NOISE TECHNICAL REPORT SUPPORTING THE UPDATES OF THE PORTOLA VALLEY NOISE ELEMENT AND NOISE ORDINANCE

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1. INTRODUCTION

Illingworth & Rodkin, Inc. (I&R) has been retained by the Town of Portola Valley to assist the town with the Portola Valley Noise Element Update. I&R is also providing assistance with the development of a noise ordinance. The work is divided into two phases. In Phase 1, a noise measurement survey was completed. The results of the noise measurement survey are presented in this report. In Phase 2, a Model Noise Element and Noise Ordinance were developed in consultation with George Mader, Town Planner, and the Town's Noise Committee. The current Noise Element was prepared before the last comprehensive update to the "Guidelines for the Preparation and Content of the Noise Element of the General Plan" (completed in 1988) so major revisions are necessary. The Noise Element requirements are set forth in Government Code Section 65302(f) which provides the following overall guidance:

A Noise Element shall identify and appraise noise problems in a community. The Noise Element shall recognize the guidelines established by the Office of Noise Control in the State Department of Health Services and shall analyze and quantify, to the extent practicable, as determined by the legislative body, current and projected noise levels for all of the following sources:

(1) Highways and freeways.
(2) Primary arterials and major local streets.
(3) Passenger and freight online railroad operations and ground rapid transit systems.
(4) Commercial or general aviation, heliport, helistop, and military airport operations, aircraft overflights, jet engine test cells and all other ground facilities and maintenance functions related to airport operation.
(5) Local industrial plants, including but not limited to railroad classification yards.
(6) Other ground stationery sources identified by local agencies as contributing to the community noise environment.

Noise contours shall be shown for all of these sources and stated in terms of Community Noise Equivalent Level (CNEL) or day/night average noise level (L_{dn}). The noise contour shall be prepared on the basis of noise monitoring or following generally accepted noise modeling techniques for various identified in paragraphs (1) to (6), inclusive. Our firm utilizes the TNM traffic noise model, developed by FHWA, and SoundPlan. These noise models would be used to develop noise contour information for the primary noise sources. We will prepare a table identifying noise exposure levels along transportation routes in the City based on the gathered noise data and noise modeling.

The noise contours shall be used as a guide for establishing a pattern of land uses in Land Use Element that minimizes the exposure of community residents to excessive noise.

The Noise Element shall include implementation measures and possible solutions that address existing and foreseeable noise problems, if any. The adopted Noise Element shall serve as a guideline for compliance with the State's Noise Insulation Standards.

Noise ordinances are specifically designed to deal with land use to land use noise issues. Typical problems in communities include noise from heating, ventilating, and air conditioning equipment, swimming pool pumps, loud parties, barking dogs, entertainment venues, etc. The Town of Portola Valley Noise Ordinance is contained in the *Municipal Code*. The current Noise Ordinance addresses noise-related issues in the community through a series of prohibitions,

conditions, and exceptions. Quantitative noise limits are presented to regulate intermittent and continuous sources of noise resulting from residential and commercial mechanical equipment and activities.

2. BACKGROUND INFORMATION ON NOISE

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its loudness. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (frequency) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. *A decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level or dBA.* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described 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 L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

TABLE 1 Definitions of Acoustical Terms Used in this Report

Term	Definitions
Decibel, dB	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period. The hourly L_{eq} used for this report is denoted as dBA $L_{eq[h]}$.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels in the night between 10:00 pm and 7:00 am.
Day/Night Noise Level, L_{dn}	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

TABLE 2 Typical Noise Levels in the Environment

Common Outdoor Noise Source	Noise Level (dBA)	Common Indoor Noise Source
	120 dBA	
Jet fly-over at 300 meters		Rock concert
	110 dBA	
Pile driver at 20 meters	100 dBA	
		Night club with live music
	90 dBA	
Large truck pass by at 15 meters		
	80 dBA	Noisy restaurant
		Garbage disposal at 1 meter
Gas lawn mower at 30 meters	70 dBA	Vacuum cleaner at 3 meters
Commercial/Urban area daytime		Normal speech at 1 meter
Suburban expressway at 90 meters	60 dBA	
Suburban daytime		Active office environment
	50 dBA	
Urban area nighttime		Quiet office environment
	40 dBA	
Suburban nighttime		
Quiet rural areas	30 dBA	Library
		Quiet bedroom at night
Wilderness area	20 dBA	
	10 dBA	Quiet recording studio
Threshold of human hearing	0 dBA	Threshold of human hearing

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level, CNEL,* is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels. The *Day/Night Average Sound Level, L_{dn},* is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

Effects of Noise

Hearing Loss

While physical damage to the ear from an intense noise impulse is rare, a degradation of auditory acuity can occur even within a community noise environment. Hearing loss occurs mainly due to chronic exposure to excessive noise, but may be due to a single event such as an explosion. Natural hearing loss associated with aging may also be accelerated from chronic exposure to loud noise.

The Occupational Safety and Health Administration (OSHA) has a noise exposure standard which is set at the noise threshold where hearing loss may occur from long-term exposures. The maximum allowable level is 90 dBA averaged over eight hours. If the noise is above 90 dBA, the allowable exposure time is correspondingly shorter.

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noise of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn} and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57-62 dBA L_{dn} with open windows and 65-70 dBA L_{dn} if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed, those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 55 dBA L_{dn}. At an L_{dn} of about 60 dBA, approximately 2 percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 12 percent of the population. There is, therefore, an increase of about 1 percent per dBA between an L_{dn} of 60-70 dBA. Between an L_{dn} of 70-80 dBA, each decibel increase increases by about 2 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the L_{dn} is 60 dBA, approximately 10 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 2 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 3 percent increase in the percentage of the population highly annoyed.

3. NOISE MEASUREMENT SURVEY

A noise measurement survey was completed to establish existing noise levels in Portola Valley. Noise measurement locations were discussed with the Town's Noise Subcommittee. There were several purposes for the noise measurements. Long-term measurements made hour by hour over a period of several days provide information on how noise levels vary throughout the day and night and may vary from day to day. Long-term noise measurements in quiet residential areas provide information on the residual background levels of noise in the community and also are useful in showing the contrast between the quieter noise environments and the noisier environments located near the roadways. Measurements away from major noise sources also provide information on the intrusiveness of individual single-events in the environment, such as aircraft overflights. A series of attended short-term measurement were also conducted. These measurements are also useful for several purposes. The person attending the measurements can identify the noise sources that occur during the measurement and note the level of noise associated with these identifiable events. This assists greatly in quantitatively and qualitatively characterizing the noise environments along the major roadways and also in the quieter areas of the town. Also, along the major roadways, short-term traffic counts are made. These traffic counts are then eventually input into the traffic noise computer models used to produce noise contours along the roadways, and the results checked against the actual measurement that has been made concurrent with the traffic count.

The State Office of Planning and Research Guidelines related to the preparation of the Noise Element of the General Plan mandate that noise exposure levels be prepared in terms of the day/night average sound level (L_{dn}) or the community noise equivalent level (CNEL). Both of these descriptors were described in the previous section and represent the 24-hour average noise level with waiting periods for the daytime (L_{dn}) or the daytime and evening (CNEL). L_{dn} is currently the preferred metric and is used in this report to characterize the 24-hour average noise exposure level. Recognizing that the Town of Portola Valley is also considering the development of a noise ordinance, it is also important to know how noise levels vary within each hour of the day and night. For this purpose, standard acoustical descriptors were measured and reported. These standard statistical descriptors are the L_{max}, the L_{10}, the L_{50}, and the L_{90}. The L_{max} noise level is the highest noise levels during the interval and the L_{10}, L_{50}, and L_{90} represent sound levels exceeded 10 percent, 50 percent (the median level), and 90 percent of the time interval (representing the background noise levels). The hourly equivalent sound level (L_{eq}), the basis for the day/night average noise levels, was measured and reported for each hour as well.

The noise survey began on the afternoon of Thursday, May 31, 2007 and concluded on Tuesday, June 5, 2007. Noise measurement locations are shown on Figure 1. During the noise survey, weather conditions were moderate in terms of temperature and wind. The noise survey was conducted with Larson Davis Laboratories precision sound level meters. Larson Davis Type 820 meters were used at long-term locations LT-1 through LT-4 and for the attended measurements. At Location LT-5, a Larson Davis Type 700B sound level meter was used. Instrumentation was calibrated at the beginning of the noise survey and checked at the end of the survey. No calibration corrections were necessary. During the survey, the microphones were fitted with windscreens.

Measurement LT-1 was on Portola Road, one of the major access roadways into the Town of Portola Valley. The measurement position was at the Presbyterian Church 115 feet from the centerline of the roadway. Vehicular traffic on Portola Road was the dominant noise source affecting the noise measurements. At night, it is likely that distant traffic and light winds in vegetation also contributed to the background noise levels. The measured data are shown on Figures 2 through 6. During the first 24-hour period, the measured L_{dn} was 58 dBA but on the subsequent four days, the measured L_{dn} ranged from 54-56 dBA. A loud source of noise, probably an emergency siren or an activity very close to the sound level meter, elevated noise levels on the first day. The data clearly demonstrate how quiet it is during the night when noise levels drop to below 25 dBA in the absence of any local traffic.

Measurement LT-2 was on Los Trancos Road at the intersection with Oak Forest Court. This measurement location was also selected to characterize noise levels along roadways in the town. The measurement position was about 75 feet from the centerline of Los Trancos Road and about 60 feet from the centerline of Oak Forest Court. There was very little traffic on Oak Forest Court. The dominant source of noise was vehicular traffic on Los Trancos Road. Measured data at Location LT-2 are shown on Figures 6 through 11.

The measured noise levels from day to day were very steady or 59 dBA L_{dn} on each of the first four days and 60 dBA L_{dn} on the fifth day. It was again very quiet at night, except when an occasional vehicle passed by.

Measurement LT-3 was on the west side of Alpine Road between Westridge Drive and Golden Oak Drive. The measurement position was about 45 feet from the centerline of Alpine Road. Alpine Road is the other major access roadway to the Town of Portola Valley from Interstate 280. Vehicular traffic on this segment of Alpine Road travels at about 45 miles per hour, a higher speed than other local roadways. The day/night average noise level was fairly steady at 66-68 dBA DNL over the five-day measurement period. This is the noisiest roadway in the Town. The measurement data are summarized in Figures 12 through 16.

Measurement Location LT-4 was at the northern edge of Portola Valley in a residential neighborhood at the end of Goya Road. Distant traffic on Interstate 280 and aircraft overflights were both noted as significant contributors to measured noise levels. Intermittent low volume local traffic and neighborhood activities, such as home maintenance and construction, also were noted and contributed to measured noise levels. During the late morning on June 1, data were affected by local activities that may have been from a nearby construction site or home maintenance. The measured noise level was 55 dBA L_{dn}. On the following four days, noise levels ranged from 51 dBA L_{dn} to 53 dBA L_{dn}. The data over these several days was very repeatable and represents typical levels in this neighborhood at this time of year. Long-distance sound propagation from freeways is affected by meteorological conditions. Temperature inversions and wind can cause noise levels to vary about +/- 5 dBA or more from neutral weather conditions. Average noise levels during most of the daytime hours on the days unaffected by local neighborhood activities were about 45 dBA L_{eq}. This is a quiet rural residential setting. Noise levels at night, however, did not fall to as low a level as other measurement locations because of the influence of distant traffic from Interstate 280. The measurement data are summarized on Figures 17 through 21.

Measurement LT-5 was in another quiet residential neighborhood in Portola Valley at No. 30 Toro Court located off Golden Oak Drive in the northern section of the town. At this location, noise levels were measured in hourly intervals rather than 10-minute intervals because of memory limitations of the sound level meter. This location was the quietest location where long-term measurements were made in the town. During the first 24-hour period, there were several hours with elevated sound levels during the morning and the mid-afternoon of Friday, June 1. Based on observations in the area, this was likely the result of home maintenance activities, such as gardening or swimming pool maintenance. After this first 24-hour period when the measured level was 53 dBA L_{dn}, the measured noise levels were 47-48 dBA L_{dn}. Typical daytime noise levels ranged from 40 dBA L_{eq} to 50 dBA L_{eq} and background noise levels at night were between 20-25 dBA. Distant traffic, wind in vegetation, and aircraft overflights all contributed to measured noise levels. These levels represent some of the quietest noise levels measured in developed communities in the Bay Area. The measurement data are summarized on Figures 22 through 26.

Short-term measurements were conducted twice during the day on June 5, 2007 at each of the long-term locations. The measured data are summarized in Table 3. At Location ST-1 on Portola Road, automobile and truck traffic on the roadway were the only significant contributors to measured noise levels. At Location ST-2, a jet aircraft overflight during the midday hour generated a maximum instantaneous noise level of 57 dBA. Vehicular traffic, on Los Trancos Road, was again the dominant source of noise at this measurement location. At Location ST-3, vehicular traffic on Alpine Road was the only significant contributor to measured noise level. No other sources were identified during the short-term measurements. At Location ST-4 on Goya Court, there were frequent general aviation aircraft flying overhead. Maximum noise levels ranged from 50-60 dBA. These aircraft were the most significant noise source other than distant vehicular traffic on Interstate 280. A second attended short-term measurement was made on the hillside below Goya Court at Location ST-4a. Sources of noise other than distant traffic included the aircraft identified at Location ST-4 and construction occurring in the distance. At Location ST-5, at the end of Toro Court in a quiet residential area, identifiable noise sources included traffic, distant construction, and a jet aircraft overflight. Most of the traffic noise was in the distance. One vehicle which passed by the sound level meter elevated noise levels during the 4:40 pm measurement. The jet aircraft generated a maximum instantaneous noise level of 50 dBA as it flew overhead. Distant construction activities generated a noise level of about 47 dBA.

Short-term measurements were made at five additional locations in Portola Valley. Measurement location ST-6 was near the intersection of Westridge Drive and Cervantes Road. Vehicular traffic on the roadways dominated the noise measurements. A commercial jet aircraft was an identifiable source and generated a maximum level of 55 dBA. Measurement location ST-7 was located adjacent to Portola Road across Georgia Lane from the Westridge Priory. Vehicular traffic on Portola Road was the only significant source of noise during the measurements. A loud truck generated a maximum noise level of 83 dBA. Location ST-8 was in Portola Valley Ranch adjacent to Longspur Road. This is a quiet area. Cars generated maximum levels of 53-59 dBA. The median noise level (L_{50}) of 40 dBA is representative of a very quiet, rural setting. Location ST-9 was on lower Los Trancos Road near Los Trancos Woods. Occasional cars on the roadway were the only identifiable source of community noise during the attended measurements. Location ST-10 was on Upper Wayside Road above the Presbyterian Church and measurement locations LT-1/ST-1. Vehicular traffic was the most significant source of noise at this location. Wind gust, estimated up to about 5 mph, caused instantaneous noise levels of up to about 60 dBA, consistent with the sound of passing cars.

A review of the measured data, both long term and short term, portrays a quiet noise environment; the exceptions are the major roadways entering Portola Valley.

TABLE 3 Noise Measurement Summary

Location	Start Time	A-Weighted Noise Level (dBA)					
		L_{eq}	L_{01}	L_{10}	L_{50}	L_{90}	L_{dn}
ST-1 (LT-1)*: Portola Rd. at Presbyterian Church, 115 ft. to centerline	11:10 am 3:40 pm	56 56	66 66	59 59	51 54	44 47	56
ST-2 (LT-2): Corner of Los Trancos Rd. and Oak Forest Ct., 75 ft. to Los Trancos Rd. centerline	12:10 pm 3:10 pm	61 61	72 71	66 66	46 49	40 42	59
ST-3 (LT-3): Alpine Rd. between Westridge Dr. and Golden Oak Dr., 45 ft. from Alpine Rd. centerline	12:30 pm 4:20 pm	65 66	74 73	68 70	62 64	52 52	67
ST-4 (LT-4): North end of Goya Rd. cul-de-sac	1:00 pm 5:00 pm	45 46	55 57	48 48	42 41	38 36	53
ST-4a: North end of Goya on hill below cul-de-sac with slightly different view of I-280	1:00 pm 5:00 pm	47 44	57 53	48 47	43 41	40 37	N/A** *
ST-5 (LT-5): End of Toro Ct. at #30 Toro Ct.	1:20 pm 4:40 pm	43 51	53 60	48 54	37 47	32 43	49
ST-6: Intersection of Westridge Dr. and Cervantes Rd.	11:30 am	55	65	59	49	43	N/A
ST-7: Portola Rd. at Georgia Ln. near Westridge Priory, 35 ft. from Portola Rd. centerline	11:50 am	65	74	68	61	48	N/A
ST-8: In Portola Valley Ranch along Longspur Rd.	2:20 pm	43	53	45	40	37	N/A
ST-9: #1044 Los Trancos Rd. past Ramona Rd. about 20 ft. from centerline	2:50 pm	47	57	51	43	37	N/A
ST-10: #300 Wayside Rd., about 25 ft. from centerline	3:40 pm	49	57	51	46	43	N/A

Day/Night Noise Level, $L_{dn:}$ The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.

Equivalent Noise Level, $L_{eq:}$ The average A-weighted noise level during the measurement period.

L_{max}, L_{min} The maximum and minimum A-weighted noise level during the measurement period.

L_{01}, L_{10}, L_{50}, L_{90} The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.

* ST refers to a "short term" measurement (10 min. duration) made 6/5/07.
LT refers to "long term" measurements made 5/31/07 through 6/5/07.

** N/A, Not Available, only short-term measurements were made so the L_{dn} cannot be directly calculated from the data.

4. NOISE COMPATIBLE LAND USE PLANNING

The definition of noise compatible land use planning is the second major component of the Noise Element. While this may not be a major issue in Portola Valley because it is largely built out, it is a requirement for the Noise Element. Noise exposure in the community is defined in terms of the 24-hour day/night average noise level (L_{dn}). The noise levels were measured throughout the community. Noise contours were prepared for the major roadways utilizing a combination of the measured noise levels and traffic data.

The noise exposure in the community is depicted in the form of noise exposure contours along the major roadways. The noise exposure contours are lines of equal loudness, similar to elevation contours that are lines of equal elevation. Noise exposure contours were calculated using a traffic noise model developed by the Federal Highway Administration and the California Department of Transportation. The traffic noise model was calibrated using the actual measured noise levels in Portola Valley. Noise exposure is presented in terms of the L_{dn} noise metric. The results of the traffic noise modeling are shown in Table 4 and the noise exposure contour map is shown in Figure 27. The noise contour map has been supplied to the Town and can be incorporated into the Town's graphic information system (GIS) software.

Paraphrasing from the State's Noise Element Guidelines, given the definition of the existing and forecasted noise environment, the Town must now approach the problem of defining how much noise is too much. The State guidelines include an example that can be used to address this issue. It is shown in Figure 28. Over the years, I&R has worked to simplify this chart while maintaining its intent. Figure 29 shows the recommended noise and land use compatibility guidelines. This chart simplifies the land uses and reduces the acceptability categories to three: normally acceptable, conditionally acceptable, and normally unacceptable. These categories translate to a noise environment for a particular use that would be acceptable without additional mitigation measures, an intermediate category where the application of available mitigation measures would normally result in an acceptable noise environment, and a noise environment that could potentially be unacceptable even after the application of available mitigation measures. In the CEQA context, this would translate to a less-than-significant impact, a less-than-significant impact after mitigation, and a significant and unavoidable impact.

One of the requirements of the noise element is to facilitate the Noise Insulation Standards contained in the State Building Code that are applicable to new multi-family housing. This code section states that where the exterior noise exposure level is 60 dBA L_{dn} or greater, the building must attenuate the interior noise level to 45 dBA L_{dn} or less. The noise and land use compatibility chart is used to screen for this and a policy is normally included to explain how this is accomplished.

Much research has resulted in the development of a correlation of exterior community noise levels and their acceptability for different land uses. In the mid-1970s the Environmental Protection Agency made a finding that an L_{dn} of 55 dBA (including a 5 dBA margin of safety) would have "no impact" on a residence. Following this, the State of California established guidelines and suggested 60 dBA L_{dn} as an upper limit for environmental noise in a residential setting. Furthermore, typical California construction with windows open provides about 15 dBA of noise reduction when going from outside

TABLE 4 Traffic Noise Levels in Portola Valley

Roadway - Segment	ADT	Speed	Ldn @ 50 feet	Distance (ft) from Roadway Centerline to Noise Contour		
				65 dBA Ldn	60 dBA Ldn	55 dBA Ldn
Alpine Road - North town limits to 586' s/o Westridge Drive	11825	35	68	110	240	510
Alpine Road – s/o Westridge Drive to 684' n/o Arastradero Road	8907	35	67	90	190	420
Alpine Road - 684' n/o Arastradero Road to 505' n/o Creek Park Drive	9981	35	67	100	210	450
Alpine Road - 505' n/o Creek Park Drive to Portola Road	7582	35	66	80	170	370
Alpine Road – Portola Road to Madera Road	3607	35	63	50	100	220
Cervantes Road – All	995	25	51	*	*	*
Los Trancos Road - Alpine Road to Los Trancos Creek	2628	35	61	*	70	150
Los Trancos Road - Los Trancos Creek to City Limits	2068	35	60	*	60	120
Portola Road – Alpine Road to Westridge Drive	4678	35	63	50	100	220
Portola Road - 600' n/o Wyndan Drive to Westridge Drive	5140	35	63	50	110	230
Portola Road - 600' n/o Wyndan Drive to Woodside Town Limits	5537	40	65	60	140	290
Westridge Drive - Alpine Road to Cervantes Drive	2860	30	57	*	*	80
Westridge Drive - Cervantes Drive East to Cervantes Drive West	1372	30	54	*	*	50
Westridge Drive - Portola Road to Cervantes Drive West	2354	30	57	*	*	70
Willowbrook Drive – All	495	25	48	*	*	*

Note: Roadway segments and traffic data defined by City Traffic Engineer. ADT's are from weekday traffic counts in December 2005. Speeds are posted speed limits supported by speed studies.

to inside, so if the exterior L_{dn} is 60 dBA or less, the interior L_{dn} will typically be 45 dBA or less. An L_{dn} of 45 dBA is considered the upper limit of acceptability for residential development in California (as defined in the State Building Code). Based on the existing conditions in Portola Valley an exterior noise goal of 55 dBA L_{dn} and an interior goal of 40 dBA L_{dn} has been proposed for new residences.

Commercial and retail establishments generate a different kind of noise referred to as non-transportation noise. The noise results from sources such as heating, ventilating, and refrigeration equipment, loading dock activities, parking lot traffic and maintenance, special events with music, etc. If a residence is planned near such a source of noise, special noise guidelines shown in Table 5 that address noise during any hour of the day and night are used to evaluate the suitability of the environment.

The following are a recommended goal and policies to implement noise compatible land use planning:

Goal 1	**Develop Land Uses Compatible with the Noise Environment**
	Transportation Noise (Policies 1-4):
Policy 1:	The Town will utilize the noise contours in Figure 1 and noise/land use compatibility standards in Figure 2.
Policy 2:	The Town will maintain a pattern of land uses that separates noise-sensitive land uses from major traffic noise sources, to the extent feasible.
Policy 3:	New development of residential or other noise sensitive land uses should not be allowed in noise impacted areas unless effective mitigation measures are incorporated into the project design to reduce noise levels in outdoor activity areas to 55 dBA L_{dn} or less.
Policy 4:	Interior noise levels shall not exceed 40 L_{dn} in all new residential units (single- and multi-family). Residential development sites exposed to noise levels exceeding 55 L_{dn} shall be analyzed following protocols in the 2007 California Building Code (Chapter 12, Appendix Section 1207.11.2) or the most recent revision.
	Non-Transportation Noise (Policy 5):
Policy 5:	New development of noise-sensitive land uses shall not be allowed where the noise level due to non-transportation noise sources will exceed the standards of Table 5. Where noise sensitive land uses are proposed in areas exposed to existing or projected exterior non-transportation noise levels exceeding the performance standards of Table 5, an acoustical analysis shall be submitted by the applicant so that noise mitigation may be included in the design of the new development.

TABLE 5: Non-Transportation Noise Standards

Land Use Receiving the Noise	Hourly Noise-Level Descriptor	Exterior Noise-Level Standard In Any Hour (dBA)		Interior Noise-Level Standard In Any Hour (dBA)	
		Daytime (7am-10pm)	Nighttime (10pm-7am)	Daytime (7am-10pm)	Nighttime (10pm-7am)
Residential	L_{eq}	50	40	40	30
	L_{max}	65	55	55	45
Medical, convalescent	L_{eq}	55	45	45	35
	L_{max}	70	60	55	45
Theater, auditorium	L_{eq}	--	--	35	35
	L_{max}	--	--	50	50
Church, meeting hall	L_{eq}	55	--	40	40
	L_{max}	--	--	55	55
Office building	L_{eq}	--	--	45	--
School, library, museum	L_{eq}	55	--	40	--
	L_{max}	--	--	55	--
Playground, park	L_{eq}	55	--	--	--

Notes:

a) The Residential standards apply to all residentially zoned properties.

b) Each of the noise levels specified above shall be lowered by 5 dBA for tonal noises characterized by a whine, screech, or hum, noises consisting primarily of speech or music, or recurring impulsive noises.

c) In situations where the existing noise level exceeds the noise levels indicated in the above table, any new noise source must include mitigation that reduces the noise level of the noise source to the existing level.

d) The exterior noise standards are measured at any point on the receiving property where there is, or could be in the future, frequent human use and quiet would be beneficial.

5. MAINTAINING THE QUIET

Traffic Noise Reduction

The Noise Element shall include measures and possible solutions that address existing and foreseeable noise problems. Traffic noise is the most significant source of community noise in Portola Valley. The noise generated by individual vehicles is pre-empted by the state, so noise limits cannot be set for individual vehicles. Noise generated by tire pavement interaction is the predominant source of noise and can be affected by local actions. During the last five years, extensive research has been completed related to tire pavement noise. Quieter pavements have been identified. These include pavements commonly used in California, such as open-grade asphalt concrete and rubberized asphalt.

The other irritating noise sources associated with traffic are poorly muffled vehicles and loud stereo systems. Both of these are regulated by the Motor Vehicle Code but enforced by local officers. The following goal and policies address these issues.

Goal 2	**Reduce Noise From Traffic**
Policy 6:	Utilizing currently available information, select a "quieter" pavement that also meets other criteria established by the Town for pavements, and use the quieter pavement when resurfacing roadways.
Policy 7:	Control the sound of vehicle amplification systems (e.g., loud stereos) by encouraging the enforcement of Section 27007 of the California Motor Vehicle Code. This section prohibits amplified sound which can be heard 50 or more feet from a vehicle.
Policy 8:	Control excessive exhaust noise by encouraging the enforcement of Section 27150 of the California Motor Vehicle Code.

Mitigate Impacts from New Projects

The fundamental principle of the California Environmental Quality Act as it relates to community noise is to keep new projects from causing a substantial increase in noise that would impact residents and other sensitive receivers. This can be accomplished if impacts are identified as a part of normal project review or through the CEQA process and mitigation measures are incorporated into projects. The following goal and policies are recommended to address this issue:

Goal 3	Maintain the Current Quality of the Acoustical Environment
Policy 9:	Require an acoustical analysis to evaluate of mitigation measures for noise generating projects that would cause the following criteria to be exceeded or would cause a significant adverse community response: • Cause the L_{dn} at noise-sensitive uses to increase by 3 dBA or more and exceed the ”normally acceptable” level. • Cause the L_{dn} at noise-sensitive uses to increase 5 dBA or more and remain “normally acceptable” Note: Locations where there is greater sensitivity to excess noise, including but not limited to, residences, hospitals, nursing homes, theaters, auditoriums, churches, meeting halls, schools, libraries, museums, and parks.
Policy 10:	Noise created by new non-transportation noise sources shall be mitigated so as not to exceed the interior and exterior noise level standards of Table 5. Where proposed non-transportation noise sources are likely to produce noise levels exceeding the performance standards of Table 4, an acoustical analysis shall be required as a part of project review or as part of the environmental review process so that noise mitigation may be included in the project design.
Policy 11:	All acoustical analyses shall: • Be the responsibility of the applicant • Be prepared by a qualified person experienced in the fields of environmental noise assessment and architectural acoustics • Include representative noise level measurements with sufficient sampling periods and locations to adequately describe local conditions • Estimate existing and projected (20 years) noise levels in terms of L_{dn} and/or the standards of Table 3, and compare those levels to the policies of this Element • Recommend appropriate mitigation to achieve compliance with the adopted policies and standards of this Element. Where the noise source in question consists of intermittent single events, the report must address the effects of maximum noise levels in sleeping rooms in terms of possible sleep disturbance • Describe a post-project assessment program which could be used to evaluate the effectiveness of the proposed mitigation measures

Manage Noise from Construction

Noise from construction activities, and particularly construction activities associated with the construction of new residences, remodeling or demolition and reconstruction of residential properties, has an adverse effect on the peace and quiet in Portola Valley.

The term “construction” covers a large range of projects ranging from new construction or the demolition and construction of a large residence that could include demolition, site grading, foundation work, framing, roofing, exterior sheeting, and site improvements and landscaping, a project that may last up to two years, to someone repairing a deck on a Saturday afternoon.

The primary method for communicating construction noise management methods to the community could be through a guidance manual and/or design guide. If a major project is expected to take less than 18 months and work would be done following all of the standard controls that would be established, including limiting the work to a certain schedule of allowable days and hours, then the project would be found to cause a less-than-significant impact under CEQA. Alternatively, if the project is going to necessitate construction activities that would last beyond 18 months, or if construction activities would have to occur outside of allowable time periods, then the project would be found to cause a potentially significant impact and would be subject to environmental review under CEQA. The assessment could result in additional mitigation measures, a finding of overriding considerations, or project denial.

The following is a representative list of standard controls:

a) Limit construction to the hours of 8:00 AM to 5:00 PM on weekdays, and 9:00 AM to 5:00 PM on Saturdays, with no noise-generating construction on Sundays or holidays.

b) Control noise from construction workers' radios to the point where they are not audible at existing residences that border the Project site.

c) Equip all internal combustion engine-driven equipment with mufflers which are in good condition and appropriate for the equipment.

d) Utilize quiet models of air compressors and other stationary noise sources where technology exists.

e) Locate stationary noise-generating equipment as far as possible from sensitive receptors when sensitive receptors adjoin or are near a construction project area.

f) Prohibit unnecessary idling of internal combustion engines.

g) Notify residents adjacent to the Project site of the construction schedule in writing.

h) Designate a noise disturbance coordinator who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator would determine the cause of the noise complaints (e.g., starting too early, bad muffler, etc.) and institute reasonable measures warranted to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site.

Goal 3	Maintain the Current Quality of the Acoustical Environment
Policy 12:	Implement appropriate standard controls (e.g., some or all of a-h above) for all construction projects.
Policy 13:	Consider CEQA review for construction projects lasting more than 18 months, and submittal of detailed construction noise management plans.
Policy 14:	Develop a guidance manual to provide information to public regarding construction noise control.

Manage Noise from Other Sources

Other sources of noise that contribute to the noise environment in Portola Valley include aircraft flights, and various neighborhood sources including barking dogs, yard maintenance, garbage trucks, noise generated by other home equipment such as swimming pool pumps and air-conditioners, early morning deliveries, and parties. The town has little direct control of aircraft operations that may constitute a noise burden to its residents. Hence, most aircraft noise abatement measures must necessarily be affected by seeking cooperation from other government agencies. The town can manage noise generated within its boundaries. The town currently uses a qualitative noise ordinance to address these issues. The adoption of a quantitative noise ordinance will provide a uniform basis for dealing with many of the town's ongoing noise issues resulting from neighborhood activities.

Goal 3	Maintain the Current Quality of the Acoustical Environment
Policy 15:	Communicate with the FAA through the San Francisco International Airport (SFO) Airport Roundtable to minimize the noise impact of commercial aircraft operations
Policy 16:	Work with local airports to promote a "fly neighborly" program to minimize noise resulting from low altitude aircraft operations and unnecessary general aviation aircraft over Portola Valley.
Policy 17:	Revise the noise ordinance to address ongoing noise issues by using quantitative noise limits where appropriate and establishing comprehensive noise control measures.
Policy 18:	Develop a "quiet neighbor" information program and distribute information to the community defining community norms.

6. PORTOLA VALLEY NOISE ORDINANCE

Portola Valley currently has a Noise Ordinance in Chapter 9.10 of the *Municipal Code.* The Ordinance establishes limitations for construction periods and use of domestic garden tools. The Ordinance prohibits excessive noise from any person's property and limits the use of amplified sound outdoors on property owned by the Town. Exceptions are included.

In consultation with the Noise Committee and Town Planner, the pros and cons of a quantitative noise ordinance were discussed. The methods for applying an ordinance and implementing one were evaluated. From these discussions, it was resolved that a quantitative noise ordinance should be considered by the Town to regulate sources of noise, such as heating, ventilating, and air conditioning systems, swimming pool pumps, noise from loading docks and other commercial areas. The heart of the Noise ordinance, however, must continue to be a description of those activities that require limitation or prohibition to protect the noise environment of the residents in the Town. Also, there must be a set of exceptions or exemptions for those activities that are recognized to generate noise but also must be able to occur in order to maintain safety, infrastructure, etc. I&R has provided, under separate cover, a Model Noise Ordinance for Portola Valley that incorporates language from the existing ordinance, and presents quantitative noise limits consistent with the non-transportation noise limits set forth in Table 5 the Model Noise Element. These quantitative limits are in terms of allowable hourly average noise levels and intermittent maximum levels during the daytime and nighttime, with the levels dependent upon the land use receiving the noise. Guidance is provided through notes in the table to address the variety of issues that are normally associated with the noise sources and the noise sensitive receiving properties. No ordinance can anticipate and cover all eventualities, but in our experience, this is the best method for establishing quantitative noise limits. This should provide a framework for the Town to move forward with the adoption of a quantitative noise ordinance if it determines that that is in the best interest of the Town.

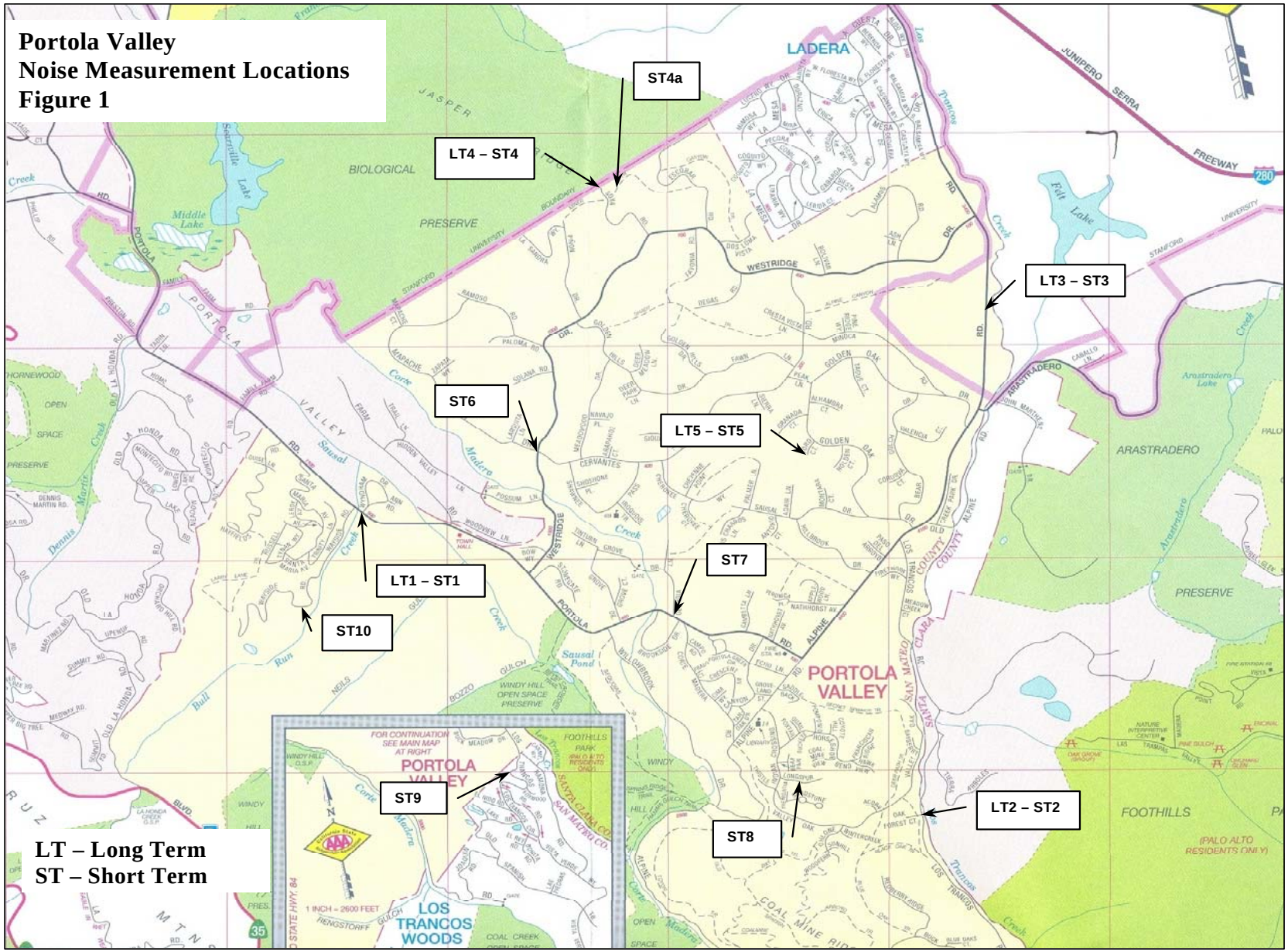
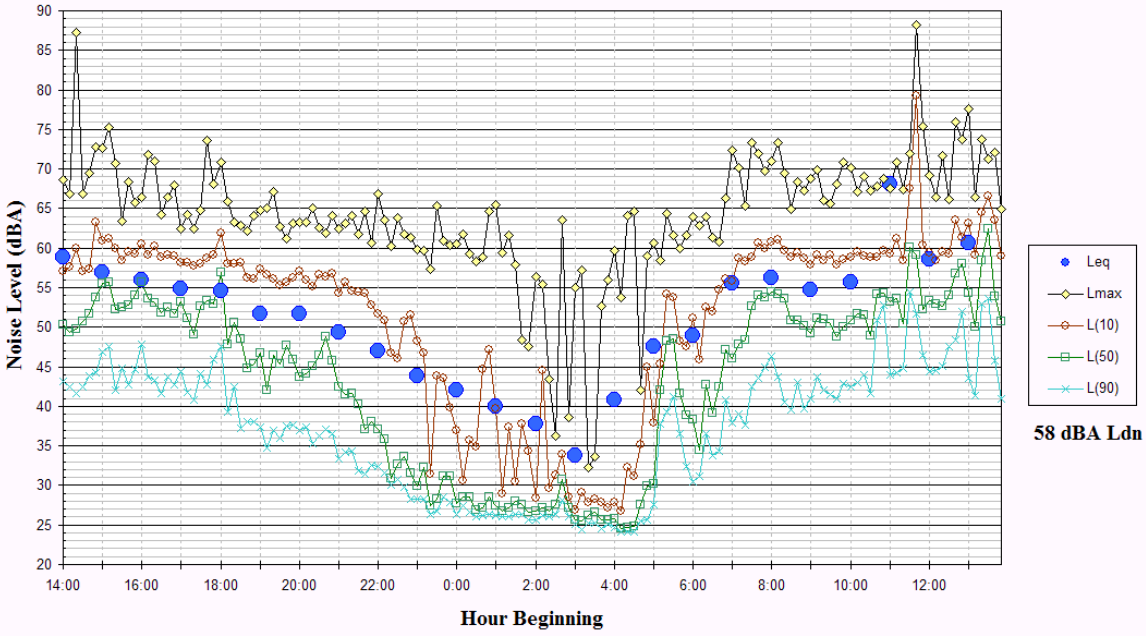
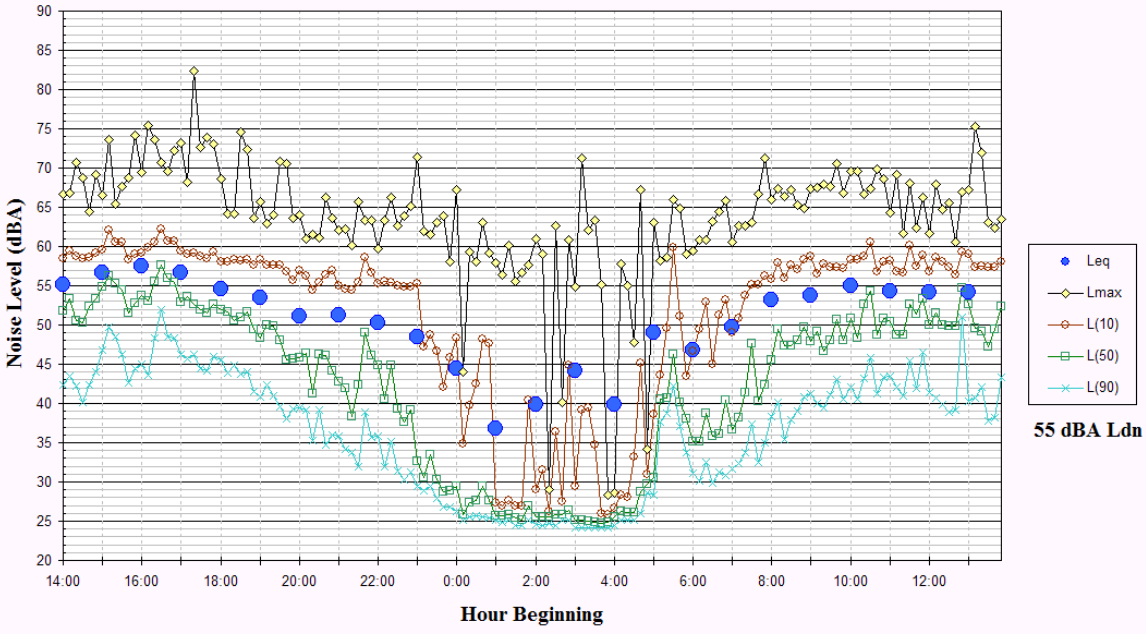

Portola Valley
Noise Measurement Locations
Figure 1
ST4a
LT4 – ST4
LT3 – ST3
ST6
LT5 – ST5
ST7
LT1 – ST1
ST10
ST9
ST8
LT2 – ST2
LT – Long Term
ST – Short Term
LADERA
PORTOLA VALLEY
ARASTRADERO
FOOTHILLS
LOS TRANCOS WOODS
WINDY HILL OPEN SPACE PRESERVE
BIOLOGICAL PRESERVE
JUNIPERO SERRA FREEWAY
WESTRIDGE
ALPINE
PORTOLA
SAND HILL ROAD
FOR CONTINUATION SEE MAIN MAP AT RIGHT
1 INCH = 2600 FEET

Figure 2: Noise Levels at LT-1
~115 feet from the Center of Portola Road at Wayside Road (Presbyterian Church)
May 31-June 1, 2007



58 dBA Ldn

Figure 3: Noise Levels at LT-1
~115 feet from the Center of Portola Road at Wayside Road (Presbyterian Church)
June 1-2, 2007



55 dBA Ldn

Figure 4: Noise Levels at LT-1
~115 feet from the Center of Portola Road at Wayside Road (Presbyterian Church)
June 2-3, 2007

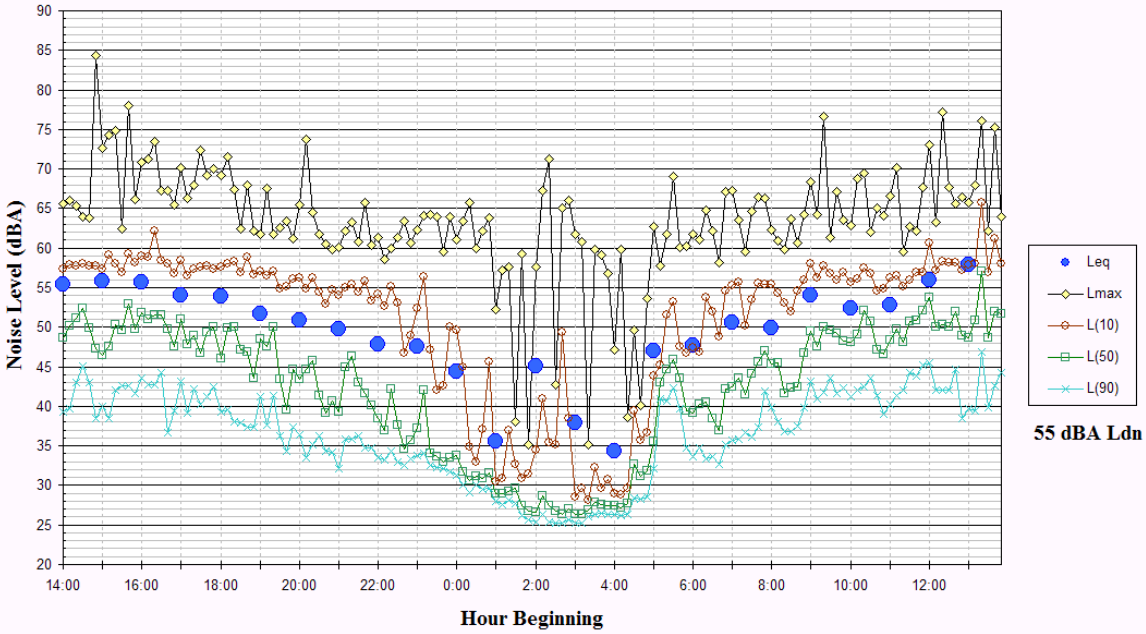


Figure 5: Noise Levels at LT-1
~115 feet from the Center of Portola Road at Wayside Road (Presbyterian Church)
June 3-4, 2007

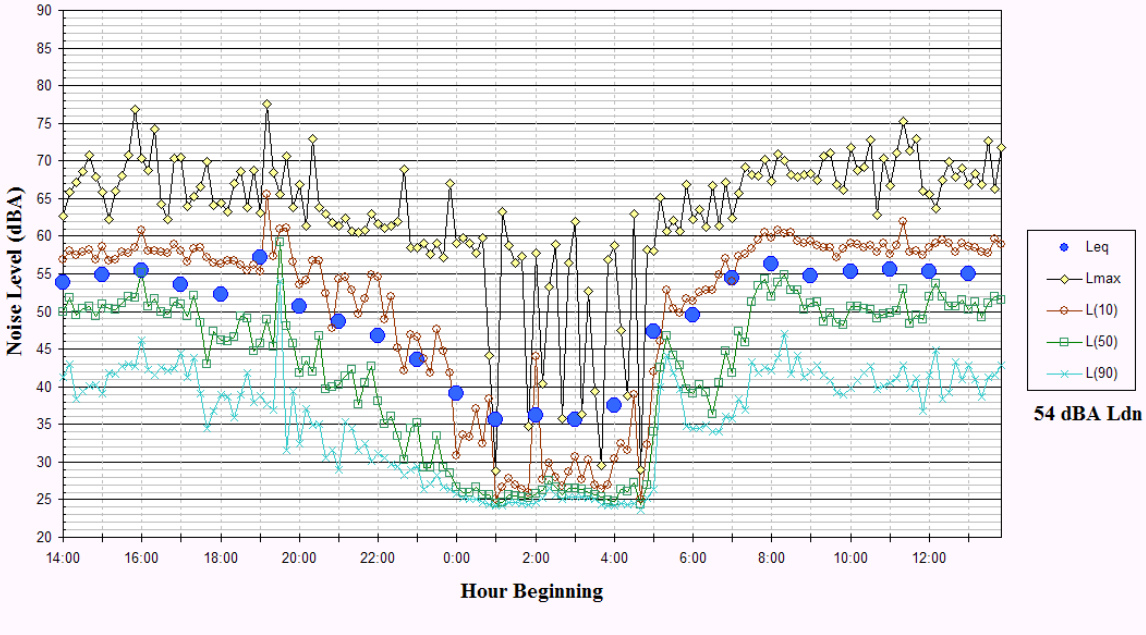
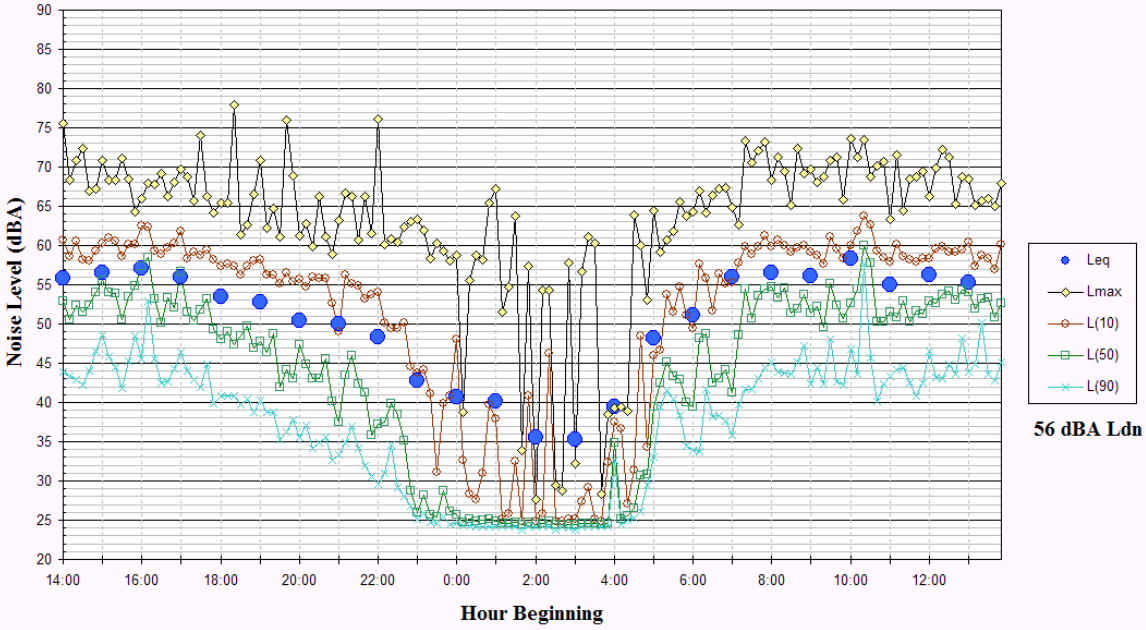
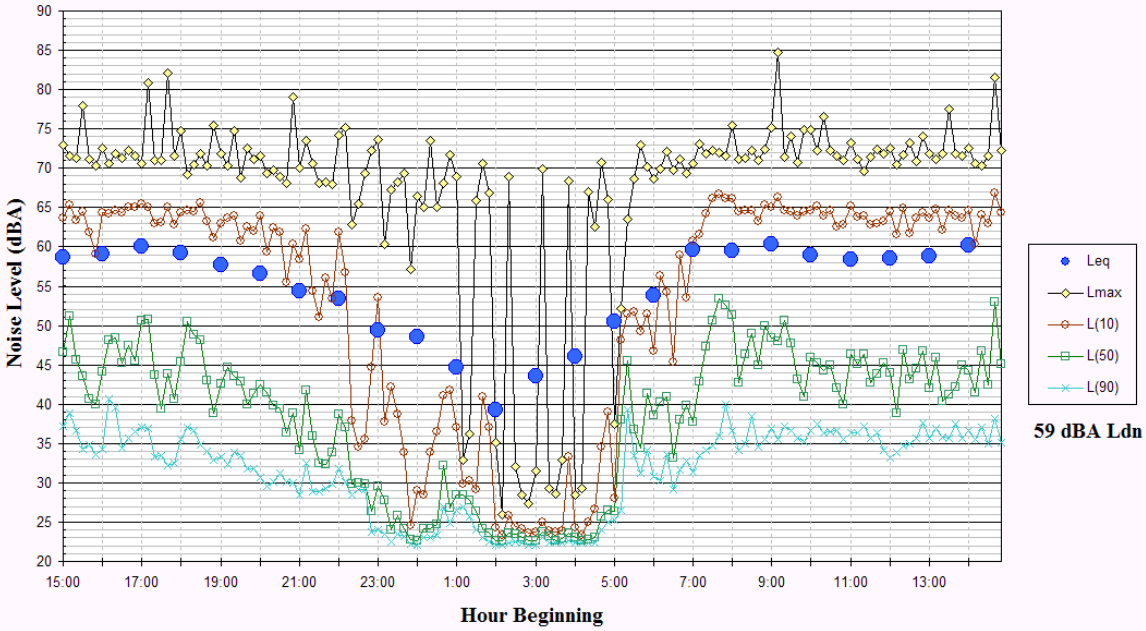


Figure 6: Noise Levels at LT-1
~115 feet from the Center of Portola Road at Wayside Road (Presbyterian Church)
June 4-5, 2007



56 dBA Ldn

Figure 7: Noise Levels at LT-2
~75 feet from the Center of Los Trancos Road at Oak Forest Court
May 31-June 1, 2007



59 dBA Ldn

Figure 8: Noise Levels at LT-2
~75 feet from the Center of Los Trancos Road at Oak Forest Court
June 1-2, 2007

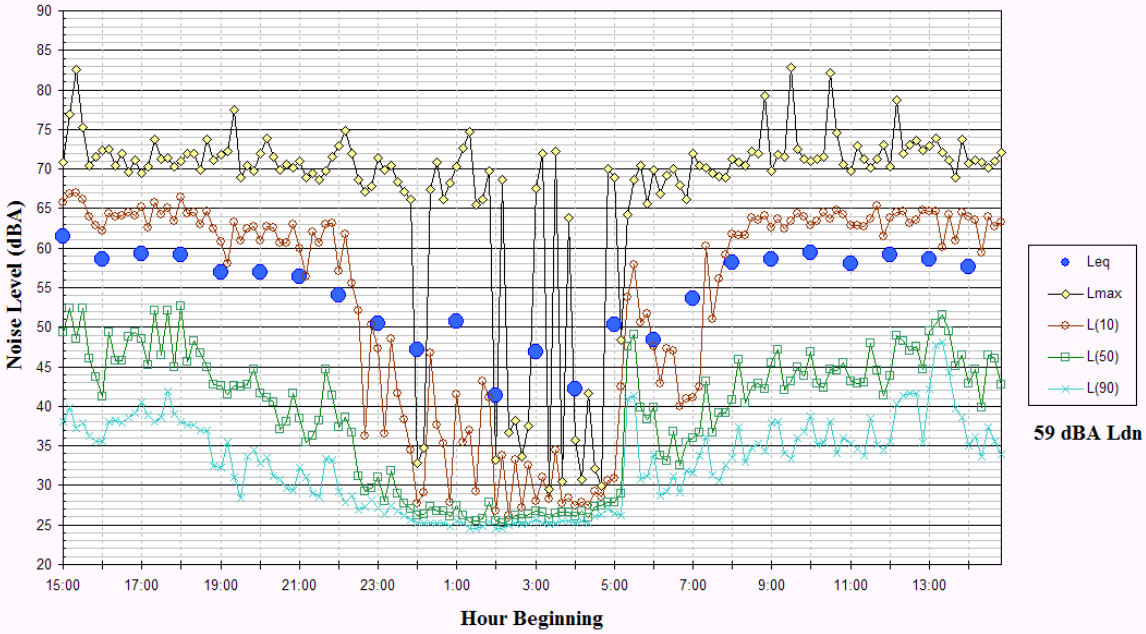


Figure 9: Noise Levels at LT-2
~75 feet from the Center of Los Trancos Road at Oak Forest Court
June 2-3, 2007

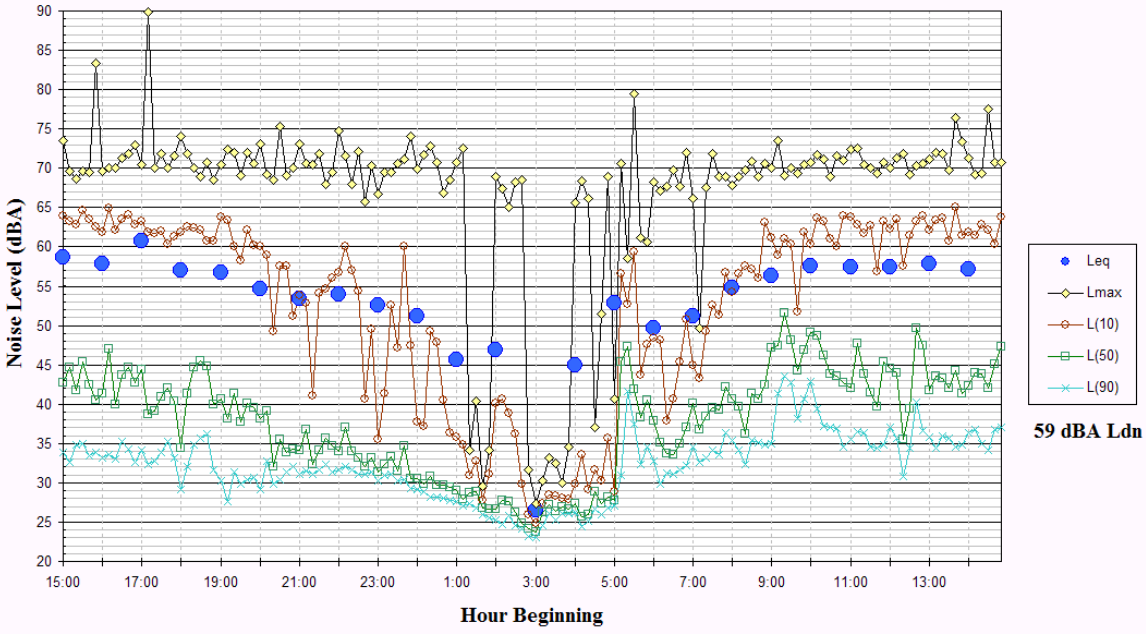
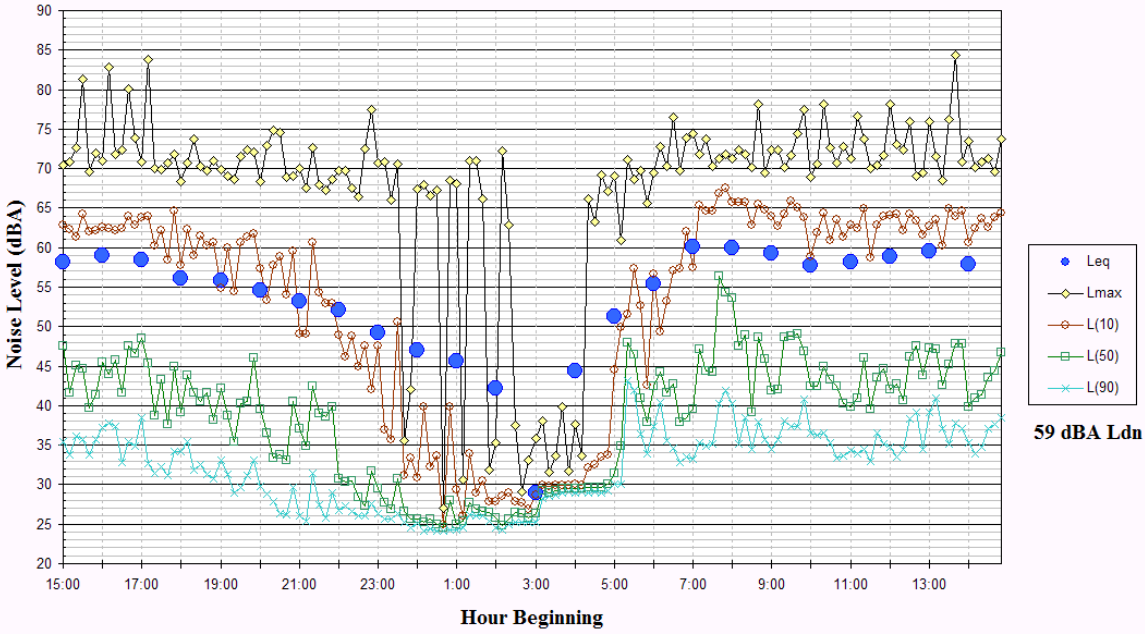
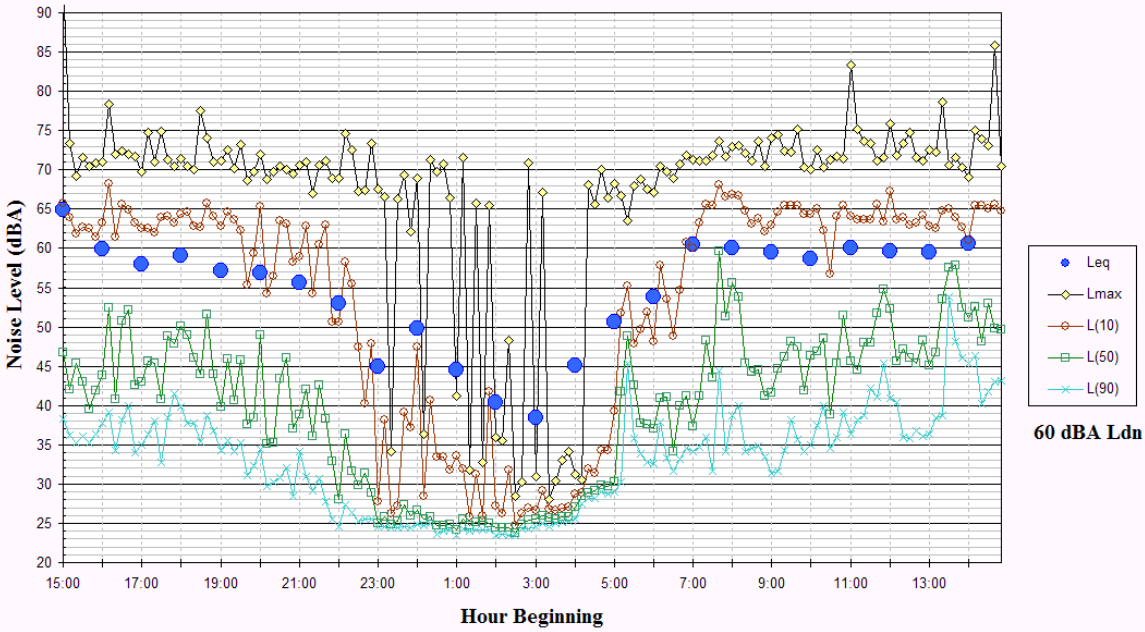


Figure 10: Noise Levels at LT-2
~75 feet from the Center of Los Trancos Road at Oak Forest Court
June 3-4, 2007



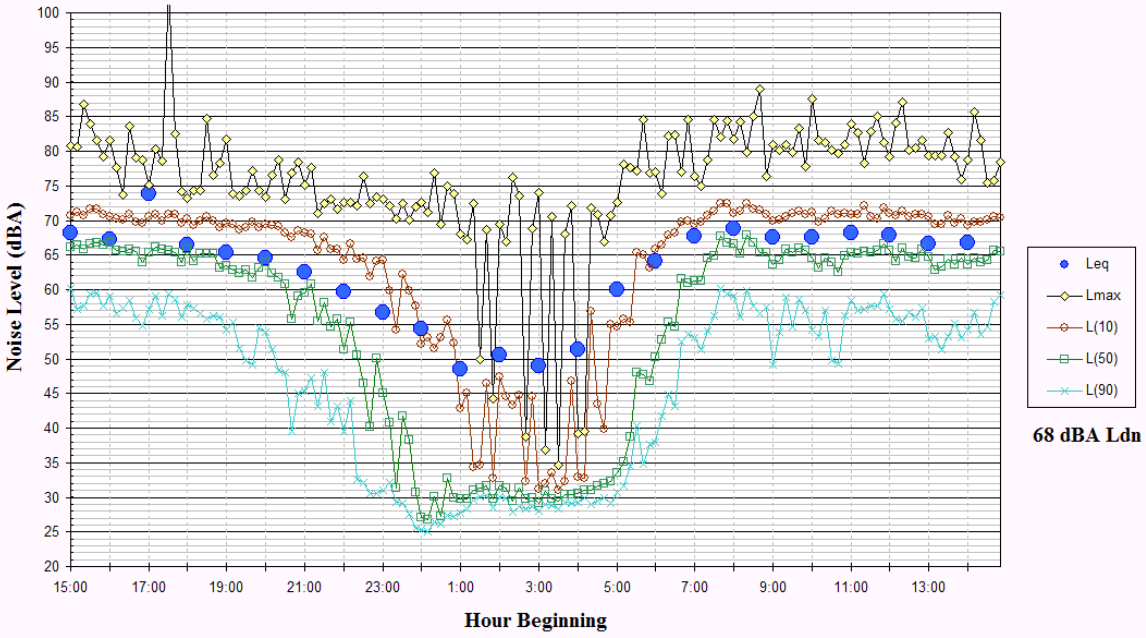
59 dBA Ldn

Figure 11: Noise Levels at LT-2
~75 feet from the Center of Los Trancos Road at Oak Forest Court
June 4-5, 2007



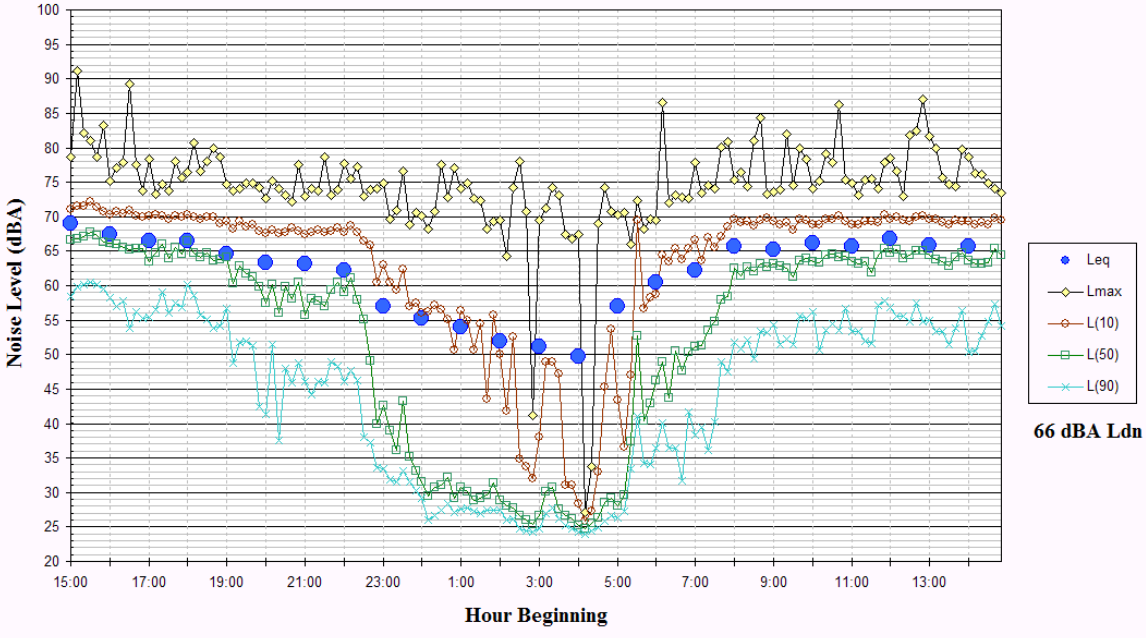
60 dBA Ldn

Figure 12: Noise Levels at LT-3
~45 feet from the Center of Alpine Road
Between Westridge Drive and Golden Oak Drive
May 31-June 1, 2007



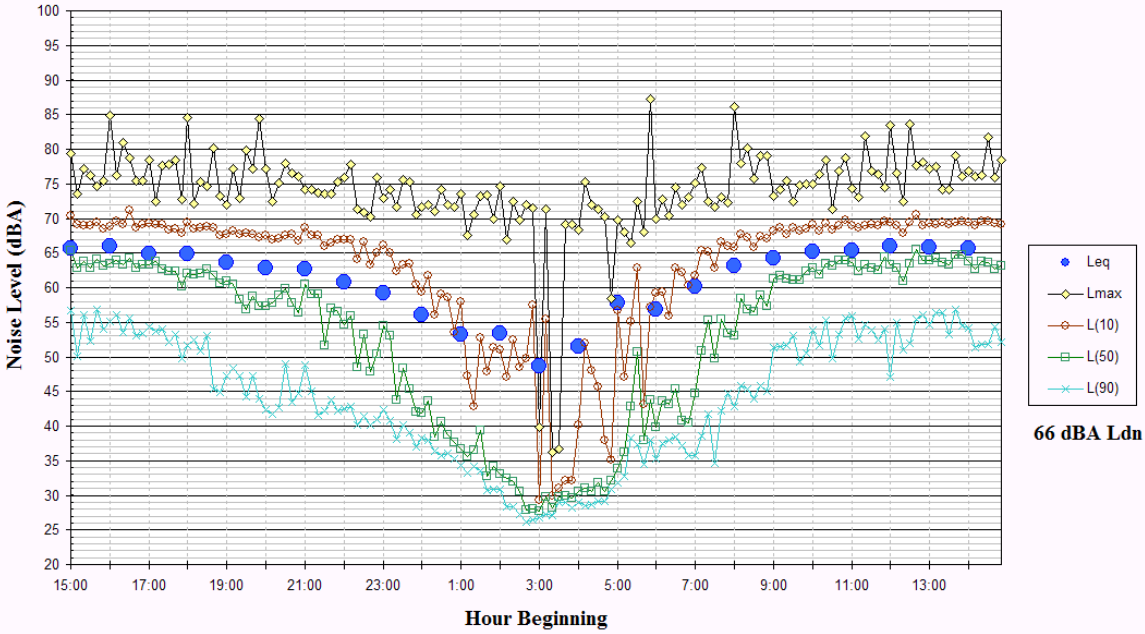
68 dBA Ldn

Figure 13: Noise Levels at LT-3
~45 feet from the Center of Alpine Road
Between Westridge Drive and Golden Oak Drive
June 1-2, 2007



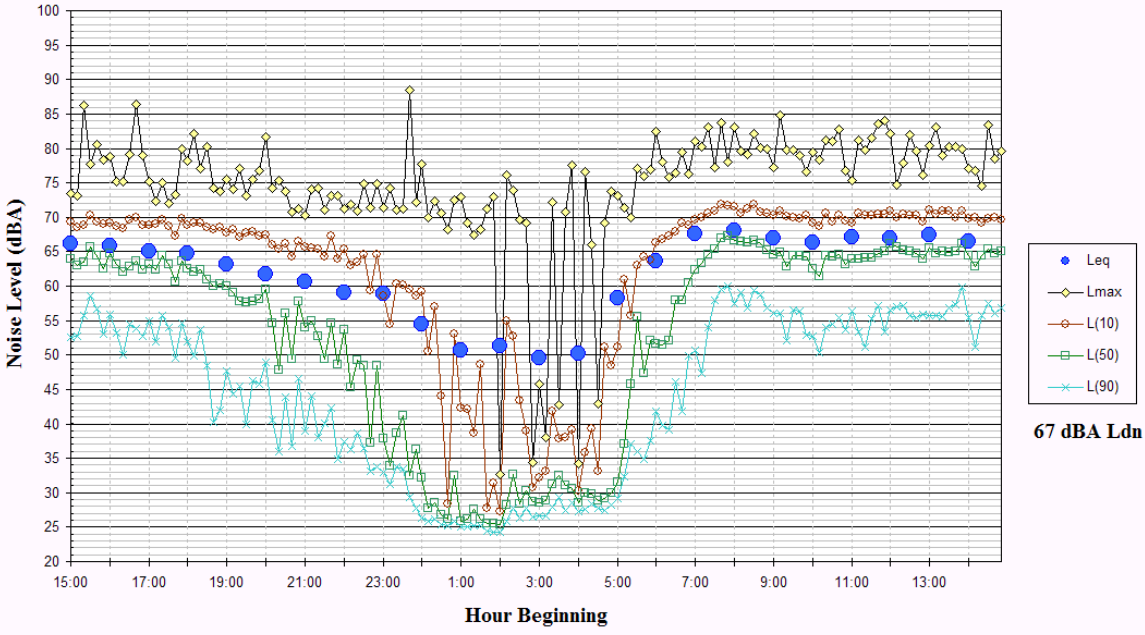
66 dBA Ldn

Figure 14: Noise Levels at LT-3
~45 feet from the Center of Alpine Road
Between Westridge Drive and Golden Oak Drive
June 2-3, 2007



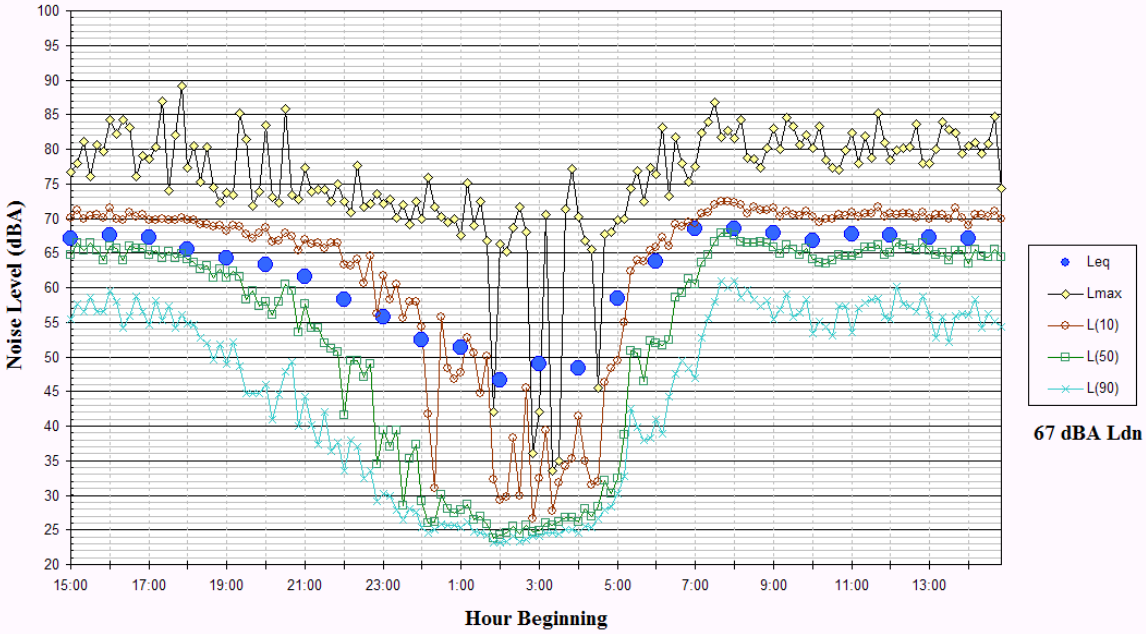
66 dBA Ldn

Figure 15: Noise Levels at LT-3
~45 feet from the Center of Alpine Road
Between Westridge Drive and Golden Oak Drive
June 3-4, 2007



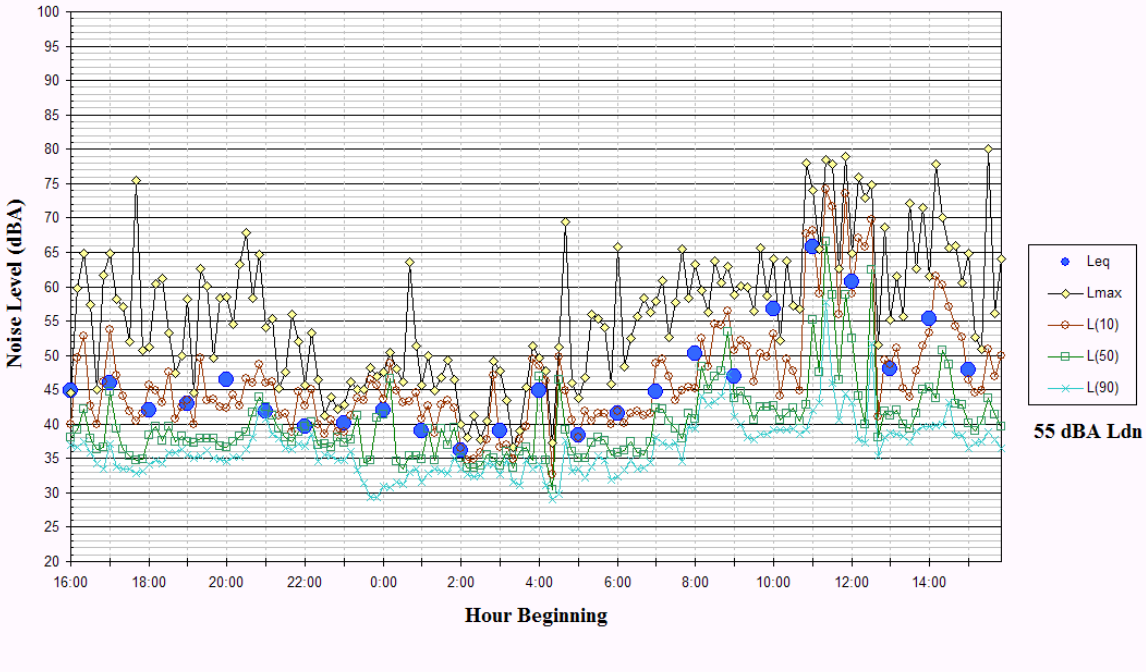
67 dBA Ldn

Figure 16: Noise Levels at LT-3
~45 feet from the Center of Alpine Road
Between Westridge Drive and Golden Oak Drive
June 4-5, 2007



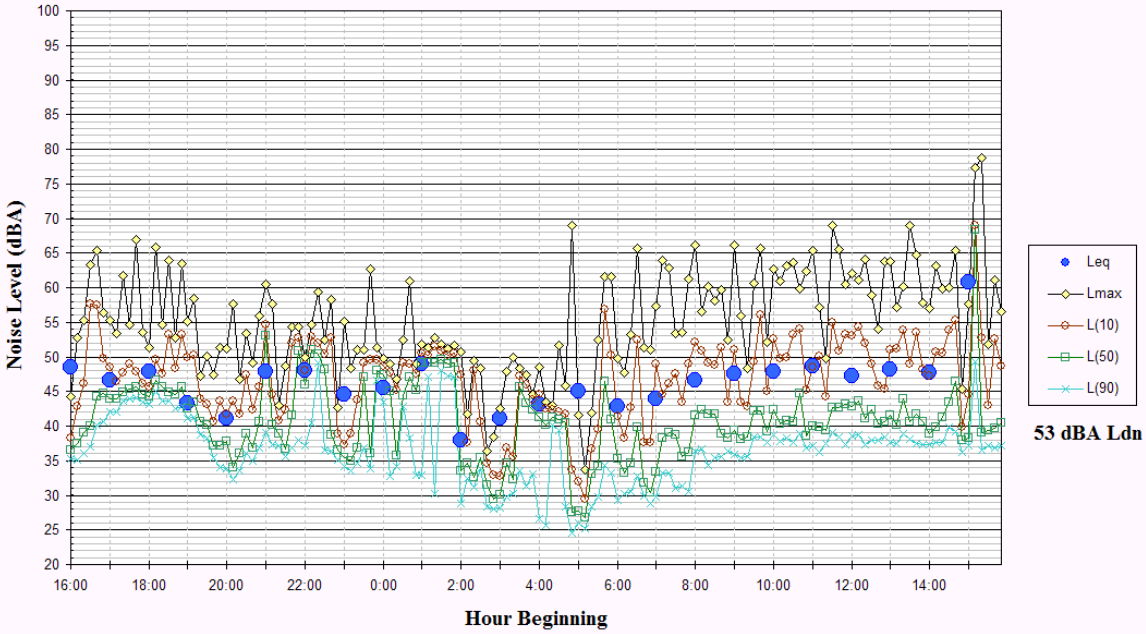
67 dBA Ldn

Figure 17: Noise Levels at LT-4
End of Goya Road
May 31-June 1, 2007



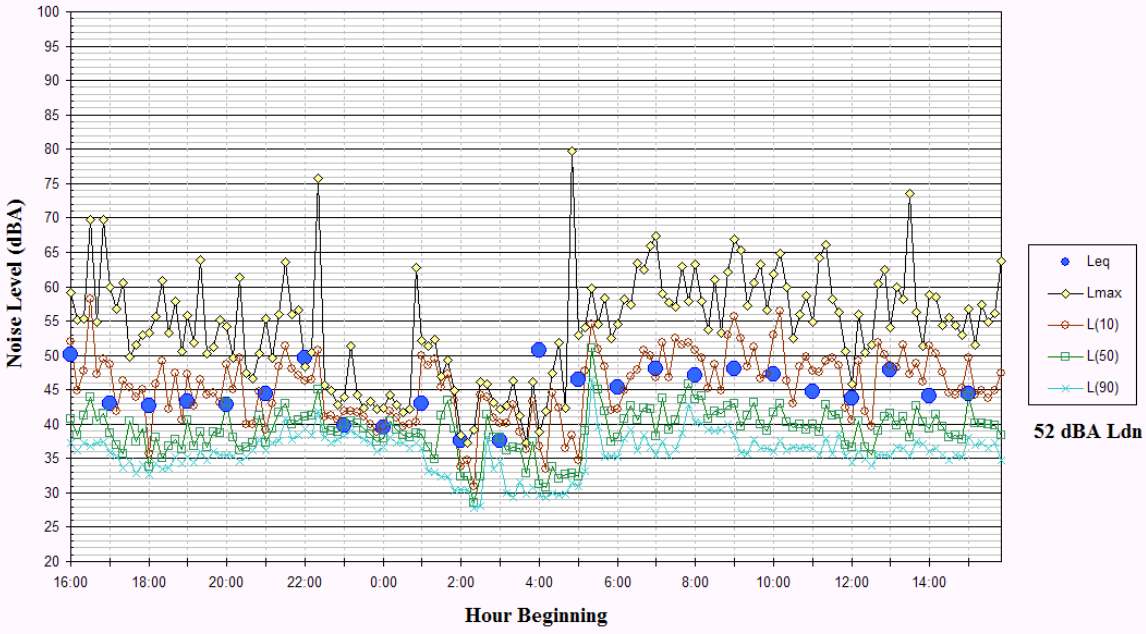
55 dBA Ldn

Figure 18: Noise Levels at LT-4
End of Goya Road
June 1-2, 2007



53 dBA Ldn

Figure 19: Noise Levels at LT-4
End of Goya Road
June 2-3, 2007



52 dBA Ldn

Figure 20: Noise Levels at LT-4
End of Goya Road
June 3-4, 2007

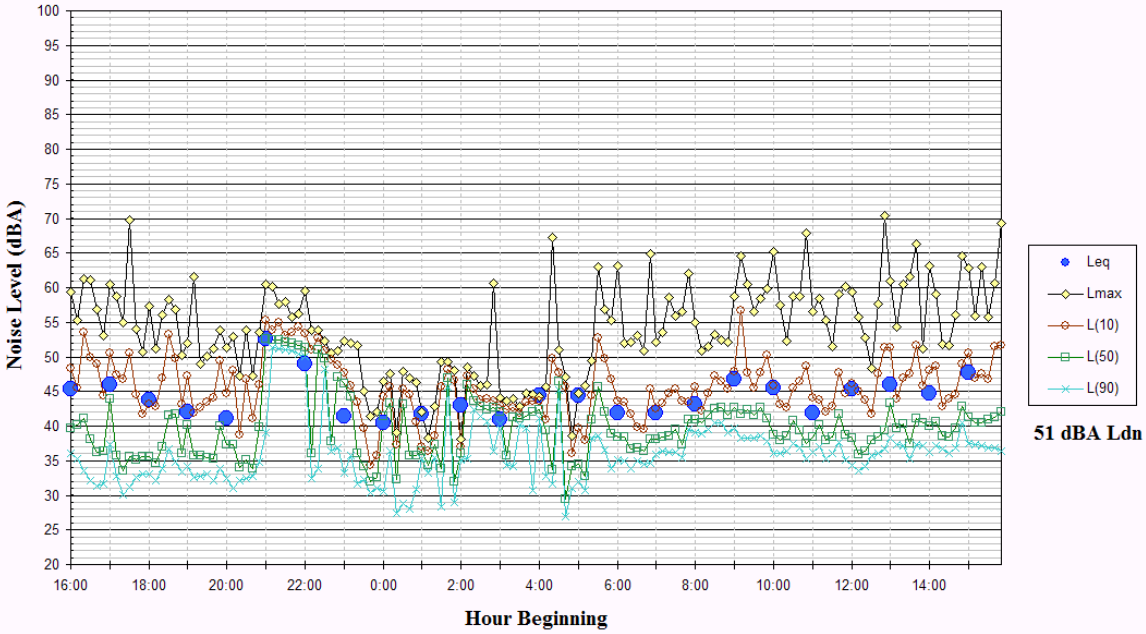


Figure 21: Noise Levels at LT-4
End of Goya Road
June 4-5, 2007

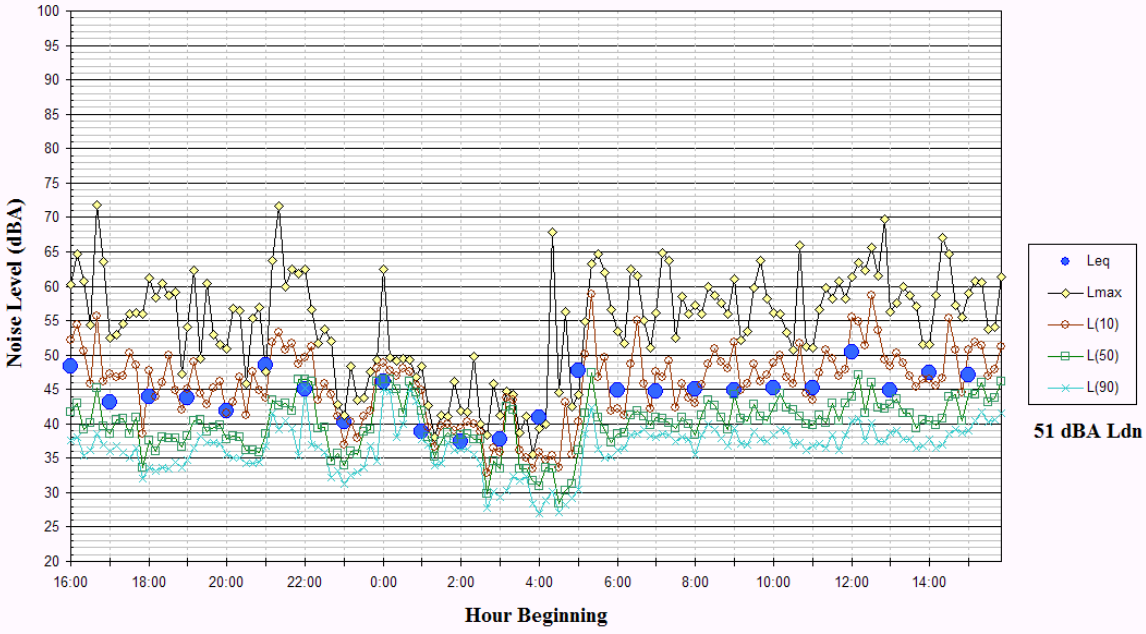


Figure 22: Noise Levels at LT-5
30 Toro Court
May 31-June 1, 2007

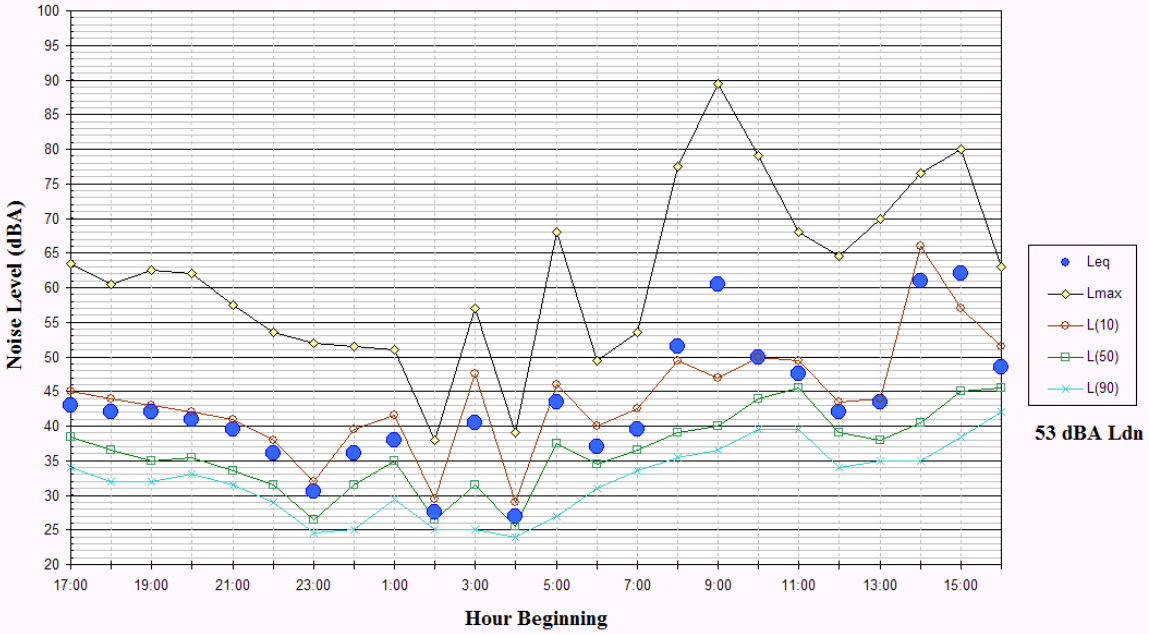


Figure 23: Noise Levels at LT-5
30 Toro Court
June 1-2, 2007

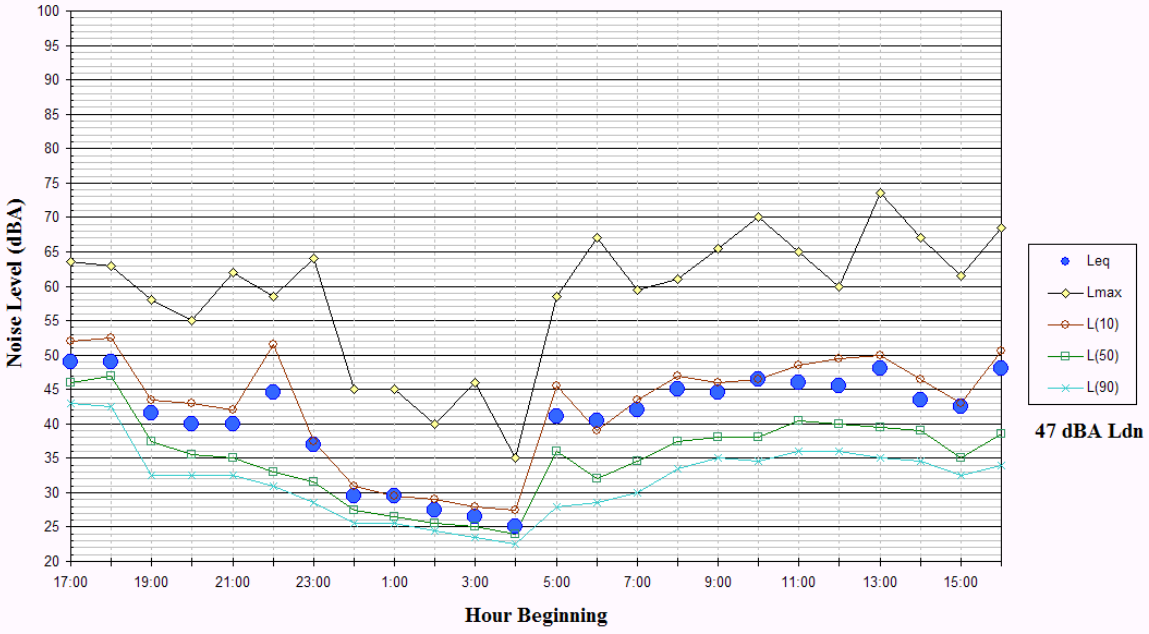


Figure 24: Noise Levels at LT-5
30 Toro Court
June 2-3, 2007

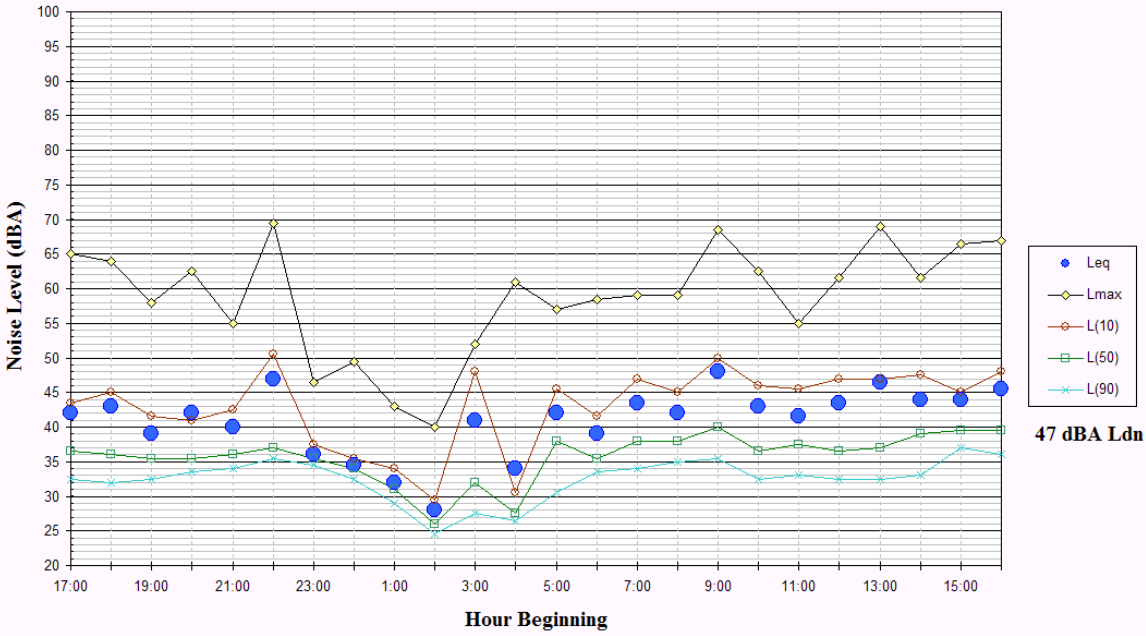


Figure 25: Noise Levels at LT-5
30 Toro Court
June 3-4, 2007

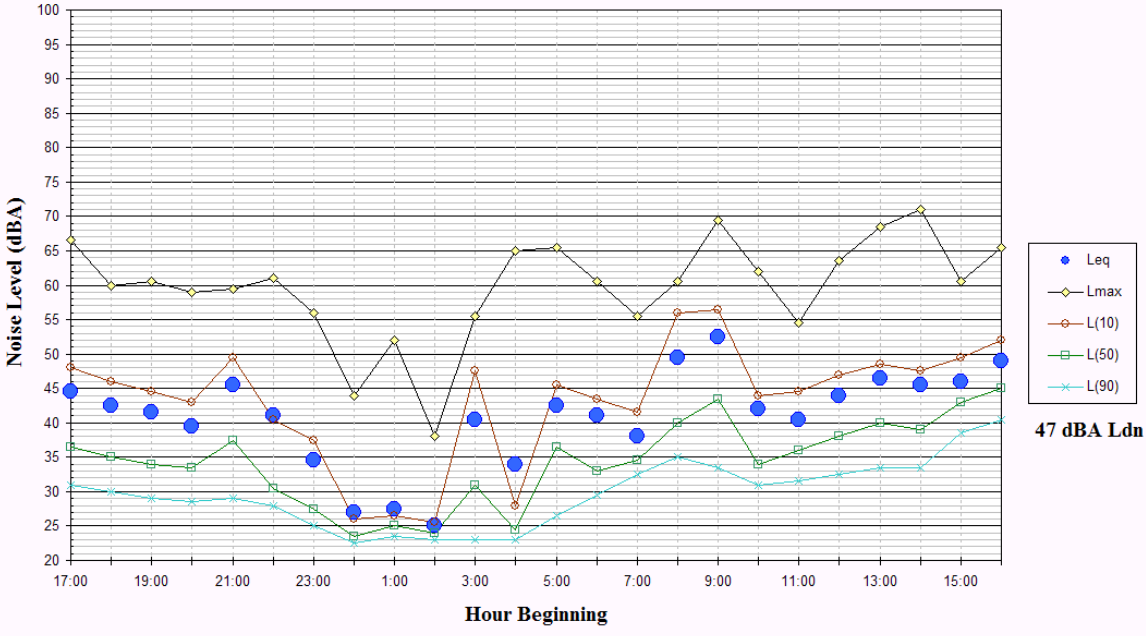
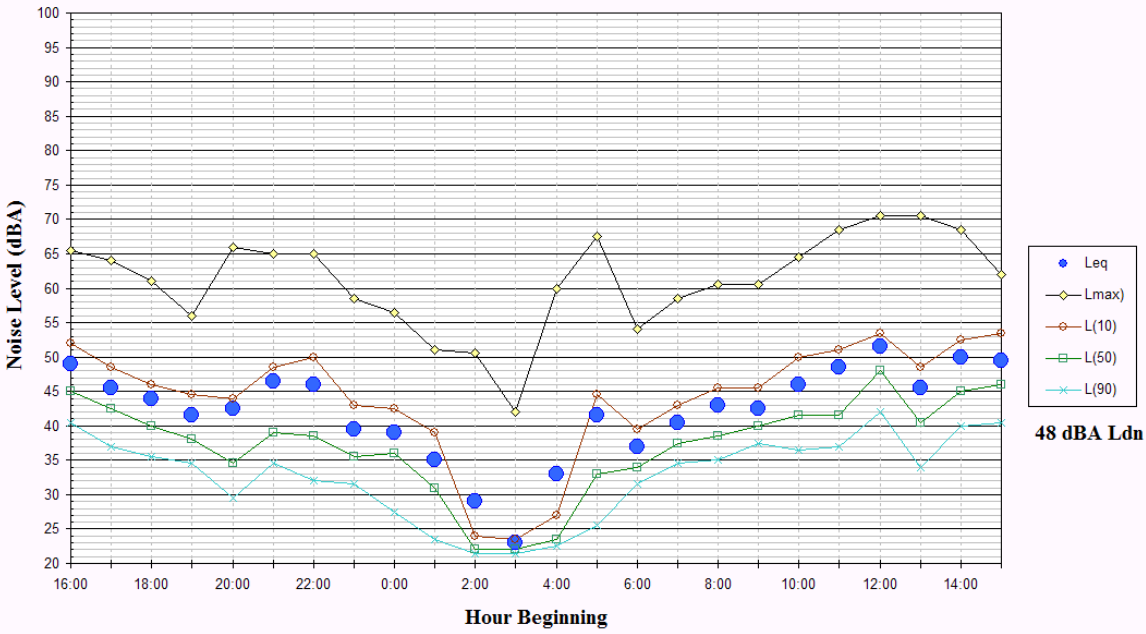


Figure 26: Noise Levels at LT-5
30 Toro Court
June 4-5, 2007



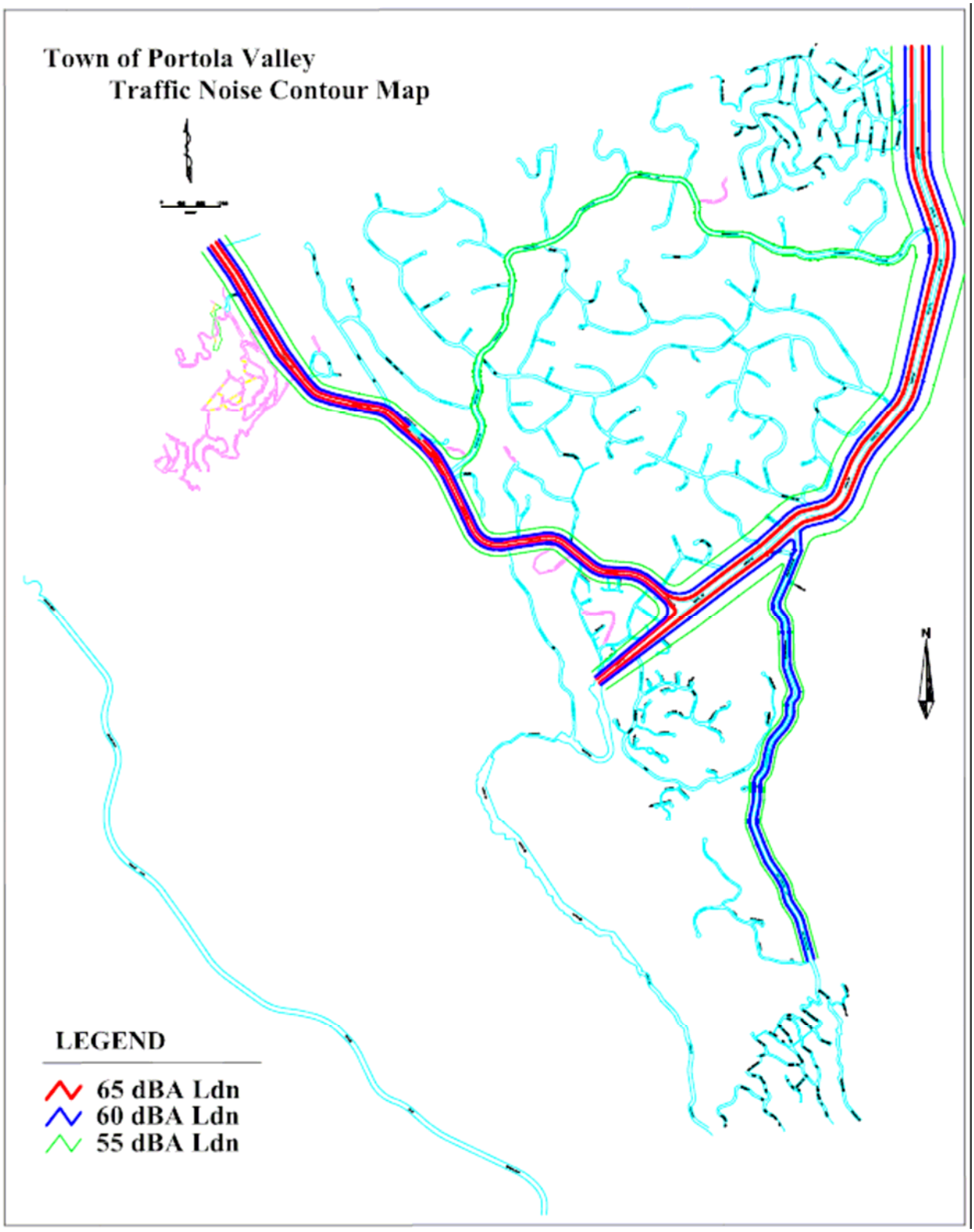


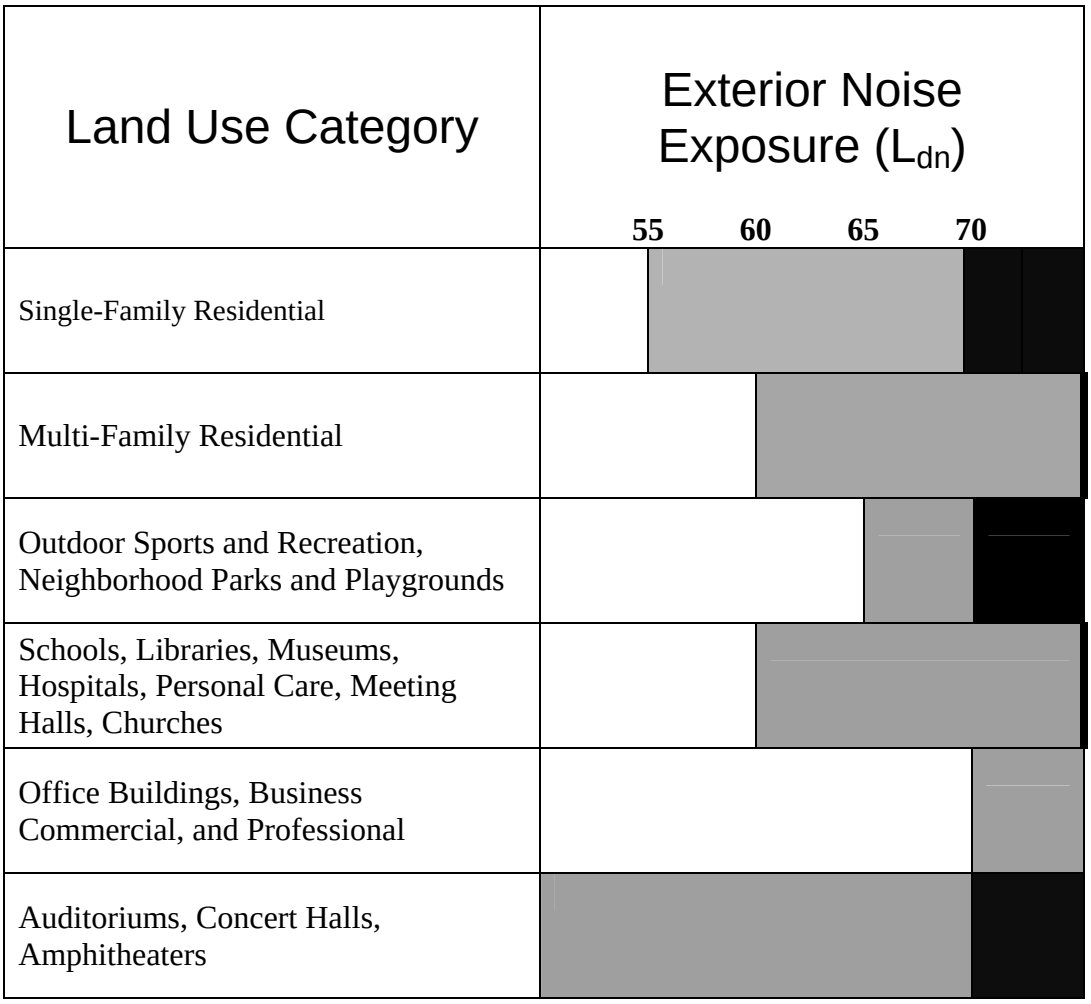
Figure 27: Noise Contour Map

LAND USE CATEGORY	COMMUNITY NOISE EXPOSURE Ldn or CNEL, dB 55 60 65 70 75 80
Residential – Low Density Single Family, Duplex, Mobile Homes	
Residential- Multi-family	
Transient Lodging – Motels, Hotels	
Schools, Libraries, Churches, Hospitals, Nursing Homes	
Auditoriums, Concert Hall, Amphitheatre	
Sports Arena, Outdoor Spectator Sports	
Playgrounds, Neighborhood Parks	
Golf Courses, Riding Stables, Water Recreation, Cemeteries	
Office Buildings, Business, Commercial and Professional	
Industrial, Manufacturing, Utilities, Agriculture	

Normally Acceptable: Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.	**Normally Unacceptable:** New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.
Clearly Unacceptable: New construction or development should generally not be undertaken	**Conditionally Acceptable:** New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Figure 28

Source: California Office of Planning and Research



NORMALLY ACCEPTABLE

Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special insulation requirements

CONDITIONALLY ACCEPTABLE

Specified land use may be permitted only after detailed analysis of the noise reduction requirements and needed noise insulation features included in the design

UNACCEPTABLE

New construction or development should generally not be undertaken because mitigation is usually not feasible to comply with noise element policies

Figure 29 - Land Use Compatibility For Transportation Noise