Noise Study Report

Noise Study Report

Ferguson Slide

On Route 140
From 1.2 Miles West
To 0.5 Miles West of South Fork Merced River Bridge

Prepared by the
State of California Department of Transportation

Approved by:

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Caltrans

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Executive Summary

A noise analysis is required for all Type I projects. A Type I project is defined by Title 23, U.S. Code of Federal Regulations, Part 772 (23 CFR 772) 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 changes either the horizontal or the vertical alignment or increases the number of through lanes.

This project lies in Mariposa County on State Route 140 from 1.2 miles west to 0.5 miles west of South Fork Merced River Bridge. This noise study report evaluates the noise impacts associated with constructing two bridges across the Merced River. Refer to the Figure 1/project map in Chapter 1.

This is a Type I project because it proposes to realign the highway on a new alignment by the construction of two bridges across the Merced River between the above post miles.

This report was prepared to address the noise impacts that could occur for pedestrians and rafters within the project limits.

During the field visit, noise measurements where taken near the north and south bridges to represent pedestrians in that area of the project. These locations are shown in Figure 1 and in Attachment A. In addition, the study identified two rafter locations, near the north and south measurement locations, that can be modeled for noise impacts.

The proposed project is not likely to cause a noise impact on people within the project limits due to the loud existing background noise of the river. Traffic noise levels in the project area, near the north and south bridges, ranges from 41.7 dBA to 55.5 dBA near the north river bridge and from 37.3 dBA to 50.6 dBA near the south river bridge. The existing noise levels near the north and south river bridges is 55 dBA and 61.6 dBA respectively. The resultant noise level increase will range from no change in noise level near the south river bridge to 1 dBA above the existing noise level near the north river bridge. This means that at the loudest location, near the north river bridge, the noise generated by traffic on the north river bridge would contribute a maximum of 1 dBA to the existing noise generated by the river.

"It is widely accepted that the average healthy human ear, however, can barely perceive noise level changes of 3 dBA", TeNS section N-2211

Purpose of Noise Report

In most cases the objective of the noise analysis is to evaluate potential noise impacts that may result from implementation of the proposed project, and to identify noise abatement and mitigation measures necessary for the project to comply with state and federal requirements. However, since this project is located in an area of recreational use and set in a scenic and pristine location, noise impacts had to be evaluated based on recreational user impacts. This noise report is to evaluate the noise generated by traffic on the south and north bridges and find out if the project will deteriorate the noise levels further by adding bridges near the river thus affecting the natural setting.

This report has been prepared in compliance with 23 CFR 772, "Procedures for Abatement of Highway Traffic Noise," and Caltrans noise analysis policy described in Caltrans Noise Analysis Protocol, October 1998 (Caltrans' Protocol).

Traffic Noise Impacts

Table 1 lists the locations where noise impacts could be incurred most within the project limits. The table indicates the existing noise levels at these locations as well as the future noise levels with the project built. The no-build alternative for this project represents a situation where the existing north and south bridges will not be utilized due to their inconsistency with Caltrans standards. Therefore, in this case, the no-build alternative does not apply here since it is not considered as an acceptable option.

Table 1. Existing and Post-Project Noise Levels

Receiver No.	Receiver Location	Existing Noise Levels (dBA)	Future Noise Levels without project	Future noise levels			
				Alt A	AltC	Alts S, S-2	AltT
1	South River	61.6	N/A	61.6	61.6	61.6	61.6
2	North River	55	N/A	55	56	56	56
3	North River-rafter	61.6	N/A	62.6	62.6	62.6	62.6
4	South River-rafter	61.6	N/A	61.6	61.6	61.6	61.6

Chapter 1 Noise Impact Technical Report

1.1 Introduction

This report presents the results of the traffic noise impact study conducted for the Ferguson Slide Project. The primary objective of this study is to evaluate the potential noise impact on pedestrians and rafters near the north and south bridges. Although 7 alternatives were proposed, this report will focus on only the 5 alternatives that recommend bridge construction. These alternatives are Alts A, C, T, S, and S-2. Refer to Figure 1.

1.2 Project Description

The California Department of Transportation (Caltrans) proposes to reopen and restore State Route 140 in Mariposa County at the section damaged by the Ferguson rockslide. The total length of the project is 0.7 mile. In April 2006, rockslides damaged and blocked State Route 140 between Mariposa and El Portal. The Ferguson rockslide covered State Route 140, and the highway was closed to traffic from 8 miles east of Briceburg to approximately 7.6 miles west of El Portal. This blockage required residents of Mariposa County to take an alternate route, which affected emergency response times and school and work commutes. In addition, a main source of income to Mariposa, tourism revenue, decreased.

1.2.1 Alternatives:

Alternative A
Realign the highway to the northeast, spanning the Merced River and bypassing the rockslide. State Route 140 would remain at existing highway grade and become Incline Road for one half mile before spanning back across the river where it would meet the existing alignment. Two bridges would be constructed at grade to cross the river. The highway would be constructed with two 12-foot lanes and 8-foot outside shoulders and would require cutting into the north canyon wall.

Alternative C
Realign the highway to the northeast, spanning the Merced River and bypassing the rockslide. The highway would cut through the mountain across from the rockslide

and then span back across the river where it would meet the existing alignment. Two bridges would be constructed across the river. The highway would be constructed with two 12- foot lanes and 8-foot outside shoulders.

Alternative S-2

Realign the highway to the northeast, spanning the Merced River with two steel type bridges and bypassing the rockslide with a hillside viaduct. The highway would be constructed with two 12-foot lanes and 8-foot outside shoulders.

Alternative S

Realign the highway to the northeast, spanning the Merced River with two bridges and bypassing the rockslide with a hillside viaduct. The highway would be constructed with two 12-foot lanes 8-foot outside shoulders.

Alternative T

Realign the highway to the northeast, spanning the Merced River and bypassing the rockslide. The highway would tunnel through the mountain across from the rockslide and then span back across the river where it would meet the existing alignment. Two bridges would be constructed to cross the river. The highway would be constructed with two 12- foot lanes and 8-foot outside shoulders.

1.2.2 No-Build Alternative

The No-Build Alternative would leave State Route 140 damaged and blocked by the Ferguson rockslide. As a result of the No-Build Alternative, the temporary detour would become the permanent State Route 140 alignment. The structures for the temporary detour were constructed during a declared emergency and were designed as a temporary solution to the closure of State Route 140. These structures would not meet current standard design features nor would the detour meet the purpose and need of the project.

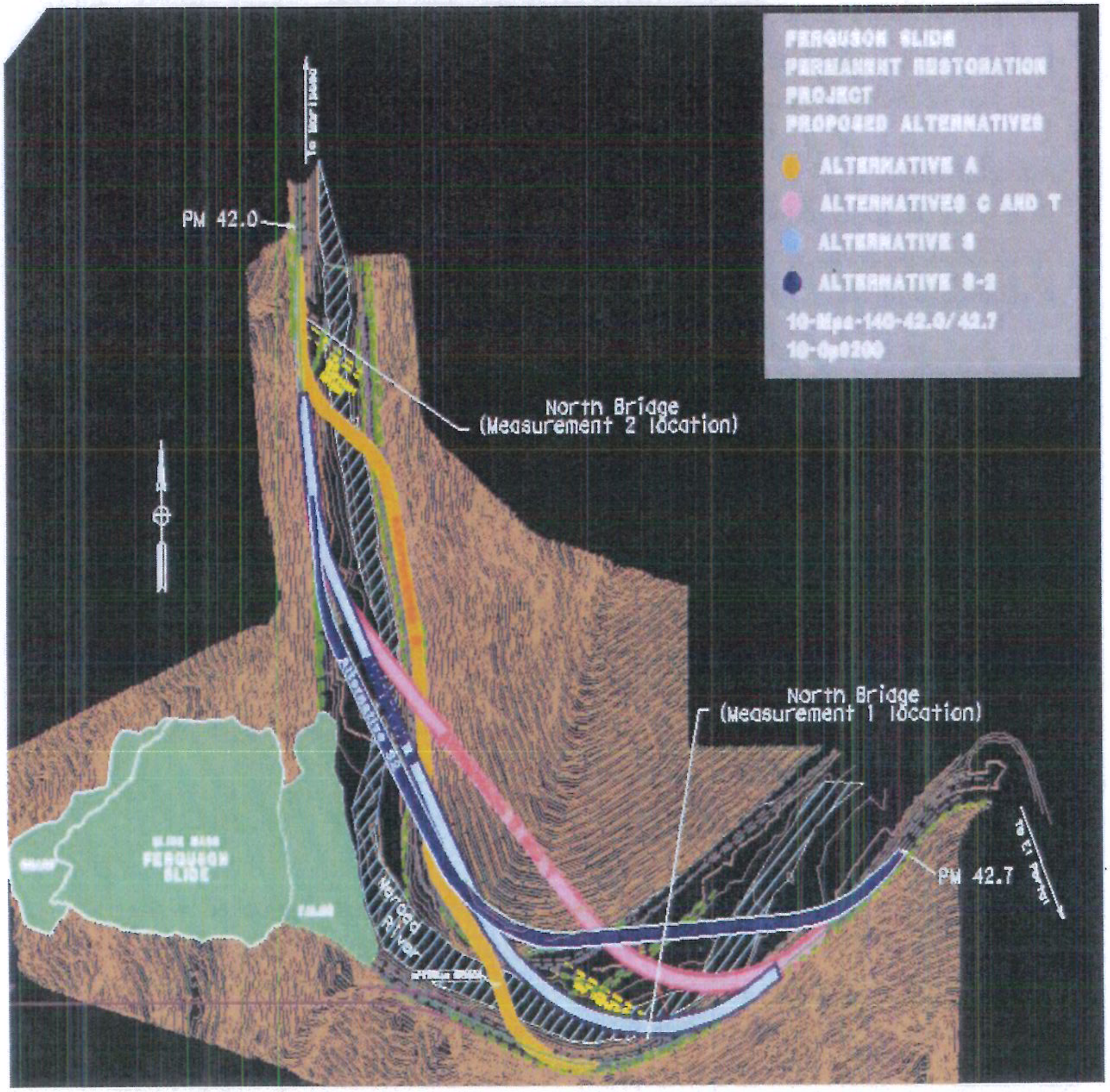

Figure 1 Project Location Map

1.3 Fundamentals of Traffic Noise

Sound is a pressure wave transmitted through the air. It is described in terms of loudness or amplitude (measured in decibels), frequency or pitch (measured in Hertz [Hz] or cycles per second), and duration (measured in seconds or minutes). The pressure at the threshold of normal human hearing is 20 micro Pascals (μPa). This pressure level is used as the reference point to measure the loudness of sound. The standard unit of measurement of the loudness of sound is the decibel (dB), which is a logarithmic scale of sound pressure relative to reference level of 20 μPa.

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

Since the human ear is not equally sensitive to sound at all frequencies, a special frequency-dependent scale is usually used to relate sound to human sensitivity. The A-weighted decibel scale (dBA) performs this compensation by adjusting sound levels to correlate to human sensitivity. The A-weighted scale deducts a variable level of decibels for sound that is not within the most sensitive frequency interval, and adds a small level of decibels for sound within this sensitive interval.

Noise is defined as unwanted sound and is known to have several adverse effects on people, including hearing loss, speech and sleep interference, physiological responses, and annoyance. Based on these known adverse effects of noise, the federal government, the state of California, and many local governments have established criteria to protect health and safety and to prevent disruption of certain human activities.

Arange in noise levels associated with common in and outdoor activities are shown in Table 2. The 0 dBA should not be construed as the absence of sound. Instead, it is the generally accepted dBA threshold of best human hearing. Sound pressure levels in negative decibel ranges are inaudible to humans. On the other extreme, the decibel scale can go much higher than shown in the table. For example gun shots, explosions reach 140 dBA or higher at close range.

Table 2. Typical Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Jet Fly-over at 300m (1000 ft)	110	Rock Band
Gas Lawn Mower at 1 m (3 ft)	100	
Diesel Truck at 15 m (50 ft), at 80 km (50 mph)	90	Food Blender at 1 m (3 ft)
Noisy Urban Area, Daytime	80	Garbage Disposal at 1 m (3 ft)
Gas Lawn Mower, 30 m (100 ft) Commercial Area	70	Vacuum Cleaner at 3 m (10 ft) Normal Speech at 1 m (3 ft)
Heavy Traffic at 90 m (300 ft)	60	Large Business Office
Quiet Urban Daytime	50	Dishwasher Next Room
Quiet Urban Nighttime Quiet Suburban Nighttime	40	Theater, Large Conference Room (Background)
Quiet Rural Nighttime	30	Library Bedroom at Night, Concert Hall (Background)
	20	Broadcast/Recording Studio
	10	
Lowest Threshold of Human Hearing	0	Lowest Threshold of Human Hearing

1.3.1 Noise Propagation

When sound propagates outdoors, the sound waves can be attenuated through the processes of absorption, refraction, reflection, and diffraction. Absorption of sound waves can occur in the ground, air, vegetation, or construction material. Refraction (bending of sound waves as it passes through materials of differing density) occurs in the air due to large-scale changes in atmospheric temperature and wind conditions. Wind turbulence can cause refraction of sound waves over a relatively short distance. Reflection occurs when sound waves strike relatively smooth, hard surfaces. Reflective surfaces include roads, hard ground, buildings, and typical noise barriers. Diffraction is the bending of sound waves as they pass the edge of an obstacle, thereby allowing sound to travel into areas that are not visible from the sound source.

Attenuation due to divergence is dependent upon the manner in which sound radiates away from the source. A point source is characterized by a divergence rate of 6 dB per doubling of distance. A line source is characterized by a divergence rate of 3dB per doubling of distance. Sound waves emanating from a vehicle traveling along a highway typically behave as a line.

1.3.2 Human Response to Changes in Noise Levels

Typical healthy human hearing can detect changes in sound levels of approximately 3 dBA, under normal conditions. Changes of 1 to 3 dBA are detectable under quiet controlled conditions, and changes of less than 1 dBA are usually undetectable. A change of 5 dBA is readily perceptible, and an increase of 10 dBA is perceived as being twice as loud. A doubling of sound energy results in a 3 dBA increase in sound, which means that doubling the traffic volume on a highway results in a barely perceptible change in sound level.

1.3.3 Atmospheric Effects

Research done by Caltrans and others has shown that atmospheric conditions can have a significant effect on noise levels within 60 meters (200 feet) of a highway. Wind has been shown to be the most important meteorological factor within approximately 150 meters (500 feet) of the source, whereas vertical air temperature gradients are more important for greater distances. Receptors located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lower noise levels. Increased sound levels can also occur as a result of temperature inversion conditions (i.e., increasing temperature with elevation). Other factors such as humidity and wind turbulence can also have significant effects on sound-wave propagation.

1.3.4 Shielding by Natural or Humanmade Features

A common method of controlling highway noise is to introduce an obstacle (a noise barrier) between the source and receiver. This attenuates noise by interrupting the direct path, so the sound must be diffracted before it reaches a receiver.

Noise barriers generally block the line of sight and to be fully effective must allow negligible amounts of noise to be transmitted through them. Barrier material, height, footprint, cross-sectional profile, width, surface properties, and relative placement with respect to the highway and receiver combine to determine barrier attenuation.

Caltrans-approved materials include precast concrete, masonry block, wood, earth, metal and synthetics, and composites of these materials. There are many commercially available wall systems that have been approved by Caltrans. Natural terrain features (such as hills and dense woods) can also substantially reduce noise levels.

A barrier that breaks the line of sight between a source and a receiver will typically result in at least 5 dBA of noise reduction. A taller wall may provide as much as 20 dBA of noise reduction.

1.4 Federal and State Policies and Procedures

Caltrans Protocol contains noise policies that fulfill the highway noise analysis and abatement/mitigation requirements of the state and federal government, including NEPA, 23 CFR 772, CEQA, and Section 216 et seq. of the California Streets and Highways Code.

1.4.1 National Environmental Policy Act (NEPA)

NEPA is a federal law that establishes environmental policy for the nation, provides an interdisciplinary framework for federal agencies to prevent environmental damage, and contains action-forcing procedures to ensure that federal-agency decision-makers take environmental factors into account. Under NEPA, adverse impacts and mitigation measures must be identified, including impacts for which no mitigation or only partial mitigation is available. The Federal Highway Administration regulations discussed below constitute the federal noise standard. Projects complying with this standard are also in compliance with the requirements stemming from NEPA.

1.4.1.1 Federal Highway Administration Regulations

Federal regulations (23 CFR 772) provide procedures for conducting highway-project noise studies and implementing noise abatement measures to help protect the public health and welfare. These regulations also establish Noise Abatement Criteria and require that information to be provided to local officials for use in planning and highway design.

Under these regulations, noise abatement must be considered for a Type I project if the project is predicted to result in a traffic noise impact. A traffic noise impact is considered to occur when the project results in a substantial noise increase or when the predicted noise levels approach or exceed Noise Abatement Criteria specified in the regulation. The regulations do not specifically define what constitutes a substantial increase or the term "approach." Rather, it leaves interpretation of these terms to the states. Caltrans Protocol, Sections 2.4.1, defines a substantial noise increase as follows:

> "A noise increase is substantial when the predicted noise levels with the project exceed existing noise levels by 12 dBA, Leq (h)."

Section 2.4.2 defines the term "approach" as follows:

> "A traffic noise impact will also occur when predicted noise levels with [the] project approach within 1 dBA, or exceed the Noise Abatement Criteria..."

Before adoption of a final environmental document, Caltrans is required to identify noise abatement measures that are feasible and reasonable, as well as noise impacts for which no apparent solution is available. Noise abatement measures that are feasible and reasonable are then incorporated into the project's plans and specifications to reduce or eliminate the noise impact.

1.4.1.2 California Environmental Quality Act (CEQA)

CEQA is the foundation of environmental law and policy in California. The main objectives of CEQA are to disclose to decision-makers and the public the significant environmental effects of proposed activities and to identify ways to avoid or reduce those effects by requiring implementation of feasible alternatives or mitigation measures.

Under CEQA, a substantial noise increase may result in a significant adverse environmental effect; if so, the noise increase must be mitigated or identified as a noise impact for which it is likely that only partial or no mitigation measures are available.

Certain economic, social, environmental, legal, and technological conditions may make noise mitigation measures infeasible.

1.4.2 Approaching or Exceeding Noise Abatement Criteria

The Noise Abatement Criteria are presented as peak-hour Leq. A noise impact is said to occur when the absolute noise levels approach (within 1dBA) or exceed the Noise Abatement Criteria for a given land use. It should be noted that even if the peak-hour noise level does not exceed the Noise Abatement Criteria listed in Table 3, noise impacts may still occur.

Table 3. Activity Categories and Noise Abatement Criteria

Activity Category	Noise Abatement Criteria, A-weighted Noise Level, Average Decibels Over One Hour	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	67 Exterior	Picnic areas, recreation areas, playgrounds, active sport areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals
C	72 Exterior	Developed lands, properties, or activities not included in Categories A or B above
D	--	Undeveloped lands
E	52 Interior	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums

Source: Caltrans Traffic Noise Analysis Manual, 1998
A-weighted decibels are adjusted to approximate the way humans perceive sound

1.5 Study Methods and Procedures

Traffic Noise Analysis Protocol consists of the following steps:

1. Identification of noise sensitive receptors such as residences, parks, churches, schools, libraries and hospitals.

2. Completion of a noise measurement survey to determine the existing noise levels at these sensitive receptors. The following measurement procedures were used:

   - Calibrate the Sound Level Meter.
   - Set up the Sound Level Meter at a height of 1.5 meters (5 feet).
   - Begin noise monitoring.
   - Collect site-specific data such as date, time, temperature, humidity, and wind speed.
   - Count passing vehicles for a period of 15 to 30 minutes. Vehicles were split into three categories: heavy truck, medium truck, and automobile.
   - A second reading should be taken, and a third reading, if needed.
   - Stop measurement.
   - Calibrate the Sound Level Meter.
   - Proceed to the next monitoring site and repeat.

3. Modeling the future noise levels using Caltrans- and Federal Highway Administration-approved software TNM 2.5.

4. Determination of the feasibility and reasonability of the noise abatement measures for areas affected by the project.

1.5.1 Traffic

The projected 2031 DHV (Design Hourly Volumes) for State Route 140 was obtained from the District 10 Planning Engineering Support Branch.

The following are traffic breakdown used for the TNM 2.5 model.

Table 4. Projected 2031 traffic used for the Build alternative A

	Automobile/speed (25 mph)	*Heavy Trucks/speed (25 mph)*
Northbound	*165*	*11*
Southbound	*306*	*20*

Table 5. Projected 2031 traffic used for the Build alternatives (C, S, S-2,T)

	Automobile/speed (40 mph)	*Heavy Trucks/speed (40 mph)*
Northbound	*165*	*11*
Southbound	*306*	*20*

Table 6. Existing traffic based on data from 2006

	Automobile/speed (15 mph)	*Heavy Trucks/speed (15 mph)*
Northbound	99	6
Southbound	183	*12*

Chapter 2 Existing and Post-Project Noise Levels

The project lies in mountainous terrain where tourists and rafters are often present. Caltrans identified four locations within the project limits where tourists and rafters could be affected by noise. Two field noise measurements were used to document the existing background noise levels generated by the river and to calibrate the noise model for future noise level calculations. And two existing locations were modeled to represent rafters near the north and south bridges. Refer to location map attached. The field noise measurements were performed using a BK Model Type 2238 sound level meter at the locations shown in the location map (Figure 1). The river water levels at the time of the field measurements were as follows:

Water level by the north bridge - 8.56 feet
Water level by the south bridge - 8.07 feet

Results of noise measurements are contained in Attachment A.

FHWA approved noise model, TNM 2.5, was used to calculate post-project peak-hour noise levels for these locations and other assumed locations along the project site. Refer to Table 7 for results.

Noise effect of Build Alternative A: The project description above states that this alternative proposes two at-grade bridges to cross the river. Table 7 shows that the existing background noise levels generated by the river on pedestrians near the north and south ends of the river are 55.0 dBA and 61.6 dBA, respectively. Traffic on the north bridge due to Alternative A will generate a noise level of 48.4 dBA. However, since the background noise level is 55.0 dBA, the combined noise level of the background and the traffic volume on the bridge is 55.0 dBA near the north bridge. (Refer to Table 8). The increase in noise level near the north bridge due to this alternative is 0 dBA. (Refer to Table 9). Following the same discussion for the south bridge and referring to Table 9 for results, we can conclude that receivers 1 and 2 near the north and south bridges will experience no noise level increase due to this alternative.

Rafters near the south bridge, receiver 4, will also experience no increase in noise if Alternative A were selected. Rafters near the north bridge, receiver 3, will experience a 1.0 dBA increase in noise level because the grade elevation of the north bridge is lower than that of the south bridge, which makes traffic noise closer to rafters near the north bridge (Refer to Table 9). The north bridge tends to have a steady increase in elevation between both banks of the river from 1,370 feet to 1,376 feet . The south bridge will have almost the same grade profile of 1,385 feet between both banks of the river. However, the increase in noise level from the contribution of Alternative A is only 1 dBA. This change is not likely to be noticeable even under quiet conditions. Refer to section 1.3.2 above. Noise generated by the constant flow of the river in addition to other sources of noise such as vehicles and humans requires a higher noise level change in order to be detected such as 5 dBA, normally 5 dBA or greater.

Noise effects of Build Alterantives C, S, S-2 and T: As mentioned in the project description above, all these alternatives contribute in a similar way to the noise level generated by traffic near the north and south bridges. Table 9 shows that only rafters near the north bridge will experience an increase of 1 dBA in the year 2031over the existing noise level. This increase is related to the profile of the north bridge being at a lower elevation than the south bridge for these alternatives. The profile of the lower end of the north bridge starts at1375 feet at one side of the river, then peaks out at 1422 feet on the other side of the river. The lower end of the south bridge starts at a grade elevation of 1393 feet at one side of the river, then peaks out at 1427 feet on the other side of the river. Even though the north bridge is at a lower grade elevation, the noise generated by traffic on the north bridge will only cause a 1 dBA increase in noise level over the existing noise of the river. This increase is not likely to be noticeable even under quiet conditions (Refer to section 1.3.2 above). The noise generated by the constant flow of the river in addition to other sources of noise such as vehicles and humans requires a higher noise level change in order to be detected (normally 5 dBA or greater).

Table 7. Existing and Post-Project Noise Levels without river noise

Receiver No.	Receiver Location	Existing Noise Levels (dBA)	Future Noise Levels without background noise			
			Alt A	AltC	Alts S, S-2	AltT
1	South River	35.8	37.3	49.5	49.5	49.5
2	North River	40.2	41.7	41.6	41.6	41.6
3	North River-rafter	49.8	49.7	55.5	55.5	55.5
4	South River-rafter	48.6	49.2	50.6	50.6	50.6

Table 8. Existing and Post-Project Noise Levels with with river noise

Receiver No.	Receiver Location	Existing Noise Levels (dBA)	Future noise levels with background noise			
			Alt A	AltC	Alts S, S-2	AltT
1	South River	61.6	61.6	61.6	61.6	61.6
2	North River	55.0	55.0	55.0	55.0	55.0
3	North River-rafter	61.6	61.6	62.6	62.6	62.6
4	South River-rafter	61.6	61.6	61.6	61.6	61.6

Table 9. Post-Project Noise levels increase above Existing Noise Levels

Receiver No.	Receiver Location	Noise levels increase above existing			
		Alt A Noise increase	AltC Noise increase	Alts S, S-2 Noise increase	AltT Noise increase
1	South River	0	0	0	0
2	North River	0	0	0	0
3	North River-rafter	0	1	1	1
4	South River-rafter	0	0	0	0

2.1 Construction Noise

Noise at the construction site would be intermittent, and its intensity would vary. The degree of construction noise impacts may vary for different areas of the project site and vary depending on the construction activities. Highway construction is accomplished in several different phases. These phases and their estimated overall noise levels at the right-of-way can be characterized by the following (Federal Highway Administration, 1977):

Phase	Leq(dBA) at 15m/30m from Source
Clearing and grubbing	86/83
Earthwork	88/85
Foundation	85/82
Base Preparation	88/85
Paving	89/86

Existing noise levels can be compared with the expected noise levels produced by various construction activities to assess construction noise impacts. During the construction period, sensitive receptors that are close to the highway may experience temporary impacts.

The following control measures should be implemented to minimize noise and vibration disturbances at sensitive receptors during periods of construction.

2.1.1 Equipment Noise Control

1. Use newer, or well-maintained, equipment with improved muffling and ensure that all equipment items have the manufacturers' recommended noise abatement measures, such as mufflers, engine enclosures, and engine vibration isolators intact and operational. Newer equipment will generally be quieter in operation than older equipment. All construction equipment should be inspected at periodic intervals to ensure proper maintenance and presence of noise control devices (e.g., mufflers and shrouding, etc.).

2. Use construction methods or equipment that will provide the lowest level of noise and ground vibration impact such as alternative low noise pile installation methods.

3. Turn off idling equipment.

4. Temporary noise barriers shall be used and relocated, as needed, to protect sensitive receptors against excessive noise from construction activities. Noise barriers can be made of heavy plywood or moveable insulated sound blankets.

2.1.2 Administrative Measures

1. Implement a construction noise- and vibration-monitoring program to limit the impacts.

2. Plan noisier operations during times of least sensitivity to receptors.

3. Keep noise levels relatively uniform and avoid impulsive noises.

4. Maintain good public relations with the community to minimize objections to the unavoidable construction impacts. Provide frequent activity update of all construction activities.

A combination of abatement techniques with equipment noise control and administrative measures can be selected to provide the most effective means to minimize effects of construction activity impacts. Application of abatement measures will reduce the construction impacts; however, temporary increase in noise and vibration will likely occur.

This noise study concludes that no further investigation is needed in order to proceed with the proposed project. Should the project design concept or scope change, please request another investigation for this project.

Chapter 3 References

Technical Noise Supplement (TENS), 1998.

Traffic Noise Analysis Protocol, August 2006.

Highway Design Manual, 5th Edition Chapter 1100.

FHWA, 1977. Highway Construction Noise: Measurement, Prediction and Mitigation by J.A. Reagan and C.A. Grant, May 2.

FHWA, 1982a. Federal Aided Program Manual, Volume 7, Right Of Way and Environment; Chapter 7, Environment; Section 3, Procedures for Abatement of Highway Traffic Noise and Construction Noise (FHPM 7-7-3).

FHWA, 2004. Noise Barrier Cost Reduction Procedure TNM 2.5.

Chapter 4 Glossary

Benefited residence – A dwelling unit expected to receive a noise reduction of at least 5 dBA from the proposed noise abatement measure. A multi-story residence counts as one benefited residence even if the proposed noise abatement provides 5 dBA for the exterior (e.g., balconies) of two or more floors. The definition is primarily used in the determination of noise abatement reasonableness.

dBA, dB(A) – Unit of sound pressure level in decibels on the "A-weighted" scale.

Existing noise level(s) – The noise, resulting from the natural and mechanical sources and human activity, considered normally present in a particular area.

FHWA Type I Project – 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 that significantly changes either the horizontal or vertical alignment or increases the number of through-traffic lanes. Caltrans extends this Type I definition to state highway projects without federal funding.

Insertion Loss (IL) – The actual noise level reduction at a specific receiver due to construction of a noise barrier between the noise source (traffic) and the receiver. Generally, it is the net effect of the (noise) barrier's attenuation and the loss of ground effects.

Affected receivers – Receivers that will receive a traffic noise impact.

Leq – The equivalent steady state sound level that in a stated period of time would contain the same acoustical energy as the time-varying sound level during the same period.

Leq (h) – The energy-average of the A-weighted sound levels occurring during a one-hour period, in decibels (i.e., a one hour Leq (see Leq)).

Noise Abatement – Noise attenuation provided for non-significant adverse environmental effects due to noise.

Noise Mitigation – Noise attenuation provided for significant adverse environmental effects due to noise.

Predicted noise level(s) – Future noise levels, resulting from the natural and mechanical sources and human activity, considered being usually present in a particular area, including the project.

Receivers – Locations selected for determining traffic noise impacts. These locations should represent areas where frequent human use occurs or is likely to occur in the foreseeable future (e.g., vacant property for which development plans have received final approval).

Traffic Noise Impact – Impact that occurs at a receiver when one or both of the following takes place: 1) The predicted noise level substantially exceeds the existing noise level. 2) The predicted noise level associated with the project approaches or exceeds the Noise Abatement Criteria (NAC).

Traffic Mix – Light (L): vehicles having two axles and four wheels; Medium (M): vehicles having two axles and six wheels; Heavy (H): vehicles having three or more axles.

Units of Measurement – Kilometers per hour (km/h), miles per hour (mp/h), meters per second (mps), minutes (min), degrees Celsius (° C), and meters (m).

ATTACHMENT A

FIELD MEASUREMENTS

① South River

2238

Instrument:		2238
Application:		BZ7125 version 1.1
Start Time:		04/25/2008 01:48:58 PM
End Time:		04/25/2008 02:08:59 PM
Elapsed Time:		0:20:01
Bandwidth:		Broad band
Detector 1/2	RMS	Peak
Range:		30.0-110.0 dB

	Time	Frequency
Detector 1:	S F I	A
Detector 2:	Peak	C
Statistic	F	A

Criterion Level:		100.0 dB
Threshold:		0.0 dB
Exchange Rate		3 and 4
Exposure Time:		7:30:00
Peaks Over:		140.0 dB

Instrument Serial Number:		2231641
Microphone Serial Number:		2230929
Input:		Microphone
Windscreen Correction:		Off
S. I. Correction:		Frontal

Calibration Time:		03/04/2008 04:20:06 PM
Calibration Level:		93.9 dB
Sensitivity:		-30.5 dB
Microphone:		2230929

001.M25

	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAIMax [dB]	LAIMin [dB]
Value				0.0	61.6	83.3	56.7
Time	01:48:58 PM	02:08:59 PM	0:20:01				
Date	04/25/2008	04/25/2008					

(2) North River

2238

Instrument:		2238
Application:		BZ7125 version 1.1
Start Time:		04/25/2008 03:03:53 PM
End Time:		04/25/2008 03:23:55 PM
Elapsed Time:		0:20:02
Bandwidth:		Broad band
Detector 1/2	RMS	Peak
Range:		30.0-110.0 dB

	Time	Frequency
Detector 1:	S F I	A
Detector 2:	Peak	C
Statistic	F	A

Criterion Level:		100.0 dB
Threshold:		0.0 dB
Exchange Rate		3 and 4
Exposure Time:		7:30:00
Peaks Over:		140.0 dB

Instrument Serial Number:		2231641
Microphone Serial Number:		2230929
Input:		Microphone
Windscreen Correction:		Off
S. I. Correction:		Frontal

Calibration Time:		03/04/2008 04:20:06 PM
Calibration Level:		93.9 dB
Sensitivity:		-30.5 dB
Microphone:		2230929

002.M25

	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAIMax [dB]	LAIMin [dB]
Value				0.0	55.0	73.3	46.8
Time	03:03:53 PM	03:23:55 PM	0:20:02				
Date	04/25/2008	04/25/2008					

ATTACHMENT B

MODEL TNM 2.5 OUTPUT TABLES

Caltrans
Stanley Armstrong

16 September 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT:	Existing Noise Levels
RUN:	Merced River Project Analysis
BARRIER DESIGN:	INPUT HEIGHTS
ATMOSPHERICS:	68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
South river	129	1	61.6	35.8	66	-25.8	12	----	36.4	-0.6	5	-5.6
North River	131	1	55.0	40.2	66	-14.8	12	----	40.3	-0.1	5	-5.1
South River-rafter	139	1	54.2	48.6	66	-5.6	12	----	49.0	-0.4	5	-5.4
North River-rafter	142	1	54.1	49.8	66	-4.3	12	----	50.3	-0.5	5	-5.5

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	4	-0.6	-0.4	-0.1
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Caltrans
Stanley Armstrong

12 September 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Alternative A
RUN: Merced River Project Analysis
BARRIER DESIGN: INPUT HEIGHTS

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

ATMOSPHERICS: 68 deg F, 50% RH

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	No Barrier Crit'n	Increase over existing Calculated	Increase over existing Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
South river	129	1	61.6	37.3	66	-24.3	12	----	37.8	-0.5	5	-5.5
North River	131	1	55.0	41.7	66	-13.3	12	----	41.7	0.0	5	-5.0
South River-rafter	139	1	54.2	49.7	66	-4.5	12	----	49.9	-0.2	5	-5.2
North River-rafter	142	1	54.1	49.2	66	-4.9	12	----	49.8	-0.6	5	-5.6

Dwelling Units	# DUs	Noise Reduction Min	Noise Reduction Avg	Noise Reduction Max
		dB	dB	dB
All Selected	4	-0.6	-0.3	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Caltrans
Stanley Armstrong

12 September 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: Alternatives C, S, S-2, T
RUN: Merced River Project Analysis
BARRIER DESIGN: INPUT HEIGHTS

ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	No Barrier Crit'n	Increase over existing Calculated	Increase over existing Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
South River	116	1	61.6	49.5	66	-12.1	12	----	49.0	0.5	5	-4.5
North River	118	1	55.0	41.6	66	-13.4	12	----	41.4	0.2	5	-4.8
North River-rafter	128	1	61.6	55.5	66	-6.1	12	----	55.4	0.1	5	-4.9
South River-rafter	132	1	61.6	50.6	66	-11.0	12	----	50.4	0.2	5	-4.8

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	4	0.1	0.2	0.5
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0