Appendix D

Community Noise Fundamentals

BACKGROUND

Three aspects of community noise are important in determining subjective response:

1) Level (i.e., magnitude or loudness) of the sound.

2) The frequency composition or spectrum of the sound.

3) The variation in sound level with time.

Airborne sound is a rapid fluctuation of air pressure and local air velocity. Sound levels are measured and expressed in decibels (dB) with 0 dB roughly equal to the threshold of hearing.

The frequency of a sound is a measure of the pressure fluctuations per second measured in units of hertz (Hz). Most sounds do not consist of a single frequency, but are comprised of a broad band of frequencies differing in level. The characterization of sound level magnitude with respect to frequency is the sound spectrum. A sound spectrum is often described in octave bands that divide the audible human frequency range (i.e., from 20 to 20,000 Hz) into ten segments. Figure 6-A shows a range of sound spectra for various types of sound over the audible hearing range.

FREQUENCY WEIGHTING

Many rating methods exist to analyze sound of different spectra. The simplest method is generally used so that measurements may be made and noise impacts readily assessed using basic acoustical instrumentation. This method evaluates all frequencies by using a single weighting filter that progressively de-emphasizes frequency components below 1000 Hz and above 5000 Hz. This frequency weighting reflects the relative decreased human sensitivity to low frequencies and to extreme high frequencies. This weighting is called A-weighting and is applied by an electrical filter in all U.S. and international standard sound level meters.

NOISE EXPOSURE

Noise exposure is a measure of noise over a period of time, whereas noise level is a single value at an instant in time. Although a single sound level may adequately describe community noise at any instant in time, community noise levels vary continuously. Most community noise is produced by many distant noise sources that produce a relatively steady background noise having no identifiable source. These distant sources change gradually throughout the day and include traffic, wind in trees, and distant industrial activities. Superimposed on this slowly varying background is a succession of identifiable noise events of brief duration. These include

nearby activities such as single vehicle pass-bys or aircraft flyovers, which cause the community noise level to vary from instant to instant.

A single number called the equivalent sound level or Leq is used to describe noise varying over a period of time. The Leq is the average noise exposure level over a period of time (i.e., the total sound energy divided by the duration). It is the constant sound level, which would contain the same acoustic energy as the varying sound level, during the same time period. The Leq is useful in describing noise over a period of time with a single numerical value.

In determining the daily measure of community noise, it is important to account for the difference in human response to daytime and nighttime noise. During the nighttime, exterior background noise levels are generally lower than in the daytime. Most household noise also decreases at night, and exterior noise intrusions become more noticeable. People are more sensitive to noise at night than during other periods of the day.

To account for human sensitivity to nighttime noise, the Community Noise Equivalent Level (CNEL) is the adopted standard in California. CNEL values are typically computed by energy summation of hourly noise level values, with the proper adjustment applied for the period of evening or night. The CNEL is computed by assessing a 5-dB penalty for evening (i.e., 7:00 pm to 10:00 pm) noise and a 10-dB penalty for nighttime (i.e., 10:00 pm to 7:00 am) noise. Noise exposure measures such as Leq and CNEL are A-weighted, with units expressed in decibels (i.e., dB).

SUBJECTIVE RESPONSE TO NOISE

The effects of noise on people can be classified into three general categories:

- Subjective effects of annoyance, nuisance, dissatisfaction.
- Interference with activities such as speech, sleep, and learning.
- Physiological effects such as anxiety or hearing loss.

The sound levels associated with community noise usually produce effects only in the first two categories. No universal measure for the subjective effects of noise has been developed, nor does a measure exist for the corresponding human reactions from noise annoyance. This is primarily due to the wide variation in individual attitude regarding the noise source(s).

An important factor in assessing a person's subjective reaction is to compare the new noise environment to the existing noise environment. In general, the more a new noise exceeds the existing, the less acceptable it is. Therefore, a new noise source will be judged more annoying in a quiet area than it would be in a noisier location.

Knowledge of the following relationships is helpful in understanding how changes in noise and noise exposure are perceived.

- Except under special conditions, a change in sound level of 1 dB cannot be perceived.
- Outside of the laboratory, a 3-dB change is considered a just-noticeable difference.

- A change in level of at least 5 dB is required before any noticeable change in community response would be expected.
- A 10-dB change is subjectively heard as an approximate doubling in loudness and almost always causes an adverse community response.

NOISE MONITORING SUMMARY

Overview

Existing noise conditions in Cupertino were measured at six locations for twenty-four hours. These measurements commenced on December 18, 2001 and ended on December 19, 2001. The six monitoring locations were chosen by the City of Cupertino.

The weather conditions during the measurement period are summarized in Table D-1.

What follows is a summary of each meter's location and measurement details.

Meter #1 (E)

The first meter was placed along Stevens Creek Boulevard, on the north side of the street between North Wolfe Road and Finch Ave., adjacent to the Vallco Financial Center SW. The meter was approximately 60 feet from the center of Stevens Creek Boulevard, the primary noise source. The Vallco Fashion Park is located just northwest of this monitoring location.

Meter #2 (A)

The second meter was placed along the south side of Stevens Creek Boulevard just east of De Anza Boulevard, a commercial area. The meter was sited on a telephone pole adjacent to the Symantec Building. There was construction occurring on the south side of Stevens Creek Boulevard at De Anza. Stevens Creek Blvd. contains six lanes of traffic at the monitoring location, and was the primary noise source.

Table D-1.

Date	High Temp.	Mean Temp.	Low Temp.	Winds	Conditions
December 18	55°	50°	45°	0 – 5 mph	Clear
December 19	57°	50°	43°	5 – 15 mph	Cloudy

Meter #3 (A2)

The third meter was placed along South Stelling Road at Tomki Court, just north of the Highway 85 overpass. The meter was positioned on a telephone pole at a height of eight feet, with the pole being located five feet from the roadway. The primary noise source is traffic along South Stelling with secondary noise sources being Highway 85 and the public park across the street.

Meter #4 (B)

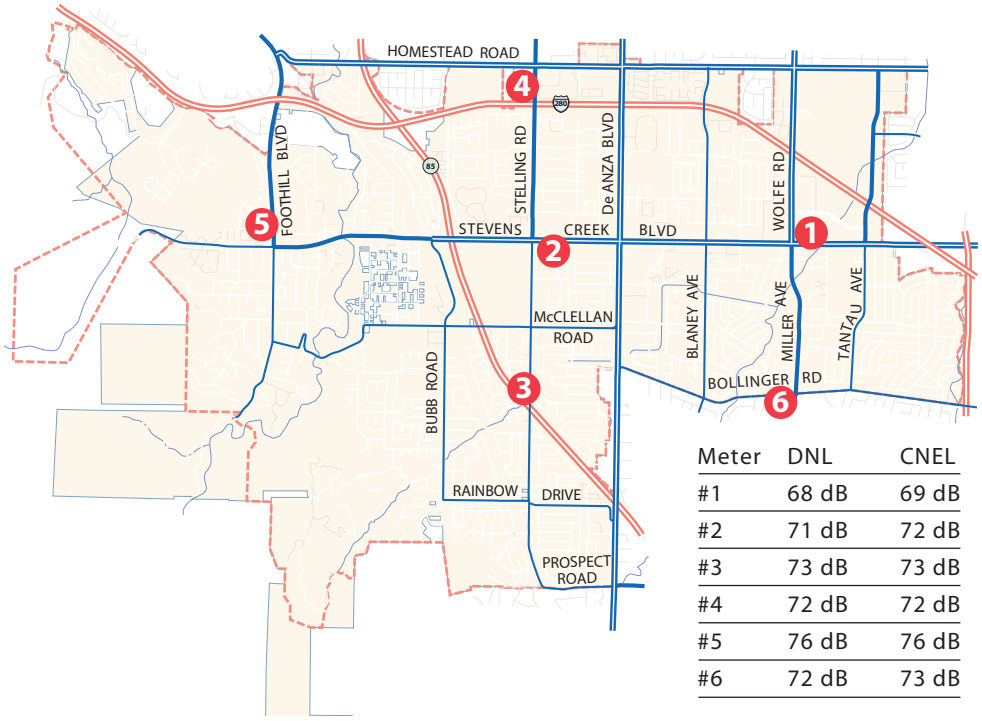
The fourth meter was placed along the west side of North Stelling Road between Highway 280 and Homestead Road. This area is primarily commercial, with a shopping center across the street and a church and some residences on the west side of Stelling Rd. The meter was located on a telephone pole at a height of eight feet. The primary noise source was vehicular traffic along North Stelling.

Meter #5 (C)

The fifth meter was placed along the west side of Foothill Boulevard just north of Silver Oak Way. At the measurement location there are six lanes of traffic (three in either direction), with residences flanking both sides of Foothill. There were a large number of trucks traveling to and from the quarry located further south on Foothill. There were approximately five trucks per minute in both directions counted at 12 pm. The primary noise source was the traffic on Foothill Blvd.

Meter #6 (H)

The sixth meter was placed along the south side of Bollinger Road just west of Miller Avenue. This area is residential yet Bollinger can be considered a major street. The primary noise source was traffic along Bollinger Road.



Meter	DNL	CNEL
#1	68 dB	69 dB
#2	71 dB	72 dB
#3	73 dB	73 dB
#4	72 dB	72 dB
#5	76 dB	76 dB
#6	72 dB	73 dB

Hourly Noise Level

Table D-2 is a summary by hour of the noise levels measured at each location.

Table D-2.

Hour	Location 1 Stevens Creek Blvd. at Vallco Financial Ctr.	Location 2 Stevens Creek Blvd. east of De Anza	Location 3 S. Stelling at Tomki Ct.	Location 4 Stelling north of I-280	Location 5 Foothill Blvd. at Silver Oak Way	Location 6 Bollinger west of Miller Ave.
2:00 PM	67 dB	70 dB	68 dB	72 dB	74 dB	72 dB
3:00 PM	70	73	69	72	73	72
4:00 PM	69	72	71	72	73	72
5:00 PM	69	72	71	72	73	72
6:00 PM	68	71	70	72	73	71
7:00 PM	67	70	66	71	71	71
8:00 PM	66	69	66	70	70	70
9:00 PM	67	70	65	70	70	69
10:00 PM	63	66	74	66	69	67
11:00 PM	60	63	60	62	66	65
12:00 AM	58	61	58	61	63	62
1:00 AM	54	57	52	57	63	60
2:00 AM	55	58	58	61	61	56
3:00 AM	51	54	53	54	63	58
4:00 AM	56	59	52	58	64	65
5:00 AM	59	62	58	64	71	63
6:00 AM	62	65	63	66	73	66
7:00 AM	67	70	68	71	75	71
8:00 AM	67	70	69	72	75	73
9:00 AM	67	70	68	71	79	72
10:00 AM	69	72	68	71	75	71
11:00 AM	68	71	68	71	75	71
12:00 PM	68	71	69	72	75	72
1:00 PM	68	71	68	71	74	71