Noise Study Report

U.S. 50 HOV Lanes Project

District 3-Sac 50-PM 0.2 to 6.1

EA: 03-3F360

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Prepared By: ______________________ Date 4-19-2017

Saeid Zandian,
Transportation Engineer,
Caltrans North Region Environmental Engineering Office (South)
703 B Street, Marysville, CA. 95901
(530) 741-4581

Approved By: ______________________ Date 4/19/2017

Doug Coleman, Chief
Caltrans North Region Environmental Engineering Office (South)
703 B Street, Marysville, CA. 95901
(530) 741-4539

Executive Summary

The purpose of this technical noise study is to assess the existing and future noise impacts in vicinity of the proposed High Occupancy Vehicle (HOV) project and to identify preliminary noise abatement measures necessary for the project alternatives to comply with state and federal noise abatement/mitigation requirements.

The proposed project involves extending the existing HOV lanes 7.8 miles west from the existing HOV lanes at the Watt Avenue I/C to the Sacramento River Viaduct (I-5 I/C) in downtown Sacramento. There are four alternatives proposed for this project.

The alternatives proposed are as follows:

- **Alternative 1. HOV Lanes**: Add HOV lanes in both directions onto the existing structural section by re-striping and signing the facility to accommodate the additional HOV.

- **Alternative 2. Mixed Flow Lanes**: Alternative 2 would have the same design features as Alternative 1 except the additional lanes are utilized as mixed flow vehicle lanes to add vehicle capacity.

- **Alternative 3. Take-a-Lane:** This alternative converts an existing mixed flow lane in each direction to a HOV lane; no new lane is striped for vehicle use.

- **Alternative 4. No Build;** This alternative makes no improvements to freeway.

Alternatives 1 & 2 require median widening of twelve structures (Sacramento River Viaduct requires one span only) and include a 0.15 ft rubberized hot mix asphalt (RHMA-O) overlay to restripe the freeway since the new lane lines will not match the existing PCC joints.

There is a mix of single-family and multi-family residential, commercial, and industrial land-uses throughout the project area. Category B-E land uses, in the form of single-family and multi-family residential land uses, open space such as parks, public areas such as churches, and hotels and motels, border a large percentage of the project alignment.

Existing Environment:

Illingworth & Rodkin (I&R) personnel conducted a noise monitoring survey from November 2-9, 2005, which included nine long-term (24-hour) monitoring locations, and 49 short-term monitoring locations for the purpose of creating a traffic noise model for predicting noise levels at measured locations. Traffic volumes and a sample of traffic speeds were also documented. Additional site visits were made by I&R staff between November 2005 and May 2006 to characterize the study area features (such as sound walls and elevations), conduct additional noise measurements, and identify possible noise abatement options and sound wall locations. A summary of the long- and short-term measurements is provided in Appendix B and Appendix C.

Existing loudest-hour $L_{eq(h)}$ noise levels were calculated to range from 58 to 74 dBA at first-tier Category B (noise sensitive) noise monitoring locations, depending on the distance to U.S. 50, the relative highway and local elevation and terrain, and the intervening structures and barriers between the measurement location and the highway. Noise measurement sites and existing barrier locations are indicated in Appendix D.

The short term noise measurements data were collected on November of 2005 in order to create a traffic noise model for the purpose of predicting noise levels for the Existing and Design year (2040) at noise sensitive locations.

Once the traffic noise model has been created and validated for accuracy, then the peak hour traffic volumes for the Existing and Design year (2040) conditions are inputted into model and noise levels at noise sensitive locations are obtained.

Since noise levels approached / exceeded the FHWA's noise criteria, noise abatement in form of sound walls were considered.

Future Traffic Noise Impact:

The FHWA Traffic Noise Model, TNM 2.5, was used to predict future noise levels, analyze noise impacts, and assess potential abatement options for this project. The model was calibrated and adjusted based on measured noise and traffic conditions. Noise levels were assessed in TNM 2.5 using the traffic volumes supplied by Caltrans for peak hours for Year 2004, Year 2020, Year 2030 and Year 2040 No Build, and Build conditions. For the Year 2040 No Build conditions, noise increases of up to 1 dBA were predicted above Year 2020 levels. Noise increases of up to 2 dBA were predicted for the Year 2040 Build conditions. Modeled noise levels at first-tier Category B receivers ranged from 58 to 74 dBA under Year 2040 No Build conditions and from 59 to 74 dBA under Year 2040 Build conditions. Noise level increases would not be considered substantial.

However, due to existing conditions, noise levels at many first- and second-tier Category B receivers would continue to approach or exceed the NAC of 67 dBA.

Noise Abatement Considerations:

Noise abatement, in the form of sound walls, was assessed for sensitive receptors that approached or exceeded the NAC. Sound wall heights were evaluated in 2 foot increments ranging in height from 6 feet to16 feet. Replacement sound walls were assessed for noise barriers that were in fair to poor condition and for those that potentially did not break the line of sight between residents in the area and traffic on U.S. 50. The replacement wall of equal height to the existing wall would not be anticipated to change the noise environment behind the wall, therefore, the insertion loss was calculated based on wall height increases over the existing wall height.

Segment 1: Westernmost Project Limit (I-5 I/C) to Alhambra Boulevard

There are currently no barriers in this segment. The predicted Year 2040 Build loudest-hour noise levels within this segment range from 62 to 74 dBA, with 17 Category B receivers approaching or exceeding the NAC of 67 dBA. There are two proposed barriers throughout this segment to mitigate these potential impacts, SWWB1 and SWEB1. The proposed barriers would reduce noise levels by 2 to 11 decibels at 150 affected receivers. A minimum barrier height of 8 ft would break the line of sight between a 3.5 m (11.5 ft)-high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $5,110,000 to $10,650,000 depending upon the barrier height.

Segment 2: Alhambra Boulevard to 65th Street

There are currently seven barriers in this segment: Barriers H, I, Q-1, Q-2, Q-3, Q-4, and J. Barriers I and J are in fair condition but may not break the line of sight between receivers, and traffic on U.S. 50 and Barriers H, Q-1, Q-2, Q-3, and Q-4 are in good condition. The predicted Year 2040 Build loudest-hour noise levels within this segment range from 58 to 74 dBA, with 27 Category B receivers approaching or exceeding the NAC of 67 dBA $L_{eq\,(h)}$.

There are seven proposed barriers throughout this segment to mitigate these potential impacts: SWWB2, SWEB2, SWEB3, SWEB4, SWEB5, SWEB6 and SWEB7.

SWWB2 would reduce noise levels by 5 to 9 decibels for up to 25 sensitive receptors. A minimum barrier height of 10 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $497,000 to $1,775,000 depending upon the barrier height.

SWEB2-2A would reduce noise levels by 5 to 10 decibels for 58 sensitive receptors. A minimum barrier height of 8 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $355,000 to $3,760,000 depending upon the barrier height.

SWEB3: Raising the existing sound wall height to 16 ft would not provide the required 5-dBA reduction; therefore, this barrier is not considered. However, replacing this barrier with a taller barrier is being considered depending on funding and final project design.

SWEB4 would reduce noise levels by 5 to 7 decibels for 2 sensitive receptors. A minimum barrier height of 8 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $142,000 to $497,000, depending upon the barrier height.

SWEB5 will reduce noise levels by 6 to 12 decibels for 7 sensitive receptors. A minimum barrier height of 6 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol is $497,000, for this barrier.

SWEB6 would reduce noise levels by 5 to 9 decibels for 26 sensitive receptors. A minimum barrier height of 6 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $639,000 to $1,846,000, depending upon the barrier height.

SWEB7-7A is comprised of two parts, the new barrier construction and the barrier height extension for existing Barrier J. A minimum barrier height of 6 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The new barrier construction would reduce noise levels by 5 to 7 decibels for 4 sensitive receptors, and the reasonable allowance calculated in accordance with the

Protocol is $284,000. For Barrier J height extension, raising the existing sound wall height to 16 ft would not provide the required 5-dBA reduction; therefore, this portion of the barrier is not considered to be feasible.

Segment 3: 65th Street to Howe Avenue

There are no Category B receivers in this segment that approach or exceed the NAC of 67 dBA. The noise levels at the baseball complex will exceed the NAC, however, since it will not meet the FWHA's reasonableness and feasibility criteria, no abatement measures are considered.

Segment 4: Howe Avenue to Watt Avenue

There are three existing barriers in this segment: Barriers G, K, and L. Barrier K is in fair condition and barriers G and L are considered to be in good condition. The predicted Year 2040 Build loudest-hour noise levels within this segment range from 60 to 72 dBA, with 24 Category B receivers approaching or exceeding the NAC of 67 dBA. The only proposed barrier in this segment is barrier SWEB8, which is the height extension for Barrier K. Raising the existing sound wall height to 16 ft would not provide the required 5-dBA reduction; therefore, this barrier is not considered to be feasible and no abatement measures are recommended for this segment of the project.

The final decision to include sound walls in the proposed project design must consider reasonableness factors, such as cost-effectiveness, as well as other feasibility considerations including topography, access requirements, other noise sources, safety, and information developed during the design and public review process.

Construction Noise Impact

No adverse noise impacts from construction are anticipated because construction would be conducted in accordance with Caltrans Standard Specifications Section 14.8-02. Construction noise would be short-term, intermittent, and overshadowed by local traffic noise.

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List of Abbreviated Terms

CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CNEL	Community Noise Equivalent Level
dB	Decibels
FHWA	Federal Highway Administration
Hz	Hertz
kHz	Kilohertz
L_{dn}	Day-Night Level
L_{eq}	Equivalent Sound Level
$L_{eq(h)}$	Equivalent Sound Level over one hour
L_{max}	Maximum Sound Level
LOS	Level of Service
L_{xx}	Percentile-Exceeded Sound Level
mPa	micro-Pascals
mph	miles per hour
NAC	noise abatement criteria
NADR	Noise Abatement Decision Report
NEPA	National Environmental Policy Act
NSR	Noise Study Report
Protocol	Caltrans Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects
SPL	sound pressure level
TeNS	Caltrans' Technical Noise Supplement
TNM 2.5	FHWA Traffic Noise Model Version 2.5

Chapter 1 Introduction

Purpose of the Noise Study Report (NSR)

The purpose of this NSR is to evaluate noise impacts and abatement under the requirements of Title 23, Part 772 of the Code of Federal Regulations (23 CFR 772) "Procedures for Abatement of Highway Traffic Noise." 23 CFR 772 provides procedures for preparing operational and construction noise studies and evaluating noise abatement considered for federal and Federal-aid highway projects. According to 23 CFR 772.3, all highway projects that are developed in conformance with this regulation are deemed to be in conformance with Federal Highway Administration (FHWA) noise standards. Compliance with 23 CFR 772 provides compliance with the noise impact assessment requirements of the National Environmental Policy Act (NEPA).

The Caltrans Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects (Protocol) (Caltrans 2011) provides Caltrans policy for implementing 23 CFR 772 in California. The Protocol outlines the requirements for preparing noise study reports (NSR). Noise impacts associated with this project under the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) has been evaluated in accordance with this Protocol.

This report presents the results of the technical noise study performed to assess both existing and future noise impacts in the vicinity of the proposed High Occupancy Vehicle (HOV) project along U.S. 50 in and around Sacramento, California. This analysis examines current noise levels and future noise levels for the year 2040 with and without the proposed project.

Project Purpose and Need

The purpose of the project is to reduce congestion by extending the existing HOV lanes west from Sacramento County at the Watt Avenue I/C to I-5 I/C in downtown Sacramento conforming to the master HOV network plan. Additional objectives to this project are as follows:

- improve mobility
- provide an option for reliable peak period travel time

- use the highway facilities as efficiently as possible
- provide incentives for commuters to use buses, carpools or vanpools for peak period travel
- improve traffic operations by reducing congestion and travel time
- enhance neighborhood livability with strategies to improve the adjacent Sacramento street system
- coordinate with other projects and studies in the corridor

Purpose and Need

This project is needed because the US 50 corridor is experiencing recurring congestion during peak commute periods. The amount and duration of congestion is expected to increase in the future as suburban development continues in the eastern portions of Sacramento County and in El Dorado County. HOV lanes mitigate congestion because they move more people in fewer vehicles than a mix flow lane.

Furthermore, the benefits of a comprehensive HOV network cannot be realized until all segments are connected and fully functional. HOV lanes on US 50 would improve connectivity with the existing network and provide consistency with the existing US 50 HOV lane corridor. Since the freeway was constructed in the 1960s and 1970s, extensive development has occurred adjacent to the corridor. Traditional expansion of the freeway would require significant right-of-way acquisition, impacting numerous businesses and residents. Increased congestion contributes to increased accidents, with the majority of accidents involving rear-ends and side swipe type crashes.

The US 50 commute traffic affects the quality of life and livability of the neighborhoods adjacent to the corridor. Regional job growth has the potential to increase the number of commuters that travel through residential neighborhoods from freeway exits to employment sites. As part of their HOV Master Plan, SACOG found that area HOV lanes convey more people during commute times than any of the adjacent mixed-flow lanes. HOV lanes carry 2-3 times the passenger volume as a comparable mixed-flow lane. In addition studies have correlated HOV lanes to improvements in air quality due to vehicle emissions.

Improvements proposed with this project are consistent with the current Transportation Concept Report that includes the addition of a HOV lane in each direction. The project is also consistent with the Caltrans District System Management Plan (January, 2013), which identifies future HOV lanes along US 50.

A resurfacing, restoration, rehabilitation (3R) project (EA 03-0H080) is planned for the 2018 SHOPP that coincides with the HOV project limits. This project is needed because the existing Portland Cement Concrete (PCC) pavement is deteriorated and has a poor ride quality that requires annual maintenance to repair and maintain. A recent pavement condition survey conveyed that there is severe slab cracking and faulting in the no. 3 and 4 lanes in both directions and minor slab cracking in the no. 1 and 2 lanes in both directions.

Chapter 2 Project Description

This project proposes to extend the existing HOV lanes 7.8 miles west from the existing HOV lanes at the Watt Avenue I/C to the Sacramento River Viaduct (I-5 I/C) in downtown Sacramento. Four alternatives are proposed:

Project Alternatives

The alternatives proposed are as follows:

- **Alternative 1. HOV Lanes**: Add HOV lanes in both directions onto the existing structural section by re-striping and signing the facility to accommodate the additional HOV.

- **Alternative 2. Mixed Flow Lanes**: Alternative 2 would have the same design features as Alternative 1 except the additional lanes are utilized as mixed flow vehicle lanes to add vehicle capacity.

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- **Alternative 4. No Build:** this alternative makes no improvements to freeway.

Alternatives 1 & 2 require median widening of twelve structures (Sacramento River Viaduct requires one span only) and include a 0.15 ft rubberized hot mix asphalt (RHMA-O) overlay to restripe the freeway since the new lane lines will not match the existing PCC joints. The Camellia City Viaduct and Brighton Overhead (OH) will require railroad involvement with Union Pacific Railroad (UPRR) and the Sacramento Regional Transit Authority (RT). UPRR & RT involvement were identified as the primary risk to project development. All build alternatives include new sound walls at the edge of shoulder in the downtown section and along state right of way east of the Oak Park I/C as recommended by the Noise Impact Study Report. There is no permanent right of way (R/W) acquisition required.

As part of the environmental approval of the project, Caltrans has agreed to include the City of Sacramento's 65th Street Bicycle/Pedestrian Improvement project. The City's project includes:

- Overlaying 65th Street and re-striping the pavement with narrower traveled lanes and new bike lanes.

- Constructing new pedestrian “pork chop” islands at the WB Route 50 off-ramp terminus, including signal modifications.

- Interconnecting the WB off-ramp, EB off-ramp, 4th Avenue, and Broadway traffic signals.

- Reconstructing the curb and gutter to provide bifurcated sidewalks with landscaped planters.

- Constructing a concrete barrier with hand railing and raising the sidewalk above the roadway level underneath the Route 50 undercrossing structure.

- Replacing the existing 5-foot wide sidewalks with 8-foot wide sidewalks where existing right of way permits.

- Reconfiguring the ramp connections to 65th Street to encourage slower speeds.

- Providing landscaping and irrigation in the medians and sidewalk planters.

- Widening the Route 50 EB off-ramp (1-right, 2-left turns) to improve ramp queuing.

- Extending the northbound 3rd lane from the Route 50 EB diagonal on-ramp to 4th Avenue.

The aerial maps of the project limit is included in this report. The measured and modeled receptors locations are provided in Appendix D.

Chapter 3 Fundamentals of Traffic Noise

The following is a brief discussion of fundamental traffic noise concepts. For a detailed discussion, please refer to Caltrans' Technical Noise Supplement (TeNS) (Caltrans 2013), a technical supplement to the Protocol, that is available on Caltrans Web site (http://www.dot.ca.gov/hq/env/noise)

Sound, Noise, and Acoustics

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air) to a hearing organ, such as a human ear. Noise is defined as loud, unexpected, or annoying sound.

In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receiver determines the sound level and characteristics of the noise perceived by the receiver. The field of acoustics deals primarily with the propagation and control of sound.

Frequency

Continuous sound can be described by frequency (pitch) and amplitude (loudness). A low-frequency sound is perceived as low in pitch. Frequency is expressed in terms of cycles per second, or Hertz (Hz) (e.g., a frequency of 250 cycles per second is referred to as 250 Hz). High frequencies are sometimes more conveniently expressed in kilohertz (kHz), or thousands of Hertz. The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

Sound Pressure Levels and Decibels

The amplitude of pressure waves generated by a sound source determines the loudness of that source. Sound pressure amplitude is measured in micro-Pascals (mPa). One mPa is approximately one hundred billionth (0.00000000001) of normal atmospheric pressure. Sound pressure amplitudes for different kinds of noise environments can range from less than 100 to 100,000,000 mPa. Because of this huge range of values, sound is rarely expressed in terms of mPa. Instead, a logarithmic scale is used to describe sound pressure level (SPL) in terms of decibels (dB). The threshold of hearing for young people is about 0 dB, which corresponds to 20 mPa.

Addition of Decibels

Because decibels are logarithmic units, SPL cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dB higher than one source under the same conditions. For example, if one automobile produces an SPL of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB—rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level 5 dB louder than one source.

A-Weighted Decibels

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Although the intensity (energy per unit area) of the sound is a purely physical quantity, the loudness or human response is determined by the characteristics of the human ear.

Human hearing is limited in the range of audible frequencies as well as in the way it perceives the SPL in that range. In general, people are most sensitive to the frequency range of 1,000–8,000 Hz, and perceive sounds within that range better than sounds of the same amplitude in higher or lower frequencies. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending on the human sensitivity to those frequencies. Then, an "A-weighted" sound level (expressed in units of dBA) can be computed based on this information.

The A-weighting network approximates the frequency response of the average young ear when listening to most ordinary sounds. When people make judgments of the relative loudness or annoyance of a sound, their judgments correlate well with the A-scale sound levels of those sounds. Other weighting networks have been devised to address high noise levels or other special problems (e.g., B-, C-, and D-scales), but these scales are rarely used in conjunction with highway-traffic noise. Noise levels for traffic noise reports are typically reported in terms of A-weighted decibels or dBA. Table 3-1 describes typical A-weighted noise levels for various noise sources.

Table 3-1. Typical A-Weighted Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	— 110 —	Rock band
Jet fly-over at 1000 feet		
	— 100 —	
Gas lawn mower at 3 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		
Gas lawn mower, 100 feet	**— 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
	— 20 —	
		Broadcast/recording studio
	— 10 —	
Lowest threshold of human hearing	**— 0 —**	Lowest threshold of human hearing

Source: Caltrans 2013.

Human Response to Changes in Noise Levels

As discussed above, doubling sound energy results in a 3-dB increase in sound. However, given a sound level change measured with precise instrumentation, the subjective human perception of a doubling of loudness will usually be different than what is measured.

Under controlled conditions in an acoustical laboratory, the trained, healthy human ear is able to discern 1-dB changes in sound levels, when exposed to steady, single-frequency (“pure-tone”) signals in the midfrequency (1,000 Hz–8,000 Hz) range. In typical noisy environments, changes in noise of 1 to 2 dB are generally not perceptible. However, it is widely accepted that people are able to begin to detect sound level increases of 3 dB in typical noisy environments. Further, a 5-dB increase is generally perceived as a distinctly noticeable increase, and a 10-dB increase is generally perceived as a doubling of loudness. Therefore, a doubling of sound energy (e.g., doubling the volume of traffic on a highway) that would result in a 3-dB increase in sound, would generally be perceived as barely detectable.

Noise Descriptors

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, but others are random. Some noise levels fluctuate rapidly, but others slowly. Some noise levels vary widely, but others are relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors most commonly used in traffic noise analysis.

- **Equivalent Sound Level (L_{eq}):** L_{eq} represents an average of the sound energy occurring over a specified period. In effect, L_{eq} is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same period. The 1-hour A-weighted equivalent sound level (L_{eq}[h]) is the energy average of A-weighted sound levels occurring during a one-hour period, and is the basis for noise abatement criteria (NAC) used by Caltrans and FHWA.

- **Percentile-Exceeded Sound Level (L_{xx}):** L_{xx} represents the sound level exceeded for a given percentage of a specified period (e.g., L_{10} is the sound level exceeded 10% of the time, and L_{90} is the sound level exceeded 90% of the time).

- **Maximum Sound Level (L_{max}):** L_{max} is the highest instantaneous sound level measured during a specified period.

- **Day-Night Level (L_{dn}):** L_{dn} is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to A-weighted sound levels occurring during nighttime hours between 10 p.m. and 7 a.m.

- **Community Noise Equivalent Level (CNEL):** Similar to L_{dn}, CNEL is the energy average of the A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to A-weighted sound levels occurring during the nighttime hours between 10 p.m. and 7 a.m., and a 5-dB penalty applied to the A-weighted sound levels occurring during evening hours between 7 p.m. and 10 p.m.

Sound Propagation

When sound propagates over a distance, it changes in level and frequency content. The manner in which noise reduces with distance depends on the following factors.

Geometric Spreading

Sound from a localized source (i.e., a point source) propagates uniformly outward in a spherical pattern. The sound level attenuates (or decreases) at a rate of 6 decibels for each doubling of distance from a point source. Highways consist of several localized noise sources on a defined path, and hence can be treated as a line source, which approximates the effect of several point sources. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of 3 decibels for each doubling of distance from a line source.

Ground Absorption

The propagation path of noise from a highway to a receiver is usually very close to the ground. Noise attenuation from ground absorption and reflective-wave canceling adds to the attenuation associated with geometric spreading. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is usually sufficiently accurate for distances of less than 200 feet. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receiver, such as a parking lot or body of water,), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface between the source and the receiver, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 decibels per doubling of distance is normally assumed. When added to the cylindrical spreading, the excess ground attenuation results in an overall drop-off rate of 4.5 decibels per doubling of distance.

Atmospheric Effects

Receptors located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels. Sound levels can be increased at large distances (e.g., more than 500 feet) from the highway due to atmospheric temperature inversion (i.e., increasing temperature with elevation). Other factors such as air temperature, humidity, and turbulence can also have significant effects.

Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receiver can substantially attenuate noise levels at the receiver. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver specifically to reduce noise. A barrier that breaks the line of sight between a source and a receiver will typically result in at least 5 dB of noise reduction. Taller barriers provide increased noise reduction. Vegetation between the highway and receiver is rarely effective in reducing noise because it does not create a solid barrier.

Chapter 4 Federal and State Policies and Procedures

This report focuses on the requirements of 23 CFR 772, as discussed below.

Federal Regulations

23 CFR 772

23 CFR 772 provides procedures for preparing operational and construction noise studies and evaluating noise abatement considered for federal and Federal-aid highway projects. Under 23 CFR 772.7, projects are categorized as Type I, Type II, or Type III projects.

- FHWA defines a Type I project as a proposed federal or federal-aid highway project for the construction of a highway on a new location or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment of the highway. The following projects are also considered to be Type I projects:
- The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a high-occupancy vehicle (HOV) lane, high-occupancy toll (HOT) lane, bus lane, or truck climbing lane,
- The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane,
- The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange,
- Restriping existing pavement for the purpose of adding a through traffic lane or an auxiliary lane,
- The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot, or toll plaza.

If a project is determined to be a Type I project under this definition, the entire project area as defined in the environmental document is a Type I project.

A Type II project is a noise barrier retrofit project that involves no changes to highway capacity or alignment. A Type III project is a project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

Under 23 CFR 772.11, noise abatement must be considered for Type I projects if the project is predicted to result in a traffic noise impact. In such cases, 23 CFR 772 requires that the project sponsor "consider" noise abatement before adoption of the final NEPA document. This process involves identification of noise abatement measures that are reasonable, feasible, and likely to be incorporated into the project, and of noise impacts for which no apparent solution is available.

Traffic noise impacts, as defined in 23 CFR 772.5, occur when the predicted noise level in the design-year approaches or exceeds the NAC specified in 23 CFR 772, or a predicted noise level substantially exceeds the existing noise level (a "substantial" noise increase). 23 CFR 772 does not specifically define the terms "substantial increase" or "approach"; these criteria are defined in the Protocol, as described below.

Table 4-1 summarizes NAC corresponding to various land use activity categories. Activity categories and related traffic noise impacts are determined based on the actual or permitted land use in a given area.

Traffic Noise Analysis Protocol for New Highway Construction and Reconstruction Projects

The Protocol specifies the policies, procedures, and practices to be used by agencies that sponsor new construction or reconstruction of federal or Federal-aid highway projects. The Protocol defines a noise increase as substantial when the predicted noise levels with project implementation exceed existing noise levels by 12 dBA or more. The Protocol also states that a sound level is considered to approach an NAC level when the sound level is within 1 dB of the NAC identified in 23 CFR 772 (e.g., 66 dBA is considered to approach the NAC of 67 dBA, but 65 dBA is not).

The Technical Noise Supplement to the Protocol provides detailed technical guidance for the evaluation of highway traffic noise. This includes field measurement methods, noise modeling methods, and report preparation guidance.

Table 4-1. Activity Categories and Noise Abatement Criteria (**23 CFR 772)**

Activity Category	Activity $L_{eq}[h]$[1]	Evaluation Location	Description of Activities
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[2]	67	Exterior	Residential.
C[2]	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A–D or F.
F			Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G			Undeveloped lands that are not permitted.

[1] The L_{eq}(h) activity criteria values are for impact determination only and are not design standards for noise abatement measures. All values are A-weighted decibels (dBA).

[2] Includes undeveloped lands permitted for this activity category.

State Regulations and Policies

California Environmental Quality Act (CEQA)

Noise analysis under the California Environmental Quality Act (CEQA) may be required regardless of whether or not the project is a Type I project. The CEQA noise analysis is completely independent of the 23 CFR 772 analysis done for NEPA. Under CEQA, the baseline noise level is compared to the build noise level. The assessment entails looking at the setting of the noise impact and then how large or perceptible any noise increase would be in the given area. Key considerations include: the uniqueness of the setting, the sensitive nature of the noise receptors, the magnitude of the noise increase, the number of residences affected, and the absolute noise level

The significance of noise impacts under CEQA are addressed in the environmental document rather than the NSR. Even though the NSR (or noise technical memorandum) does not specifically evaluate the significance of noise impacts under CEQA, it must contain the technical information that is needed to make that determination in the environmental document.

Section 216 of the California Streets and Highways Code

Section 216 of the California Streets and Highways Code relates to the noise effects of a proposed freeway project on public and private elementary and secondary schools. Under this code, a noise impact occurs if, as a result of a proposed freeway project, noise levels exceed 52 dBA-L_{eq}(h) in the interior of public or private elementary or secondary classrooms, libraries, multipurpose rooms, or spaces. This requirement does not replace the "approach or exceed" NAC criterion for FHWA Activity Category E for classroom interiors, but it is a requirement that must be addressed in addition to the requirements of 23 CFR 772.

If a project results in a noise impact under this code, noise abatement must be provided to reduce classroom noise to a level that is at or below 52 dBA-L_{eq}(h). If the noise levels generated from freeway and roadway sources exceed 52 dBA-L_{eq}(h) prior to the construction of the proposed freeway project, then noise abatement must be provided to reduce the noise to the level that existed prior to construction of the project.

Chapter 5 Study Methods and Procedure

Selection of Receivers and Measurement Sites

A field investigation was conducted to identify land uses that could be subject to traffic and construction noise impacts from the proposed project. Existing land uses in the project area were categorized by land use type and Activity Category as defined in Table 4-1, and the extent of frequent human use. Category B land uses, in the form of single-family and multifamily residential land uses, border most of the project alignment. As stated in the Protocol, noise abatement is only considered where frequent human use occurs and where a lowered noise level would be of benefit. Although all land uses are evaluated in this analysis, the focus is on locations of frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focuses on locations with defined outdoor activity areas, such as residential backyards and common use areas at multi-family residences. The geometry of the project relative to nearby existing and planned land uses was also identified.

Short-term measurement locations were selected to represent each major developed area within the project area. A single long term measurement site was selected to capture the diurnal traffic noise level pattern in the project area. Short-term measurement locations were selected to serve as representative modeling locations. Several other non-measurement locations were selected as modeling locations.

Field Measurement Procedures

A field noise study was conducted in accordance with recommended procedures in TeNS. The following is a summary of the procedures used to collect short-term and long term sound level data.

Short-term (Site) Measurements:

Short-term noise measurements were made at forty nine (49) locations within the study area. These measurements were made in intervals concurrent with the intervals at the long-term noise measurement sites. At each measurement site, two 10-minute measurements were taken. At all locations, noise levels were measured at a height of 5 feet above the ground and at least 10 feet from structures. Loudest-hour noise levels at each receiver were calculated by adjusting for differences in traffic conditions during measurements and the loudest existing hourly traffic conditions.

The loudest hourly traffic condition for each short-term measurement site was calculated based on a correlation between short and long-term measurement results. The results of the short-term measurements are provided in Appendix C and are summarized in Table 6-4.

The short term and long-term noise measurements data were collected on year 2005 and 2006 to determine the Existing (2020) and Design year (2040) levels at noise sensitive locations. Since noise levels approached / exceeded the FHWA's noise criteria, noise abatement in form of soundwalls were considered.

Traffic conditions were documented for post-processing with a video recorder from various vantage points within the project corridor (e.g., overpasses, over-crossings). The video recorder documented traffic along the segment of U.S. 50 that was being monitored for traffic noise. Vehicle speeds were sampled using a hand-held traffic radar gun.

Noise measurement locations are used as noise modeling receivers for prediction of future traffic noise levels. Locations of these receivers are shown in Appendix B and Appendix C. Photographs of noise measurement locations are shown in Appendix B and Appendix C.

Long-term (LT) Measurements:

Long-term noise measurements were made at nine locations within the study area to quantify the daily trend in noise levels throughout a 24-hour period and identify the peak traffic noise hour or "loudest" hour. Long-term noise measurement locations were selected to generally represent human activity in areas adjoining U.S. 50. These measurement positions were located at Category B-E activity areas or in areas considered to be acoustically equivalent to Category B-E activity areas. Some locations were only used to evaluate the trend in traffic noise levels and establish the peak traffic noise hour. Care was taken to select sites that were primarily affected by noise from U.S. 50 and to avoid sites in which noise contamination from sources other than the roadway could affect levels. Noise levels were generally measured at a height of 5 feet to represent noise levels at an average receiver ear height. Long-term measurement locations are summarized in Table 6-3, and the results of the long-term measurements are graphically displayed in Appendix B.

Instrumentation and Setups

Noise measurements were made using Larson Davis Model 820 Integrating Sound Level Meters (SLMs) set at “slow” response. The Model 820 Sound Level Meters were equipped with G.R.A.S. Type 40AQ ½ - inch random incidence microphones, and windscreens were placed over the microphones during all measurements. The sound level meters were calibrated prior to each measurement using either a Larson Davis Model CA250 or Model CAL200 acoustical calibrator. The response of the system was checked after each measurement session and was always found to be within 0.2 dBA. No calibration adjustments were made to the sound levels measured by the SLMs. At the completion of each monitoring event, the measured interval noise level data were obtained from the SLM using the Larson Davis SLM utility software program. All instrumentation meets the requirements of the American National Standards Institute (ANSI) SI.4-1983 for Type 1 use.

Meteorology

Meteorological conditions were observed during long-term and short-term noise measurements and consisted generally of partly cloudy skies, calm to light winds and mild to warm temperatures.

Noise Prediction Methodology

Traffic noise levels were predicted using the FHWA Traffic Noise Model Version 2.5 (TNM 2.5). TNM 2.5 is a computer model based on two FHWA reports: FHWA-PD-96-009 and FHWA-PD-96-010. Key inputs to the traffic noise model were the locations of roadways, traffic mix and speed, shielding features (e.g., topography and buildings), noise barriers, ground type, and receptors. Three-dimensional representations of these inputs were developed using CAD drawings, aerials, and topographic contours provided by the County Transportation Authority.

Traffic noise was evaluated under existing conditions, design-year no-project conditions, and design-year conditions with the project alternative. Loudest-hour traffic volumes, vehicle classification percentages, and traffic speeds under existing (2020) and design-year (2040) conditions were provided by Caltrans for input into the traffic noise model. Appendix A summarizes the traffic volumes and assumptions used for modeling existing and design-year conditions with and without the project alternative.

The loudest hour is generally characterized by free-flowing traffic at the highway design speed (i.e., Level of Service [LOS] C or better). For this analysis, it is assumed that each lane has a maximum capacity of 2000 vehicles per hour at the design speed of the highway.

To validate the accuracy of the model calculations, TNM 2.5 was used to compare measured traffic noise levels to modeled noise levels at field measurement locations. For each receptor, traffic volumes counted during the short-term measurement periods were normalized to 1-hour volumes. These normalized volumes were assigned to the corresponding project area roadways to simulate the noise source strength at the roadways during the actual measurement period. Modeled and measured sound levels were then compared to determine the accuracy of the model and if additional adjustment of the model was necessary.

Methods for Identifying Traffic Noise Impacts and Consideration of Abatement

Traffic noise impacts are considered to occur at receptor locations where predicted design-year noise levels are 12 dB or more greater than existing noise levels, or where predicted design-year noise levels approach or exceed the NAC for the applicable activity category. Where traffic noise impacts are identified, noise abatement must be considered for reasonableness and feasibility as required by 23 CFR 772 and the Protocol.

According to the Protocol, abatement measures are considered acoustically feasible if a minimum noise reduction of 5 dB at impacted receptor locations is predicted with implementation of the abatement measures. In addition, barriers should be designed to intercept the line-of-sight from the exhaust stack of a truck to the first tier of receptors, as required by the Highway Design Manual, Chapter 1100. Other factors that affect feasibility include topography, access requirements for driveways and ramps, presence of local cross streets, utility conflicts, other noise sources in the area, and safety considerations.

The overall reasonableness of noise abatement is determined by the following three factors:

- The noise reduction design goal.
- The cost of noise abatement.

- The viewpoints of benefited receptors (including property owners and residents of the benefited receptors).

The Caltrans’ acoustical design goal is that a barrier must be predicted to provide at least 7 dB of noise reduction at one benefited receptor. This design goal applies to any receptor and is not limited to impacted receptors.

The Protocol defines the procedure for assessing reasonableness of noise barriers from a cost perspective. Based on 2015 construction costs an allowance of $71,000 is provided for each benefited receptor (i.e., receptors that receive at least 5 dB of noise reduction from a noise barrier). The total allowance for each barrier is calculated by multiplying the number of benefited receptors by $71,000. If the estimated construction cost of a barrier is less than the total calculated allowance for the barrier, the barrier is considered reasonable from a cost perspective. The viewpoints of benefits receptors are determined by a survey that is typically conducted after completion of the noise study report. The process for conducting the survey is described in detail in the Protocol. The noise study report identifies traffic noise impacts and evaluates noise abatement for acoustical feasibility. It also reports information that will be used in the reasonableness analysis including if the 7 dB design goal reduction in noise can be achieved and the abatement allowances. The noise study report does not make any conclusions regarding reasonableness. The feasibility and reasonableness of noise abatement is reported in the Noise Abatement Decision Report.

Chapter 6 Existing Noise Environment

Existing Environment and Noise-Sensitive Land Use

The existing noise environment throughout the project corridor varies by location, depending on site characteristics such as proximity to U.S. 50 and other noise sources, the relative highway and local elevations and terrain, and any intervening structures or barriers. There is a mix of single-family and multi-family residential, commercial, and industrial land-uses throughout the project area. Category B-E land uses, in the form of single-family and multi-family residential land uses, open space such as parks, public areas such as churches, and hotels and motels, border a large percentage of the project alignment.

Identification of Potentially Impacted Areas

Areas of potential noise impacts with respect to this project extend along U.S. 50 to the north and south of the roadway throughout the majority of the project area. Regions within the study area where the proposed project could cause substantial noise increases, or cause noise levels to approach or exceed the NAC under Year 2040 Build conditions have been identified. Table 6-1 identifies the applicable receiver category associated with each of the noise measurement locations. Noise measurement site locations are shown in Appendix D.

Existing Barriers

Eleven existing barriers were identified in the study area. Existing barrier characteristics were compiled through a combination of observations made during the noise measurement survey, visits to the site for the purposes of characterizing the barriers, and information available on as-built drawings that were provided by Caltrans for some barrier segments.

Each barrier was assigned with a current condition of good, fair, or poor. Barriers considered to be in good condition appeared to be structurally and acoustically solid, with no gaps between barrier materials or at the base of the barrier. Fair condition barriers were found to be structurally sound and to provide some acoustical attenuation, but contained gaps that lowered the acoustical effectiveness of the barrier. Poor condition barriers were found to be structurally damaged and falling down in areas, resulting in poor acoustical properties.

Table 6-1: Summary of Noise Measurement IDs and Land Uses for Each Project Segment

Segment	Area	Applicable Activity Category	Receiver ID
1	Western Project Limit to Alhambra Boulevard	B, C, D	LT-11, LT-12
			Sites 1, 2, 3, 4, 4b, 5, 6, 6b, 7, 7b, 8, 8b
2	Alhambra Boulevard to 65th Street	B, C, D	LT-5, LT-9, LT-10, LT-13
			Sites 9, 10, 11, 12, 13, 13b, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 88
3	65th Street to Howe Avenue	B, C, D	LT-6 and ST-28
4	Howe Avenue to Watt Avenue	B, C, D	LT-7, LT-8
			Sites 29, 29b, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 43, 101

Existing barriers in the study area are summarized in Table 6.2. The table provides a name identifier for each barrier, and lists the location, construction material, height, and current condition. The location of each barrier can be found on the study-area maps, given in Appendix D. Ten of the eleven existing barriers are constructed of masonry block, all of which appear to be in good condition.

Table 6-2: Existing Barriers

Wall ID	Location	Construction Material	Height, feet	Condition
G -1	Watt Ave. to Occidental Dr.	Masonry	12 to 14 ft	Good
G -2	Occidental Dr. to Howe Ave.	Masonry	12 to 14 ft	Good
H	43rd St. to 37th St.	Masonry	10 ft	Good
I	39th St. to 43rd St.	Steel on 10 ft high berm	5 to 6 ft	Fair
J	61st St. to 63rd St.	Concrete spray on chain-link fence, on 3 to 12 ft berm	5 to 6 ft	Good
K	Howe Ave. to Marquette	Precast concrete	8 ft	Good
L-1	Marquette Dr. to Occidental Dr.	Masonry	13 to 14 ft	Good
L-2	Occidental Dr. to Watt Ave.	Masonry	12 to 14 ft	Good
Q-1	46th St. to 47th St.	Masonry	10 ft	Good
Q-2	47th St. to 48th St.	Masonry	10 ft	Good
Q-3	48th St. to 51st St.	Masonry	12 ft	Good

Barrier J consists of concrete sprayed onto chain-link fence to form a 5 to 6 foot high wall. The wall is in generally good condition, but it is cracked in some locations and possibly beginning to separate from the fence.

Receivers and Noise Measurement Sites

There were 49 short-term measurements and nine (9) long-term measurements taken along the project alignment to document the baseline noise environment. The measurement locations were chosen to accurately represent areas of Category B-E land uses that would potentially benefit from lower future noise levels. The sites were also selected to minimize interference from outside noise sources. Appendix D shows the locations of the field noise measurements and the modeled receivers.

Existing Noise Levels at Receivers

The short-term and long-term measurement results, as well as charts showing the trends in hourly noise levels measured at the nine (9) long-term measurement sites, are contained in Appendix B and Appendix C. The estimated loudest-hour noise levels were based on daytime measurement data, peak-hour traffic data, and trends in hourly noise levels measured at representative 24-hour measurement locations. The results of the long- and short-term field measurements are summarized in Table 6-3 and Table 6-4.

Table 6-3: Summary of Long-Term Measurement Results

Receiver ID	Location	Date	Time	Loudest Hour (dBA)
LT-5	Coloma Community Center Park	11/9/2005	11:00am	83
LT-6	Mcauliffe Baseball Field	11/9/2005	10:00am	72
LT-7	East of Sarina Ct., in park	11/9/2005	10:00am	72
LT-8	Glenwood Park	11/9/2005	10:00am	73
LT-9	In front of 3201 U Street	11/10/2005	10:00am	73
LT-10	43rd St. and S St.	11/10/2005	11:00am	77
LT-11	Rear yard of 1001 Yale St.	11/10/2005	2:00pm	73
LT-12	Front of 2230 18th St.	11/10/2005	2:00pm	70
LT-13	1739 47th St.	11/1/2005	6:00pm	66

Table 6-4: Summary of Short-Term Measurement Results

Receiver ID	Location	Date	Time	Leq, dBA
Site-1	W Street	11/10/2005	2:40-2:50	71
			2:50-3:00	71
Site-2	In front of 1100 X Street	11/10/2005	1:30-1:40	73
			1:40-1:50	73
Site-3	Rear yard of 1029 Yale Street	11/10/2005	1:30-1:40	62
			1:40-1:50	62
Site-4	In front of 2222 14th Street	11/10/2005	2:00-2:10	66
			2:10-2:20	66
Site-4b	1323 W Street	11/10/2005	2:10-2:20	73
			2:20-2:30	73

Receiver ID	Location	Date	Time	Leq, dBA
Site-5	1722 X Street	11/10/2005	1:40-1:50	71
			1:50-2:00	71
Site-6	Backyard of 1801 W Street	11/10/2005	1:20-1:30	62
			1:30-1:40	62
Site-6b	2211 18th Street	11/10/2005	1:10-1:20	62
			1:20-1:30	64
Site-7	Side yard of 2509 W Street	11/10/2005	12:24-12:30	69
			12:30-12:40	69
Site-7b	25th Street, 41 meters to edge of W Street	11/10/2005	12:20-12:30	67
			13:30-12:40	67
Site-8	In front of 2320 X Street	11/10/2005	2:10-2:20	71
			2:20-2:30	71
Site-8b	Front of 2414 X Street	11/10/2005	2:10-2:20	71
			2:20-2:30	71
Site-9	2232 32nd Street	11/10/2005	11:40-11:50	69
			11:50-12:00	69
Site-10	3330 T Street at right-of-way fence	11/10/2005	11:40-11:50	71
			11:50-12:00	71
Site-11	In front of 3305 T Street	11/10/2005	11:40-11:50	68
			11:50-12:00	67
Site-12	In backyard of 2016 35th Street	11/10/2005	11:40-11:50	66
			11:50-12:00	65
Site-13	1748 38th Street	11/10/2005	10:50-11:00	62
			11:00-11:10	62
Site-13b	Front yard of 1731 37th Street	11/10/2005	12:30-12:40	60
			12:40-12:50	60
Site-14	In front of 1840 42nd Street	11/10/2005	11:30-11:40	70
			11:40-11:50	70
Site-15	East Lawn Memorial	11/10/2005	9:50-10:00	65
			10:00-10:10	65
Site-16	Corner of 46th and S Street	11/10/2005	10:20-10:30	71
			10:30-10:40	70
Site-17	Backyard of 1733 49th Street	11/10/2005	9:50-10:00	60
			10:00-10:10	60
Site-18	Backyard of 1709 49th Street	11/10/2005	9:50-10:00	55
			10:00-10:10	55
Site-19	Side yard of 1841 49th Street	11/10/2005	10:50-11:00	72
			11:00-11:10	72
Site-20	Backyard of 1841 52nd Street	11/10/2005	10:40-10:50	70
			10:50-11:00	70
Site-21	1857 52nd Street	11/10/2005	10:40-10:50	62
			10:50-11:00	61
Site-22	Backyard of 5317 S Street	11/10/2005	10:42-10:50	69
			10:50-11:00	69
Site-23	In front of Lighthouse Day Care	11/10/2005	12:00-12:10	70
			12:10-12:20	70

Receiver ID	Location	Date	Time	Leq, dBA
Site-24	On 60th and T Street	11/9/2005	3:50-4:00	66
			4:00-4:10	68
Site-25	In front of 6134 T Street	11/9/2005	3:30-3:40	70
			3:40-3:50	68
Site-26	6015 1st Ave.	11/9/2005	3:30-3:40	57
			3:40-3:50	55
Site-27	Near side yard of 1931 63rd Street	11/9/2005	3:20-3:30	68
			3:30-3:40	68
Site-27b	Backyard of 6321 2nd Ave.	11/9/2005	3:40-3:50	66
			3:50-4:00	66
Site-28	Ball fields at Sacramento State	11/9/2005	3:00-3:10	73
			3:10-3:20	72
Site-29	Woodlake Village	11/9/2005	2:30-2:40	68
			2:40-2:50	69
Site-29b	Woodlake Village	11/9/2005	2:30-2:40	65
			2:40-2:50	65
Site-30	7944 La Riviera Drive	11/9/2005	2:40-2:50	65
			2:50-3:00	65
Site-32	Front yard of 76 Lido	11/9/2005	1:30-1:40	61
			1:40-1:50	63
Site-33	8370 Mediterranean Court	11/9/2005	1:00-1:10	70
			1:10-1:20	70
Site-34	Backyard of 2528 Belhaven	11/9/2005	1:00-1:10	68
			1:10-1:20	67
Site-35	Jefferson Elementary School	11/9/2005	1:10-1:20	57
			1:20-1:30	59
Site-36	Backyard of 2611 Heullebury Court	11/9/2005	1:00-1:10	68
			1:10-1:20	68
Site-37	In park	11/9/2005	12:10-12:20	69
			12:20-12:30	69
Site-39	Backyard of 31 Lochness	11/9/2005	12:21-12:30	71
			12:30-12:40	70
Site-40	Front yard of 14 Lochness	11/9/2005	12:20-12:30	59
			12:30-12:40	60
Site-41	Side yard of 2808 Symphony Ct.	11/9/2005	12:20-12:30	65
			12:30-12:40	65
Site-43	Backyard of 2800 Marter Court	11/9/2005	12:10-12:20	68
			12:20-12:30	68

Noise Measurements

Segment 1: Westernmost Project Limit (I-5 I/C) to Alhambra Boulevard

U.S. 50 is elevated approximately 16 to 33 feet above sensitive receivers located north and south of the highway and is the predominant source of environmental noise at nearby receiving land uses. There are no existing sound walls along the elevated highway structure. However, 1 to 2 foot-high safety barriers are located at the edge of the structure for both the eastbound and westbound directions throughout most of this segment. These barriers, in combination with the edge of the elevated structure, provide partial shielding of traffic noise generated along the highway. Local vehicular traffic along W Street, X Street, and 9th Street to 28th Street, as well as highway on-ramps and off-ramps, also contribute to the ambient noise environment at nearby sensitive land uses. Two long-term noise measurements (Receivers: LT-11 and LT-12) and twelve short-term noise measurements (Receivers: Sites 1, 2, 3, 4, 4b, 5, 6, 6b, 7, 7b, 8, and 8b) were made in this area to quantify existing worst-hour noise levels at Category B, C, and D receiver locations. Loudest -hour noise levels ranged from 72 to 76 dBA $L_{eq\ (h)}$ at first-row receivers and from 64 to 69 dBA $L_{eq\ (h)}$ at second-row receivers. First-row receivers and some second-row receivers have noise levels that approach or exceed the NAC (67 dBA $L_{eq\ (h)}$).

Segment 2: Alhambra Boulevard to 65th Street

Category B-E receivers are located north and south of U.S. 50 and include single-family residences, Faith Bible Church, East lawn Memorial cemetery and the Lighthouse Childcare Center. The majority of receivers in this segment are partially shielded from traffic noise generated along the highway by the edge of the elevated structure or by existing noise barriers ranging from 6 to 12 feet in height (Barriers H, I, J, and Q). The profile of U.S. 50 transitions from above the receivers to below the receivers near 43rd Street and to above the receivers again near 52nd Street. Residential receivers to the north between Stockton Boulevard and 59th Street are also affected by intermittent LRT passbys, but are currently shielded by an 8 to 10 foot high sound wall (Barrier Q). Four long-term noise measurements (Receivers: LT-5, LT-9, LT-10, and LT-13) and twenty-one short-term measurements (Receivers: Sites 9, 10, 11, 12, 13, 13b, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, and 88) were made at representative receiver locations along this portion of the project. Loudest-hour noise levels ranged from 62 to 73 dBA $L_{eq\ (h)}$ at first-row receivers and from 62 to 70 dBA $L_{eq\ (h)}$ at second-row receivers. First-row and some second-row receivers located in unshielded areas approach or exceed the noise abatement criteria (67 dBA $L_{eq\ (h)}$). In addition, existing traffic noise levels at first-row receivers located behind Barriers I and J also approach or exceed the noise abatement criteria (67 dBA $L_{eq\ (h)}$).

Segment 3: 65th Street to Howe Avenue

Land uses within this segment of U.S. 50 are primarily non-noise-sensitive commercial and industrial uses. Calvary Church, which does not include any outdoor activity areas, is located south of U.S. 50, west of Folsom Boulevard. Sacramento State University's baseball fields and a radio station are located to the north of U.S. 50, west of Hornet Drive. Motels are located north and south of U.S. 50 near Howe Avenue. The highway is located at an elevation of approximately 13 to 33 feet above adjacent land uses. One long-term noise measurement (LT-6) and one series of short-term noise measurements (Site 28) were made at Sacramento State University's baseball fields. Loudest-hour noise levels were approximately 72 to 73 dBA $L_{eq\ (h)}$.

Segment 4: Howe Avenue to Watt Avenue

Noise-sensitive land uses in this segment of U.S. 50 include single- and multi-family residences, Thomas Jefferson Elementary School, and open space areas. Existing noise barriers, ranging in height from 8 to 14 feet, are located both north and south of the highway throughout this segment (Barriers G, K, and L). Long-term noise measurements were made north and south of U.S. 50 in open space areas (Receivers: LT-7 and LT-8). In addition, fifteen short-term noise measurements (Receivers: Sites 29, 29b, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 43, and 101) were made at Category B receiver locations north and south of U.S. 50. Although sound walls shield receivers along this segment, existing loudest-hour noise levels at first-row residences were about 66 to 72 dBA $L_{eq\ (h)}$, approaching or exceeding the noise abatement criteria (67 dBA $L_{eq\ (h)}$). Loudest-hour noise levels at second-row receivers ranged from 61 to 65 dBA $L_{eq\ (h)}$.

Model Calibration

The FHWA Traffic Noise Model, TNM 2.5, was the traffic noise model used in the noise impact analysis for this project. The project area was modeled in 5 independent sections to accommodate for the complexity of the model and slow run times with break points selected primarily at major roadway overpass locations. The modeled segments are listed as follows:

- I-5 I/C to Oak Park interchange
- Oak Park interchange to 51st Street
- 51st Street to 65th Street
- 65th Street to Howe Avenue
- Howe Avenue to Watt Avenue

The digitized roadway, barrier, receiver, terrain, ground zones, and building row locations were input into the traffic noise model for calibration. Traffic counts conducted simultaneously with noise measurements were adjusted to reflect 1-hour conditions, assuming that traffic volumes during the noise measurement interval (10 minutes) were equal during the six 10-minute intervals. These 1-hour volumes were input into the model for calibration. Traffic volumes were classified into three vehicle types: (1) light-duty autos and trucks, (2) medium-duty trucks (typically trucks with two axles and more than four wheels), and (3) heavy-duty trucks (typically trucks with more than two axles).

Noise barrier, terrain, and building features provide substantial reduction of traffic noise generated by U.S. 50. For each measured condition, the corresponding observed traffic conditions are used in the model to predict the noise level. The predicted and measured noise levels are compared to assess differences. Calibration factors or model adjustments are used to adjust the model to closer represent measured conditions. Modeled results that vary from measurements are adjusted after a careful review of all measurement and modeled data. The adjustment was calculated as follows:

- Where modeled levels are lower than measured levels, the modeled results are adjusted to measured conditions: Adjustment = Measured – Modeled
- Where the modeled result is 0 to +2 dB higher than the measured level, no adjustment is made: Adjustment = 0
- Where the modeled result is more than +2 dB higher than the measured level, an adjustment is made to bring the modeled result to within 2 dB of measured conditions: Adjustment = (Measured + 2) – Modeled

The adjustment is added to modeled results for existing and future loudest-hour traffic conditions. The adjustment factor for each receiver can be found in Table 6-5.

Table 6-5: TNM Adjustment Factors

Receiver ID	$L_{eq(h)}$ Noise Level, dBA				Adjustment Factor, dBA
	Measured Level 1	TNM Validation 1	Measured Level 2	TNM Validation 2	
Site-1	71	70	71	69	1
Site-4	66	68	66	68	0
Site-4b	73	68	73	68	5
Site-2	73	70	73	70	3
Site-3	62	68	62	68	-4
Site-5	71	70	71	70	1
Site-6	62	68	62	69	-5
Site-6b	64	67	62	67	-3
Site-7	67	69	67	69	0
Site-7a	69	69	69	70	0
Site-8	71	69	71	69	2
Site-8b	71	69	71	69	2
Site-9	69	70	69	70	0
Site-10	71	71	71	71	0
Site-11	68	68	67	68	0
Site-12	66	67	65	68	0
Site-13b	60	61	60	61	0
Site-13	62	59	62	59	3
Site-14	70	68	70	68	2
Site-16	71	69	70	69	1
Site-15	65	65	65	65	0
Site-17	60	61	60	62	0
Site-18	55	58	55	59	-2
Site-19	72	73	72	73	0
Site-20	70	69	70	69	1
Site-21	62	62	61	62	0
Site-22	69	68	69	68	0
Site-23	70	72	70	72	0
Site-24	66	69			-1
Site-25	70	66	68	66	2
Site-26	57	62	55	62	0
Site-27	68	68	68	68	0
Site-27b	66	66	66	67	0
Site-88	63	62	63	62	0
Site-28	73	69	72	69	4
Site-29b	65	64	65	65	0
Site-29	68	67	69	67	2
Site-30	65	63	65	63	2
Site-32	61	61			0
Site-34	68	65	67	64	3
Site-35	57	58	59	58	0
Site-36	68	66	68	66	2

Receiver ID	$L_{eq(h)}$ Noise Level, dBA				Adjustment Factor, dBA
	Measured Level 1	TNM Validation 1	Measured Level 2	TNM Validation 2	
Site-33	70	67	70	67	3
Site-37	69	65	69	65	3
Site-41	65	65	65	65	0
Site-39	71	65	70	65	5
Site-40	59	61	60	61	0
Site-43	68	63	68	63	5

Chapter 7 Future Noise Environment, Impacts, and Considered Abatement/Mitigation

Future Traffic Data Assumptions and Site Geometry

Once the traffic noise model was calibrated, existing, future no-project, and future with project loudest-hour traffic noise levels were calculated. Traffic volume inputs for the noise model were taken from the project traffic projections provided by Caltrans. Peak hour a.m. and p.m. traffic volumes were provided by Caltrans for each of the following conditions:

- Year 2020
- Year 2030 Build and No Build
- Year 2040 Build and No Build

The noisiest hour is not necessarily the hour with peak traffic volumes. Congestion results in slower speeds, which substantially reduces traffic noise levels. The loudest hour is typically an hour where traffic flows freely at or near capacity conditions. Peak-hour traffic conditions were assumed to be at Level of Service C to reflect conservative loudest-hour noise levels for each condition. The volumes used for this report are summarized in Appendix A.

The traffic counts were used to calibrate the traffic model. The reported Caltrans truck percentages were used to calculate Year 2004, Year 2030 No Build, and Year 2030 Build traffic noise levels.

Table 7-1: Vehicle Mix for U.S. 50

	I & R Counts			2004 Truck Volumes		
Count Location	Light-duty	Medium Trucks	Heavy Trucks	Light-duty	Medium Trucks	Heavy Trucks
Watt Avenue	94%	4%	3%	96%	2%	2%
Howe Avenue	96%	2%	2%	96%	2%	2%
Alhambra Boulevard	92%	4%	4%	97%	2%	1%
20th Street	92%	4%	3%	98%	1%	1%

Free-flow traffic speeds observed in the field during the noise monitoring survey were approximately 65 mph for light-duty vehicles and medium-duty trucks and 60 mph for heavy-duty trucks.

Noise Level Predictions

Noise levels were predicted within the four receiver areas listed in Chapter 6. Each area is discussed below in detail. There are no NAC Category C-E land uses in the project area that are considered to have outdoor activity areas with frequent human usage that would benefit from a lower noise level. Consequently, a detailed assessment of traffic noise impacts and abatement is not considered at Category C-E land uses in the project area. Noise levels discussed in this section are based on the adjusted modeled results, using traffic volumes supplied by Caltrans for the peak hours for Year 2004, Year 2020, Year 2030 and Year 2040, No Build and Build conditions.

Segment 1: Westernmost Project Limit (I-5 I/C) to Alhambra Boulevard

Two long-term measurements (LT- 11 and LT-12) and twelve short-term measurements (Sites 1, 2, 3, 4, 4b, 5, 6, 6b, 7, 7b, 8, and 8b) were made within this section, and there are nine additional modeled receiver locations (MR-1.1 through MR-1.9). There are no existing noise barriers within this segment. As shown in Table 7-2, the loudest-hour $L_{eq\ (h)}$ for the Year 2020 condition ranges from 62 to 72 dBA at first-tier residences and from 62 to 73 dBA at second-tier residences. Under Year 2030 and Year 2040 No Build conditions, noise levels at receiver locations are expected to range from 62 to 72 dBA at first-tier residences and from 62 to 73 dBA at second-tier residences.

The Year 2030 and Year 2040 Build condition is anticipated to increase the loudest-hour $L_{eq\ (h)}$ noise levels in this segment by 0 to 1 decibels, resulting in noise levels of 63 to 72 dBA at first-tier residences and from 62 to 74 dBA at second-tier residences. This increase in noise levels is a result of an increase in traffic volumes. The noise level increase is not enough to be considered a substantial increase. However, most first- and second-tier residences are predicted to experience noise levels that approach or exceed the NAC. Noise abatement in the form of sound barriers on structure was considered throughout this area. Predicted traffic noise impacts are shown in Table 7-3.

Table 7-2: Existing and Predicted Noise Levels: Westernmost Project Limit to Alhambra Boulevard

Loudest Hour Noise Levels, Leq (h) dBA								
Receiver ID	**2004**	**2020**	**2030 No Build**	**2030 Build**	**2040 No Build**	**2040 Build**	**Type of Development**	**Barrier Shielding**
Site-1	69	69	69	69	69	69	First-Tier Residence	None
MR-1.1	68	68	68	69	69	69	First-Tier Residence	None
MR-1.2	67	67	67	67	67	67	Second-Tier Residence	None
Site-4	67	67	67	67	67	67	Second-Tier Residence	None
Site-4b	71	71	71	72	71	72	First-Tier Residence	None
Site-2	71	71	72	72	72	72	First-Tier Residence	None
Site-3	62	62	63	63	63	63	Second-Tier Residence	None
MR-1.3	71	71	72	72	72	72	Church	None
MR-1.4	73	73	73	74	73	74	Second-Tier Residence	None
Site-5	70	70	70	70	70	70	First-Tier Residence	None
MR-1.5	69	69	70	70	70	70	First-Tier Residence	None
MR-1.6	61	61	62	62	62	62	Second-Tier Residence	None
MR-1.7	67	67	67	67	67	67	First-Tier Residence	None
Site-6	62	62	62	63	62	63	First-Tier Residence	None
Site-6b	63	63	63	63	63	63	Second-Tier Residence	None
MR-1.8	68	68	68	68	68	68	First-Tier Residence	None
Site-7	68	68	68	68	68	68	Second-Tier Residence	None
Site-7a	69	68	68	69	69	69	First-Tier Residence	None
Site-8	70	70	70	70	70	70	First-Tier Residence	None
Site-8b	70	70	70	70	70	70	First-Tier Residence	None
MR-1.9	71	71	71	71	71	71	First-Tier Residence	None

Table 7-3: Predicted Traffic Noise Impacts: Westernmost Project Limit to Alhambra Boulevard

Receiver ID	2020 Loudest-Hour, dBA	2040 Build Loudest-Hour, dBA	Noise Increase[1]	Impact Type[2]	Number of Units Represented
Site-1	69	69	0	A/E	35
MR-1.1	68	69	0	A/E	11
MR-1.2	67	67	0	A/E	16
Site-4	67	67	1	A/E	12
Site-4b	71	72	1	A/E	14
Site-2	72	72	0	A/E	11
Site-3	63	63	0	None	13
MR-1.3	71	72	0	A/E	1
MR-1.4	73	74	1	A/E	3
Site-5	70	70	0	A/E	26
MR-1.5	69	70	0	A/E	11
MR-1.6	62	62	1	None	6
MR-1.7	67	67	1	A/E	15
Site-6	62	63	1	None	10
Site-6b	63	63	1	None	10
MR-1.8	68	68	1	A/E	42
Site-7	68	68	1	A/E	18
Site-7a	69	69	1	A/E	19
Site-8	70	70	0	A/E	21
Site-8b	70	70	0	A/E	20
MR-1.9	71	71	0	A/E	39

[1] Discrepancies may occur due to rounding.

[2] Impact Type: S = Substantial Increase (12 dBA or more), A/E = Approach or Exceed NAC

Segment 2: Alhambra Boulevard to 65th Street

Four long-term measurements (LT- 5, LT-9, LT-10 and LT-13) and twenty-one short-term measurements (ST-9, 10, 11, 12, 13, 13b, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, and 88) were taken within this segment, and there are thirty-three additional modeled receiver locations (MR-2.1 through MR-2.33). There are currently six sound walls within this section of roadway (Barriers H, I, J, Q-1, Q-2, and Q-3). Modeled sound levels for each receiver location are shown in Table 7-4 for peak-hour traffic volumes under Year 2004, Year 2020; Year 2030 and Year 2040 No Build, and Build conditions.

In unshielded locations, Year 2020 loudest-hour $L_{eq\ (h)}$ noise levels ranged from 62 to 74 dBA at first-tier residences and from 61 to 68 dBA at second-tier residences. Loudest-hour noise levels ranged from 57 to 65 at first- and second-tier residences under Year 2020 conditions in areas that were shielded from roadway noise by Barrier H, and from 58 to 63 dBA at receivers located behind Barriers Q-1, Q-2, and Q-3. At receivers located behind Barrier I, Year 2020 loudest-hour $L_{eq\ (h)}$ noise levels ranged from 65 to 70 dBA at first- and second-tier residences. Year 2020 loudest-hour $L_{eq\ (h)}$ noise levels ranged from 62 to 68 dBA at first- and second-tier residences with the shielding provided by Barrier J.

Under Year 2030 and Year 20140 No Build conditions, modeled noise levels are expected to vary from about -1 to +1 decibels as compared to the Year 2020. The resulting loudest-hour $L_{eq\ (h)}$ noise levels would range from 61 to 74 dBA at first- and second-tier residences in unshielded areas, 57 to 65 dBA with the shielding provided by Barrier H, 58 to 64 dBA with the shielding provided by Barriers Q-1, Q-2, and Q-3, 65 to 70 dBA with the shielding provided by Barrier I, and 62 to 68 dBA with the shielding provided by Barrier J.

The Year 2040 Build condition is anticipated to increase the noise levels at modeled locations by 0 to 1 decibel. Resulting loudest-hour $L_{eq\ (h)}$ noise levels range from 61 to 74 dBA at first- and second-tier residences in unshielded areas, 58 to 65 dBA with the shielding provided by Barrier H, 59 to 64 dBA with the shielding provided by Barriers Q-1, Q-2, and Q-3, 65 to 71 dBA with the shielding provided by Barrier I, and 62 to 69 dBA with the shielding provided by Barrier J.

The noise level increase anticipated under the Year 2040 Build condition is not enough to be considered a substantial increase. However, predicted noise levels approach or exceed the NAC in most first- and second-tier residences that are located in unshielded areas and at first-tier residences located behind Barriers I and J, which are in fair condition. Predicted traffic noise impacts are shown in Table 7-5.

Table 7-4: Existing and Predicted Noise Levels: Alhambra Avenue to 65th Street

Loudest Hour Noise Levels, Leq (h) dBA								
Receiver ID	**2004**	**2020**	**2030 No Build**	**2030 Build**	**2040 No Build**	**2040 Build**	**Type of Development**	**Barrier Shielding**
MR-2.1	70	70	70	70	70	70	First-Tier Residence	None
Site-9	70	70	70	70	70	70	First-Tier Residence	None
MR-2.2	61	61	61	61	61	61	Second-Tier Residence	None
MR-2.3	72	72	72	72	72	72	First-Tier Residence	None
MR-2.4	65	65	65	65	65	65	Second-Tier Residence	None
MR-2.5	63	63	63	63	63	63	Second-Tier Residence	None
MR-2.6	68	68	68	68	68	68	First-Tier Residence	None
MR-2.7	68	68	68	69	69	69	First-Tier Residence	None
MR-2.8	66	66	66	67	67	67	Second-Tier Residence	None
LT-9	68	68	68	68	68	68	First-Tier Residence	None
MR-2.9	65	65	65	65	65	65	Second-Tier Residence	None
Site-10	72	72	71	72	72	72	First-Tier Residence	None
Site-11	68	68	68	69	69	69	Second-Tier Residence	None
Site-12	68	68	68	68	68	68	First-Tier Residence	None
MR-2.10	64	64	64	64	64	64	Second-Tier Residence	None
MR-2.11	71	71	71	72	72	72	First-Tier Residence	None
MR-2.12	70	70	71	71	71	71	First-Tier Residence	None
MR-2.13	67	67	68	68	68	68	First-Tier Residence	I
Site-13b	60	60	60	60	60	60	Second-Tier Residence	H
Site-13	63	63	63	63	63	63	First-Tier Residence	H
MR-2.14	57	57	57	57	57	57	Second-Tier Residence	H
MR-2.15	62	62	62	62	62	62	First-Tier Residence	H
MR-2.16	65	65	65	65	65	65	Second-Tier Residence	I
Site-14	70	70	71	71	71	71	First-Tier Residence	I
MR-2.17	72	72	72	72	72	72	First-Tier Residence	None
MR-2.18	65	65	65	65	65	65	Second-Tier	None

Loudest Hour Noise Levels, Leq (h) dBA								
Receiver ID	**2004**	**2020**	**2030 No Build**	**2030 Build**	**2040 No Build**	**2040 Build**	**Type of Development**	**Barrier Shielding**
							Residence	
Site-16	71	71	71	71	72	71	First-Tier Residence	None
MR-2.19	71	71	71	70	71	71	First-Tier Residence	None
MR-2.20	65	65	65	64	65	65	First-Tier Residence	H
MR-2.21	60	60	60	60	61	61	Second-Tier Residence	H
MR-2.22	68	68	68	68	69	69	Cemetery	None
MR-2.23	64	64	65	64	65	65	Cemetery	None
Site-15	66	66	66	66	67	67	Cemetery	None
MR-2.24	63	63	64	63	64	64	First-Tier Residence	Q-1
MR-2.25	61	61	61	60	62	61	Second-Tier Residence	Q-1
LT-13	63	63	63	63	64	63	First-Tier Residence	Q-2
Site-17	63	63	63	62	64	63	First-Tier Residence	Q-3
Site-18	58	58	58	57	59	58	Second-Tier Residence	Q-3
MR-2.26	72	72	72	71	72	72	First-Tier Residence	None
Site-19	74	74	74	73	74	74	First-Tier Residence	None
MR-2.27	62	62	62	62	63	63	First-Tier Residence	None
MR-2.28	63	63	63	62	64	63	First-Tier Residence	None
Site-20	71	71	71	70	71	71	First-Tier Residence	None
Site-21	61	61	61	61	62	61	Second-Tier Residence	None
Site-22	69	69	69	69	70	69	First-Tier Residence	None
MR-2.29	66	66	67	66	67	67	First-Tier Residence	None
Site-23	73	73	73	72	73	73	Childcare	None
MR-2.30	68	68	68	67	68	68	First-Tier Residence	None
MR-2.31	64	64	64	63	64	64	Second-Tier Residence	None
Site-24	69	69	69	69	70	69	Church	None
MR-2.32	62	62	62	61	62	62	Second-Tier Residence	J
Site-25	68	68	68	68	69	69	First-Tier Residence	J
Site-26	62	62	63	62	63	63	Second-Tier Residence	J
Site-27	68	68	69	68	69	69	First-Tier Residence	None
Site-27b	66	66	67	66	67	67	First-Tier Residence	None
MR-2.33	65	65	65	65	66	66	Second-Tier	None

Loudest Hour Noise Levels, Leq (h) dBA								
Receiver ID	2004	2020	2030 No Build	2030 Build	2040 No Build	2040 Build	Type of Development	Barrier Shielding
							Residence	
Site-88	62	62	63	62	63	63	First-Tier Residence	None

Table 7-5: Predicted Traffic Noise Impacts: Alhambra Avenue to 65th Street

Receiver ID	2020 Loudest-Hour, dBA	2040 Build Loudest-Hour, dBA	Noise Increase[1]	Impact Type[2]	Number of Units Represented
MR-2.1	70	70	0	A/E	11
Site-9	70	70	0	A/E	8
MR-2.2	61	61	0	None	5
MR-2.3	72	72	0	A/E	12
MR-2.4	65	65	0	None	5
MR-2.5	63	63	0	None	6
MR-2.6	68	68	0	A/E	6
MR-2.7	68	69	1	A/E	7
MR-2.8	66	67	1	A/E	6
LT-9	68	69	1	A/E	6
MR-2.9	65	65	0	None	0
Site-10	72	72	1	A/E	6
Site-11	68	69	0	A/E	5
Site-12	68	68	0	A/E	5
MR-2.10	64	64	0	None	8
MR-2.11	71	72	1	A/E	4
MR-2.12	70	71	1	A/E	5
MR-2.13	68	68	1	A/E	11
Site-13b	60	60	1	None	5
Site-13	63	64	1	None	3
MR-2.14	57	58	1	None	5
MR-2.15	62	63	1	None	4
MR-2.16	65	65	1	None	18
Site-14	70	71	1	A/E	5
MR-2.17	72	72	1	A/E	5
MR-2.18	65	65	0	None	11
Site-16	71	72	1	A/E	2
MR-2.19	71	71	1	A/E	2
MR-2.20	65	65	1	None	7
MR-2.21	60	61	1	None	7
MR-2.22	68	69	1	None	0[3]
MR-2.23	65	65	1	None	0[3]
Site-15	66	67	1	None	0[3]
MR-2.24	63	64	1	None	6
MR-2.25	61	62	1	None	8
LT-13	63	64	1	None	2
Site-17	63	64	1	None	9
Site-18	58	59	1	None	6
MR-2.26	72	72	0	A/E	3
Site-19	74	74	0	A/E	4
MR-2.27	62	63	1	None	10

Receiver ID	2020 Loudest-Hour, dBA	2040 Build Loudest-Hour, dBA	Noise Increase[1]	Impact Type[2]	Number of Units Represented
MR-2.28	63	64	1	None	6
Site-20	71	71	0	A/E	4
Site-21	61	62	0	None	12
Site-22	69	70	0	A/E	9
MR-2.29	66	67	1	A/E	5
Site-23	73	73	1	A/E	1
MR-2.30	68	68	1	A/E	8
MR-2.31	64	64	1	None	6
Site-24	69	70	1	A/E	4
MR-2.32	62	62	1	None	3
Site-25	68	69	1	A/E	10
Site-26	62	63	1	None	4
Site-27	68	69	1	A/E	4
Site-27b	66	67	1	A/E	4
MR-2.33	65	66	1	A/E	6
Site-88	62	63	1	None	4

[1] Discrepancies may occur due to rounding.

[2] Impact Type: S = Substantial Increase (12 dBA or more), A/E = Approach or Exceed NAC

[3] East Lawn Memorial Cemetery - Not an area of frequent human usage that would benefit from a lower noise level

Segment 3: 65th Street to Howe Avenue

One long-term measurement (LT-6) and one short-term measurement (Site-28) were taken within this region, and there are two additional modeled receiver locations (MR-3.1 and MR-3.2). There are no sound walls within this segment. As shown in Table 7-6, the loudest-hour $L_{eq\ (h)}$ noise levels under Year 2020 conditions range from 55 to 71 dBA. Under Year 2030 and Year 2040 No Build conditions, noise levels at modeled locations are expected to decrease between 0 and 1 decibel to range from 55 to 70 dBA.

The Year 2030 Build condition will increase the noise levels at modeled locations by 0 to 1 decibels to range from 55 to 71 dBA. This increase in noise levels is a result of the increase in traffic volumes. The noise level increase is not enough to be considered a substantial increase. The church parking areas are not considered to be areas of frequent human use that would benefit from a lowered noise level. The predicted noise levels at the baseball field would approach or exceed the federal NAC of 67 dBA, however, noise abatement is not considered because it will not meet the FHWA's reasonableness and feasibility criteria. The predicted traffic noise impacts are shown in Table 7-7.

Table 7-6: Existing and Predicted Noise Levels: 65th Street to Howe Avenue

Receiver ID	Loudest Hour Noise Levels, Leq (h) dBA						Type of Development	Barrier Shielding
	2004	2020	2030 No Build	2030 Build	2040 No Build	2040 Build		
Site-28	71	71	70	71	71	71	Baseball	None
MR-3.1	69	69	70	70	70	70	Church	None
MR-3.2	55	55	55	55	55	55	Motel	None
LT-6	71	71	70	71	71	71	Baseball	None

Table 7-7: Predicted Traffic Noise Impacts: 65th Street to Howe Avenue

Receiver ID	2020 Loudest-Hour, dBA	2040 Build Loudest-Hour, dBA	Noise Increase[1]	Impact Type[2]	Number of Units Represented
Site-28	71	71	0	None	0[3]
MR-3.1	70	70	1	A/E	0[4]
MR-3.2	55	55	1	None	1
LT-6	71	71	0	None	0[3]

[1] Discrepancies may occur due to rounding.
[2] Impact Type: S = Substantial Increase (12 dBA or more), A/E = Approach or Exceed NAC
[3] CSUS Baseball fields – Will not meet the FHWA's reasonableness and feasibility criteria.
[4] Located in front of church where there is no outside activity.

Segment 4: Howe Avenue to Watt Avenue

Two long-term measurements (LT- 7 and LT-8) and fifteen short-term measurements (Sites 29, 29b, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 41, 43, and 101) were taken within this region, and there are 21 additional modeled receiver locations (MR-4.1 through MR-4.21). Existing sound walls (Barriers G-1, G-2, K, L-1, and L-2) provided acoustical shielding to all measured and modeled receivers in this segment. As shown in Table 7-8, the loudest-hour $L_{eq\ (h)}$ for the Year 2020 conditions ranges from 62 to 72 dBA at first- tier residences and from 59 to 66 dBA at second-tier residences. Under Year 2030 No Build conditions, noise levels at modeled locations are expected to increase by less than 1 decibel to range from 62 to 72 dBA at first-tier residences and from 59 to 66 dBA at second-tier residences.

The Year 2030 and Year 2040 Build condition will increase noise levels at modeled locations by 0 to 1 decibels. Resulting noise levels are anticipated to be 63 to 72 dBA at first-tier residences and 60 to 66 dBA at second-tier residences. This increase in noise levels is a result of the increase in traffic volumes. The noise level increase would not be considered a substantial increase. However, many first-row receivers would continue to approach or exceed the NAC of 67 dBA; therefore, noise abatement, in the form of increasing the existing wall heights in the area, was considered for this region. Predicted traffic noise impacts are shown in Table 7-9.

Table 7-8: Existing and Predicted Noise Levels: Howe Avenue to Watt Avenue

Receiver ID	Loudest Hour Noise Levels, Leq (h) dBA						Type of Development	Barrier Shielding
	2004	2020	2030 No Build	2030 Build	2040 No Build	2040 Build		
Site-29b	64	64	65	65	65	65	First-Tier Residence	K
Site-29a	69	69	69	69	69	69	First-Tier Residence	K
Site-30	65	65	65	66	66	66	First-Tier Residence	G-1
Site-31	65	65	65	66	66	66	First-Tier Residence	G-1
Site-32	62	62	62	62	62	62	Second-Tier Residence	G-1
MR-4.1	67	67	67	67	67	67	First-Tier Residence	L-1
MR-4.2	63	63	64	64	64	64	Second-Tier Residence	L-1
MR-4.3	68	68	69	69	69	69	First-Tier Residence	L-1
MR-4.4	62	62	62	63	63	63	Second-Tier Residence	L-1
Site-34	69	69	69	69	69	69	First-Tier Residence	L-1
Site-35	59	59	59	60	60	60	Second-Tier Residence	L-1
MR-4.5	68	68	69	69	69	69	First-Tier Residence	L-1
Site-36	69	69	69	70	70	70	First-Tier Residence	L-1
MR-4.6	69	69	69	69	69	69	First-Tier Residence	G-1
Site-33	72	72	72	72	72	72	First-Tier Residence	G-1
MR-4.7	66	66	66	66	66	66	Second-Tier Residence	G-1
Site-101	65	65	65	65	65	65	Second-Tier Residence	G-1
MR-4.8	70	70	70	71	71	71	First-Tier Residence	G-1
MR-4.9	70	70	70	70	70	70	First-Tier Residence	G-1
MR-4.10	70	70	71	71	71	71	First-Tier Residence	L-2
MR-4.11	62	62	62	62	62	62	Second-Tier Residence	L-2
Site-37	69	69	70	70	70	70	Park	L-2
MR-4.12	69	69	69	70	70	70	First-Tier Residence	L-2
MR-4.13	61	61	61	61	61	61	Second-Tier Residence	L-2
Site-41	66	66	66	67	67	67	First-Tier Residence	L-2
MR-4.14	63	63	63	64	64	64	Second-Tier Residence	L-2

Receiver ID	Loudest Hour Noise Levels, Leq (h) dBA						Type of Development	Barrier Shielding
	2004	2020	2030 No Build	2030 Build	2040 No Build	2040 Build		
MR-4.15	72	72	72	71	72	72	First-Tier Residence	G-2
MR-4.16	64	64	64	63	64	64	Second-Tier Residence	G-2
MR-4.17	71	71	71	71	72	72	Park	G-2
Site-39	72	72	72	71	72	72	First-Tier Residence	G-2
Site-40	63	63	63	62	63	63	Second-Tier Residence	G-2
Site-43	69	69	70	69	70	70	First-Tier Residence	L-2
MR-4.18	66	66	67	66	67	67	First-Tier Residence	L-2
MR-4.19	62	62	62	62	63	63	First-Tier Residence	L-2
MR-4.20	70	70	70	70	71	70	First-Tier Residence	G-2
MR-4.21	67	67	67	67	68	67	First-Tier Residence	G-2

Table 7-9: Predicted Traffic Noise Impacts: Howe Avenue to Watt Avenue

Receiver ID	2020 Loudest-Hour, dBA	2040 Build Loudest-Hour, dBA	Noise Increase[1]	Impact Type[2]	Number of Units Represented
Site-29b	65	65	1	None	34
Site-29a	69	70	1	A/E	2
Site-30	65	66	1	A/E	26
Site-31	65	66	1	A/E	6
Site-32	62	62	1	None	6
MR-4.1	67	68	1	A/E	10
MR-4.2	63	64	1	None	8
MR-4.3	69	69	1	A/E	10
MR-4.4	62	63	1	None	12
Site-34	69	70	1	A/E	10
Site-35	59	60	1	None	12
MR-4.5	68	69	1	A/E	6
Site-36	69	70	1	A/E	5
MR-4.6	69	69	0	A/E	6
Site-33	72	72	0	A/E	7
MR-4.7	66	66	1	A/E	4
Site-101	65	65	0	None	4
MR-4.8	70	71	0	A/E	9
MR-4.9	70	70	0	A/E	5
MR-4.10	70	71	1	A/E	6
MR-4.11	62	62	0	None	11
Site-37	70	70	1	A/E	4
MR-4.12	69	70	1	A/E	6
MR-4.13	61	61	1	None	14
Site-41	66	67	1	A/E	8
MR-4.14	63	64	1	None	10
MR-4.15	72	72	0	A/E	8
MR-4.16	64	64	1	None	6

Receiver ID	2020 Loudest-Hour, dBA	2040 Build Loudest-Hour, dBA	Noise Increase[1]	Impact Type[2]	Number of Units Represented
MR-4.17	71	72	0	A/E	2
Site-39	72	72	0	A/E	12
Site-40	63	63	1	None	12
Site-43	69	70	1	A/E	8
MR-4.18	66	67	1	A/E	4
MR-4.19	62	63	1	None	5
MR-4.20	70	71	0	A/E	8
MR-4.21	67	68	1	A/E	5

[1] Discrepancies may occur due to rounding.

[2] Impact Type: S = Substantial Increase (12 dBA or more), A/E = Approach or Exceed NAC

Assessment of Noise Impacts and Abatement Options

Receivers that exceed either state or federal thresholds must be evaluated for potential abatement/mitigation measures. Substantial noise increases would not occur at Category B, C and D land uses in the study area, but many receivers along the project would experience future noise levels that would approach or exceed the NAC. As a result, noise abatement must be evaluated for these receivers. Potential noise abatement measures identified in the Protocol include:

- Avoiding the project impact by using design alternatives, such as altering the horizontal and vertical alignment of the project;
- Constructing sound walls;
- Using traffic management measures to regulate types of vehicles and speeds;
- Acquiring property to serve as a buffer zone; and/or
- Acoustically insulating public use or nonprofit institutional structures.

Noise barriers are the only form of noise abatement considered for this project. Each noise barrier evaluated has been evaluated for feasibility based on achievable noise reduction. For each noise barrier found to be acoustically feasible, reasonable cost allowances were calculated by multiplying the number of benefited receptors by $71,000.

For any noise barrier to be considered reasonable from a cost perspective the estimated cost of the noise barrier should be equal to or less than the total cost allowance calculated for the barrier. The cost calculations of the noise barrier must include all items appropriate and necessary for construction of the barrier, such as traffic control, drainage modification, retaining walls, landscaping for graffiti abatement, and right-of-way costs. Construction cost estimates are not provided in this NSR, but are presented in the NADR. The NADR is a design responsibility and is prepared to compile information from the NSR, other relevant environmental studies, and design considerations into a single, comprehensive document before public review of the project. The NADR is prepared by the project engineer after completion of the NSR and prior to publication of the draft environmental document. The NADR includes noise abatement construction cost estimates that have been prepared and signed by the project engineer based on site-specific conditions. Construction cost estimates are compared to reasonableness allowances in the NADR to identify which wall configurations are reasonable from a cost perspective.

The design of noise barriers presented in this report is preliminary and has been conducted at a level appropriate for environmental review and not for final design of the project. Preliminary information on the physical location, length, and height of noise barriers is provided in this report. If pertinent parameters change substantially during the final project design, preliminary noise barrier designs may be modified or eliminated from the final project. A final decision on the construction of the noise abatement will be made upon completion of the project design.

Traffic noise modeling and impact assessment was conducted at NAC activity Category B, C, D land uses where frequent human usage occurs and a lowered noise level would be of benefit. The existing Caltrans sound walls are typically constructed to meet the criteria in Chapter 1100 of the *Highway Design Manual.* The manual states that sound walls should not be higher than 14 feet above the pavement when located within 4.5 meters (15 feet) of the edge of traveled way and 16 feet above ground when located more than 15 feet from the edge of traveled way.

In many locations, receivers located behind existing barriers and sound walls exceeded the NAC. Replacement barriers were assessed for barriers that were in fair to poor condition. Noise barriers were evaluated at the most acoustically effective location within the Caltrans right-of-way. Where U.S. 50 is elevated above receivers, the most acoustically effective location for a barrier is near the edge of shoulder, either on structure or at the top of slope.

For the sound walls that are less than the maximum height allowed, raising the sound wall height to the maximum height would not provide at least 5 dBA of noise reduction (a sound wall must achieve at least 5 dBA of reduction for Caltrans to consider it feasible). Because of this, a detailed assessment of impacts and abatement at NAC activity Category B land uses currently protected by Caltrans sound walls was not conducted. An exception was made at locations where the existing sound walls were low, and residents in the area potentially had a direct line of sight to traffic on U.S. 50 (Barriers F, I, J, K). Because the existing walls are structurally in fair or good condition, a replacement wall of equal height to the existing wall would not be anticipated to change the noise environment behind the wall. Therefore, the insertion loss for these sound walls was calculated based on wall height increases over the existing wall height.

All existing masonry barriers are in good condition and range in height from 10 to 14 feet. Although receivers behind some of these walls (Barriers G-1, L-1, L-2) approach or exceed the NAC, increasing the heights of these barriers could not achieve the minimum 5-decibel reduction below existing levels. Therefore, replacement of existing masonry barriers would not be considered feasible and these walls are not assessed further in this document.

Potential sound walls are discussed below in detail by study area segment. Once a noise barrier achieved the minimum of a 5-decibel reduction at a given receiver, the reasonableness allowance was determined. Tables 7-20 through 7-41 show the predicted Year 2040 loudest-hour noise levels and insertion loss for each barrier at various design heights. Table 7-42 summarizes the insertion loss, benefited receivers, and reasonable allowances for each assessed barrier.

Segment 1: Westernmost Project Limit (I-5 I/C) to Alhambra Boulevard

There are currently no barriers in this segment. The predicted Year 2040 Build loudest-hour noise levels within this segment range from 62 to 74 dBA, with 17 Category B receivers approaching or exceeding the NAC of 67 dBA. There are two proposed barriers throughout this segment to mitigate these potential impacts, SWWB1 and SWEB1. Based on preliminary design data, the proposed barriers would reduce noise levels by 2 to 11 decibels at affected receivers. Tables 7-20 and 7-21 show the predicted Year 2040 loudest-hour noise levels and insertion loss for each barrier at various design heights.

Table 7-10: SWWB1 Insertion Loss

Receiver I.D. No.	Number of Units Represented	Noise Level w/o Wall	With Wall H=6 ft		With Wall H=8 ft[1]		With Wall H=10 ft		With Wall H=12 ft		With Wall H=14 ft	
			Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Site-1	35	69	63	3	63	3	61	8	59	10	59	10
MR-1.1	11	69	64	5	62	7	61	8	60	9	60	9
MR-1.2	16	67	61	6	60	7	58	9	57	10	57	10
Site-4	12	67	63	4	62	5	61	6	60	7	59	8
Site-4b	14	72	70	2	69	3	68	4	68	4	67	5
MR-1.7	15	67	64	3	64	3	64	3	63	4	63	4
Site-6	10	63	59	4	58	5	57	6	56	7	55	8
Site-6b	10	63	58	5	57	6	56	7	56	7	55	8
MR-1.8	42	68	64	4	63	5	62	6	62	6	61	7
Site-7	18	68	68	0	68	0	67	1	67	1	67	1
Site-7a	19	69	69	0	69	0	69	0	69	0	69	0

[1] Breaks line of sight between 11.5-ft truck stack and 5-ft-high receiver in the first row of residences.

Table 7-11: SWEB1 Insertion Loss

Receiver I.D. No.	Number of Units Represented	Noise Level w/o Wall	With Wall H=6 ft		With Wall H=8 ft[1]		With Wall H=10ft		With Wall H=12 ft		With Wall H=14 ft	
			Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
MR-1.9	39	71	69	2	69	2	69	2	69	2	68	3
Site-8	21	70	66	4	65	5	64	6	63	7	63	7
Site-8b	20	70	65	5	64	6	63	7	62	8	62	8
MR-1.5	11	70	66	4	65	5	64	6	64	6	63	7
MR-1.6	6	62	58	4	56	6	56	6	55	7	54	8
Site-5	26	70	67	3	66	4	66	4	65	5	65	5
MR-1.4	3	74	70	4	69	5	67	7	66	8	65	9
MR-1.3	1	72	68	4	65	7	64	8	64	8	63	9
Site-2	11	72	68	4	65	7	64	8	63	9	63	9
Site-3	13	63	58	5	57	6	54	9	53	10	52	11

1- Break the line of sight between a 3.5 m (11.5 ft)-high truck stack and a 5 ft high receiver in the first row of residences.

The reasonable allowance calculated in accordance with the Protocol ranges from $5,110,000 to $10,650,000 depending upon the barrier height.

SWWB1 would reduce noise levels by 5 to 10 decibels for up to 150 sensitive receptors. A minimum barrier height of 8 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $5,112,000 to $10,650,000 depending upon the barrier height.

SWEB1 would reduce noise levels by 5 to 11 decibels for up to 112 sensitive receptors. A minimum barrier height of 8 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $2,343,000 to $7,950,000 depending upon the barrier height.

Segment 2: Alhambra Boulevard to 65th Street

There are currently seven barriers in this segment: Barriers H, I, Q-1, Q-2, Q-3, Q-4, and J. Barriers I and J are in fair condition but may not break the line of sight between receivers, and traffic on U.S. 50 and Barriers H, Q-1, Q-2, Q-3, and Q-4 are in good condition. Barriers I and J were studied further to determine whether increasing the height of these barriers would provide an additional 5-decibel reduction.

The predicted Year 2040 Build loudest-hour noise levels within this segment range from 58 to 74 dBA, with 27 Category B receivers approaching or exceeding the NAC of 67 dBA $L_{eq\ (h)}$. There are seven proposed barriers throughout this segment to mitigate these potential impacts: SWWB2, SWEB2, SWEB3, SWEB4, SWEB5, SWEB6 and SWEB7. Calculations based on preliminary design data indicate that the proposed barriers would reduce noise levels by 1 to 12 decibels at affected receivers. Tables 7-22 to 7-28 show the Year 2040 Build loudest-hour noise levels along with the insertion loss for each barrier.

Table 7-12: SWWB2 Insertion Loss

Receiver I.D. No.	Number of Units Represented	Noise Level w/o Wall	With Wall H=8 ft.[1]		With Wall H=10 ft		With Wall H=12 ft		With Wall H=14 ft		With Wall H=16 ft.	
			Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
LT-9	6	69	65	4	63	6	62	7	61	8	60	9
Site-11	5	69	66	3	66	3	65	4	65	4	65	4
Site-10	6	72	67	5	67	5	66	6	66	6	66	6
MR-2.8	6	67	64	3	62	5	61	6	60	7	59	8
MR-2.7	7	69	64	5	63	6	62	7	61	8	60	9

[1] Breaks line of sight between 11.5-ft truck stack and 5-ft-high receiver in the first row of residences.

Table 7-13: SWEB2 Insertion Loss

Receiver I.D. No.	Number of Units Represented	Noise Level w/o Wall	With Wall H=6 ft		With Wall H=8 ft		With Wall H=10ft[1]		With Wall H=12 ft		With Wall H=14 ft	
			Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
MR-2.12	5	71	66	5	65	6	65	6	64	7	64	7
MR-2.11	4	72	70	2	70	2	69	3	69	3	69	3
MR-2.10	8	64	63	1	63	1	63	1	63	1	63	1
Site-12	5	71	70	1	70	1	70	1	70	1	70	1
MR-2.6	6	68	63	5	63	5	60	8	59	9	59	9
MR-2.5	6	63	59	4	59	4	58	5	57	6	57	6
MR-2.4	5	65	60	5	59	6	59	6	58	7	57	8
MR-2.3	12	72	66	6	66	6	65	7	62	10	62	10
MR-2.2	5	61	57	4	56	5	56	5	55	6	54	7
Site-9	8	70	65	5	64	6	64	6	61	9	61	9
MR-2.1	11	70	66	4	65	5	65	5	63	7	62	8

Table 7-14: SWEB3 Insertion Loss

Receiver I.D. No.	Number of Units Represented	Noise Level w/o Wall	With Wall H=8 ft		With Wall H=10ft[1]		With Wall H=12 ft		With Wall H=14 ft		With Wall H=16 ft	
			Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
MR-2.13	11	68	68	0	67	1	67	1	67	1	66	2
MR-2.16	18	63	62	1	61	2	60	3	59	4	59	4
Site-14	5	71	70	1	69	2	68	3	67	4	67	4

[1]Breaks line of sight between 11.5-ft truck stack and 5-ft-high receiver in the first row of residences.

Table 7-15: SWEB4 Insertion Loss

Receiver I.D. No.	Number of Units Represented	Noise Level w/o Wall	With Wall H=8 ft		With Wall H=10ft[1]		With Wall H=12 ft		With Wall H=14 ft		With Wall H=16 ft	
			Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
MR-2.19	2	71	68	3	68	3	68	3	67	4	67	4
Site-16	2	72	67	5	66	6	66	6	65	7	65	7
MR-2.18	11	72	69	3	69	3	69	3	68	4	68	4
MR-2.17	5	65	62	3	62	3	61	4	61	4	60	5

[1] Breaks line of sight between 11.5-ft truck stack and 5-ft-high receiver in the first row of residences.

Table 7-16: SWEB5 Insertion Loss

Receiver I.D. No.	Number of Units Represented	Noise Level w/o Wall	With Wall H=8 ft		With Wall H=10ft		With Wall H=12 ft[1]		With Wall H=14 ft		With Wall H=16 ft	
			Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
MR-2.26	4	72	66	7	65	7	64	8	64	9	63	9
Site-19	3	74	65	9	65	9	64	10	63	11	62	12

[1] Breaks line of sight between 11.5-ft truck stack and 5-ft-high receiver in the first row of residences.

Table 7-17: SWEB6 Insertion Loss

Receiver I.D. No.	Noise Level w/o Wall	With Wall H=6 ft[1]		With Wall H=8 ft		With Wall H=10ft		With Wall H=12 ft		With Wall H=14 ft		With Wall H=16 ft	
		Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
MR-2.29	67	65	2	64	3	64	3	64	3	64	3	60	7
MR-2.30	68	64	4	64	4	63	5	62	6	62	6	62	6
MR-2.31	64	62	2	61	3	61	3	61	3	61	3	61	3
Site-20	71	68	3	67	4	66	5	65	6	64	7	64	7
Site-21	62	61	1	61	1	60	2	60	2	59	3	59	3
Site-22	70	65	5	64	6	63	7	63	7	62	8	61	9

[1] Breaks line of sight between 11.5-ft truck stack and 5-ft-high receiver in the first row of residences.

Table 7-18: SWEB7 Insertion Loss

Receiver I.D. No.	Number of Units Represented	Noise Level w/o Wall	With Wall H=6 ft[1]		With Wall H=8 ft		With Wall H=10ft		With Wall H=12 ft		With Wall H=14 ft	
			Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
MR-2.32	3	62	59	3	56	3	55	4	55	4	55	4
Site-24	4	70	65	5	59	6	59	6	58	7	58	7
Site-25	10	-	69	5	68	1	67	2	67	2	66	3
Site-26	4	-	63	4	62	1	61	2	61	2	60	3
Site-27	4	-	69	1	69	0	69	0	69	0	69	0

[1] Breaks line of sight between 11.5-ft truck stack and 5-ft-high receiver in the first row of residences.

SWWB2 would reduce noise levels by 5 to 9 decibels for up to 19 sensitive receptors. A minimum barrier height of 10 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $497,000 to $1, 7750,000 depending upon the barrier height.

SWEB2-2A would reduce noise levels by 5 to 10 decibels for 58 sensitive receptors. A minimum barrier height of 8 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $355,000 to $3,760,000 depending upon the barrier height.

SWEB3: Raising the existing sound wall height to 16 ft would not provide the required 5-dBA reduction. However, replacing this barrier with a taller barrier is being considered depending on funding and final project design.

SWEB4 would reduce noise levels by 5 to 7 decibels for 7 sensitive receptors. A minimum barrier height of 8 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $142,000 to $497,000, depending upon the barrier height.

SWEB5 will reduce noise levels by 6 to 12 decibels for 7 sensitive receptors. A minimum barrier height of 6 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol is $497,000, for this barrier.

SWEB6 would reduce noise levels by 5 to 9 decibels for 26 sensitive receptors. A minimum barrier height of 6 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The reasonable allowance calculated in accordance with the Protocol ranges from $639,000 to $1,846,000, depending upon the barrier height.

SWEB7-7A is comprised of two parts, the new barrier construction and the barrier height extension for existing Barrier J. A minimum barrier height of 6 ft would break the line of sight between an 11.5 ft high truck stack and a 5 ft high receiver in the first row of residences. The new barrier construction would reduce noise levels by 5 to 7 decibels for 4 sensitive receptors, and the reasonable allowance calculated in accordance with the Protocol is $284,000. For Barrier J height extension, raising the existing sound wall height to 16 ft would not provide the required 5-dBA reduction; therefore, this portion of the barrier is not considered to be feasible.

Segment 3: 65th Street to Howe Avenue

There are no Category B land use receivers in this segment that approach or exceed the noise abatement criteria. The noise levels at McAuliffe baseball complex, exceeds the NAC, however, noise abatement is not considered because it will not meet the FHWA's reasonableness and feasibility criteria.

Segment 4: Howe Avenue to Watt Avenue

There are three existing barriers in this segment: Barriers G, K, and L. Barrier K is in fair condition but may not break the line of sight between receivers and traffic on U.S. 50, and Barriers G and L are considered to be in good condition. Barrier K was studied further to determine if increasing the height of the existing barrier would provide an additional 5-decibel reduction.

The predicted Year 2040 Build loudest-hour noise levels within this segment range from 60 to 72 dBA, with 24 Category B receivers approaching or exceeding the NAC of 67 dBA. The only proposed barrier in this segment is barrier SWEB8, which is the height extension for Barrier K. Table 7-29 shows the Year 2040 Build loudest-hour noise levels and the corresponding insertion losses for this barrier. Raising the existing sound wall height to 16 ft would not provide the required 5-dBA reduction; therefore, this barrier is not considered to be feasible and no abatement measures are recommended.

Table 7-19: SWEB8 Insertion Loss

Receiver I.D. No.	Number of Units Represented	Noise Level With Existing Wall H=8 ft[1]	With Wall H=10 ft		With Wall H=12 ft		With Wall H=14 ft		With Wall H=16 ft	
			Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.	Leq(h)	I.L.
Site-29a	34	70	69	1	68	2	68	2	67	3
Site-29b	2	67	65	2	64	3	64	3	63	4

[1] Breaks line of sight between 11.5-ft truck stack and 5-ft-high receiver in the first row of residences.

Table 7-20: Reasonable Allowances for All Barriers

Sound Wall ID	Approximate Stationing	Type of Analysis[1]	Barrier Height	Predicted Noise Reduction, dBA	Number of Benefited Receivers	Reasonable Allowance Per Benefited Receptor	Total Reasonableness Allowance
SW WB-1	WB, Station 51+50 to 134+70	New Wall	6 ft	5 to 6	72	$71,000	$5,112,000
			8 ft*	5 to 7	136	$71,000	$9,656,000
			10 ft	6 to 9	136	$71,000	$9,656,000
			12 ft	5 to 10	136	$71,000	$9,656,000
			14 ft	5 to 10	150	$71,000	$10,650,000
SW WB-2	WB, Station 149+80 to 164+40	New Wall	6 ft	5	7	$71,000	$497,000
			8 ft	5 to 6	25	$71,000	$1,775,000
			10 f*	6 to 7	25	$71,000	$1,775,000
			12 ft	5 to 8	25	$71,000	$1,775,000
			14 ft	5 to 9	25	$71,000	$1,775,000
SW EB-1	EB, Station 58+00 to 133+80	New Wall	6 ft	5	33	$71,000	$2,343,000
			8 ft*	5 to 7	86	$71,000	$6,106,000
			10 ft	6 to 9	86	$71,000	$6,106,000
			12 ft	5 to 10	112	$71,000	$7,952,000
			14 ft	5 to 11	112	$71,000	$7,952,000

Sound Wall ID	Approximate Stationing	Type of Analysis[1]	Barrier Height	Predicted Noise Reduction, dBA	Number of Benefited Receivers	Reasonable Allowance Per Benefited Receptor	Total Reasonableness Allowance
SW EB-2	EB, Station 144+30 to 175+50	New Wall	6 ft	5 to 6	31	$71,000	$2,201,000
			8 ft*	5 to 6	47	$71,000	$3,337,000
			10 ft	5 to 8	53	$71,000	$3,763,000
			12 ft	6 to 10	53	$71,000	$3,763,000
			14 ft	6 to 10	53	$71,000	$3,763,000
SW EB-2A	EB, Station 174+12 to 186+44	New Wall	6 ft	5 to 6	5	$71,000	$355,000
			8 ft*	5 to 6	5	$71,000	$355,000
			10 ft	5 to 8	5	$71,000	$355,000
			12 ft	6 to 10	5	$71,000	$355,000
			14 ft	6 to 10	5	$71,000	$355,000
SW EB-3	EB, Station 186+45 to 199+00	Increase Assessment (I)	16 ft	<5	0	$71,000	$0
SW EB-4	EB, Station 199+00 to 214+23	New Wall	8 ft*	5	2	$71,000	$142,000
			10 ft	6	2	$71,000	$142,000
			12 ft	6	2	$71,000	$142,000
			14 ft	7	2	$71,000	$142,000
			16 ft	5 to 7	7	$71,000	$497,000
SW EB-5	EB, Station 214+84 to 226+64	New Wall	6 ft*	6 to 8	7	$71,000	$497,000
			8 ft	7 to 9	7	$71,000	$497,000
			10 ft	7 to 9	7	$71,000	$497,000
			12 ft	8 to 10	7	$71,000	$497,000
			14 ft	9 to 11	7	$71,000	$497,000
			16 ft	9 to 12	7	$71,000	$497,000
SW EB-6	EB, Station 227+22 to 252+98	New Wall	6 ft*	5	9	$71,000	$639,000
			8 ft	6	9	$71,000	$639,000
			10 ft	5 to 7	21	$71,000	$1,491,000
			12 ft	6 to 7	21	$71,000	$1,491,000
			14 ft	6 to 8	21	$71,000	$1,491,000
			16 ft	7 to 9	26	$71,000	$1,846,000
SW EB-7A	EB, Station 254+02 to 260+38	New Wall	6 ft*	5	4	$71,000	$284,000
			8 ft	6	4	$71,000	$284,000
			10 ft	6	4	$71,000	$284,000
			12 ft	7	4	$71,000	$284,000
			14 ft	7	4	$71,000	$284,000
			16 ft	7	4	$71,000	$284,000
SW EB-7B	EB, Station 260+38 to 270+96	Increase Assessment	16 ft	<5	0	$71,000	$0

***** Minimum feasible barrier height, which breaks line of sight between 11.5-ft, truck stack and 5-ft-high receiver in the first row of residences.

Increase Assessment= Increase in height of existing wall of substandard height

Chapter 8 Construction Noise

During construction of the project, noise from construction activities may intermittently dominate the noise environment in the immediate area of construction. Noise associated with construction is controlled by Caltrans Standard Specification Section 14-8.02, “Noise Control,” which states “Control and monitor noise from work activities.” And “Do not exceed 86 dBA LMax at 50 feet from the job site activities from 9 p.m. to 6 a.m.”

Table 8-1 summarizes noise levels produced by construction equipment that is commonly used on roadway construction projects. Construction equipment is expected to generate noise levels ranging from 70 to 90 dB at a distance of 50 feet, and noise produced by construction equipment would be reduced over distance at a rate of about 6 dB per doubling of distance.

Table 8-1. Construction Equipment Noise

Equipment	Maximum Noise Level (dBA at 50 feet)
Scrapers	89
Bulldozers	85
Heavy Trucks	88
Backhoe	80
Pneumatic Tools	85
Concrete Pump	82

Source: Federal Transit Administration, 2006. See also: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm

No adverse noise impacts from construction are anticipated because construction would be conducted in accordance with Caltrans Standard Specifications Section 14.8-02. Construction noise would be short-term, intermittent, and overshadowed by local traffic noise.

Chapter 9 References

California Department of Transportation, 2004 Annual Daily Truck Traffic on the California State Highway System, August 2005.

California Department of Transportation, Technical Noise Supplement (TeNS), September 2013.

California Department of Transportation, *Traffic Noise Analysis Protocol (Protocol),* May 2011.

Harris, Miller, Miller, and Hanson, Inc., Land Use Report for U.S. 50 HOV Noise Study, June 10, 2005.

Appendix A Traffic Data

Appendix B Long-Term Measurement Data

Appendix C Short-Term Measurement Data

Appendix D Receiver and Barrier Locations