3.11 Noise

3.11.1 Setting

Noise can be generally defined as unwanted sound. Sound, traveling in the form of waves from a source, exerts a sound pressure level (referred to as sound level) which is measured in decibels (dB), with zero dB corresponding roughly to the threshold of human hearing and 120 to 140 dB corresponding to the threshold of pain. Sound pressure fluctuations can be measured in units of hertz (Hz), which correspond to the frequency of a particular sound. Typically, sound does not consist of a single frequency, but rather a broad band of frequencies varying in levels of magnitude (sound power). The sound pressure level, therefore, constitutes the additive force exerted by a sound corresponding to the frequency/sound power level spectrum.

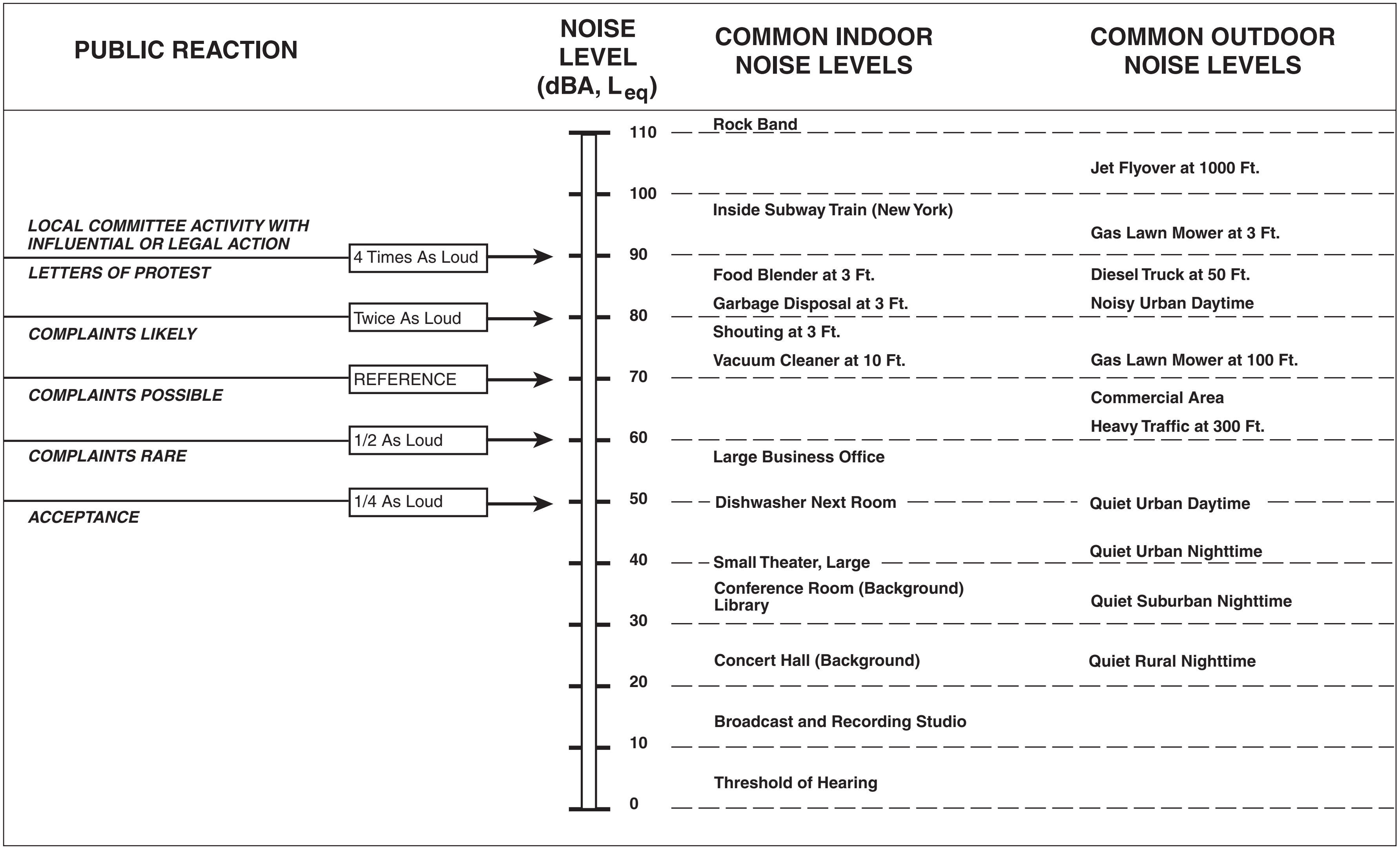
The typical human ear is not equally sensitive to all frequencies of the audible sound spectrum. As a consequence, when assessing potential noise impacts, sound is measured using an electronic filter that de-emphasizes the frequencies below 1,000 Hz and above 5,000 Hz in a manner corresponding to the human ears decreased sensitivity to low and extremely high frequencies instead of the frequency mid-range. This method of frequency weighting is referred to as A-weighting and is expressed in units of A-weighted decibels (dBA). Frequency A-weighting follows an international standard methodology of frequency de-emphasis and is typically applied to community noise measurements. Some representative noise sources and their corresponding A-weighted noise levels are shown in **Figure 3.11-1**.

3.11.2 Existing Conditions

Noise Exposure and Community Noise

An individual's noise exposure is a measure of noise over a period of time. A noise level is a measure of noise at a given instant in time. Community noise varies continuously over a period of time with respect to the contributing sound sources of the community noise environment. Community noise is primarily the product of many distant noise sources, which constitute a relatively stable background noise exposure, with the individual contributors unidentifiable. The background noise level changes throughout a typical day, but does so gradually, corresponding with the addition and subtraction of distant noise sources such as traffic and atmospheric conditions. What makes community noise constantly variable throughout a day, besides the slowly changing background noise, is the addition of short duration single event noise sources (e.g., aircraft flyovers, motor vehicles, sirens), which are readily identifiable to the individual.

These successive additions of sound to the community noise environment vary the community noise level from instant to instant requiring the measurement of noise exposure over a period of time to legitimately characterize a community noise environment and evaluate cumulative noise impacts. This time-varying characteristic of environmental noise is described using statistical noise descriptors. The most frequently used noise descriptors are summarized:



SOURCE: ESA, 2007

Figure 3.11-1
Effect of Noise on People

Leq: the energy-equivalent sound level is used to describe noise over a specified period of time, typically one hour, in terms of a single numerical value. The Leq is the constant sound level which would contain the same acoustic energy as the varying sound level, during the same time period (i.e., the average noise exposure level for the given time period).

Lmax: the instantaneous maximum noise level for a specified period of time.

L_{50}: the noise level that is equaled or exceeded 50 percent of the specified time period. The L_{50} represents the median sound level.

L_{90}: the noise level that is equaled or exceeded 90 percent of the specific time period. This is considered the background noise level during a given time period.

Ldn: 24-hour day and night A-weighted noise exposure level which accounts for the greater sensitivity of most people to nighttime noise by weighting noise levels at night ("penalizing" nighttime noises). Noise between 10:00 p.m. and 7:00 a.m. is weighted (penalized) by adding 10 dBA to take into account the greater annoyance of nighttime noises.

CNEL: similar to Ldn, the Community Noise Equivalent Level (CNEL) adds a 5-dBA "penalty" for the evening hours between 7:00 p.m. and 10:00 p.m. in addition to a 10-dBA penalty between the hours of 10:00 p.m. and 7:00 a.m.

As a general rule, in areas where the noise environment is dominated by traffic, the Leq during the peak-hour is generally within one to two decibels of the Ldn at that location.

Effects of Noise on People

Environmental noise within an urbanized area typically fluctuates over time. This time-varying characteristic of environmental noise is described using statistical noise descriptors. An individual's noise exposure is a measure of noise exposure over a time period. A noise level is a measure of noise at a given instant in time. However, community noise varies continuously over time because of the contributing sound sources of the community noise environment. What makes community noise constantly variable throughout a day is the addition of short duration single-event noise sources, such as aircraft flyovers, passing vehicle, sirens, or similar sources, all of which are readily identifiable to the individual.

A way of predicting a human reaction to a new noise environment is the way it compares to the existing environment to which one has adapted: the so-called "ambient noise" level. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by those hearing it. With regard to increases in A-weighted noise level, the following relationships occur:

- except in carefully controlled laboratory experiments, a change of 1 dBA cannot be perceived;
- outside of the laboratory, a 3-dBA change is considered a just-perceivable difference;
- a change in level of at least 5 dBA is required before any noticeable change in human response would be expected; and
- a 10-dBA change is subjectively heard as approximately a doubling in loudness, and can cause adverse response

These relationships occur in part because of the logarithmic nature of sound and the decibel system. The human ear perceives sound in a non-linear fashion; hence the decibel scale was developed. Because the decibel scale is based on logarithms, two noise sources do not combine in a simple additive fashion, rather logarithmically. For example, if two identical noise sources produce noise levels of 50 dBA, the combined sound level would be 53 dBA, not 100 dBA.

Noise Attenuation

Stationary point sources of noise, including stationary mobile sources such as idling vehicles, attenuate (lessen) at a rate between 6 dBA for hard sites and 7.5 dBA for soft sites for each doubling of distance from the reference measurement. Hard sites are those with a reflective surface between the source and the receiver such as parking lots or smooth bodies of water. No excess ground attenuation is assumed for hard sites and the changes in noise levels with distance (drop-off rate) is simply the geometric spreading of the noise from the source. Soft sites have an absorptive ground surface such as soft dirt, grass or scattered bushes and trees. In addition to geometric spreading, an excess ground attenuation value of 1.5 dBA (per doubling distance) is normally assumed for soft sites. Line sources (such at traffic noise from vehicles) attenuate at a rate between 3 dBA for hard sites and 4.5 dBA for soft sites for each doubling of distance from the reference measurement (Caltrans, 1998).

Fundamentals of Vibration

As described in the Federal Transit Administration's *Transit Noise and Vibration Impact Assessment* (FTA, 2006), ground-borne vibration can be a concern for nearby neighbors of a transit system route or maintenance facility, causing buildings to shake and rumbling sounds to be heard. In contrast to airborne noise, ground-borne vibration is not a common environmental problem. It is unusual for vibration from sources such as buses and trucks to be perceptible, even in locations close to major roads. Some common sources of ground-borne vibration are trains, buses on rough roads, and construction activities such as blasting, pile-driving and operating heavy earth-moving equipment.

There are several different methods that are used to quantify vibration. The peak particle velocity (PPV) is defined as the maximum instantaneous peak of the vibration signal. The PPV is most frequently used to describe vibration impacts to buildings. The root mean square (RMS) amplitude is most frequently used to describe the affect of vibration on the human body. The RMS amplitude is defined as the average of the squared amplitude of the signal. Decibel notation (Vdb) is commonly used to measure RMS. The decibel notation acts to compress the range of numbers required to describe vibration. Typically, ground-borne vibration generated by man-made activities attenuates rapidly with distance from the source of the vibration. Sensitive receptors for vibration include structures (especially older masonry structures), people (especially residents, the elderly and sick), and vibration sensitive equipment.

The effects of ground-borne vibration include movement of the building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. In extreme cases, the vibration can cause damage to buildings. Building damage is not a factor for most projects, with the occasional exception of blasting and pile-driving during construction. Annoyance from vibration often occurs when the vibration exceeds the threshold of perception by only a small margin. A vibration level that causes annoyance will be well below the damage threshold for normal buildings. The FTA measure of the threshold of architectural damage for conventional sensitive structures is 0.2 in/sec peak particle velocity (PPV) (FTA, 2006).

Existing Noise Environment and Sensitive Receptors

Some land uses are considered more sensitive to ambient noise levels than others, due to the amount of noise exposure (in terms of both exposure duration and insulation from noise) and the types of activities typically involved. Residences, motels and hotels, schools, libraries, churches, hospitals, nursing homes, auditoriums, parks, and other outdoor recreation areas generally are more sensitive to noise than are commercial (other than lodging facilities) and industrial land uses. The nearest sensitive receptor to the project site is a residence approximately 250 feet to the south on Santana Drive. There are also residences located across Highway 101 to the west, the nearest being approximately 500 feet to the west on Otto Boni Drive.

The noise environment surrounding the site is influenced primarily by truck and automobile traffic on Highway 101 and operation noise from the Reuser Inc. manufacturing facility to the south of the project site. To quantify the existing noise environment, three long term (LT) 72-hour noise level measurements and seven short term (ST) 5-minute noise level measurements were taken on and around the site. All noise measurements were collected using Calibrated Metrosonics dB3080 sound level meters. The location of the noise measurements are shown in **Figure 3.11-2**. Results of the long-term noise measurements are presented in **Table 3.11-1** and **Figures 3.11-3**, through **3.11-11**. As indicated by these measurements, areas adjacent to Highway 101 experience hourly average noise levels of between approximately 50 and 64 Leq as a result of traffic noise.

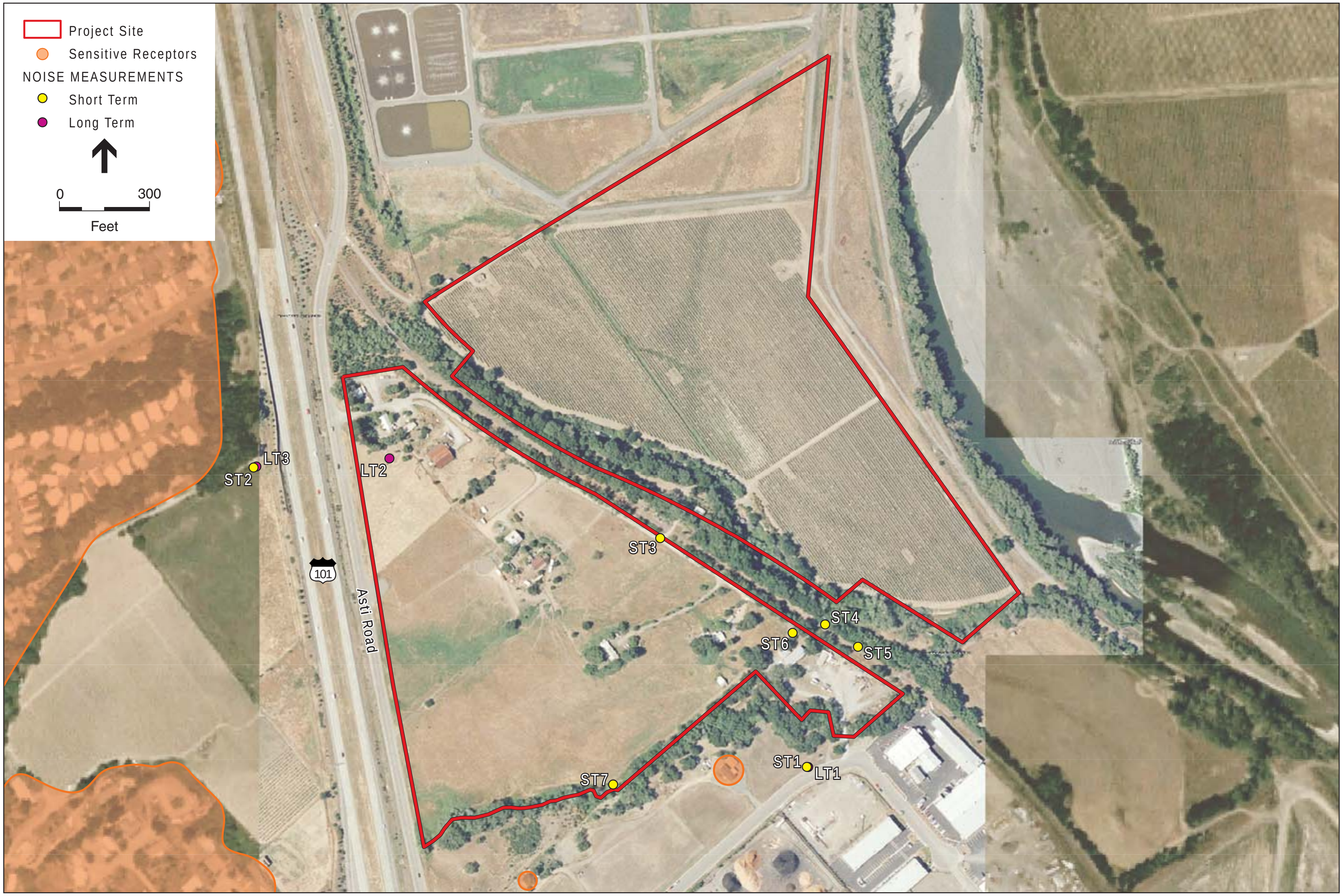
TABLE 3.11 -1
EXISTING NOISE ENVIRONMENTS AT PROJECT SITE

Location	Time Period	Leq (decibels)	Noise Sources
LT-1: Electric Pole Across Santana Drive from Reuser Inc. Near Home.	24 hour CNEL measurements were: Friday 63 Saturday 61 Sunday 63	Hourly Average Leq's ranged from: 50 to 63	Unattended noise measurements do not specifically identify noise sources.
ST-1: Electric Pole Across Santana Drive from Reuser Inc. Near Home.	Monday 04/14/08 10:34 – 10:39 AM	5-minute Average Noise Level, Leq 55	Traffic on Hwy 101 Dozer at Reuser Inc.: 58 dBA Truck on Santana Dr.: 65 dBA
LT-2: Tree next to house at North End of Property 223 feet from Hwy 101 NB.	24 hour CNEL measurements were: Friday 69 Saturday 65 Sunday 64	Hourly Average Leq's ranged from: 56 to 64	Unattended noise measurements do not specifically identify noise sources.
LT-3: Fence 115 feet from Hwy 101 SB	24 hour CNEL measurements were: Friday 68 Saturday 66 Sunday 64	Hourly Average Leq's ranged from: 55 to 64	Unattended noise measurements do not specifically identify noise sources.
ST-2: Fence 115 feet from Hwy 101 SB	Monday 04/14/08 11:34 – 11:39 AM	5-minute Average Noise Level, Leq 59	Traffic on Hwy 101 No traffic: 50 dBA

TABLE 3.11 -1
EXISTING NOISE ENVIRONMENTS AT PROJECT SITE

Location	Time Period	Leq (decibels)	Noise Sources
ST-3: On train tracks behind yellow house on Santana.	Thursday 04/10/08 10:05 – 10:10 AM	5-minute Average Noise Level, Leq 50	Traffic on Hwy 101: 52 dBA Quiet: 45 dBA
ST- 4: On train tracks behind yellow house	Monday 04/14/08 10:52 – 10:57 AM	5-minute Average Noise Level, Leq 53	Traffic on Hwy 101 Wind: 57 dBA Bird: 55 dBA
ST- 5: On train tracks behind yellow house	Thursday 04/10/08 10:25 – 10:30 AM	5-minute Average Noise Level, Leq 64	Traffic on Hwy 101: 68 dBA Traffic on Asti Rd.: 73 dBA
ST- 6: End of dirt road at yellow house	Monday 04/14/08 11:00 – 11:05 AM	5-minute Average Noise Level, Leq 50	Traffic on 101 Wind: 57 dBA
ST- 7: North and Middle of Riparian area.	Monday 04/14/08 10:52 – 10:57 AM	5-minute Average Noise Level, Leq 55	Traffic on Hwy 101 Wind: 65 dBA

SOURCE: ESA, 2008.



SOURCE: GlobeXplorer, 2006; and ESA, 2009

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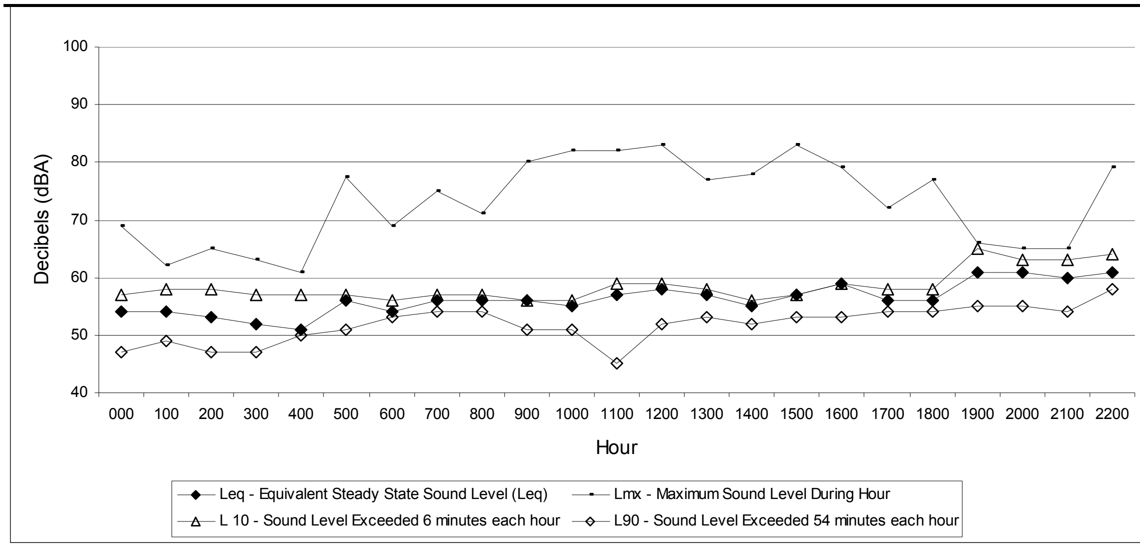
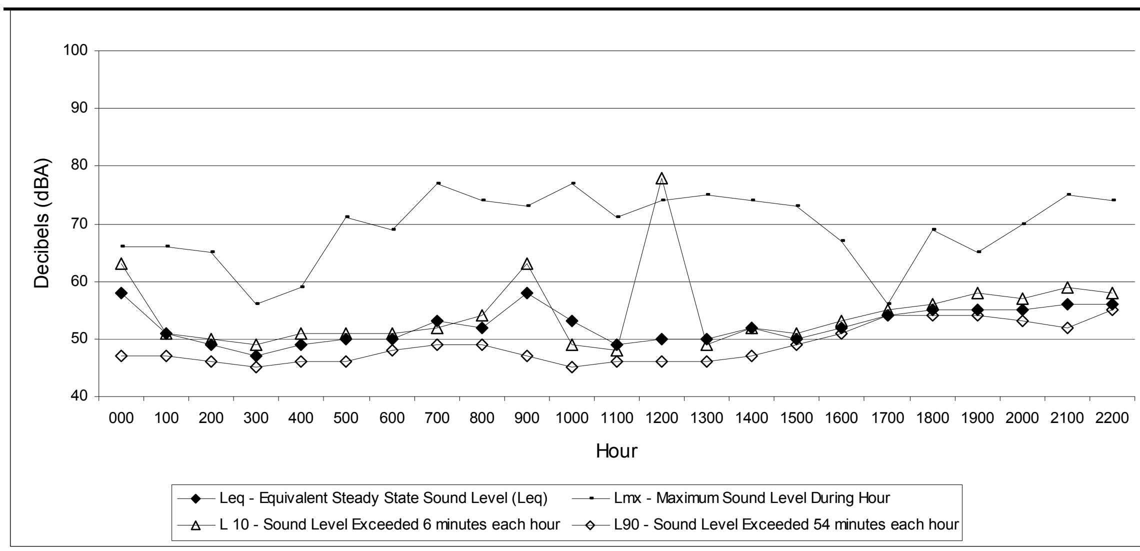
Figure 3.11-2
Noise Measurement Locations



Cloverdale Rancheria Casino Project. 207737

Figure 3.11-3

Long Term Measurement 1: Santana Drive
Friday April 11, 2008



Cloverdale Rancheria Casino Project. 207737

Figure 3.11-4

Long Term Measurement 1: Santana Drive
Saturday April 12, 2008

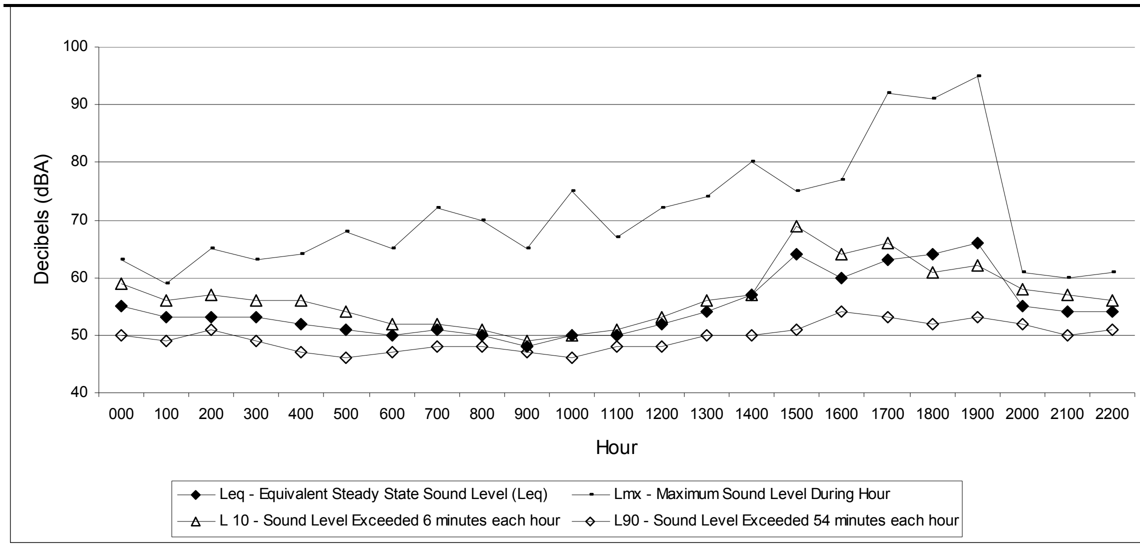


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Figure 3.11-5

Long Term Measurement 1: Santana Drive

Sunday April 13, 2008

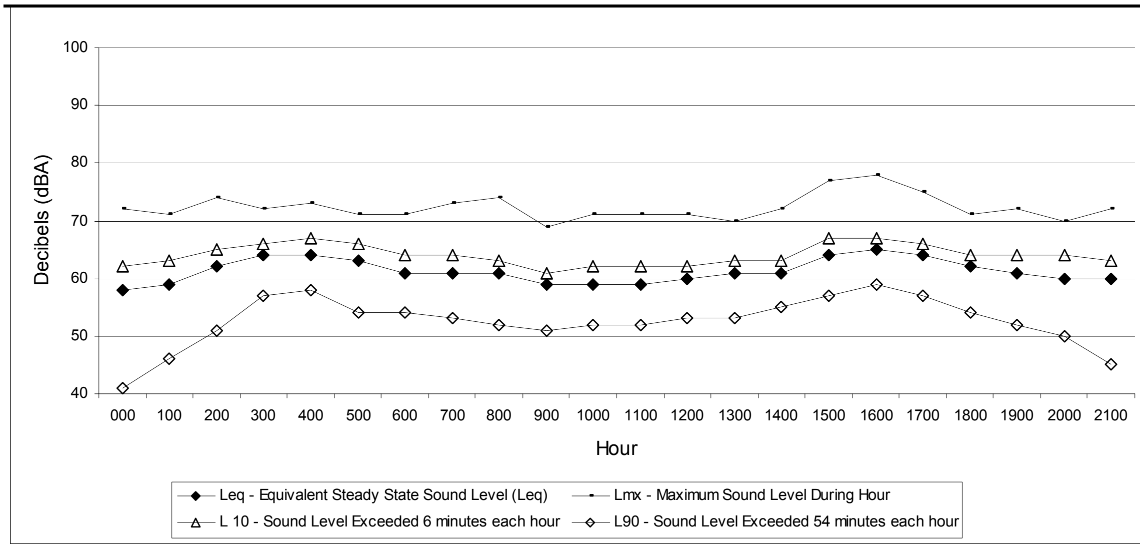

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Figure 3.11-6

Long Term Measurement 2: North Side of Property

Friday April 11, 2008

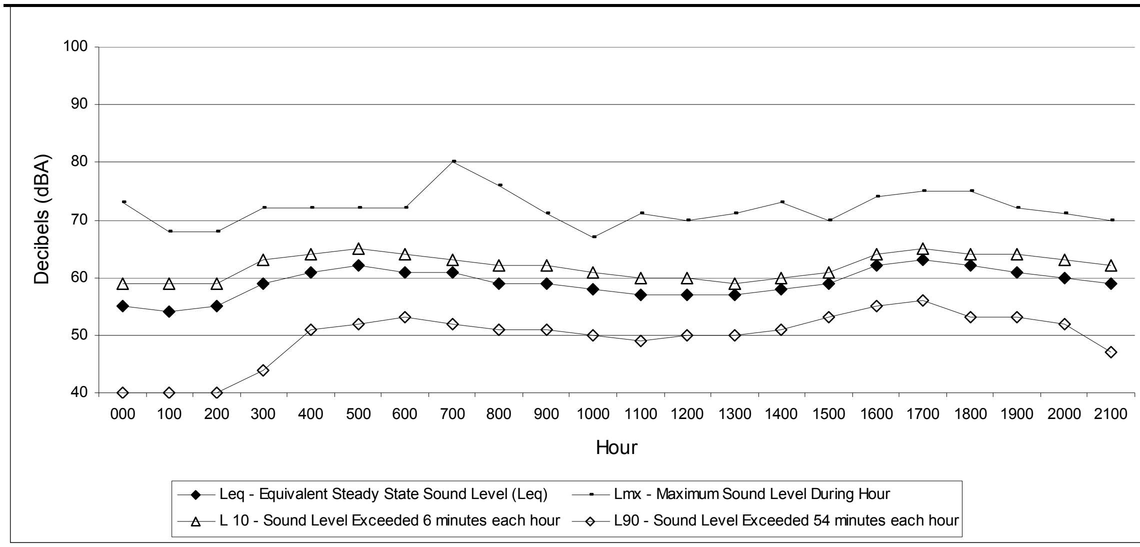

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Figure 3.11-7

Long Term Measurement 2: North Side of Property
Saturday April 12, 2008

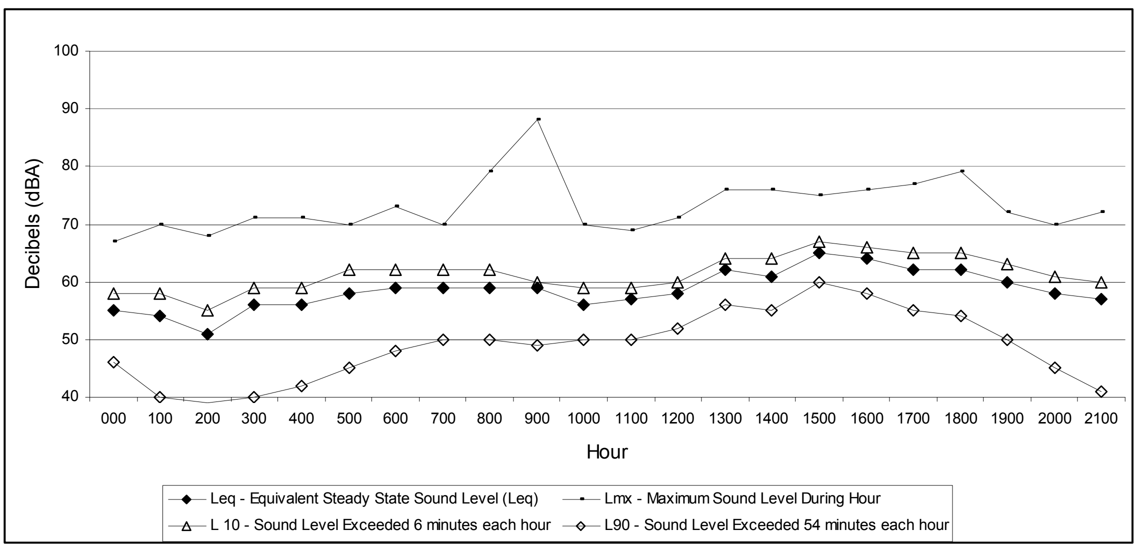

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Figure 3.11-8

Long Term Measurement 2: North Side of Property
Sunday April 13, 2008

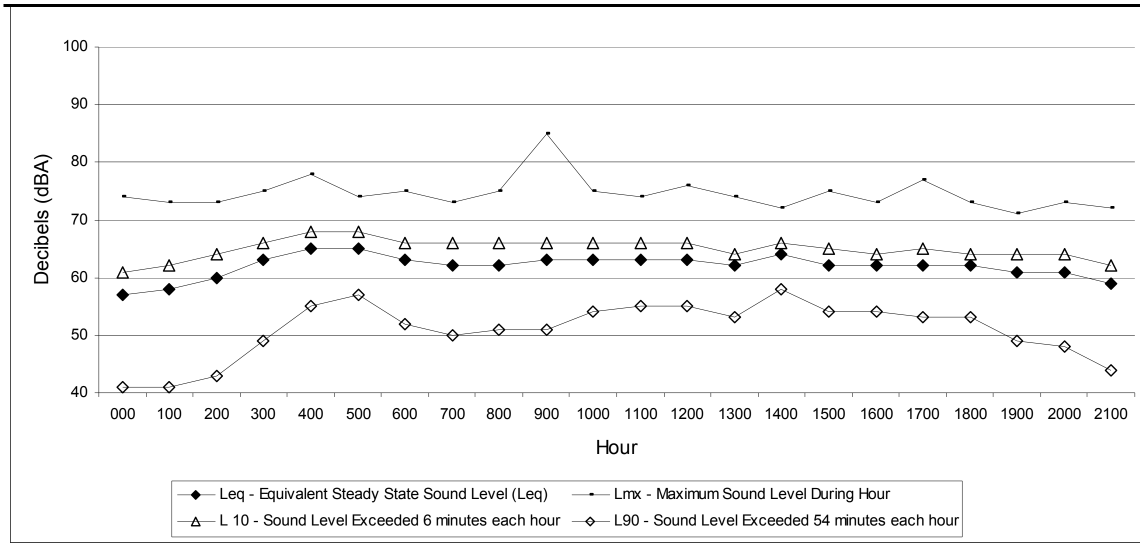

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Figure 3.11-9

Long Term Measurement 3: 115 ft from 101 SB

Friday April 11, 2008

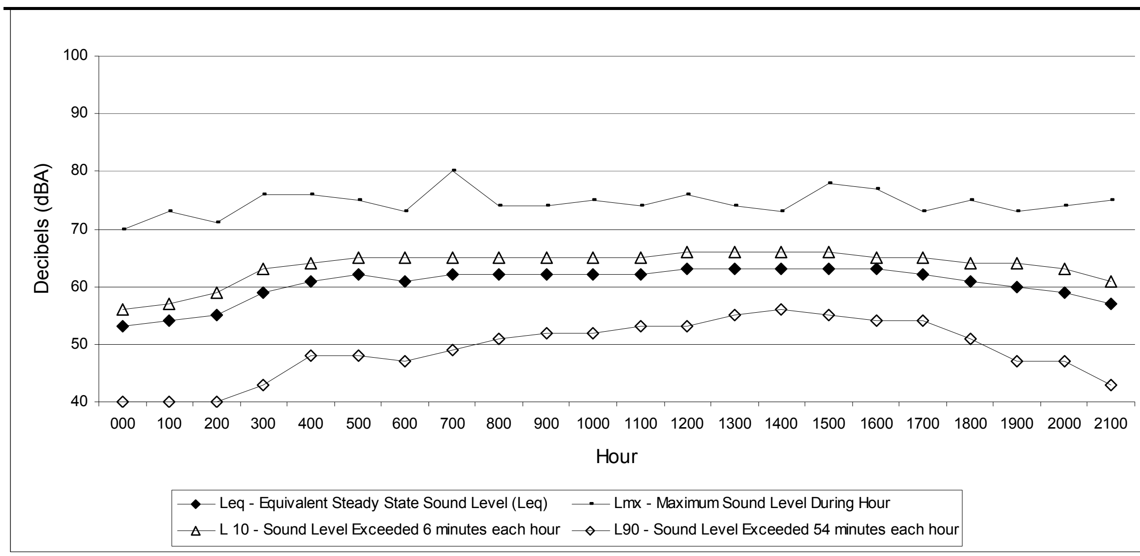

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Figure 3.11-10

Long Term Measurement 3: 115 ft from 101 SB

Saturday April 12, 2008

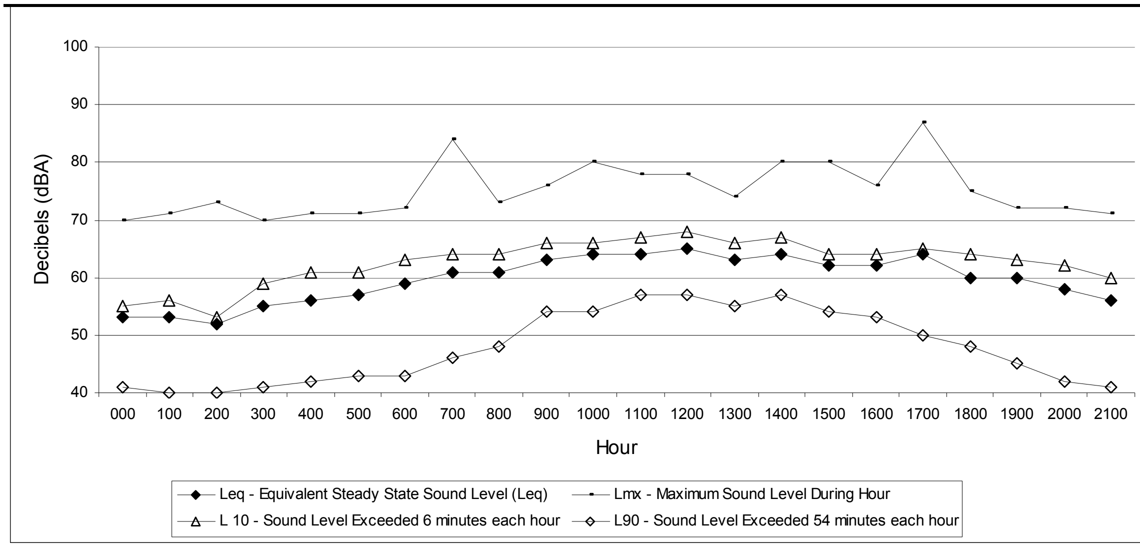

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Figure 3.11-11
Long Term Measurement 3: 115 ft from 101 SB
Sunday April 13, 2008

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