4.9 NOISE

This section describes the existing ambient noise conditions of the Specific Plan Area and evaluates the potential noise impacts associated with the Specific Plan. Noise levels were measured in locations where future development of noise sensitive land uses would occur or where future development would border existing noise sensitive land uses.

A. Regulatory Framework

Fundamental concepts of environmental acoustics vibration begin the discussion of this section. Following these fundamental concepts is a summary of federal, State and local laws, policies and regulations that apply to the noise analyses.

1. Fundamental Concepts of Environmental Acoustics and Vibration

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound can 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 that 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 4.9-1.

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 4.9-2. 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 Leq. The most common averaging period is hourly, but Leq 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.

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 p.m. - 10:00 p.m.) and a 10 dB addition to nocturnal (10:00 p.m. - 7:00 a.m.) noise levels. The Day/Night Average Sound Level (Ldn or DNL), is essentially the same as CNEL, with the exception that the

Table 4.9-1 **DEFINITIONS OF ACOUSTICAL TERMS**

Term	Definitions
Decibel, dB	A unit describing the amplitude of sound.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure.
A-Weighted Sound Level, dBA	Decibel level as measured using the A-weighting filter network which 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 correlating well with subjective reactions to noise. All sound levels in this report are A-weighted, unless reported otherwise.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1 percent, 10 percent, 50 percent, and 90 percent of the time during the measurement period.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels to sound levels measured from 7:00 p.m. to 10:00 p.m. and 10 decibels to sound levels measured between 10:00 p.m. and 7:00 a.m.
Day/Night Noise Level, L_{dn} or DNL	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 p.m. and 7:00 a.m.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level 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	Noise which intrudes over and above the existing ambient noise at a given location. Relative intrusiveness depends on amplitude, duration, frequency, time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

TABLE 4.9-2 **TYPICAL SOUND LEVELS**

Outdoor Sound (distance from source)	DBA	Indoor Sound	Threshold
	140		
Civil Defense Siren (100')	130		
Jet Takeoff (200')	120		Pain Threshold
	110		
Diesel Pile Driver (100')	100	Rock Music Concert	Very Loud
	90	Boiler Room Printing Press Plant	
Freight Cars (50')	80		
	70	In Kitchen With Garbage Disposal Running	Moderately Loud
Freeway (100') Vacuum Cleaner (10')	60	Data Processing Center	
Light Traffic (100') Large Transformer (200')	50	Department Store	
	40	Private Business Office	
Soft Whisper (5')	30	Quiet Bedroom	Quiet
	20		
	10	Recording Studio	
	0		Threshold of Hearing

evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

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 Ldn. Typically, the highest steady traffic noise level during the daytime is about equal to the Ldn, 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 15 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 60 dBA Ldn with open windows and 65-70 dBA Ldn 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 have closable windows, and bedrooms facing major roadways and freeways typically need special glass windows.

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. Previous attitude surveys have determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The Ldn as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. There continues to be disagreement about the relative annoyance of noise caused by aircraft and ground transportation. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 55 dBA Ldn. At an Ldn of about 60 dBA, approximately 2 percent of the population is highly annoyed. When the Ldn 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 Ldn of 60-70 dBA. Between an Ldn of 70-80 dBA, each decibel increases percentage of the population highly annoyed by about 2 percent.

People appear to respond more adversely to aircraft noise. When the Ldn 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.

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several methods are typically used to quantify the amplitude of vibration including Peak Particle Velocity (PPV) and Root Mean Square (RMS) velocity. PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. RMS velocity is defined as the average of the squared amplitude of the signal. PPV and RMS vibration velocity amplitudes are used to evaluate human response to vibration.

Table 4.9-3 displays continuous vibration impacts on human annoyance and on buildings. As discussed previously, annoyance is a subjective measure and vibrations may be found to be annoying at much lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying.

Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage. In high noise environments, which are more prevalent where groundborne vibration approaches perceptible levels, this rattling phenomenon may also be produced by loud airborne environmental noise causing induced vibration in exterior doors and windows.

TABLE 4.9-3 **REACTION OF PEOPLE AND DAMAGE TO BUILDINGS FOR CONTINUOUS VIBRATION LEVELS**[a]

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.006- 0.019	Threshold of perception: Possibility of intrusion	Vibration unlikely to cause damage of any type
0.08	Vibrations readily perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.10	Level at which continuous vibrations begin to annoy people	Virtually no risk of "architectural" damage to normal buildings
0.20	Vibrations annoying to people in buildings	Threshold at which there is a risk of "architectural" damage to normal dwellings such as plastered walls or ceilings.
0.50	Vibrations considered unpleasant by people subjected to continuous vibrations	Vibration at this level would cause "architectural" damage and possibly minor structural damage.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generate the highest construction related ground-borne vibration levels. Because of the impulsive nature of such activities, the use of the peak particle velocity descriptor has been routinely used to measure and assess ground-borne vibration and almost exclusively to assess the potential of vibration to induce structural damage and the degree of annoyance for humans.

The two primary concerns with vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Studies have shown that the threshold of perception for average persons is in the range of 0.006 to 0.09 inches/sec, PPV. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels such as people in an urban environment may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as minor cracking of building elements, or may threaten the integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher and there is no general consensus as to what amount of vibration may pose a threat for structural damage to the building. Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is already at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

Railroad train vibration is an example of a vibration that can be annoying to people. People's response to ground vibration has been correlated best with the velocity of the ground. The velocity of the ground is expressed on the decibel scale. The reference velocity is 1 x 10^{-6} in./sec. RMS, which equals 0 VdB, and 1 in./sec. equals 120 VdB. Although not a universally accepted notation, the abbreviation "VdB" is used in this document for vibration decibels to reduce the potential for confusion with sound decibels.

Typical background vibration levels in residential areas are usually 50 VdB or lower, well below the threshold of perception for most humans. Perceptible vibration levels inside residences are attributed to the operation of heating and air conditioning systems, door slams and foot traffic. Construction activities, train operations, and street traffic are some of the most common external sources of vibration that can be perceptible inside residences.

One of the problems with developing suitable criteria for groundborne vibration is the limited research into human response to vibration and more importantly human annoyance inside buildings. However, experience with rapid transit systems over the last few decades has developed rational vibration limits that can be used to evaluate human annoyance to groundborne vibration. These criteria are primarily based on experience with passenger train operations, such as rapid transit and commuter rail systems. The main difference between passenger and freight operations is the time duration of individual events; a passenger train lasts few seconds whereas a long freight train may last several minutes, depending on speed and length. Although these criteria are based on shorter duration events reflected by passenger trains, they are also used in this assessment to evaluate the potential of vibration annoyance on the site due to large freight trains.

The City of Santa Rosa has not identified quantifiable vibration limits that can be used to evaluate the compatibility of land uses with the expected vibration environment. Although there are no local standards that control the allowable vibration in a new residential development, the U.S. Department of Transportation has developed vibration impact assessment criteria for evaluating vibration impacts associated with transit projects. The Federal Transit Administration (FTA) has proposed vibration impact criteria, based on maximum overall levels for a single event. The impact criteria for groundborne vibration are shown in Table 4.9-5. Note that there are criteria for frequent events (more than 70 events of the same source per day), occasional events (30 to 70 vibration events of the same source per day), and infrequent events (less than 30 vibration events of the same source per day).

2. State Laws and Regulations

a. California Building Code

New multi-family housing in the State of California is subject to the environmental noise limits set forth in Appendix Chapter 1208A.8.4 of the California Building Code. The noise limit is a maximum interior noise level of 45 dBA DNL. Where exterior noise levels exceed dBA 60 dBA DNL, a report must be submitted with the building plans describing the noise control measures that have been incorporated into the design of the project to meet the interior noise limit.

TABLE 4.9-5 **RAILROAD TRAIN GROUNDBORNE VIBRATION IMPACT CRITERIA**

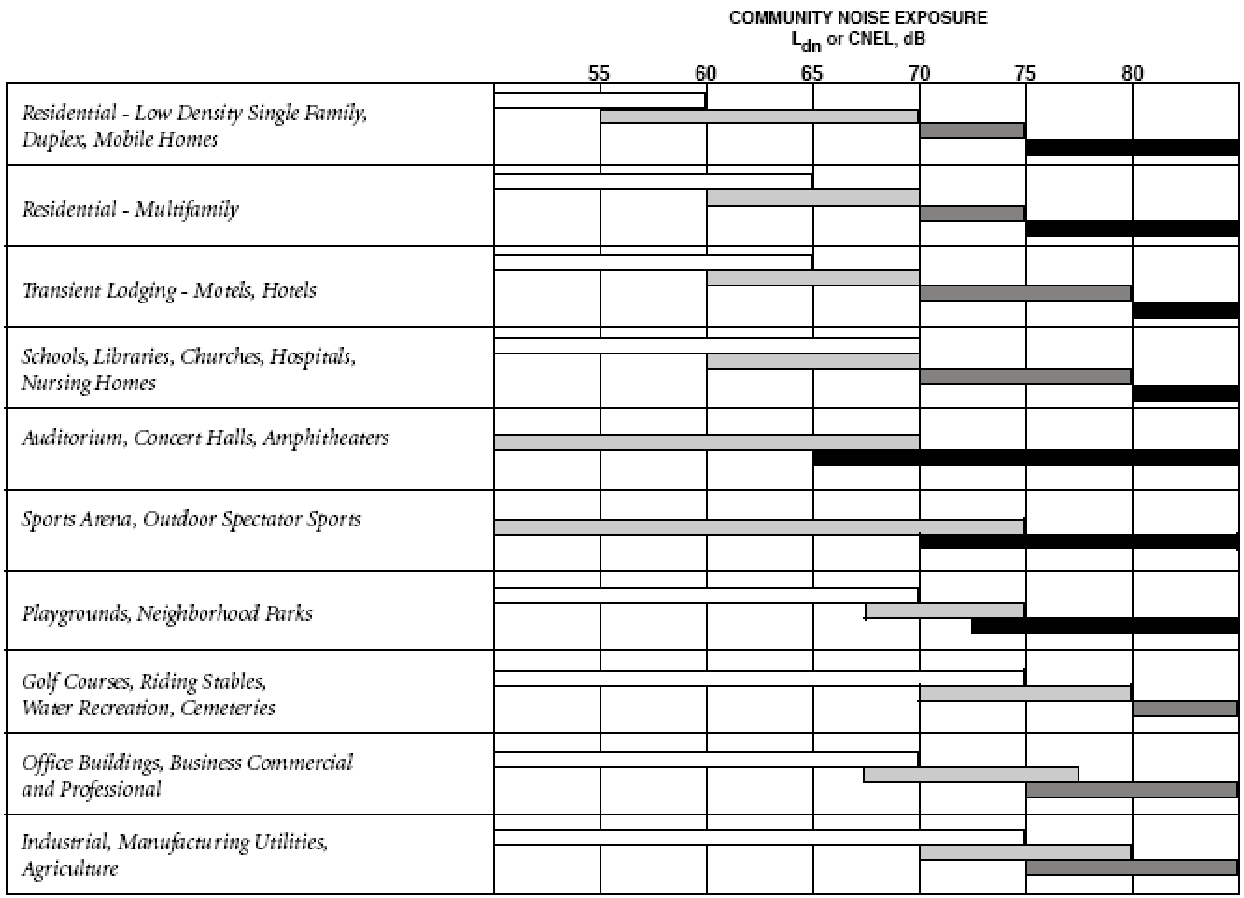
Land Use Category *Note, Existing Conds	Groundborne Vibration Impact Levels (VdB re 1 µinch/sec, RMS)		
	Frequent Events[a]	Occasional Events[b]	Infrequent Events[c]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB[d]	65 VdB[d]	65 VdB[d]
Category 2: Residences and buildings where people normally sleep	72 VdlB	75 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB

[a] "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall in this category.
[b] "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day.
[c] "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
[d] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research should always require detailed evaluation to define the acceptable vibration levels. Ensuring low vibration levels in a building requires special design of HVAC systems and stiffened floors.
Source: U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment, May 2006, FTA-VA-90-1003-06.

3. Local Laws and Regulations

a. City of Santa Rosa General Plan Noise and Safety Element

- Policy NS-B-1. Do not locate noise-sensitive uses in proximity to major noise sources.
- Policy NS-B-2. Encourage residential developers to provide buffers other than sound walls, where practical. Allow sound walls only when projected (2020) noise levels at a site exceed land use compatibility standards in Figure 4.9-1.



LEGEND:

NORMALLY ACCEPTABLE
Specified land use is satisfactory, based upon the assumption that any building involved is of normal conventional construction, without any special noise insulation requirements.

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.

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.

FIGURE 4.9-1

NOISE LAND USE COMPATIBILITY GUIDELINES

- ♦ Policy NS-B-3. Prevent new stationary and transportation noise sources from creating a nuisance in existing developed areas. Use a comprehensive program of noise prevention through planning and mitigation, and consider noise impacts as a crucial factor in project approval.

- ♦ Policy NS-B-4. Require new projects in the following categories to submit an acoustical study, prepared by a qualified acoustical consultant:

  - All new projects proposed for areas with existing noise above 60dBA DNL. Mitigation shall be sufficient to reduce noise levels below 45 dBA DNL in habitable rooms and 60dBA DNL in private and shared recreational facilities. Additions to existing housing units are exempt.

  - All new projects that could generate noise whose impacts on other existing uses would be greater than those normally acceptable (as specified in the Land Use Compatibility Standards).

- ♦ Policy NS-B-5. Pursue measures to reduce noise impacts primarily through site planning. Engineering solutions for noise mitigation, such as sound walls, are the least desirable alternative.

- ♦ Policy NS-B-8. Adopt mitigations, including reduced speed limits, improved paving texture, and traffic controls, to reduce noise to normally acceptable levels in areas where noise standards may be exceeded (e.g., where homes front regional/arterial streets and in areas of mixed use development).

- ♦ Policy NS-B-9. Encourage developers to incorporate acoustical site planning into their projects. Recommended measures include:
  - Incorporating buffers and/or landscaped earth berms;
  - Orienting windows and outdoor living areas away from unacceptable noise exposure;
  - Using reduced-noise pavement (rubberized-asphalt);
  - Incorporating traffic calming measures, alternative intersection designs, and lower speed limits; and
  - Incorporating state-of-the-art structural sound attenuation and setbacks.

- Policy NS-B-10. Work with private enterprises to reduce or eliminate nuisance noise from industrial and commercial sources that impact nearby residential areas. If progress is not made within a reasonable time, the City shall issue abatement orders or take other legal measures.
- Policy NS-B-14. Discourage new projects that have potential to create ambient noise levels more than 5 dBA DNL above existing background, within 250 feet of sensitive receptors.

b. Santa Rosa Municipal Code Noise Ordinance

The Santa Rosa Municipal Code regulates and controls the adverse effects of noise on citizens. The following provisions apply to the Specific Plan:

- *17-16.030 Ambient Base Noise Level Criteria.* The following criteria will be used as a base (ambient noise level) from which noise levels can be compared.

Zone	**Time**	**Sound Level A (decibels) Community Environment Classification**
R1 and R2	10 p.m. to 7 a.m.	45
R1 and R2	7 p.m. to 10 p.m.	50
R1 and R2	7 a.m. to 7 p.m.	55
Multi-family	10 p.m. to 7 a.m.	50
Multi-family	7 a.m. to 10 p.m.	55
Office & Commercial	10 p.m. to 7 a.m.	55
Office & Commercial	7 a.m. to 10 p.m.	60
Intensive Commercial*	10 p.m. to 7 a.m.	55
Intensive Commercial	7 a.m. to 10 p.m.	65
Industrial	Anytime	70

- *17-16.120 Machinery and Equipment.* It is unlawful for any person to operate any machinery, equipment, pump, fan, air-conditioning apparatus or similar mechanical device in any manner so as to create any noise which would cause the noise level at the property line of any property to exceed the ambient base noise level by more than five decibels.

B. Existing Conditions

Illingworth & Rodkin, Inc. measured noise levels from February 6 to 8, 2006 at locations where noise sensitive uses may be developed or where development may impact existing noise sensitive land uses. Seven long-term (LT) and nine short-term (ST) measurements were made within the project area. Noise measurement locations (LT & ST) are shown on Figure 4.9-2. Noise measurements were made using a Larson Davis Model 820 sound level meters fitted with precision microphones. The sound level measuring assemblies were calibrated prior to and immediately after the noise measurement and were found to be within 0.1 dBA.

Long-term measurements were made along each of the major transportation routes, including U.S. Highway 101, State Route 12, and representative arterial roadways. From these data, one determines the hour-by-hour distribution of noise levels, allowing the 24-hour day/night average noise level to be estimated from short-term measurements made at satellite locations. The measurement sites were picked to provide information on the noise levels at key locations identified within the Specific Plan Area.

The primary noise source within the Specific Plan Area is traffic along the arterial roadways and highways. Noise produced by stationary industrial sources was audible in the vicinity of existing industrial uses. The following is a description of the noise measurements.

Specific Plan Area
Railroad
Long-term Site
Short-term Site

FIGURE 4.9-2

NOISE MEASUREMENT LOCATIONS

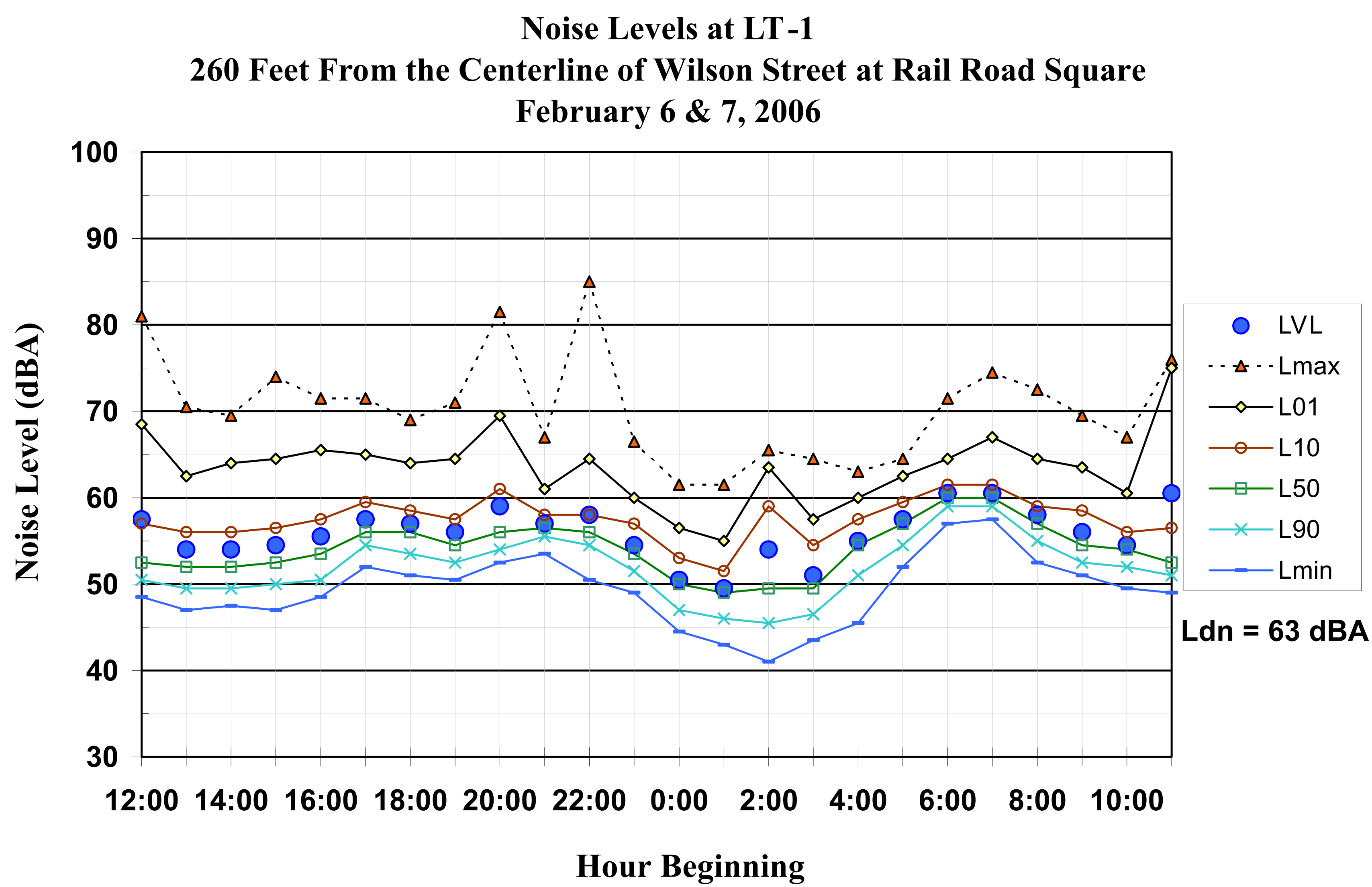
1. Long-Term Noise Measurements

Long-term measurement one (LT-1) was made from February 6^{th} to 7^{th}, 2006, and was located in Railroad Square, about 260 feet from Wilson Street and 280 feet from West Sixth Street. The primary noise source at this location was Wilson Street with steady background noise from Highway 101. The microphone was positioned at a height of approximately 12 feet above the surrounding ground. Hourly Leq noise levels ranged from about 54 dBA to 60 dBA. The calculated day-night average noise level was 63 dBA Ldn. The daily trend in noise levels at the long-term location is shown in Figure 4.9-3.

Long-term measurement two (LT-2) was made from February 6 to 7, 2006, and was about 40 feet from the centerline of Cleveland Avenue, near 10th Street. The primary noise source at this location was Cleveland Avenue with intermittent industrial noise. Steady background noise from Highway 101 was also present. The microphone was positioned at a height of approximately 10 feet above the surrounding ground. Hourly Leq noise levels ranged from about 52 dBA to 67 dBA. The calculated day-night average noise level was 67 dBA Ldn. The daily trend in noise levels at the long-term location is shown in Figure 4.9-4.

Long-term measurement three (LT-3) was made from February 6 to 7, 2006, and was located on the north side of Highway 12 near the eastern border of the project boundary. The measurement was made about 110 feet from the centerline of Highway 12. The primary noise source at this location was Highway 12. The microphone was positioned at a height of approximately 12 feet above the surrounding ground. Daytime Hourly Leq noise levels ranged from about 70 dBA to 75 dBA and nighttime Leq noise levels ranged from 62 dBA to 70 dBA. The calculated day-night average noise level was 75 dBA Ldn. The daily trend in noise levels at the long-term location is shown in Figure 4.9-5.

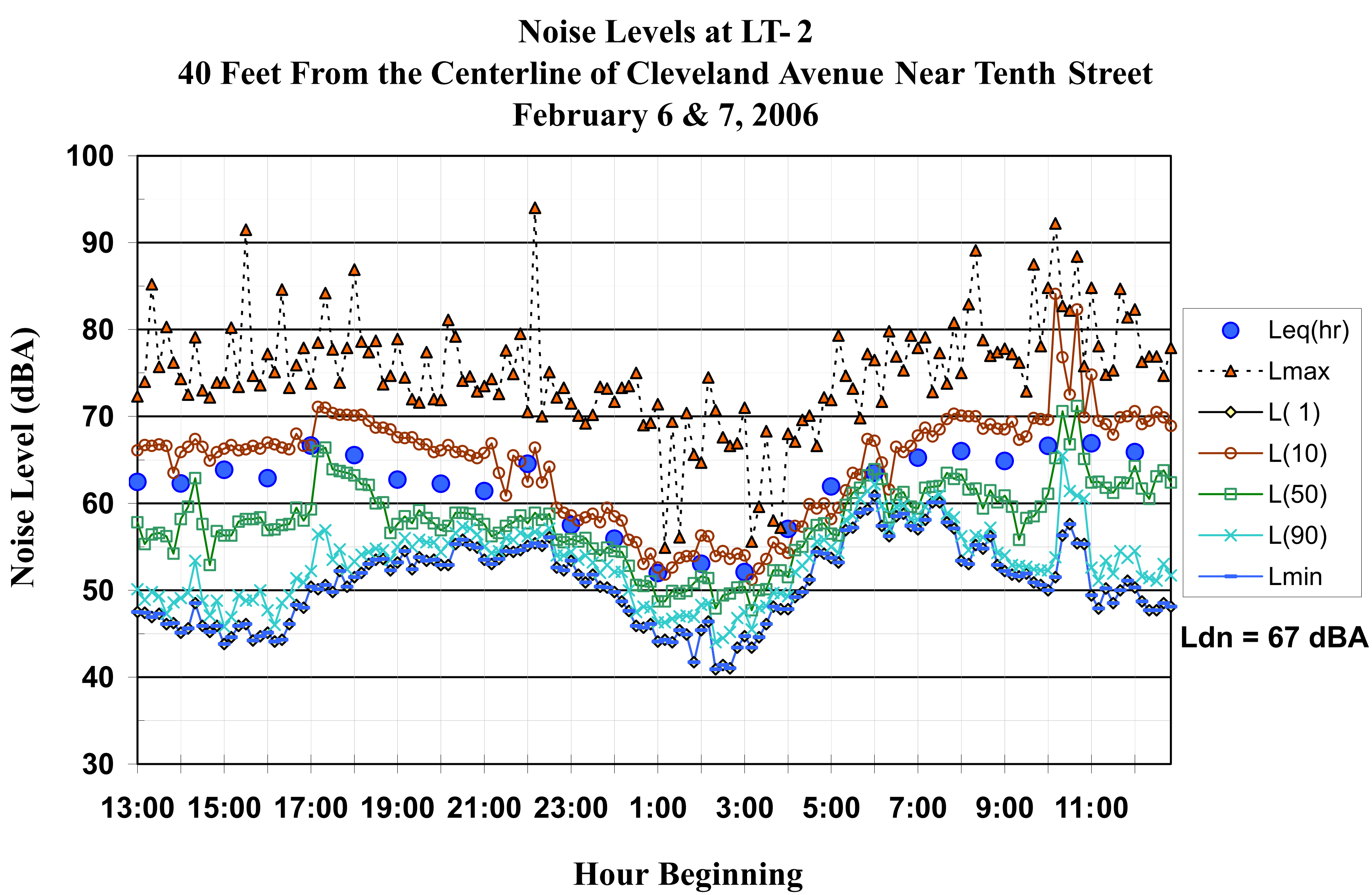
Long-term measurement four (LT-4) was made from February 7 to 8, 2006, and was located on the south side of Highway 12, at the end of Roberts Avenue. The measurement was about 140 feet from the Highway 12 centerline.



Source: Illungworth & Rodkin, Inc.

FIGURE 4.9-3

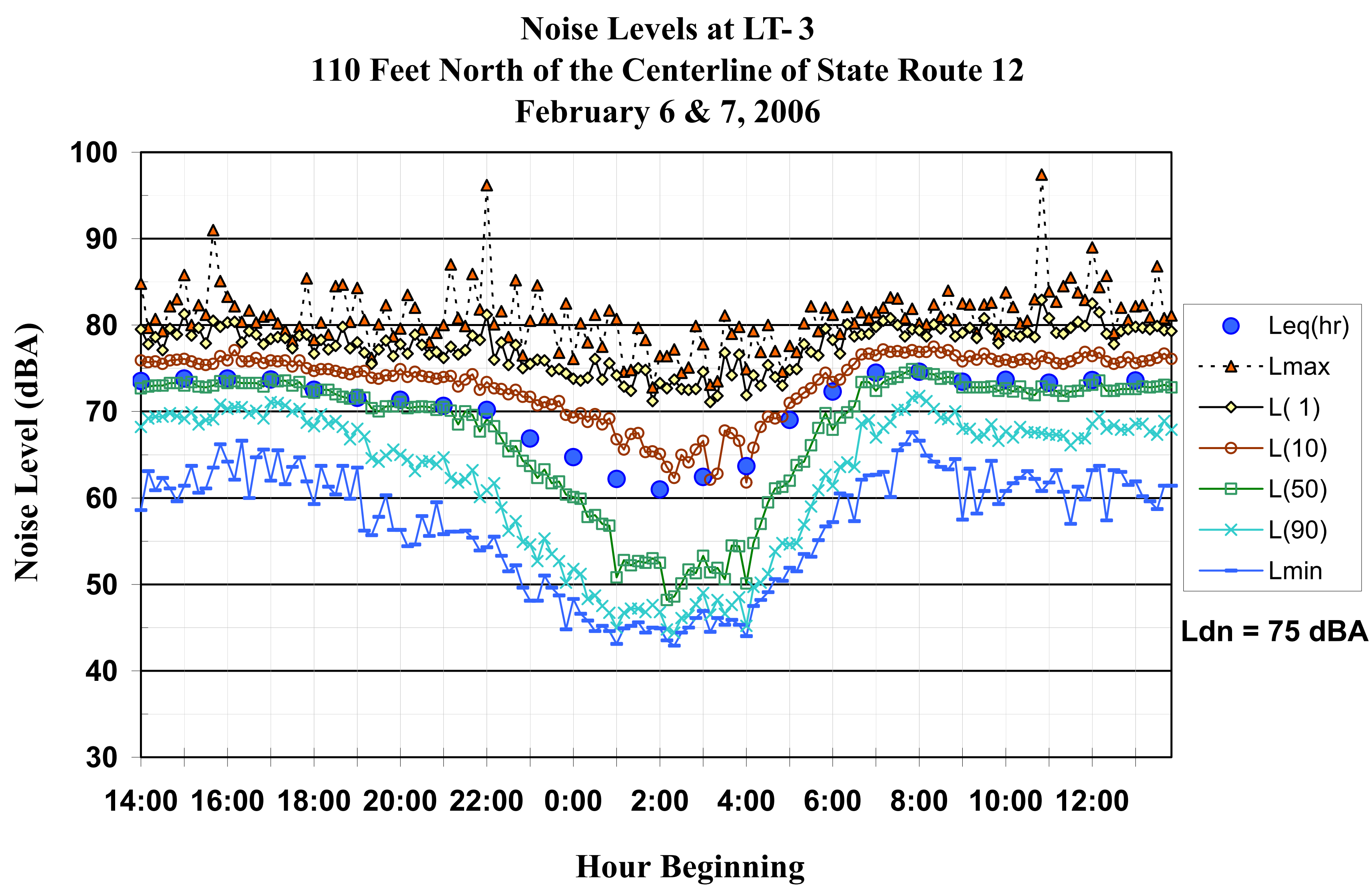
DAILY TREND IN NOISE LEVELS AT LT-1



Source: Illungworth & Rodkin, Inc.

FIGURE 4.9-4

DAILY TREND IN NOISE LEVELS AT LT-2



Source: Illungworth & Rodkin, Inc.

FIGURE 4.9-5

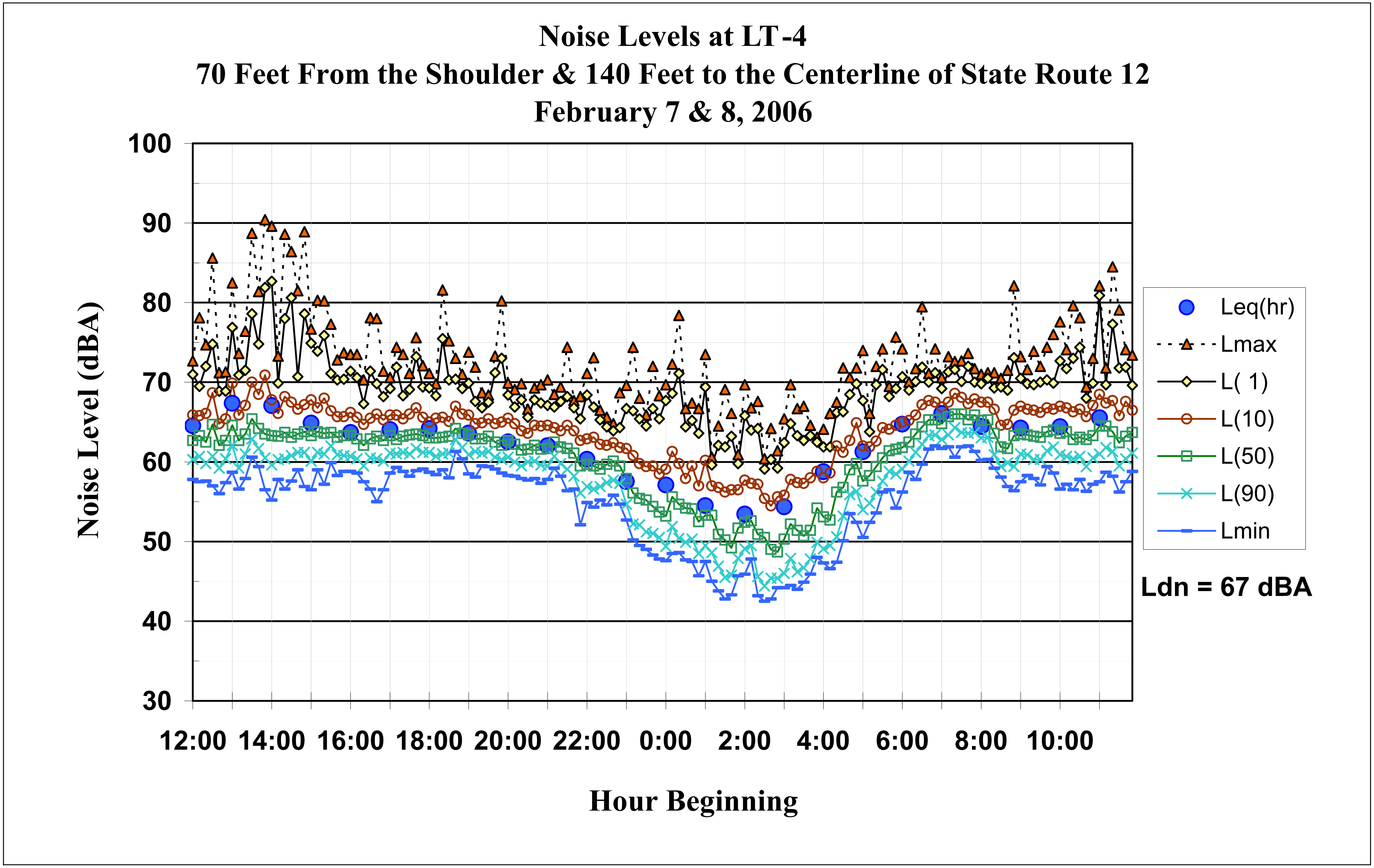
DAILY TREND IN NOISE LEVELS AT LT-3

The primary noise source at this location was Highway 12 with nearby industrial noise. The microphone was positioned at a height of approximately 12 feet above the surrounding ground. There was significant acoustic shielding from Highway 12, because the highway is about 30 feet above ground from this development area. Hourly Leq noise levels ranged from about 53 dBA to 67 dBA. The calculated day-night average noise level was 67 dBA Ldn. The daily trend in noise levels at the long-term location is shown in Figure 4.9-6.

Long-term measurement five (LT-5) was made from February 7 to 8, 2006, and was located about 160 feet from the centerline of Highway 101. The primary noise source at this location was Highway 101 with occasional passbys on Morgan Street. The microphone was positioned with a clear, unobstructed view of the freeway. Hourly Leq noise levels ranged from about 62 dBA to 72 dBA. The calculated day-night average noise level was 74 dBA Ldn. The daily trend in noise levels at the long-term location is shown in Figure 4.9-7.

Long-term measurement six (LT-6) was made from February 7 to 8, 2006, and was located about 43 feet from the centerline of B Street. The primary noise source at this location was B Street with occasional parking lot traffic. The microphone was positioned at a height of approximately 10 feet above the surrounding ground. Hourly Leq noise levels ranged from about 53 dBA to 67 dBA. The calculated day-night average noise level was 68 dBA Ldn. The daily trend in noise levels at the long-term location is shown in Figure 4.9-8.

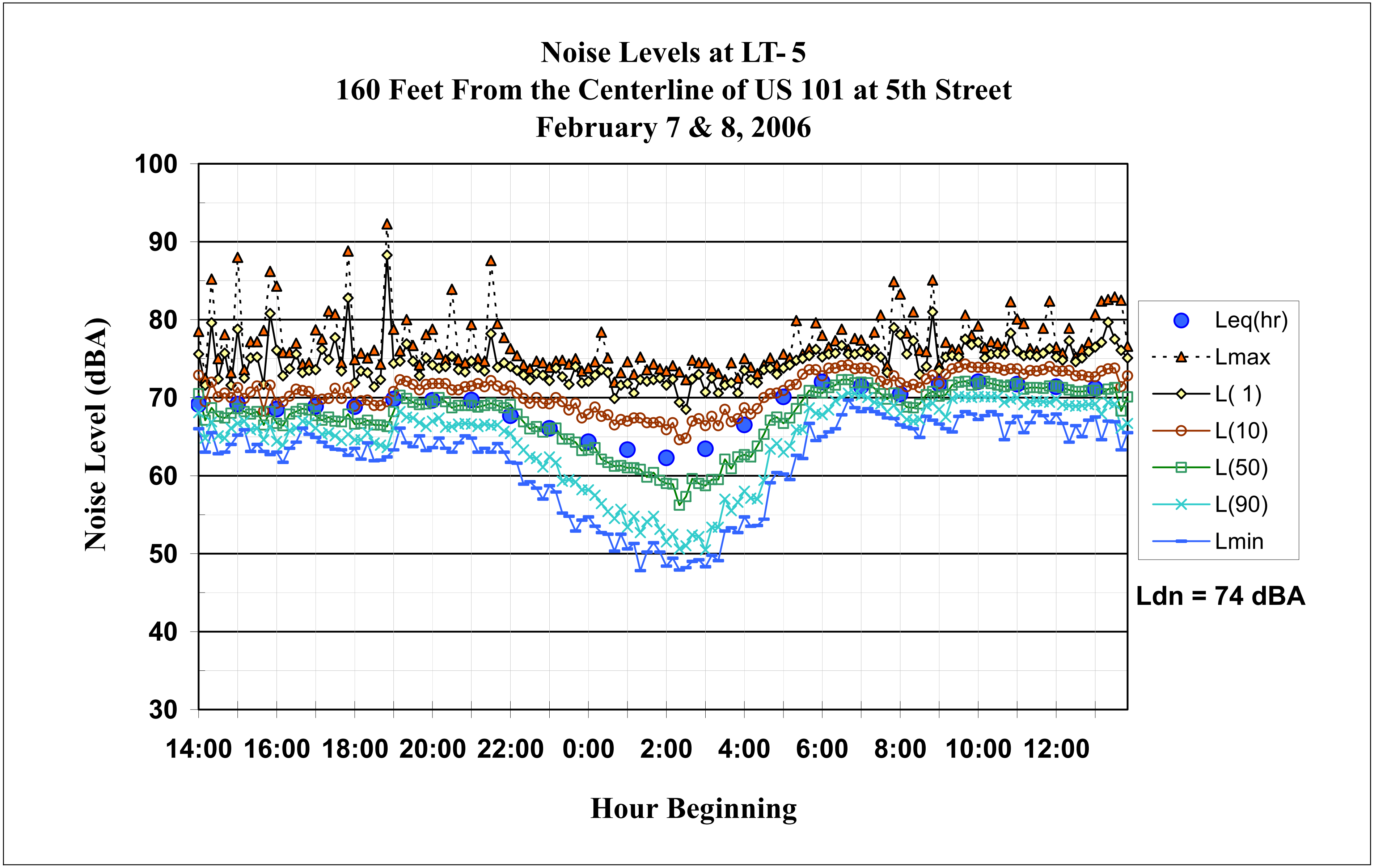
Long-term measurement seven (LT-7) was made from February 7 to 8, 2006, and was located about 30 feet from the centerline of 3rd Street. The primary noise source at this location was 3rd Street with occasional parking lot noise. The microphone was positioned at a height of approximately 10 feet above the surrounding ground. Hourly Leq noise levels ranged from about 54 dBA to 68 dBA. The calculated day-night average noise level was 69 dBA Ldn. The daily trend in noise levels at the long-term location is shown in Figure 4.9-9.



Source: Illungworth & Rodkin, Inc.

FIGURE 4.9-6

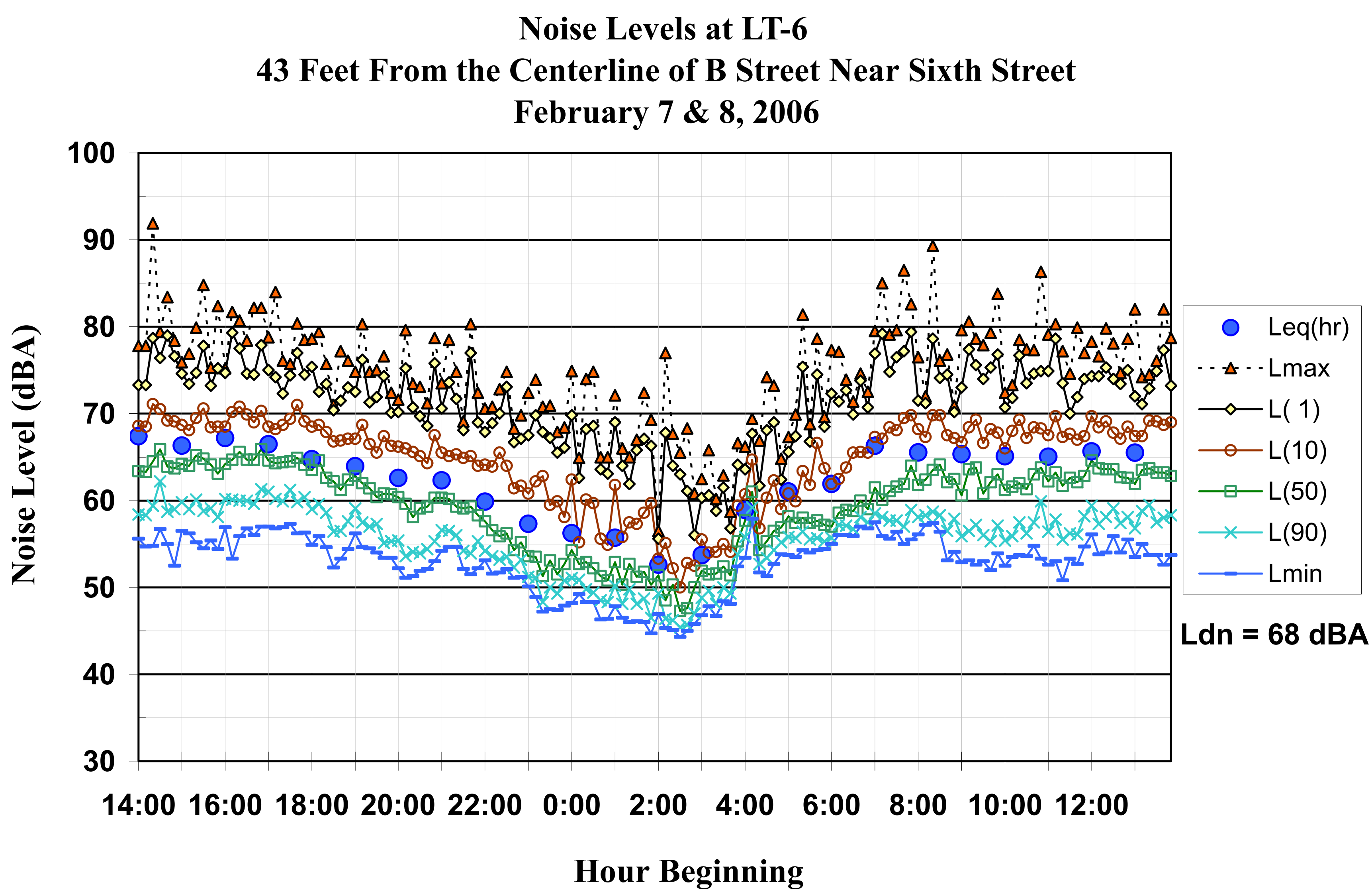
DAILY TREND IN NOISE LEVELS AT LT-4



Source: Illungworth & Rodkin, Inc.

FIGURE 4.9-7

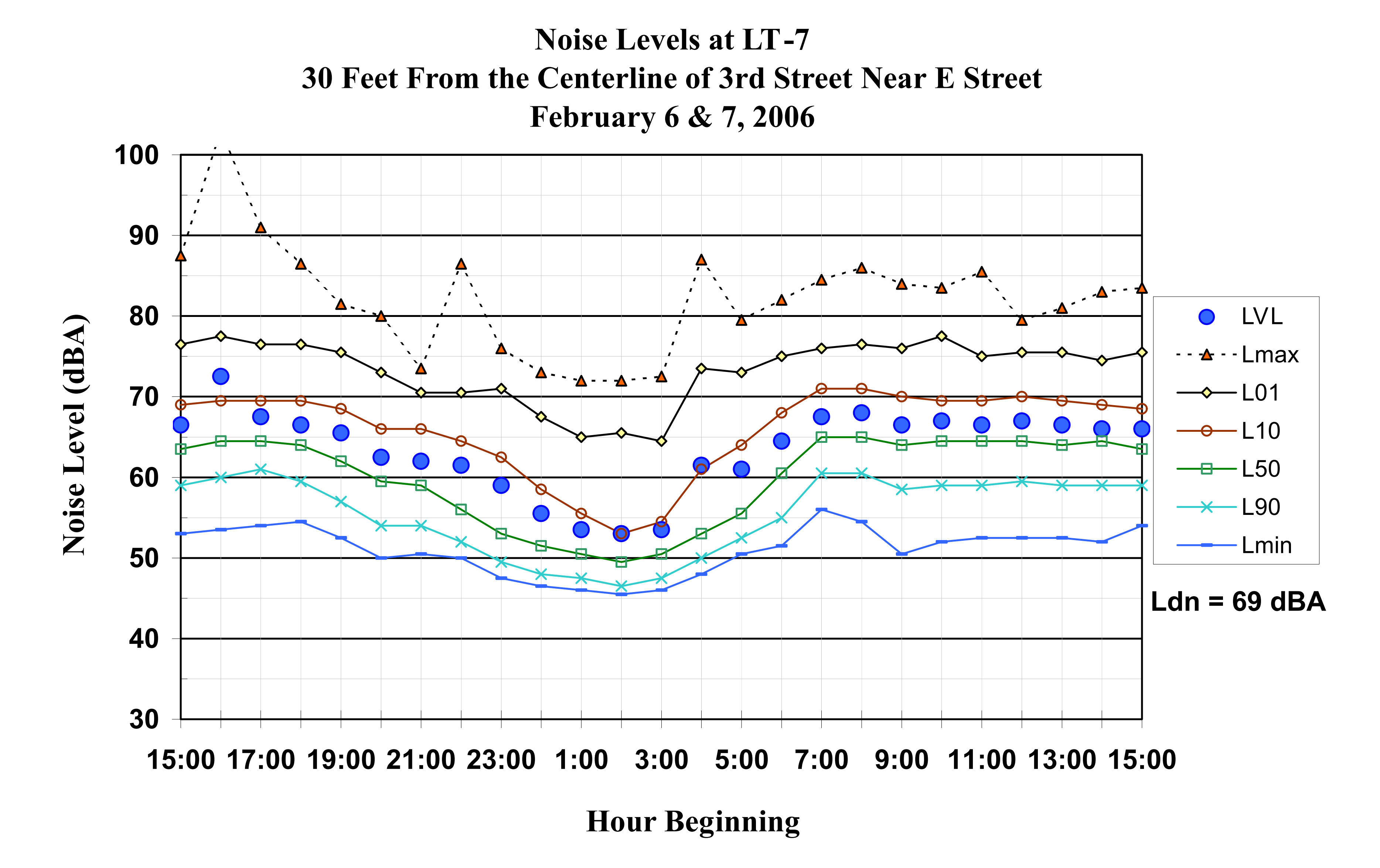
DAILY TREND IN NOISE LEVELS AT LT-5



Source: Illungworth & Rodkin, Inc.

FIGURE 4.9-8

DAILY TREND IN NOISE LEVELS AT LT-6



Source: Illungworth & Rodkin, Inc.

FIGURE 4.9-9

DAILY TREND IN NOISE LEVELS AT LT-7

2. Short-Term Noise Measurements

Short-term noise measurements were made at additional representative locations. At Locations ST-2 through ST-5, the DNL at each location was estimated by correlating the short-term measurement to a corresponding long-term site. At the other sites, the DNL could not be derived from a long-term site so a range of levels is presented.

Short-term measurement one (ST-1) was made on February 6, 2006, and was located at the southeast corner of the intersection of North Dutton Avenue and College Avenue, at a distance of about 30 feet from the centerline of each roadway and at a height of about 5 feet above the ground. The primary noise source at this location was traffic noise along both roadways as well as construction noise that was located about 300 feet from the measurement.

The 10-minute equivalent noise level (Leq) was 72 dBA. This measurement does not correlate to any long-term measurement site Based on typical daily noise level distributions, the day/night average noise level is estimated to be 65-70 dBA DNL. A summary of the data measured at the short term locations are shown in Table 4.9-4.

Short-term measurement two (ST-2) was made on February 6, 2006, was located in the railway corridor between 8th and 9th Streets. The noise sources at this location include occasional traffic along 8th Street, distant traffic noise from Highway 101 and industrial activity in an adjacent lot to the east. The 10-minute equivalent noise level (Leq) was 49 dBA. The estimated L_{dn} noise level for this measurement was 54 dBA.

Short-term measurement three (ST-3) was made on February 6, 2006, was located on the creek trail between Stony Point Road and Dutton Avenue. The noise sources at this location include birds that reside along the creek and distant traffic along West 3rd Street and Highway 12. The background noise level from Highway 12 was about 49 dBA, about 25 decibels down from concurrent noise level at LT-3. The 10-minute equivalent noise level (Leq) was 49

TABLE 4.9-4 **SUMMARY OF SHORT-TERM NOISE LEVELS MEASURED**

Site	Date /Time	L_{eq} dBA	L_{10} dBA	L_{50} dBA	L_{90} dBA	Est. LDN	Noise Sources
ST-1	2-6-05 14:35-14:45	72	74	69	66	65-70	Traffic Noise & Construction Noise
ST-2	2-6-05 15:05-15:15	49	52	47	45	54	Traffic Noise & Industrial Noise
ST-3	2-6-05 15:50-16:00	49	50	49	48	50	Chirping Birds & Distant Traffic
ST-4	2-7-06 11:50-12:00	61	62	60	59	62	Traffic on Highway 101 & Highway 12
ST-5	2-7-06 14:50-15:00	63	65	62	60	68	Nearby & Distant Traffic
ST-6	2-7-06 15:05-15:15	65	69	62	53	N/A65-70	Secondary Street Traffic
ST-7	2-7-06 14:45-14:55	68	71	66	61	N/A65-70	Arterial Traffic
ST-8	2-7-06 15:05-15:15	68	71	64	51	N/A65-70	Arterial Traffic
ST-9	2-7-06 15:35-15:45	69	71	66	64	N/A65-70	Idling Traffic & Bus Station

dBA. The estimated L_{dn} noise level resulting from traffic noise for this measurement was less than 50 dBA.

Short-term measurement four (ST-4) was made on February 7, 2006, and was located at the southwest corner of the intersection of Orange Street and Laurel Street, in the Olive Park Neighborhood, at a height of about 5 feet above the ground. The primary noise source at this location was traffic noise along both Highway 101 and Highway 12. The measurement was located about 440 feet from the centerline of Highway 101 and about 400 feet from the centerline of Highway 12. Noise from a ramp serving the intersection, which was about 280 feet from the noise measurement, at times exceeded the ambient noise level generated by the highways. The 10-minute equivalent noise level (Leq) was 61 dBA. The estimated L_{dn} noise level for this measurement was 62 dBA.

Short-term measurement five (ST-5) was made on February 7, 2006, and was located about 30 feet from the centerline of A Street. The primary noise source at this location was traffic noise along Highway 101. The measurement was located about 520 feet from the centerline of Highway 101. Noise from A Street occasionally exceeded the background noise level generated by the highways. The 10-minute equivalent noise level (Leq) was 63 dBA, 5 decibels down from the concurrent noise measured at LT-5. The estimated L_{dn} noise level for this measurement was 68 dBA.

Short-term measurement six (ST-6) was made on February 7, 2006, and was located about 30 feet from the centerline of B Street. The primary noise source at this location was traffic noise along B Street with a steady background noise from Highway 101. The 10-minute equivalent noise level (Leq) was 65 dBA, and was about the same noise measured concurrently at LT-6, which was also located on B Street. The estimated L_{dn} noise level for this measurement was not calculated because the traffic flow at the measurement location does not correlate to LT-6. Based on typical daily noise level distributions, the day/night average noise level is estimated to be 65-70 dBA DNL.

Short-term measurement seven (ST-7) was made on February 7, 2006, and was located about 35 feet from the centerline of Mendocino Avenue. The primary noise source at this location was vehicular traffic along Mendocino Avenue. The 10-minute equivalent noise level (Leq) was 68 dBA. The estimated L_{dn} noise level for this measurement was not calculated because it does not correlate to any long-term measurement. Based on typical daily noise level distributions, the day/night average noise level is estimated to be 65-70 dBA DNL.

Short-term measurement eight (ST-8) was made on February 7, 2006, and was located about 40 feet from the centerline of 4th Street and about 150 feet from the centerline of Mendocino Avenue. The primary noise source at this location was vehicle traffic noise along 4th Street. Noise from Mendocino Avenue occasionally was audible, as well as voices in the downtown square area. The 10-minute equivalent noise level (Leq) was 68 dBA. The estimated L_{dn} noise level for this measurement was not calculated because it does not correlate to any long-term measurement. Based on typical daily noise level distributions, the day/night average noise level is estimated to be 65-70 dBA DNL.

Short-term measurement nine (ST-9) was made on February 7, 2006, and was located about 35 feet from the centerline of B Street, about 150 feet south of 3rd Street, in front of Traverso's Italian market. The primary noise source at this location was traffic noise from idling buses and cars queued to enter the intersection of B and 3rd Streets. In addition to B Street, the bus station was a major contributor to noise levels, with idling buses and many people waiting for their bus. The 10-minute equivalent noise level (Leq) was 69 dBA, and was about 3 decibels louder than noise measured concurrently at LT-6, which was also located on B Street. The estimated L_{dn} noise level for this measurement was not calculated because it does not correlate to any long-term measurement. Based on typical daily noise level distributions, the day/night average noise level is estimated to be 65-70 dBA DNL.

C. *Standards of Significance*

The Specific Plan would have a significant impact with respect to noise or vibration if implementation of the Specific Plan would result in: Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.

a. Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels.

b. A permanent increase in ambient noise levels in the project vicinity above levels existing without the project.

c. A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

The Specific Plan Area is not located within an airport land use plan, within two miles of a public airport or public use airport, or within the vicinity of a private airstrip. There will be no further analysis of aircraft noise issues.

D. Impact Discussion

This section describes the potential noise impacts on the Specific Plan Area, as well as potential impacts of environmental noise on the Specific Plan.

1. Project Impacts

a. Construction Noise

Residences and businesses are located throughout the Specific Plan Area, and would be affected by construction noise during build-out of the Specific Plan. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (early morning, evening, or night-time hours), the construction occurs in areas immediately adjoining noise sensitive land uses, or when construction durations last over extended periods of time. Major noise generating construction activities would include removal of existing pavement and structures, site grading and excavation, building framing, paving and landscaping. For most areas that may be developed under the Specific Plan Area, the distance from these activities to noise-sensitive receptors would be less than 100 feet.

The highest construction noise levels would be generated during grading excavation and foundation work, with lower noise levels occurring during building construction. Large pieces of earth-moving equipment, such as graders, scrapers, and bulldozers, generate maximum noise levels of 85 to 90 dBA at a distance of 50 feet. Typical hourly average construction-generated noise levels are about 80 to 85 dBA measured at a distance of 50 feet from the site during busy construction periods. In addition, pile driving may occur at some of the potential project sites. This type of construction activity can produce very high noise levels of approximately 105 dBA at 50 feet, which are difficult to control. The noise levels drop off at a rate of about 6 dBA per doubling of distance between the noise source and receptor. Intervening structures would also result in lower noise levels.

Although construction noise would be localized to the individual sites during construction, businesses and residences throughout the Specific Plan Area would be intermittently exposed to high levels of noise throughout the years of construction. However, General Plan Policy NS-B-2 and NS-B-3 would require that construction sites provide noise buffers and prevent new stationary and transportation noise sources from creating a nuisance to the community. Construction workers are also required to adhere to appropriate equipment noise controls set forth in the Santa Rosa Municipal Code Noise Ordinance.

Although construction noise would be localized to the individual sites during construction, businesses and residences throughout the Specific Plan Area would be intermittently exposed to high levels of noise throughout the years of construction. Construction would elevate noise levels at adjacent businesses and residences by as much as 15 to 20 dBA. Such a large increase in the noise level, although short-term in duration, would be a *significant* impact.

b. Noise and Land Use Compatibility

i. Specific Plan Area Impact

The Specific Plan proposes to develop noise sensitive residential uses Downtown, along major and local roadways and along the railroad corridor in the Specific Plan Area. The majority of the development in the Specific Plan would include retail or commercial uses on the ground floor with residences located on the upper stories. These residential units could be exposed to traffic or railroad train noise. The majority of the proposed residential uses developed in the Specific Plan Area would not be expected to include private outdoor yards, and small decks and entry porches would not be required to meet the exterior guidelines.. Outdoor common use areas located in noise environments exceeding 60 dBA L_{dn} would require noise mitigation, such as proper site planning or sound barriers, to achieve the compatibility guideline.

The existing noise environment throughout the Specific Plan Area is in the range of 60 to 70 dBA L_{dn} along the surface streets and about 75 dBA L_{dn} along Highway 101 and Highway 12. Noise levels along many Specific Plan roadways would, therefore, exceed those considered normally compatible with exterior residential uses (60 dBA L_{dn}).

Where exterior noise levels exceed 60 dBA L_{dn}, interior noise levels may also exceed the interior 45 dBA L_{dn} standard established in the City's Noise Element and the State Building Code. Typical California construction provides approximately 15 dBA of noise reduction from exterior noise sources with windows partially open, and approximately 20 to 25 dBA of noise reduction with windows kept closed. Where exterior noise levels do not exceed 65 to 70 dBA L_{dn}, interior noise can be mitigated with standard wall and window construction and the inclusion of mechanical forced air ventilation, acceptable to the City of Santa Rosa, to allow occupants the option of maintaining windows closed to control noise. Where exterior noise levels exceed 65 to 70 dBA L_{dn}, residential units would not normally be able to meet the 45 dBA L_{dn} interior standard simply through typical construction methods. This would be a *significant* impact.

The Specific Plan would implement development of new residential uses adjacent to or sometimes within the same building as noise-generating commercial and retail uses. Noise levels resulting from heating, ventilating, air conditioning equipment, entertainment, etc., could exceed the noise ordinance limits. However, enforcement of General Plan Policy NS-B-9 would require developers to incorporate acoustical site planning into their projects. Construction workers are also required to adhere to appropriate equipment noise controls set forth in the Santa Rosa Municipal Code Noise Ordinance, as well as hours of operation. Proper enforcement of these policies would reduce this impact to *a less-than-significant* level.

ii. Northwestern Pacific Railroad Corridor Impact

The Northwestern Pacific Railroad (NWPR) corridor has been proposed as a rail transit corridor by the Sonoma-Marin Area Rail Transit (SMART). SMART proposes to operate trains consisting of diesel-powered, self-propelled vehicles called Diesel Multiple Unit (DMU) vehicles. Information regarding noise levels from the proposed SMART project is set forth in the Sonoma-Marin Area Rail Transit DEIR (November 2005) and FEIR (June 2006). SMART proposes 12 passenger train movements in each direction between 5:00 a.m. and 8:00 p.m. Noise from train operations includes noise from the engines and wheel-rail interaction. In addition, the sound of railroad train warning horns is a dominant source within approximately one-quarter mile of grade crossings. Data presented in Table 3.7-5 of the FEIR indicate that the 60 dBA L_{dn} noise exposure level is predicted to be at a distance of 25 feet from the tracks in areas where there are not at-grade crossings requiring the sounding of train horns. Train horns would be expected to be prominent during passages through the Specific Plan Area. The instantaneous maximum noise level from a train horn is about 105 dBA at 70 feet. At a distance of 40 feet, the nearest typical building setbacks from the railroad tracks, the maximum instantaneous noise level is calculated to be about 108 dBA. Day/night average noise levels were not presented in the SMART documents for areas near at-grade crossings. The analysis focused on maximum instantaneous noise levels in these areas. The L_{dn} can be calculated if certain assumptions are made. In this instance, it is assumed that there would be two train passages during the early morning hours when train movements might occur (5:00 a.m. to 7:00 a.m.) and the balance of train movements would be during daytime hours (7:00 a.m. – 8:00 p.m.). Given this assumption and the assumption that the sound of a horn at the maximum amplitude of 108 dBA would be sustained for one second adjacent to a given unit, the calculated 24-hour average noise level is 75 dBA L_{dn} at 40 feet. This is a reasonable estimate for noise exposure at the properties adjoining the NWPR. Noise levels inside housing adjoining the tracks could exceed 45 dBA L_{dn}, which would be *significant*.

Furthermore, consideration should be given to controlling the maximum instantaneous noise levels of the train horn to acceptable levels inside the units. It is recommended that the maximum instantaneous noise levels from the train horns not exceed 55 dBA inside bedrooms and other habitable rooms. The SMART FEIR identified that the sound of train horns could cause a significant environmental impact upon existing housing. The EIR outlined the methods by which communities could obtain Quiet Zone applications from the Federal Railroad Administration (FRA). SMART has committed to work with any local jurisdictions wishing to be designated Quiet Zones to cooperatively meet the requirements for designation and budget needs for supplementary safety measures for Quiet Zones.[1] The FRA has final jurisdiction over Quiet Zones. Because it is not known whether or not the Quiet Zone designation would be granted, the impact of a "single event" noise from train horns is considered to be *significant*.

Retail units developed under the Specific Plan along most of the area roadways would meet the exterior commercial land use compatibility guideline of 70 dBA L_{dn} established in the Noise Element. However, exterior noise levels would exceed 70 dBA L_{dn} along Highway 101 and Highway 12. This would be a *significant* impact.

c. Increased Traffic Noise

The implementation of the Specific Plan would result in an increase in traffic and traffic noise in the Specific Plan Area and surrounding neighborhoods. The increase in traffic noise is calculated by comparing existing traffic volume on the street network to future traffic volumes that are projected if the Specific Plan is implemented. Traffic noise increases were calculated for the 21 intersections analyzed in the traffic report. Measurable increases ranging from less than 1 dBA to up to about 2 dBA DNL are predicted to occur along most of the streets throughout the Specific Plan Area. Noise levels along Third Street are calculated to increase about 3 dBA DNL A short segment of B Street north of Third Street and First Street east and west of Santa Rosa

[1] SMART FEIR, page 4-55, June 2006.

Avenue are predicted to have noise level increases of 3 to 4 dBA DNL Policy NS-B-14 of the Noise Element of the City General Plan proposes to "discourage new projects that have potential to create ambient noise levels more than 5 dBA DNL above existing background, within 250 feet of sensitive receptors." The implementation of the Specific Plan is not calculated to result in an increase of 5 dBA DNL as a result of increased project traffic at any sensitive receptors adjoining roadways in the Specific Plan Area or surrounding neighborhoods. This is a *less-than-significant* impact.

d. Groundborne Vibration

i. Construction

Construction of projects under the Specific Plan would be located adjacent to existing structures. Construction activities may include demolition of existing structures, site preparation work, excavation of below grade levels, foundation work, pile driving, and framing. Demolition for an individual site may last several weeks and at times may produce substantial vibration. Excavation for underground levels would also occur on some project sites and vibratory pile driving could be used to stabilize the walls of the excavated area. Piles or drilled caissons may also be used to support building foundations.

Pile driving has the potential to generate the highest ground vibration levels and is of primary concern to structural damage, particularly when it occurs within 100 feet of structures. Vibration levels generated by pile driving activities would vary depending on project conditions such as soil conditions, construction methods, and equipment used. Past studies have established a peak vertical particle velocity of 0.2 in./sec PPV as the limit which could potentially cause cosmetic damage. Other project construction activities, such as caisson drilling, the use of jackhammers, rock drills and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.) may also potentially generate substantial vibration in the immediate vicinity.

Depending on the proximity of existing structures to each construction site, the structural soundness of the existing buildings and the methods of construction used, vibration levels caused by pile driving or other impact work may be high enough to damage existing structures. Construction workers are also required to adhere to appropriate equipment noise controls set forth in the Santa Rosa Municipal Code Noise Ordinance, which will help reduce the potential impact. However, this would remain a *significant* impact.

As with any type of construction, vibration levels may at times be perceptible. However, construction phases that have the highest potential of producing vibration (pile driving and use of jackhammers and other high power tools) would be intermittent and would only occur for short periods of time for any individual project site. By use of administrative controls such as notifying neighbors of scheduled construction activities and scheduling construction activities with the highest potential to produce perceptible vibration to hours with least potential to affect nearby businesses, perceptible vibration can be kept to a minimum and as such would result in a *less-than-significant* impact with respect to perception.

ii. Railroad Operations

Railroad operations are potential sources of ground vibration depending on distance to the receptor, the type and the speed of trains, and the type of railroad track.

Ground-borne vibration levels from railroad train operations were discussed in the SMART DEIR (page 3-132). The 80 VdB FTA threshold for infrequent events is applicable because fewer than 30 events per day are projected. Ground-borne vibration levels are projected to be below 0.01 inches per second rms vibration velocity (80 VdB re micro inch per second) at distances greater than 20 feet from the tracks. This is consistent with ground vibration from low speed train movements in other areas. The nearest residential buildings are likely to be proposed at a distance of at least 40 feet from the tracks. Because ground vibration levels would be less than the FTA impact significance criteria, this is a *less-than-significant* impact.

2. Cumulative Impacts

Development within the Santa Rosa Urban Growth Boundary has the potential to result in a cumulative impact related to noise sources. However, the 2002 General Plan EIR identified that with the policies included in the General Plan, that the potential for noise disturbance under the General Plan to result in a cumulative impact related to noise would be reduced to a less-than-significant level with the included General Plan policies. All of the reasonably foreseeable development in the Specific Plan Area is in keeping with the overall intent of the General Plan and is subject to General Plan policies. The Specific Plan policies regarding noise are designed to help the City better reduce noise impacts, consistent with the 2002 General Plan. Additionally, The future traffic projections used for the noise analysis were generated by a traffic model that considered the cumulative growth for the entire City of Santa Rosa in conjunction with the Specific Plan (see Chapter 4.12, Traffic). No significant impact associated with increased traffic noise was identified and therefore there would not be a cumulative traffic noise-related impact. For these reasons, the Specific Plan would not result in a significant cumulative impact on noise.

E. Impacts and Mitigation Measures

Impact NOI-1: Although construction noise would be localized to the individual construction sites, businesses and residences throughout the Specific Plan Area would be intermittently exposed to high levels of noise throughout the construction period. Construction would elevate noise levels at adjacent businesses and residences by 15 to 20 dBA or more. This would be a *significant* impact.

Mitigation Measure NOI-1: Developers shall ensure that construction equipment be well maintained and used judiciously to be as quiet as practical. The following measures, when applicable, will be required from developers to reduce noise from construction activities:

- Equip all internal combustion engine-driven equipment with mufflers, which are in good condition and appropriate for the equipment.
- Utilize "quiet" models of air compressors and other stationary noise sources where technology exists.
- Locate stationary noise-generating equipment as far as feasible from sensitive receptors when sensitive receptors adjoin or are near a construction project area.
- Prohibit unnecessary idling of internal combustion engines.
- Pre-drill foundation pile holes to minimize the number of impacts required to seat the pile.
- Construct solid plywood fences around construction sites adjacent to operational business, residences or noise-sensitive land uses.
- A temporary noise control blanket barrier shall be erected, if necessary, along building facades facing construction sites. This mitigation would only be necessary if conflicts occurred which were irresolvable by proper scheduling. Noise control blanket barriers can be rented and quickly erected.
- Route construction-related traffic along major roadways and as far as feasible from sensitive receptors.
- Ensure that construction activities (including the loading and unloading of materials and truck movements) are limited to the hours of 7:00 a.m. to 7:00 p.m.
- Businesses, residences or noise-sensitive land uses adjacent to construction sites shall be notified of the construction schedule in writing. Designate a "construction liaison" that will be responsible for responding to any local complaints about construction noise. The liaison would determine the cause of the noise complaints and institute reasonable measures to correct the problem. Conspicuously post a telephone number for the liaison at the construction site.

Significance After Mitigation: Less than significant.

Impact NOI-2: The future residential units in the Specific Plan would be exposed to outdoor noise levels in excess of 60 Ldn and indoor levels in excess of 45 Ldn. Future commercial uses along Highway 101, Highway 12 and major arterial roadways would be exposed to outdoor noise levels in excess of 70 Ldn. These noise levels would exceed the City and State established land use compatibility thresholds. This would be a *significant* impact.

Mitigation Measure NOI-2a: In areas where new residential development would be exposed to an L_{dn} of greater than 60 dB, site-specific noise studies shall be conducted to determine the area of impact and to present appropriate mitigation measures to reduce noise levels to within established allowable levels, which may include the following:

- Utilize site planning to minimize noise in shared residential outdoor activity areas by locating the areas behind the buildings, in courtyards, or orienting the terraces to alleyways rather than streets, whenever possible.
- Mechanical ventilation satisfactory to the City of Santa Rosa should be provided in all units so that windows can remain closed at the choice of the occupants to maintain interior noise levels below 45 dBA L_{dn}.
- Sound rated windows and construction methods necessary to provide the requisite noise control for residential units proposed along Highway 101, Highway 12 and NWPR tracks where noise levels could exceed 70 dBA L_{dn}.
- Adopt a policy to limit typical instantaneous maximum noise levels caused by railroad trains to 55 dBA L_{max} inside new housing units proposed along the NWPR tracks.
- New development shall incorporate the identified mitigation measures contained in the noise study, as approved by the City.

Mitigation Measure NOISE-2b: Avoid locating noise sensitive outdoor commercial areas (i.e., outdoor dining, childcare facilities, etc.) adjacent to Highway 101, Highway 12 or major arterial roadways unless they are shielded by sound barriers or structures. Mechanical ventilation should be provided in all noise sensitive commercial uses (i.e., offices, childcare, art galleries, libraries, etc) adjoining Highway 101, Highway 12 or major arterial roadways. Sound rated windows and construction methods may also be necessary.

Significance After Mitigation: Less than significant.

IMPACT NOI-3: Structures in the vicinity of development allowed in the Specific Plan Area could be exposed to construction-related vibration during the excavation and foundation work associated with projects implementing the Specific Plan. This would be a *significant* impact.

Mitigation Measure NOI-3a: Developers shall reduce vibration from construction activities by implementing the following during construction:

- ♦ Avoid impact pile driving where possible and use drilled piles when possible since drilled piles causes lower vibration levels where geological conditions permit their use.
- ♦ Avoid using vibratory rollers and tampers near sensitive areas.

Mitigation Measure NOI-3b: In areas where project construction is anticipated to include vibration-generating activities, such as pile driving, in close proximity to existing structures, site-specific vibration studies shall be conducted to determine the area of impact and to present appropriate mitigation measures that may include the following:

- ♦ Identification of sites which would include vibration compaction activities, such as pile driving, and have the potential to generate groundborne vibration, while considering the sensitivity of nearby structures to groundborne vibration. Vibration limits shall be applied to all vibration-sensitive structures located within 200 feet of the project. This task shall be conducted by a qualified structural engineer.

- Development of a vibration monitoring and construction contingency plan to identify structures where monitoring would be conducted, set up a vibration monitoring schedule, define structure-specific vibration limits and address the need to conduct photo, elevation and crack surveys to document before and after construction conditions. Construction contingencies would be identified for when vibration levels approached the limits.
- At a minimum, vibration monitoring shall be conducted during initial demolition activities and during pile driving activities. Monitoring results may indicate the need for more or less intensive measurements.
- When vibration levels approach limits, suspend construction and implement contingencies to either lower vibration levels or secure the affected structures.
- Conduct post-survey on structures where either monitoring has indicated high levels or complaints of damage has been made. Make appropriate repairs or compensation where damage has occurred as a result of construction activities.

Appropriate mitigation shall be approved and required by the City prior to commencement of construction.

Significance After Mitigation: Less than significant.