over a 24-hour period. Peak sound levels are generally motorcycles and trucks. Sound levels are dBA, slow meter setting.

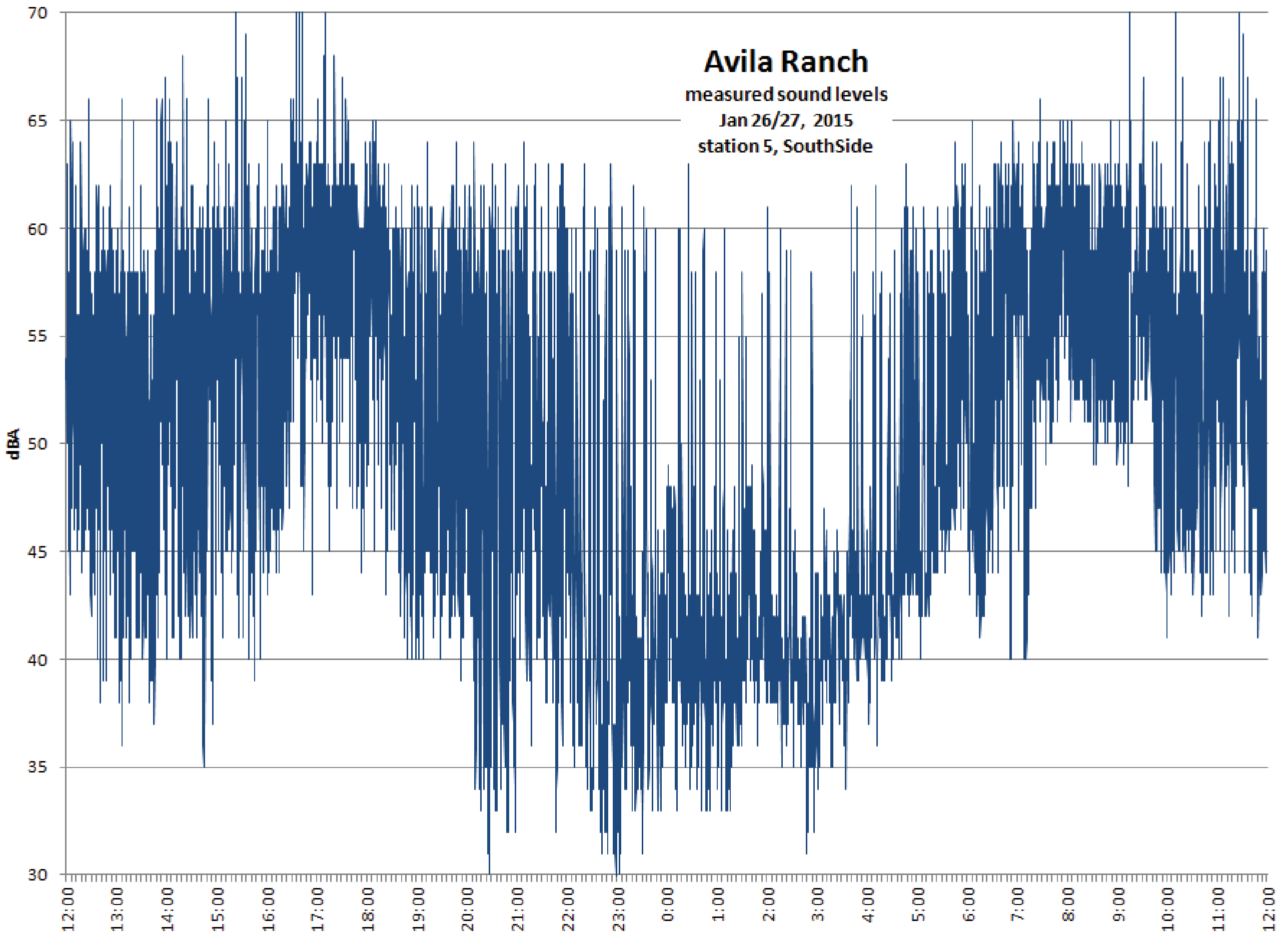


Figure 18. Station Five hourly Leq

Station Five Sound Levels, expressed as hourly Leq over a 24-hour period. The calculated LDN/CNEL for the 24-hour period is 59/60 dBA, including calculated penalties for evening and nighttime noise.

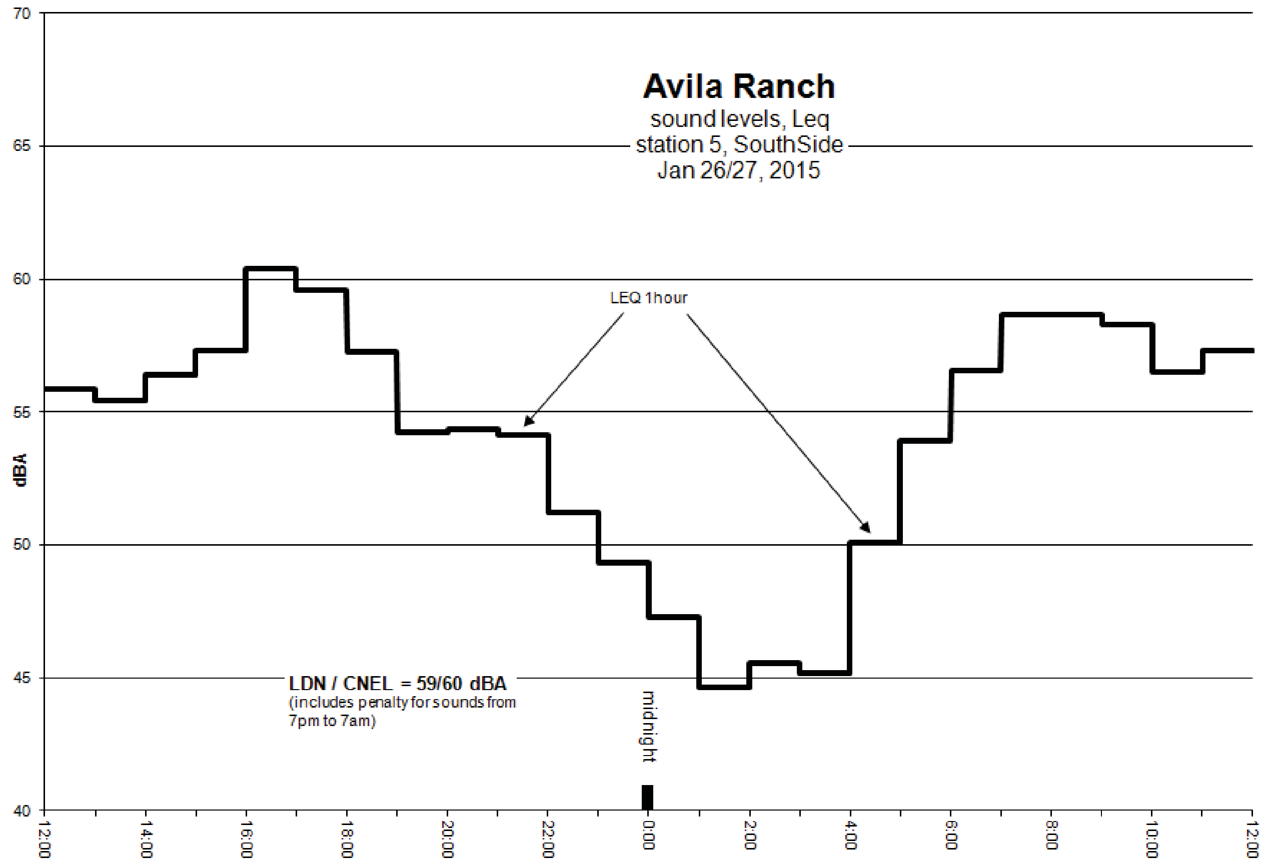


Figure 19. Station Six Sound Level

Station six Sound Levels, measured every 10 seconds over a 24-hour period. Peak sound levels are generally airplane and helicopter flyovers. Sound levels are dBA, slow meter setting.

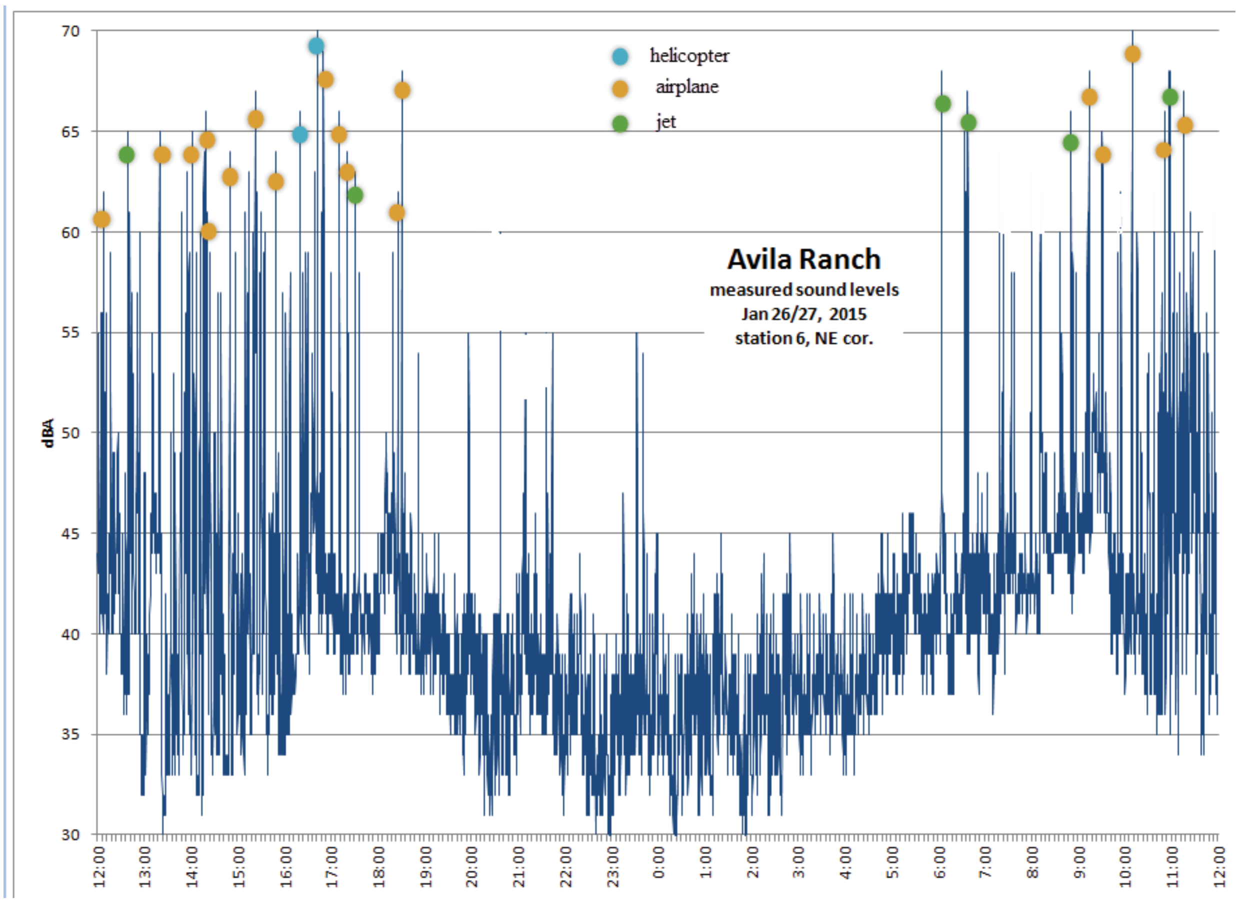


Figure 20. Airport Departures

Information taken from http://www.flightstats.com which are in agreement with the flight departure sound levels in “Figure 19. Station Six Sound Level” on page 29.

January 23, 2015 PM departures
San Luis Obispo County Airport

Airline	Departure Sched	Departure Actual	Term Gate	Status	Equip
US Airways	12:30 PM	12:26 PM		Landed On-time	CR9
American Airlines	12:30 PM	12:26 PM		Landed On-time	CR9
United Airlines	2:13 PM	2:04 PM		Landed On-time	EM2
United Airlines	2:58 PM	2:53 PM		Landed On-time	EM2
Copa Airlines	2:58 PM	2:53 PM		Landed On-time	EM2
US Airways	4:10 PM	4:03 PM		Landed On-time	CRJ
American Airlines	4:10 PM	4:03 PM		Landed On-time	CRJ
West Air (USA)	5:10 PM	5:10 PM		Landed On-time	
Ameriflight	5:28 PM	5:28 PM ~		Unknown	
United Airlines	5:42 PM	5:33 PM		Landed On-time	EM2
Lufthansa	5:42 PM	5:33 PM		Landed On-time	EM2
United Airlines	6:10 PM	6:04 PM		Landed On-time	EM2
Copa Airlines	6:10 PM	6:04 PM		Landed On-time	EM2
United Airlines	8:15 PM	8:12 PM		Landed On-time	EM2
Copa Airlines	8:15 PM	8:12 PM		Landed On-time	EM2
United Airlines	8:38 PM	8:26 PM		Landed On-time	EM2

January 24, 2015 AM departures
San Luis Obispo County Airport

Airline	Departure Sched	Departure Actual	Term Gate	Status	Equip
United Airlines	6:00 AM	5:53 AM		Landed On-time	EM2
Copa Airlines	6:00 AM	5:53 AM		Landed On-time	EM2
US Airways	6:25 AM	6:15 AM	B7	Landed On-time	CR9
American Airlines	6:25 AM	6:15 AM	B7	Landed On-time	CR9
United Airlines	7:45 AM	7:42 AM		Landed On-time	EM2
Copa Airlines	7:45 AM	7:42 AM		Landed On-time	EM2
United Airlines	8:50 AM	8:41 AM		Landed On-time	EM2
United Airlines	10:02 AM	9:54 AM		Landed On-time	EM2
Lufthansa	10:02 AM	9:54 AM		Landed On-time	EM2
United Airlines	11:51 AM	11:45 AM		Landed On-time	EM2
Copa Airlines	11:51 AM	11:45 AM		Landed On-time	EM2
Lufthansa	11:51 AM	11:45 AM		Landed On-time	EM2
US Airways	12:30 PM	12:19 PM		Landed On-time	CR9
American Airlines	12:30 PM	12:19 PM		Landed On-time	CR9
United Airlines	2:13 PM	2:03 PM		Landed On-time	EM2
United Airlines	2:58 PM	2:48 PM		Landed On-time	EM2
Copa Airlines	2:58 PM	2:48 PM		Landed On-time	EM2
US Airways	4:10 PM	4:00 PM		Landed On-time	CRJ
American Airlines	4:10 PM	4:00 PM		Landed On-time	CRJ
United Airlines	5:42 PM	5:36 PM		Landed On-time	EM2
Lufthansa	5:42 PM	5:36 PM		Landed On-time	EM2
United Airlines	6:13 PM	6:10 PM		Landed On-time	EM2
Copa Airlines	6:13 PM	6:10 PM		Landed On-time	EM2
United Airlines	8:15 PM	8:16 PM		Landed On-time	EM2
Copa Airlines	8:15 PM	8:16 PM		Landed On-time	EM2

Figure 21. Station Six hourly Leq

Station Six Sound Levels, expressed as hourly Leq over a 24-hour period. The calculated LDN/CNEL for the 24-hour period is 51 dBA, including calculated penalties for evening and nighttime noise.

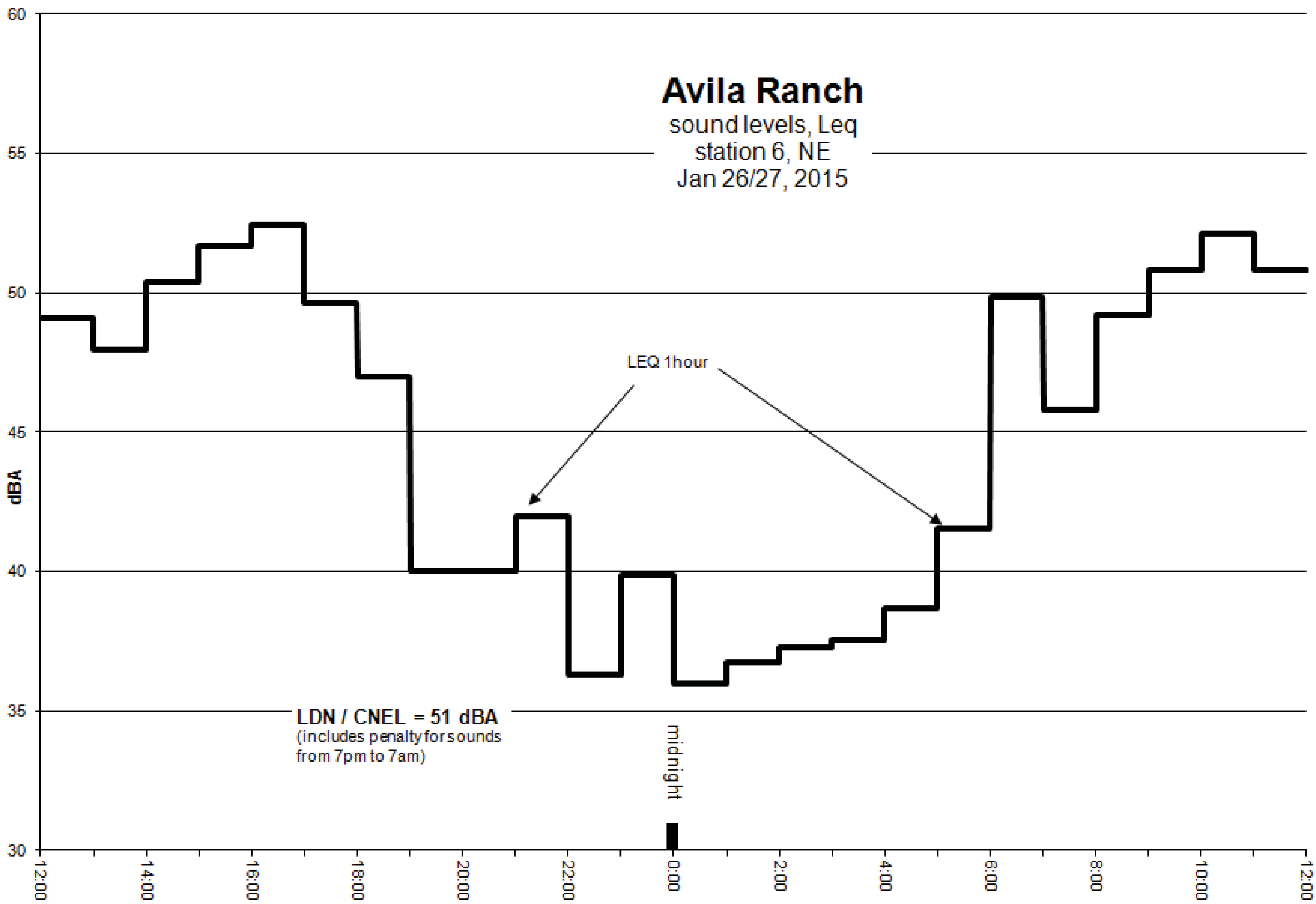


Figure 22. Outdoor Activity Area Noise Mitigation

Where exterior sound levels exceed CNEL = 60 dBA, especially facing transportation noise from Buckley Road, noise mitigation shall be required. The feasibility of berming for noise mitigation is illustrated below: “**no berm**” on left and, “**with berm**” on right. Substitution of lower berm height and partial noise wall may be made for equivalent performance.

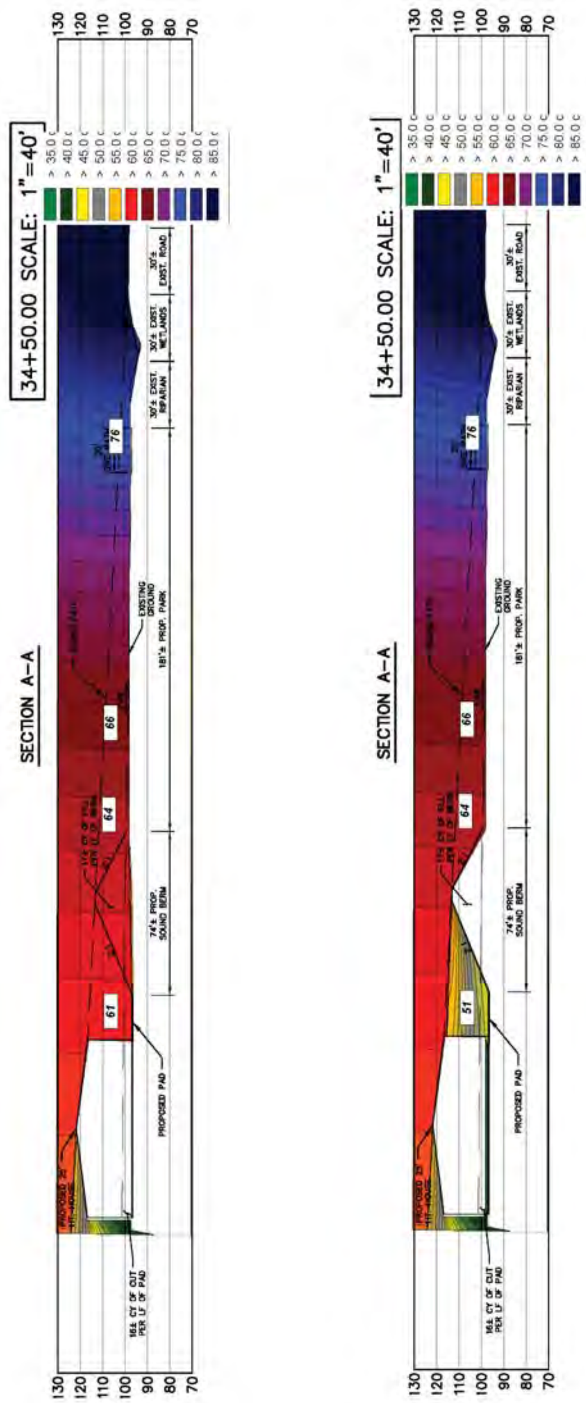


Figure 23. Weather Data, January 23, 2015

Atmospheric conditions that may affect sound level measurements are shown. Wind speed above 10 mph on the afternoon of January 23, 2015 from 2 pm to 7 pm may have caused a small increase in sound levels below 45 dBA, measured during that time. There would be no effect on accuracy of sound levels measured above 50 dBA.

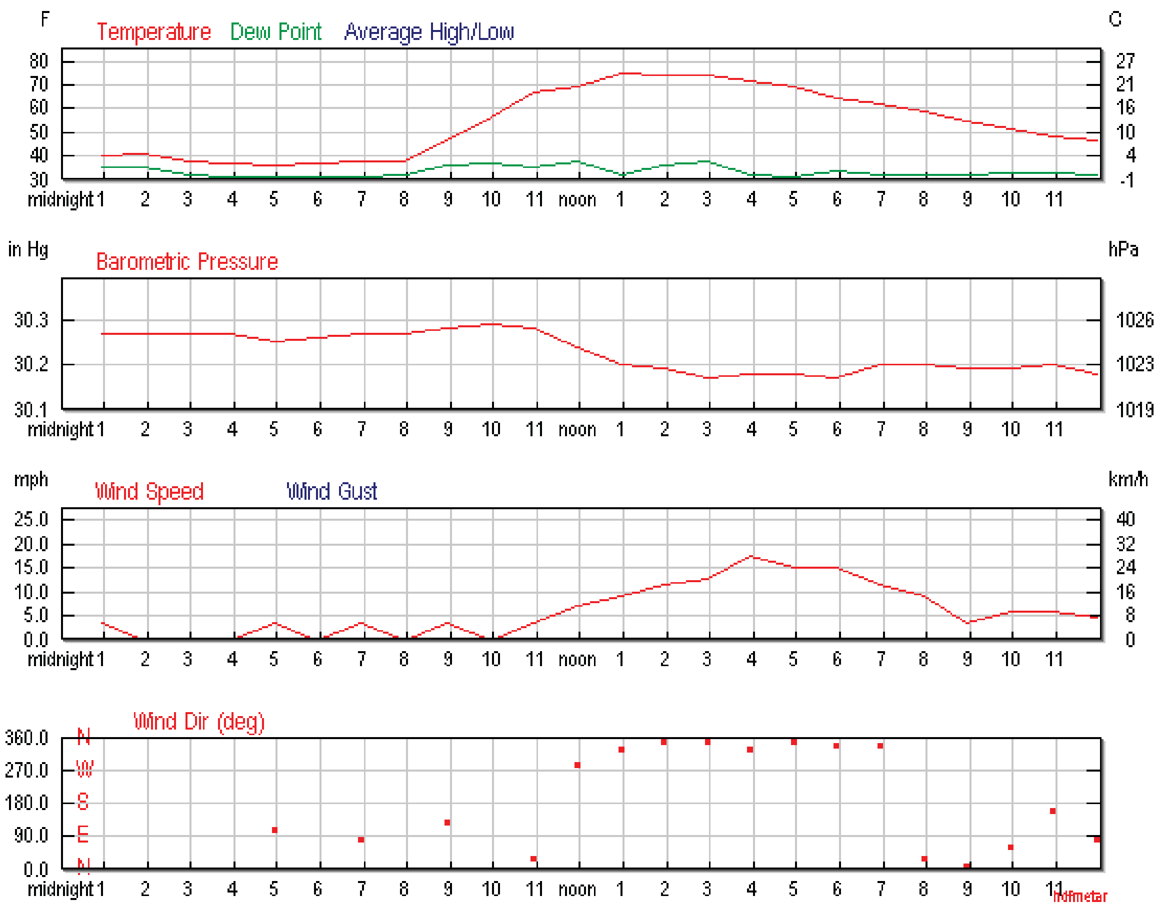


Figure 24. Weather Data, January 24, 2015

Atmospheric conditions that may affect sound level measurements are shown. Wind speed above 10 mph on the afternoon of January 24, 2015 from 1 pm to 3 pm and around 7 pm may have caused a small increase in sound levels below 45 dBA, measured during that time. There would be no effect on sound levels measured above 50 dBA.

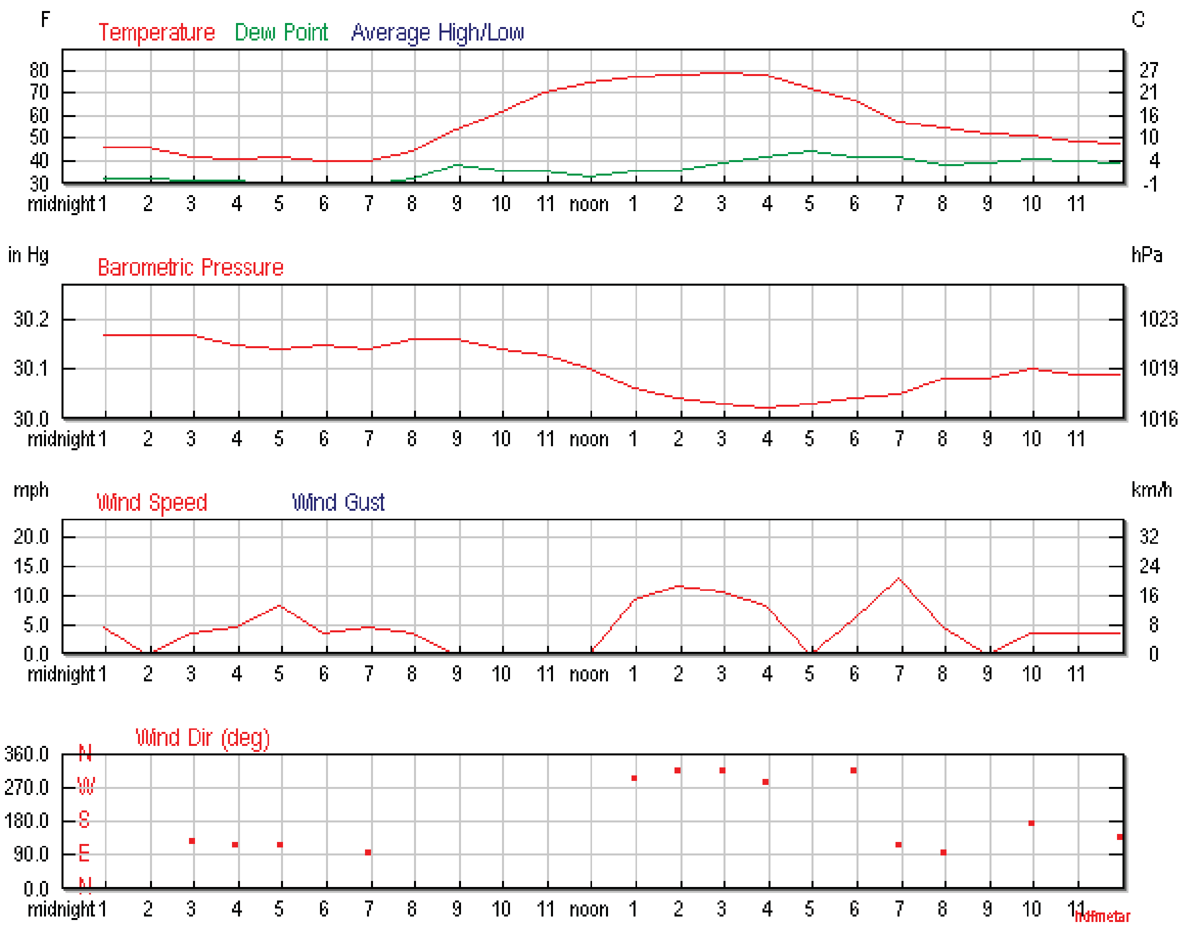


Figure 25. Weather Data, January 26, 2015

Atmospheric conditions that may affect sound level measurements are shown. Wind speed at 10 mph on the morning of Monday, January 26, 2015 at 7 am may have caused a small increase in sound levels below 45 dBA, measured during that time. There would be no effect on sound levels measured above 50 dBA.

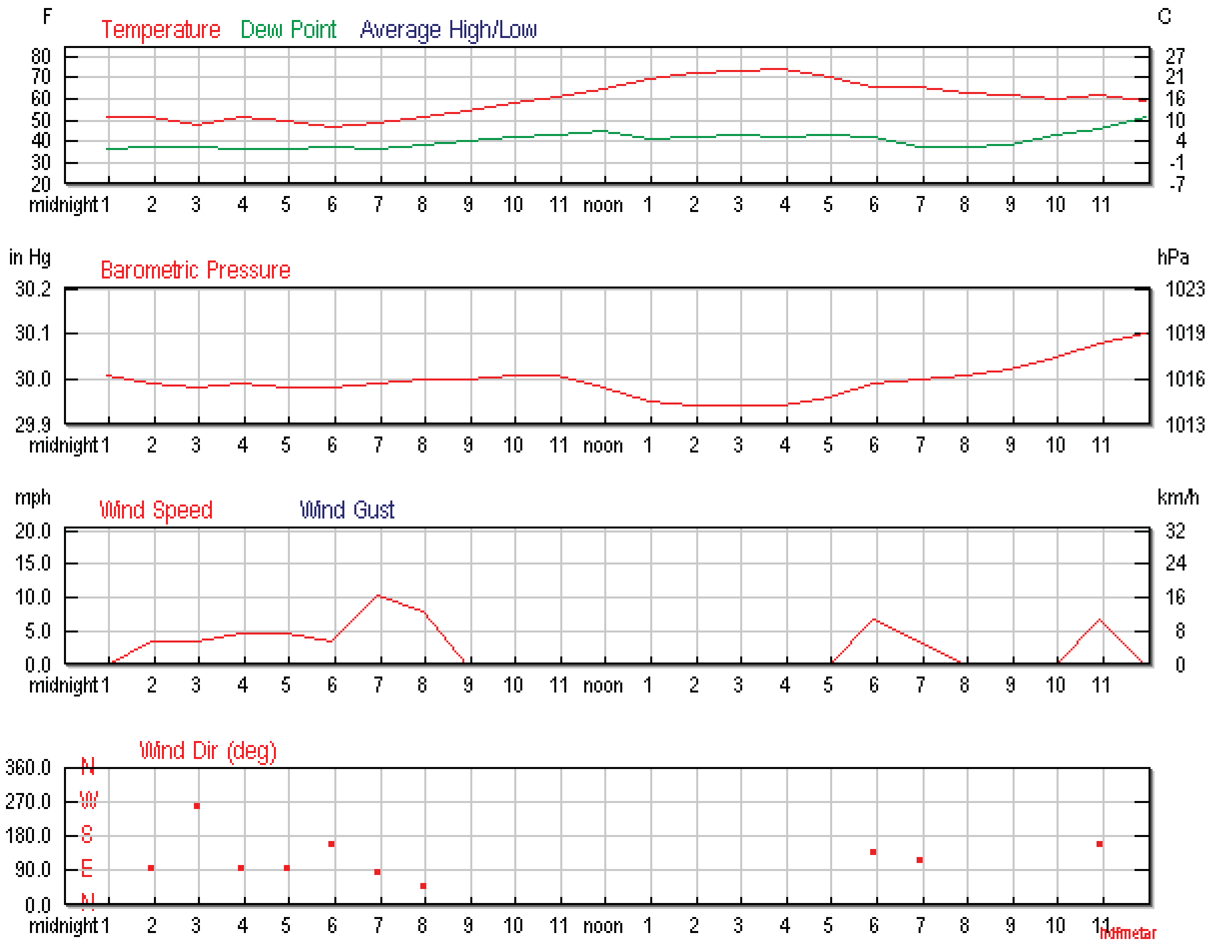
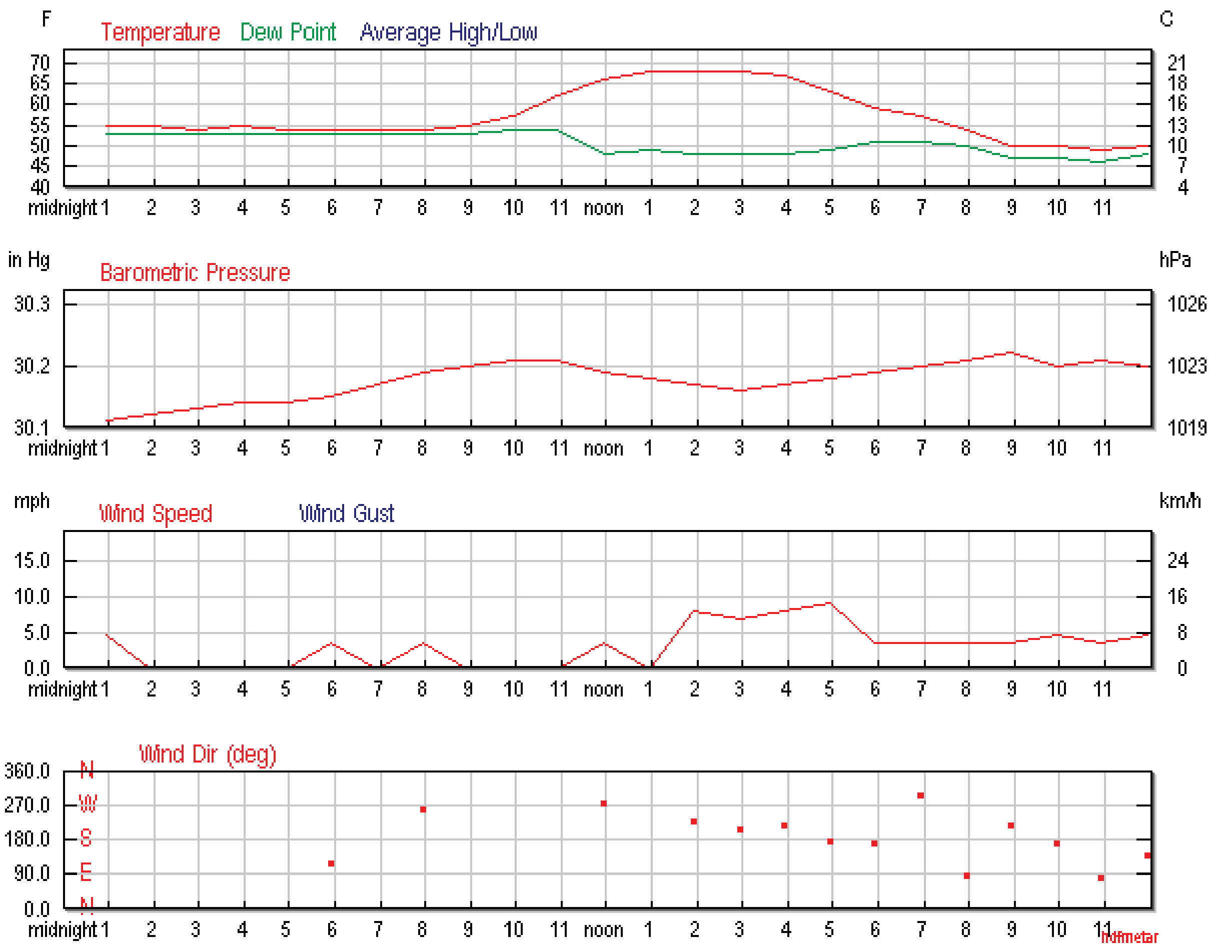


Figure 26. Weather Data, January 27, 2015

Atmospheric conditions that may affect sound level measurements are shown. Wind speed did not exceed 10 mph on Tuesday, January 27, 2015. There would be no wind effect on sound levels measured on that day.



6.0 REFERENCES

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7.0 APPENDIX A: 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.

Airborne 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.

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.

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 facade 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 perceived by most people as being *twice* (or *half*) as loud.

8.0 Measurements, Calculations and Modeling

8.1 Wind Measurement

Sound level measurements become less reliable when average wind speed is greater than 11 m.p.h. at the measurement site. Therefore, wind speed and direction are measured periodically at the measurement site and the results are correlated with wind data from a nearby established weather station. A Larson Davis WS 001 windscreen is used as wind protection for all microphones and is left in place at all times.

Wind speed and direction were noted throughout the measurement period and compared with data from the nearby National Weather Service weather station at San Luis Obispo County Regional Airport. A Davis Turbo Wind meter was used to measure wind speed at the measurement site to cross-check wind speeds at the airport. The Turbo Wind meter is a high performance wind speed indicator with exceptional accuracy.

8.2 Precision of Sound Level Meters.

The American National Standards Institute (ANSI) specifi es several types of sound levelmeters according to their precision. Types 1,2, and 3 are referred to as “precision,” “generalpurpose,” and “survey” meters, respectively. Most measurements carefully taken with a type 1 sound level meter will have an error not exceeding 1 dB. The corresponding error for a type 2 sound level meter is about 2 dB.

The sound level meters used for measurements shown in this report are Larson-Davis Laboratories Model 820. These sound level meters meet all requirements of ANSI s1.4, IEC 651 for Type 1 accuracy and include the following features: 110 dB dynamic range for error free measurements. Measures FAST, SLOW, Unweighted PEAK, Weighted PEAK, Impulse, Leq, LDOD, LOSHA, Dose, Time Weighted Average, SEL, Lmax, Lmin, LDN. Time history sampling periods from 32 samples per second up to one sample every 255 seconds.

Field calibration of each sound level meter with an external calibrator is accomplished before and after all field measurements. Laboratory calibration of the all instruments is performed at least biannually and accuracy can be traced to the U.S. National Institute of Science and Technology standard.

8.3 Sound Level Measurement Method

The protocol for conducting sound level measurements is prescribed in detail by the American Society for Testing and Materials (ASTM) in their E 1014 publication and the CalTrans Traffic Noise Analysis Protocol. The procedures and standards in those documents are met or exceeded for sound level measurements shown in this report. The standards of ASTM E 1014 are exceeded by using Type 1 sound level meters for all measurements in this report instead of the less accurate Type 2 meters. Therefore, the precision of the measurements in this report is likely to be better than +/- 2 dB as stated in ASTM E1014. Particular and specific sound sources are identified by listening to synchronous audio recordings of peak sound level events.

Caltrans Noise Measurement Guidelines: Caltrans makes available general guidelines for taking into account environmental elements in noise measurements. The following is an excerpt from their guidelines. The Traffic Noise Analysis Protocol contains Caltrans noise policies, which fulfill the highway noise analysis and abatement/mitigation requirements stemming from the following State and Federal environmental statutes:

- California Environmental Quality Act (CEQA)
- National Environmental Policy Act (NEPA)
- Title 23 United States Code of Federal Regulations, Part 772 “Procedures for Abatement of Highway Traffi c Noise and Construction Noise” (23 CFR 772)
- Section 216 et seq. of the California Streets and Highways Code

Noise Contour Modeling

Noise contours incorporating the measured sound level values were generated using CADNA/A, an acoustical modeling program that incorporates the TNM 2.5 algorithms, and which was developed to predict hourly Leq values for free-flowing traffic conditions. This computer modeling tool, made by Datakustik GmbH, is an internationally accepted acoustical modeling software program, used by many acoustics and noise control professional offices in the U.S. and abroad. The software has been validated by comparison with actual values in many different settings. The program has a high level of reliability and follows methods specified by the International Standards Organization in their ISO 9613-2 standard, “Acoustics – Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation.” The 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.”

The computer modeling software takes into account source sound power levels, surface reflection and absorption, atmospheric absorption, geometric divergence, meteorological conditions, walls, barriers, berms, and terrain variations. The CADNA/A software uses a grid of receivers covering the project site.