

Appendix H Noise Fundamentals

Appendix

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N O I S E F U N D A M E N T A L S

Fundamentals of Noise

NOISE

Noise is most often defined as unwanted sound; whether it is loud, unpleasant, unexpected, or otherwise undesirable. Although sound can be easily measured, the perception of noise and the physical response to sound complicate the analysis of its impact on people. People judge the relative magnitude of sound sensation in subjective terms such as “noisiness” or “loudness.”

Noise Descriptors

The following are brief definitions of terminology used in this chapter:

- **Sound.** A disturbance created by a vibrating object, which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.
- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
- **Decibel (dB).** A unitless measure of sound, expressed on a logarithmic scale and with respect to a defined reference sound pressure. The standard reference pressure is 20 micropascals (20 μPa).
- **Vibration Decibel (VdB).** A unitless measure of vibration, expressed on a logarithmic scale and with respect to a defined reference vibration velocity. In the U.S., the standard reference velocity is 1 micro-inch per second (1×10^{-6} in/sec).
- **A-Weighted Decibel (dBA).** An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.
- **Equivalent Continuous Noise Level (L_{eq}); also called the Energy-Equivalent Noise Level.** The value of an equivalent, steady sound level which, in a stated time period (often over an hour) and at a stated location, has the same A-weighted sound energy as the time-varying sound. Thus, the L_{eq} metric is a single numerical value that represents the equivalent amount of variable sound energy received by a receptor over the specified duration.
- **Statistical Sound Level (L_n).** The sound level that is exceeded “n” percent of time during a given sample period. For example, the L_{50} level is the statistical indicator of the time-varying noise signal that is exceeded 50 percent of the time (during each sampling period); that is, half of the sampling time, the changing noise levels are above this value and half of the time they are below it. This is called the “median sound level.” The L_{10} level, likewise, is the value that is exceeded 10 percent of the time (i.e., near the maximum) and this is often known as the “intrusive sound level.” The L_{90} is the sound level exceeded 90 percent of the time and is often considered the “effective background level” or “residual noise level.”

- **Maximum Sound Level ($L_{\max}$).** The highest RMS sound level measured during the measurement period.
- **Root Mean Square Sound Level (RMS).** The square root of the average of the square of the sound pressure over the measurement period.
- **Day-Night Sound Level (L_{dn} or DNL).** The energy-average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the sound levels occurring during the period from 10:00 PM to 7:00 AM.
- **Community Noise Equivalent Level (CNEL).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 5 dB added from 7:00 PM to 10:00 PM and 10 dB from 10:00 PM to 7:00 AM. NOTE: For general community/environmental noise, CNEL and L_{dn} values rarely differ by more than 1 dB (with the CNEL being only slightly more restrictive – that is, higher than the L_{dn} value). As a matter of practice, L_{dn} and CNEL values are interchangeable and are treated as equivalent in this assessment.
- **Peak Particle Velocity (PPV).** The peak rate of speed at which soil particles move (e.g., inches per second) due to ground vibration.
- **Sensitive Receptor.** Noise- and vibration-sensitive receptors include land uses where quiet environments are necessary for enjoyment and public health and safety. Residences, schools, motels and hotels, libraries, religious institutions, hospitals, and nursing homes are examples.

Characteristics of Sound

When an object vibrates, it radiates part of its energy in the form of a pressure wave. Sound is that pressure wave transmitted through the air. Technically, airborne sound is a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure that creates sound waves.

Sound can be described in terms of amplitude (loudness), frequency (pitch), or duration (time). Loudness or amplitude is measured in dB, frequency or pitch is measured in Hertz [Hz] or cycles per second, and duration or time variations is measured in seconds or minutes.

Amplitude

Unlike linear units such as inches or pounds, decibels are measured on a logarithmic scale. Because of the physical characteristics of noise transmission and perception, the relative loudness of sound does not closely match the actual amounts of sound energy. Table 1 presents the subjective effect of changes in sound pressure levels. Ambient sounds generally range from 30 dBA (very quiet) to 100 dBA (very loud). Changes of 1 to 3 dB are detectable under quiet, controlled conditions, and changes of less than 1 dB are usually not discernible (even under ideal conditions). A 3 dB change in noise levels is considered the minimum change that is detectable with human hearing in outside environments. A change of 5 dB is readily discernible to most people in an exterior environment, and a 10 dB change is perceived as a doubling (or halving) of the sound.

Table 1 Noise Perceptibility

Change in dB	Noise Level
± 3 dB	Barely perceptible increase
± 5 dB	Readily perceptible increase
± 10 dB	Twice or half as loud
± 20 dB	Four times or one-quarter as loud

Source: California Department of Transportation (Caltrans). 2013, September. Technical Noise Supplement ("TeNS").

Frequency

The human ear is not equally sensitive to all frequencies. Sound waves below 16 Hz are not heard at all, but are “felt” more as a vibration. Similarly, though people with extremely sensitive hearing can hear sounds as high as 20,000 Hz, most people cannot hear above 15,000 Hz. In all cases, hearing acuity falls off rapidly above about 10,000 Hz and below about 200 Hz.

When describing sound and its effect on a human population, A-weighted (dBA) sound levels are typically used to approximate the response of the human ear. The A-weighted noise level has been found to correlate well with people’s judgments of the “noisiness” of different sounds and has been used for many years as a measure of community and industrial noise. Although the A-weighted scale and the energy-equivalent metric are commonly used to quantify the range of human response to individual events or general community sound levels, the degree of annoyance or other response also depends on several other perceptibility factors, including:

- Ambient (background) sound level
- General nature of the existing conditions (e.g., quiet rural or busy urban)
- Difference between the magnitude of the sound event level and the ambient condition
- Duration of the sound event
- Number of event occurrences and their repetitiveness
- Time of day that the event occurs

Duration

Time variation in noise exposure is typically expressed in terms of a steady-state energy level equal to the energy content of the time varying period (called L_{eq}), or alternately, as a statistical description of the sound level that is exceeded over some fraction of a given observation period. For example, the L_{50} noise level represents the noise level that is exceeded 50 percent of the time; half the time the noise level exceeds this level and half the time the noise level is less than this level. This level is also representative of the level that is exceeded 30 minutes in an hour. Similarly, the L_2 , L_8 and L_{25} values represent the noise levels that are exceeded 2, 8, and 25 percent of the time or 1, 5, and 15 minutes per hour, respectively. These “n” values are typically used to demonstrate compliance for stationary noise sources with many cities’ noise ordinances. Other values typically noted during a noise survey are the L_{min} and L_{max} . These values represent the minimum and maximum root-mean-square noise levels obtained over the measurement period, respectively.

Because community receptors are more sensitive to unwanted noise intrusion during the evening and at night, state law and many local jurisdictions use an adjusted 24-hour noise descriptor called the Community Noise Equivalent Level (CNEL) or Day-Night Noise Level (L_{dn}). The CNEL descriptor requires that an artificial increment (or “penalty”) of 5 dBA be added to the actual noise level for the hours from 7:00 PM to 10:00

PM and 10 dBA for the hours from 10:00 PM to 7:00 AM. The L_{dn} descriptor uses the same methodology except that there is no artificial increment added to the hours between 7:00 PM and 10:00 PM. Both descriptors give roughly the same 24-hour level, with the CNEL being only slightly more restrictive (i.e., higher). The CNEL or L_{dn} metrics are commonly applied to the assessment of roadway and airport-related noise sources.

Sound Propagation

Sound dissipates exponentially with distance from the noise source. This phenomenon is known as “spreading loss.” For a single-point source, sound levels decrease by approximately 6 dB for each doubling of distance from the source (conservatively neglecting ground attenuation effects, air absorption factors, and barrier shielding). For example, if a backhoe at 50 feet generates 84 dBA, at 100 feet the noise level would be 79 dBA, and at 200 feet it would be 73 dBA. This drop-off rate is appropriate for noise generated by on-site operations from stationary equipment or activity at a project site. If noise is produced by a line source, such as highway traffic, the sound decreases by 3 dB for each doubling of distance over a reflective (“hard site”) surface such as concrete or asphalt. Line source noise in a relatively flat environment with ground-level absorptive vegetation decreases by an additional 1.5 dB for each doubling of distance.

Psychological and Physiological Effects of Noise

Physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 dBA. Exposure to high noise levels affects the entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, thereby affecting blood pressure and functions of the heart and the nervous system. Extended periods of noise exposure above 90 dBA results in permanent cell damage, which is the main driver for employee hearing protection regulations in the workplace. For community environments, the ambient or background noise problem is widespread, though generally worse in urban areas than in outlying, less-developed areas. Elevated ambient noise levels can result in noise interference (e.g., speech interruption/masking, sleep disturbance, disturbance of concentration) and cause annoyance. Since most people do not routinely work with decibels or A-weighted sound levels, it is often difficult to appreciate what a given sound pressure level number means. To help relate noise level values to common experience, Table 2 shows typical noise levels from familiar sources.

Table 2 Typical Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Onset of physical discomfort	120+	
	110	Rock Band (near amplification system)
Jet Flyover at 1,000 feet		
	100	
Gas Lawn Mower at three feet		
	90	
Diesel Truck at 50 feet, at 50 mph		Food Blender at 3 feet
	80	Garbage Disposal at 3 feet
Noisy Urban Area, Daytime		
	70	Vacuum Cleaner at 10 feet
Commercial Area		Normal speech at 3 feet
Heavy Traffic at 300 feet	60	
		Large Business Office
Quiet Urban Daytime	50	Dishwasher Next Room
Quiet Urban Nighttime	40	Theater, Large Conference Room (background)
Quiet Suburban Nighttime		
	30	Library
Quiet Rural Nighttime		Bedroom at Night, Concert Hall (background)
	20	
		Broadcast/Recording Studio
	10	
Lowest Threshold of Human Hearing	0	Lowest Threshold of Human Hearing

Source: California Department of Transportation (Caltrans). 2013, September. Technical Noise Supplement ("TeNS").

Vibration Fundamentals

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Vibration is normally associated with activities stemming from operations of railroads or vibration-intensive stationary sources, but can also be associated with construction equipment such as jackhammers, pile drivers, and hydraulic hammers. As with noise, vibration can be described by both its amplitude and frequency. Vibration displacement is the distance that a point on a surface moves away from its original static position; velocity is the instantaneous speed that a point on a surface moves; and acceleration is the rate of change of the speed. Each of these descriptors can be used to correlate vibration to human response, building damage, and acceptable equipment vibration levels. During construction, the operation of construction equipment can cause groundborne vibration. During the operational phase of a project, receptors may be subject to levels of vibration that can cause annoyance due to noise generated from vibration of a structure or items within a structure.

Vibration amplitudes are usually described in terms of either the peak particle velocity (PPV) or the root mean square (RMS) velocity. PPV is the maximum instantaneous peak of the vibration signal and RMS is the

square root of the average of the squared amplitude of the signal. PPV is more appropriate for evaluating potential building damage and RMS is typically more suitable for evaluating human response.

As with airborne sound, annoyance with vibrational energy is a subjective measure, depending on the level of activity and the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Persons accustomed to elevated ambient vibration levels, such as in an urban environment, may tolerate higher vibration levels. Table 3 displays the human response and the effects on buildings resulting from continuous vibration (in terms of various levels of PPV).

Table 3 Human Reaction to Typical Vibration Levels

Vibration Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.006–0.019	Threshold of perception, possibility of intrusion	Vibrations unlikely to cause damage of any type
0.08	Vibrations readily perceptible	Recommended upper level of vibration to which ruins and ancient monuments should be subjected
0.10	Level at which continuous vibration begins to annoy people	Virtually no risk of “architectural” (i.e. not structural) damage to normal buildings
0.20	Vibrations annoying to people in buildings	Threshold at which there is a risk to “architectural” damage to normal dwelling – houses with plastered walls and ceilings
0.4–0.6	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Vibrations at a greater level than normally expected from traffic, but would cause “architectural” damage and possibly minor structural damage

Source: California Department of Transportation (Caltrans). 2020, April. *Transportation and Construction Vibration Guidance Manual*. Prepared by ICF International.

N O I S E M O N I T O R I N G D A T A

Measurement Report

Report Summary

Meter's File Name	LxT_Data.140.s	Computer's File Name	LxT_0005424-20250819 151047-LxT_Data.140.ldbin		
Meter	LxT1 0005424	Firmware	2.404		
User	AC	Location	ST-1		
Job Description	TSD-21				
Note					
Start Time	2025-08-19 15:10:47	Duration	0:15:00.0		
End Time	2025-08-19 15:25:47	Run Time	0:14:59.4	Pause Time	0:00:00.6
Pre-Calibration	2025-08-19 15:10:37	Post-Calibration	None	Calibration Deviation	---

Results

Overall Metrics

LA _{eq}	63.3 dB		
LAE	92.8 dB	SEA	--- dB
EA	213.7 µPa²h		
EA8	6.8 mPa²h		
EA40	34.2 mPa²h		
LA _{Speak}	103.3 dB		2025-08-19 15:20:26
LA _{Smax}	74.2 dB		2025-08-19 15:20:26
LA _{Smin}	44.9 dB		2025-08-19 15:18:34
LA _{eq}	63.3 dB		
LC _{eq}	69.2 dB	LC _{eq} - LA _{eq}	5.9 dB
LA _l _{eq}	64.9 dB	LA _l _{eq} - LA _{eq}	1.6 dB

Exceedances

	Count	Duration
LAS > 85.0 dB	0	0:00:00.0
LAS > 115.0 dB	0	0:00:00.0
LASpk > 135.0 dB	0	0:00:00.0
LASpk > 137.0 dB	0	0:00:00.0
LASpk > 140.0 dB	0	0:00:00.0

Community Noise

LDN	LDay	LNight	
--- dB	--- dB	0.0 dB	
LDEN	LDay	LEve	LNight
--- dB	--- dB	--- dB	--- dB

Any Data

	A			C			Z	
	Level	Time Stamp		Level	Time Stamp		Level	Time Stamp
L _{eq}	63.3 dB			--- dB			--- dB	
L _{S(max)}	74.2 dB	2025-08-19 15:20:26		--- dB	None		--- dB	None
L _{S(min)}	44.9 dB	2025-08-19 15:18:34		--- dB	None		--- dB	None
L _{Peak(max)}	103.3 dB	2025-08-19 15:20:26		--- dB	None		--- dB	None

Overloads

Count	Duration
0	0:00:00.0

Statistics

LAS 2.0	70.3 dB
LAS 8.0	67.1 dB
LAS 25.0	64.7 dB
LAS 50.0	61.3 dB
LAS 90.0	50.5 dB
LAS 99.0	46.1 dB



Project Name: _____

Date: 8/19/25Project Number: TSD - 21Monitoring Personnel: ACMonitoring Site #: ST #1Time Start: 3:10 End: 3:25Site Location/Address: South of 1486 Valencia AvenuePrimary Noise Source: Roadway Traffic ("After school traffic"); Student talking as they walk by

Measurement Results	
Percentiles	dBA
Leq	<u>63.3</u>
Lmax	<u>74.2</u>
Lmin	<u>44.9</u>
L2	<u>70.3</u>
L8	<u>67.1</u>
L25	<u>64.7</u>
L50	<u>61.3</u>
Other	
SEL/CNEL	

Observed Noise Sources/Events		
Time	Noise Source Event	dBA
<u>3:58</u>	<u>Student walking by i talking</u>	<u>67</u>
<u>6:10</u>	<u>Semi passing by</u>	<u>72.8</u>
<u>10:45</u>	<u>3 Students scooting by</u>	<u>65</u>

Data File: 140 ☒ Photos: yes

Comments (sound walls, height, etc.): Approx 3 foot Wall before the residential courtyard
but no walls at z edge residences; 391m from glass entrance to Legacy Magnet
Academy; 345m from north eastern pillar to burned down UCMC hanger

Max Wind Velocity (knots/hr)	Average Wind Velocity (knots/hr)	Temperature (F)	Relative Humidity (%)
	<u>10 mph</u>	<u>85</u>	<u>47%</u>

Traffic counts in both directions:

Roadway	# Lanes	Posted Speed	Autos	MD	HD

Calibration

Note, for ST measurements, calibration is only necessary before and after each monitoring period per day per meter - not before and after every ST measurement in that day. So only fill out calibration info on one ST sheet unless using two different meters for ST's.

LD CAL 200 ☐ SN-14280 ☒ SN-14279

1 kHz Tone Reference Level: ☒ 94 dB ☐ 114 dB

Calibration Offset Prior: 0.22/B

Offset After: 1.14

Caltone File Before: File # _____

Caltone File Before: File # _____

Additional Notes:

Measurement Report

Report Summary

Meter's File Name	LxT_Data.141.s	Computer's File Name	LxT_0005424-20250819 153824-LxT_Data.141.ldbin		
Meter	LxT1 0005424	Firmware	2.404		
User	AC	Location	ST-2		
Job Description	TSD-21				
Note					
Start Time	2025-08-19 15:38:24	Duration	0:15:00.0		
End Time	2025-08-19 15:53:24	Run Time	0:14:59.9	Pause Time	0:00:00.1
Pre-Calibration	2025-08-19 15:37:24	Post-Calibration	None	Calibration Deviation	---

Results

Overall Metrics

LA _{eq}	56.9 dB		
LAE	86.4 dB	SEA	--- dB
EA	49.0 µPa²h		
EA8	1.6 mPa²h		
EA40	7.8 mPa²h		
LA _{Speak}	99.3 dB	2025-08-19 15:50:24	
LA _{Smax}	71.6 dB	2025-08-19 15:41:25	
LA _{Smin}	43.6 dB	2025-08-19 15:52:28	
LA _{eq}	56.9 dB		
LC _{eq}	69.8 dB	LC _{eq} - LA _{eq}	12.9 dB
LA _l _{eq}	59.9 dB	LA _l _{eq} - LA _{eq}	3.0 dB

Exceedances

Count Duration

LAS > 85.0 dB	0	0:00:00.0
LAS > 115.0 dB	0	0:00:00.0
LASpk > 135.0 dB	0	0:00:00.0
LASpk > 137.0 dB	0	0:00:00.0
LASpk > 140.0 dB	0	0:00:00.0

Community Noise

LDN	LDay	LNight		
--- dB	--- dB	0.0 dB		
LDEN	LDay	LEve	LNight	
--- dB	--- dB	--- dB	--- dB	

Any Data

A			C		Z	
Level	Time Stamp		Level	Time Stamp	Level	Time Stamp
L _{eq}	56.8 dB		--- dB		--- dB	
L _{S(max)}	71.6 dB	2025-08-19 15:41:25	--- dB	None	--- dB	None
L _{S(min)}	43.6 dB	2025-08-19 15:52:28	--- dB	None	--- dB	None
L _{Peak(max)}	99.3 dB	2025-08-19 15:50:24	--- dB	None	--- dB	None

Overloads

Count	Duration
0	0:00:00.0

Statistics

LAS 2.0	66.5 dB
LAS 8.0	61.8 dB
LAS 25.0	55.0 dB
LAS 50.0	50.0 dB
LAS 90.0	46.3 dB
LAS 99.0	44.5 dB



Project Name: _____

Date: 8/19/25Project Number: TSD-21Monitoring Personnel: ACMonitoring Site #: ST#2Time Start: 3:38 End: 3:53Site Location/Address: Just before the Legacy Magnet Academy drivewayPrimary Noise Source: Student Pickup Vehicle traffic, after initial wave of transient vehicles

Measurement Results	
Percentiles	dBA
Leq	<u>56.8</u>
Lmax	<u>71.6</u>
Lmin	<u>43.6</u>
L2	<u>66.5</u>
L8	<u>61.8</u>
L25	<u>55.0</u>
L50	<u>50.0</u>
Other	
SEL/CNEL	

Observed Noise Sources/Events		
Time	Noise Source Event	dBA

Data File: 141 ☒ Photos: yes

Comments (sound walls, height, etc.) No walls; Legacy Magnet Academy margin 58m; 144m from glass arch entrance of campus; 28m from light pole across the street; 441.7m from from north eastern beam of USMC high

Max Wind Velocity (knots/hr)	Average Wind Velocity (knots/hr)	Temperature (F)	Relative Humidity (%)
	<u>10 mph</u>	<u>85</u>	<u>47%</u>

Traffic counts in both directions:

Roadway	# Lanes	Posted Speed	Autos	MD	HD

Calibration

Note, for ST measurements, calibration is only necessary before and after each monitoring period per day per meter - not before and after every ST measurement in that day. So only fill out calibration info on one ST sheet unless using two different meters for ST's.

LD CAL 200 ☐ SN-14280 ☒ SN-14279

1 kHz Tone Reference Level: ☐ 94 dB ☐ 114 dB

Calibration Offset Prior: -76

Offset After: -13

Caltone File Before: File # _____

Caltone File Before: File # _____

Additional Notes:

Long-Term 24 Hour Continuous Noise Monitoring
Calculation Input Sheet

Project: TSD-21
Date: August 19-20, 2025
Site: LT-1

Calculated CNEL, dBA

62.3

Averages

	Leq	Lmax	L50	L90
Daytime (7 a.m. - 7 p.m.)	61.3	79.0	56.2	47.2
Evening (7 p.m. - 9 p.m.)	57.8	76.5	51.2	44.2
Nighttime (9 p.m. - 7 a.m.)	53.3	70.3	43.0	39.7

Hour	Leq	Lmax	L50	L90
15:00	60.1	75.0	56.1	49.1
16:00	61.6	83.2	57.0	49.0
17:00	61.5	79.7	57.1	48.7
18:00	61.2	81.2	56.6	46.2
19:00	59.2	77.2	54.4	46.3
20:00	57.7	76.4	51.7	44.4
21:00	55.9	75.8	47.5	42.0
22:00	52.9	71.0	44.5	40.8
23:00	55.3	69.8	50.7	39.8
0:00	47.0	66.5	40.4	39.0
1:00	46.6	70.5	39.2	38.4
2:00	45.0	68.1	39.3	38.0
3:00	45.0	67.0	40.4	39.6
4:00	49.9	70.2	39.6	39.0
5:00	55.5	72.0	44.1	40.0
6:00	58.9	77.8	49.1	42.7
7:00	63.3	85.1	57.1	48.2
8:00	63.2	83.7	58.5	49.3
9:00	61.7	75.8	56.2	46.2
10:00	58.6	71.8	53.3	43.6
11:00	59.8	74.7	54.3	44.7
12:00	61.0	74.9	56.6	48.1
13:00	61.5	85.2	56.2	47.7
14:00	59.7	77.6	54.8	45.9

Percentage of Energy

Daytime	81%
Evening	9%
Nighttime	10%



Project: TSD-21

User: AC

Location: LT-1

<u>No.</u>	<u>Start Date</u>	<u>Start Time</u>	<u>End Time</u>	<u>Duration</u>	<u>Leg</u>	<u>Lmax</u>	<u>Lmin</u>	<u>L1</u>	<u>L2</u>	<u>L5</u>	<u>L8</u>	<u>L10</u>	<u>L25</u>	<u>L50</u>	<u>L90</u>	<u>L95</u>	<u>L99</u>
1	8/19/2025	3:00 PM	4:00 PM	1:00	60.1	75.0	43.7	68.6	67.6	65.8	64.8	64.2	61.0	56.1	49.1	47.4	45.6
2	8/19/2025	4:00 PM	5:00 PM	1:00	61.6	83.2	43.0	69.8	68.3	66.7	65.5	64.9	61.5	57.0	49.0	47.5	45.3
3	8/19/2025	5:00 PM	6:00 PM	1:00	61.5	79.7	43.3	69.8	68.4	66.8	66.1	65.6	62.3	57.1	48.7	46.9	44.8
4	8/19/2025	6:00 PM	7:00 PM	1:00	61.2	81.2	41.3	69.8	68.5	66.6	65.5	64.9	61.4	56.6	46.2	44.6	42.7
5	8/19/2025	7:00 PM	8:00 PM	1:00	59.2	77.2	42.4	67.9	67.0	65.1	64.2	63.6	59.5	54.4	46.3	45.3	43.5
6	8/19/2025	8:00 PM	9:00 PM	1:00	57.7	76.4	41.5	67.4	66.3	64.3	63.1	62.2	57.1	51.7	44.4	43.8	42.9
7	8/19/2025	9:00 PM	10:00 PM	1:00	55.9	75.8	39.5	66.6	65.1	62.9	61.2	60.1	54.2	47.5	42.0	41.4	40.6
8	8/19/2025	10:00 PM	11:00 PM	1:00	52.9	71.0	38.7	64.9	63.2	59.7	57.2	55.8	49.5	44.5	40.8	39.7	38.9
9	8/19/2025	11:00 PM	12:00 AM	1:00	55.3	69.8	39.0	64.5	62.3	59.8	59.3	59.2	58.8	50.7	39.8	39.5	39.1
10	8/20/2025	12:00 AM	1:00 AM	1:00	47.0	66.5	38.4	60.7	56.6	50.3	47.1	45.5	42.7	40.4	39.0	38.8	38.6
11	8/20/2025	1:00 AM	2:00 AM	1:00	46.6	70.5	38.1	58.9	52.3	44.1	42.9	42.0	40.1	39.2	38.4	38.3	38.2
12	8/20/2025	2:00 AM	3:00 AM	1:00	45.0	68.1	37.8	58.0	51.8	44.3	42.8	42.4	40.5	39.3	38.0	37.9	37.8
13	8/20/2025	3:00 AM	4:00 AM	1:00	45.0	67.0	39.1	56.6	51.6	45.0	43.4	42.8	41.3	40.4	39.6	39.3	39.1
14	8/20/2025	4:00 AM	5:00 AM	1:00	49.9	70.2	38.7	64.4	60.5	54.1	48.2	45.6	40.9	39.6	39.0	38.9	38.8
15	8/20/2025	5:00 AM	6:00 AM	1:00	55.5	72.0	39.1	67.4	66.1	63.0	60.7	59.5	51.5	44.1	40.0	39.6	39.2
16	8/20/2025	6:00 AM	7:00 AM	1:00	58.9	77.8	40.4	69.5	68.2	66.0	64.3	63.3	57.3	49.1	42.7	41.8	40.9
17	8/20/2025	7:00 AM	8:00 AM	1:00	63.3	85.1	42.9	71.8	70.9	69.4	68.2	67.5	63.2	57.1	48.2	46.5	44.0
18	8/20/2025	8:00 AM	9:00 AM	1:00	63.2	83.7	42.4	71.6	70.1	68.6	67.6	67.0	63.8	58.5	49.3	47.0	44.3
19	8/20/2025	9:00 AM	10:00 AM	1:00	61.7	75.8	41.5	71.2	69.7	68.1	66.9	66.2	62.2	56.2	46.2	44.5	42.6
20	8/20/2025	10:00 AM	11:00 AM	1:00	58.6	71.8	40.6	67.7	66.9	65.2	64.1	63.4	58.9	53.3	43.6	42.5	41.3
21	8/20/2025	11:00 AM	12:00 PM	1:00	59.8	74.7	40.6	69.8	68.0	66.1	64.9	64.1	59.7	54.3	44.7	43.0	41.3
22	8/20/2025	12:00 PM	1:00 PM	1:00	61.0	74.9	42.1	70.9	68.8	66.7	65.5	64.9	61.6	56.6	48.1	46.3	44.5
23	8/20/2025	1:00 PM	2:00 PM	1:00	61.5	85.2	42.1	70.4	68.4	66.8	65.7	65.1	61.5	56.2	47.7	45.9	43.5
24	8/20/2025	2:00 PM	3:00 PM	1:00	59.7	77.6	41.5	69.2	67.1	65.4	64.3	63.7	60.0	54.8	45.9	44.4	42.7

C O N S T R U C T I O N M O D E L I N G R E S U L T S

TSD-21.0 - Construction Noise Modeling Attenuation Calculations			
Levels in dBA Leq			
Phase	RCNM Reference Noise Level	Multi-Family Receptor to	
		East	School Receptor to South
<i>Distance in feet</i>	50	350	275
Demolition	85	68	70
Site Prep	81	64	66
Grading	83	66	68
<i>Distance in feet</i>	50	175	285
Building Construction	79	68	64
Architectural Coating	74	63	59
<i>Distance in feet</i>	50	200	120
Paving	79	67	71
Attenuation calculated through Inverse Square Law: $L_p(R2) = L_p(R1) - 20\log(R2/R1)$			

Report date: 08/27/2025
Case Description: TSD-21.0 Demolition

Description	Land Use	Baselines (dBA)		
		Daytime	Evening	Night
Receptor at 50 ft	Residential	65.0	60.0	55.0

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Saw	No	20		89.6	50.0	0.0
Dozer	No	40		81.7	50.0	0.0
Excavator	No	40		80.7	50.0	0.0

[illegible]

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 08/27/2025
Case Description: TSD-21.0 Site Preparation

**** Receptor #1 ****

Description	Land Use	Baselines (dBA)		
		Daytime	Evening	Night
Receptor at 50 ft	Residential	65.0	60.0	55.0

Description	Impact Device	Usage (%)	Equipment			
			Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	50.0	0.0
Dozer	No	40		81.7	50.0	0.0
Backhoe	No	40		77.6	50.0	0.0

Results

		Noise Limits (dBA)								Noise Limit Exceedance (dBA)					
		Calculated (dBA)		Day		Evening		Night		Day		Evening		Night	
		Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Equipment															
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer		81.7	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total		81.7	80.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 08/27/2025
Case Description: TSD-21.0 Grading

**** Receptor #1 ****

Description	Land Use	Baselines (dBA)		
		Daytime	Evening	Night
Receptor at 50 ft	Residential	65.0	60.0	55.0

Description	Impact Device	Usage (%)	Equipment			
			Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	50.0	0.0
Grader	No	40	85.0		50.0	0.0
Excavator	No	40		80.7	50.0	0.0

Results

		Noise Limits (dBA)								Noise Limit Exceedance (dBA)					
		Calculated (dBA)		Day		Evening		Night		Day		Evening		Night	
		Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Equipment															
Front End Loader		79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader		85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator		80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total		85.0	83.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 08/27/2025
Case Description: TSD-21.0 Building Construction

**** Receptor #1 ****

Description	Land Use	Baselines (dBA)		
		Daytime	Evening	Night
Receptor at 50 ft	Residential	65.0	60.0	55.0

Equipment						
Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Generator	No	50		80.6	50.0	0.0
Man Lift	No	20		74.7	50.0	0.0
Backhoe	No	40		77.6	50.0	0.0

Results															
Equipment				Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
				Calculated (dBA)		Day		Evening		Night		Day		Evening	
				Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Generator				80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift				74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe				77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total				80.6	79.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 08/27/2025
Case Description: TSD-21.0 Architectural Coating

**** Receptor #1 ****

Description	Land Use	Baselines (dBA)		
		Daytime	Evening	Night
Receptor at 50 ft	Residential	65.0	60.0	55.0

Description	Impact Device	Usage (%)	Equipment			
			Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Compressor (air)	No	40		77.7	50.0	0.0

		Results													
		Noise Limits (dBA)								Noise Limit Exceedance (dBA)					
		Calculated (dBA)		Day		Evening		Night		Day		Evening		Night	
Equipment		Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Compressor (air)		77.7	73.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total		77.7	73.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 08/27/2025
Case Description: TSD-21.0 Paving

**** Receptor #1 ****

Description	Land Use	Baselines (dBA)		
		Daytime	Evening	Night
Receptor at 50 ft	Residential	65.0	60.0	55.0

Description	Impact Device	Usage (%)	Equipment			
			Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Paver	No	50		77.2	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Paver	No	50		77.2	50.0	0.0

Results

Equipment	Noise Limits (dBA)										Noise Limit Exceedance (dBA)					
	Calculated (dBA)		Day		Evening		Night		Day		Evening		Night			
	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq		
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	80.0	78.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TSD-21.0 - Vibration Damage Attenuation Calculations			
	Vibration Reference Level	Multi-Family Receptor to East	School Receptor to South
<i>Distance in feet</i>	<i>at 25 feet</i>	<i>150</i>	<i>90</i>
Vibratory Roller	0.21	0.014	0.031
Clam shovel	0.202	0.014	0.030
Hoe Ram	0.089	0.006	0.013
Large Bulldozer	0.089	0.006	0.013
Caisson Drilling	0.089	0.006	0.013
Loaded Trucks	0.076	0.005	0.011
Jackhammer	0.035	0.002	0.005
Small Bulldozer	0.003	0.000	0.000

T R A F F I C M O D E L I N G R E S U L T S

Traffic Noise Calculator: FHWA 77-108										Tustin USD Project (TSD-21.0) Existing 2025 Traffic Noise Traffic Conditions														
		Output																		Auto Inputs				
		dBA at 50 feet			Distance to CNEL Contour																			
ID	L _{eq-24hr}	L _{dn}	CNEL	70 dBA	65 dBA	60 dBA	Roadway			Segment From - To	ADT	Posted Speed Limit	Grade	% Autos	% Med Trucks	% Heavy Trucks	% Daytime	% Evening	% Night	Number of Lanes	Site Condition	Distance to Reciever	Ground Absorption	Lane Distance
1	65.6	68.3	69.0	43	93	200	Valencia Avenue		Legacy Road	Columbus Square	10,706	45	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44
2	66.1	68.9	69.5	47	101	217	Valencia Avenue		Legacy Road	Tustin Ranch Road	12,057	45	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44
3	62.8	65.6	66.3	28	61	131	Kensington Park Drive		Valencia Avenue	Georgia Street	7,430	40	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44

Traffic Noise Calculator: FHWA 77-108							Tustin USD Project (TSD-21.0) 2028 No Project Traffic Noise Traffic Conditions																	
	Output						Inputs														Auto Inputs			
	dBA at 50 feet			Distance to CNEL Contour																				
ID	L _{eq} 24hr	L _{dn}	CNEL	70 dBA	65 dBA	60 dBA	Roadway			Segment From - To	ADT	Posted Speed Limit	Grade	% Autos	% Med Trucks	% Heavy Trucks	% Daytime	% Evening	% Night	Number of Lanes	Site Condition	Distance to Receiver	Ground Absorption	Lane Distance
1	65.7	68.5	69.2	44	95	204	Valencia Avenue	Legacy Road	Columbus Square		11,030	45	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44
2	66.2	69.0	69.7	48	103	221	Valencia Avenue	Legacy Road	Tustin Ranch Road		12,422	45	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44
3	62.9	65.7	66.4	29	62	134	Kensington Park Drive	Valencia Avenue	Georgia Street		7,655	40	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44

Traffic Noise Calculator: FHWA 77-108							Tustin USD Project (TSD-21.0) 2025 Plus Project Traffic Noise Traffic Conditions																	
	Output						Inputs															Auto Inputs		
	dBA at 50 feet			Distance to CNEL Contour																				
ID	L _{eq} 24hr	L _{dn}	CNEL	70 dBA	65 dBA	60 dBA	Roadway			Segment From - To	ADT	Posted Speed Limit	Grade	% Autos	% Med Trucks	% Heavy Trucks	% Daytime	% Evening	% Night	Number of Lanes	Site Condition	Distance to Receiver	Ground Absorption	Lane Distance
1	65.8	68.6	69.3	45	97	208	Valencia Avenue	Legacy Road	Columbus Square		11,352	45	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44
2	66.3	69.1	69.8	48	104	224	Valencia Avenue	Legacy Road	Tustin Ranch Road		12,703	45	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44
3	63.2	66.0	66.6	30	64	139	Kensington Park Drive	Valencia Avenue	Georgia Street		8,076	40	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44

Traffic Noise Calculator: FHWA 77-108							Tustin USD Project (TSD-21.0) 2028 with Project Traffic Noise Traffic Conditions																				
	Output						Inputs														Auto Inputs						
	dBA at 50 feet			Distance to CNEL Contour																							
ID	L _{eq} 24hr	L _{dn}	CNEL	70 dBA	65 dBA	60 dBA	Roadway			Segment From - To	ADT	Posted Speed Limit	Grade	% Autos	% Med Trucks	% Heavy Trucks	% Daytime	% Evening	% Night	Number of Lanes	Site Condition	Distance to Receiver	Ground Absorption	Lane Distance			
1	65.9	68.7	69.4	46	98	212	Valencia Avenue			Legacy Road			Columbus Square	11,676	45	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44
2	66.4	69.2	69.9	49	106	229	Valencia Avenue			Legacy Road			Tustin Ranch Road	13,068	45	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44
3	63.3	66.1	66.8	30	65	141	Kensington Park Drive			Valencia Avenue			Georgia Street	8,301	40	0.0%	96.0%	2.5%	1.5%	75.0%	15.0%	10.0%	4	Soft	50	0.5	44