Chapter 3
Noise

Introduction

This chapter describes the noise impacts that would result from implementation of the proposed project. Information in this chapter is based on the report entitled State Route 32 Widening Project – Noise Impact Assessment –February 24, 2009 (Illingworth & Rodkin 2009) (see Appendix E for a copy of this report). The noise impact assessment in Appendix E was used to determine the sound barrier locations and height that would be needed to mitigate significant direct and cumulative noise impacts. Criteria used to assess the significance of noise impacts are based on City noise standards in the City's general plan noise element. As described in Chapter 2 ("Project Description") of this report, sound barriers that would be required to reduce impacts to a less than significant level have been incorporated into the proposed project. The use of open-graded asphalt concrete (OGAC) along the project corridor has also been incorporated into the proposed project. Therefore, the impact analysis and significance conclusions contained in this chapter assume that these two noise attenuation features would be included with construction of the proposed project.

As noted in Chapter 2, the noise impact analysis contained in the 2007 IS assumed that the project would not incorporate sound barriers or OGAC. So these features were identified as "mitigation measures" in the 2007 IS.

It should be noted that the City's noise threshold, as described in the "Regulatory Setting/Local" section, below, calls for evaluation of noise impacts by comparing noise levels with and without the project. For the proposed project, the City's threshold calls for a comparison of predicted 2030 noise levels with the project to predicted 2030 noise levels without the project. The noise analysis contained in the project's 2007 IS was erroneously based on a comparison of predicted 2030 noise levels with the project to *existing* noise levels. Therefore, Appendix E of this report and the noise impact analysis below have been revised based on the correct interpretation of the City's noise threshold. These analyses also include an assessment of cumulative noise impacts.

Environmental Setting

This section discusses fundamental concepts of environmental noise, planning guidelines and regulations related to noise that would apply to the proposed project, and a description of existing noise conditions in the project area.

Fundamentals of Environmental Noise

Technical acoustical terms commonly used in this report are defined in Table 3-1. Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its loudness. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (frequency) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is the intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

Table 3-1. Definitions of Acoustical Terms

Term	Definitions
Decibel, dB	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period. The hourly L_{eq} used for this report is denoted as dBA $L_{eq\ [h]}$.
L_{max} RMS Level	The maximum root-mean-square (RMS) sound pressure level during a measurement – measured using the "fast" exponential time constant.
Linear Peak Level	Peak sound pressure level based on the largest absolute value of the instantaneous sound pressure over the frequency range from 20 Hz to 20,000 Hz.
L_{01}, L_{05}, L_{10}, L_{90}	The A-weighted noise levels that are exceeded 1%, 5%, 10%, and 90% of the time during the measurement period.

Term	Definitions
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Decibels and Frequency

In addition to the concepts of pitch and loudness, there are several noise measurement scales, which are used to describe noise. The *decibel (dB)* is a unit of measurement, which indicates the relative amplitude of a sound. Zero on the decibel scale is based on the lowest sound level that a healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10-decibel increase in sound level is perceived as approximately a doubling of loudness over a wide range of intensities. Since decibels are logarithmic units, sound pressure levels are not added arithmetically. Two sounds of equal sound pressure level are added; the result is a sound pressure level that is 3 dB higher. For example, if the sound pressure level were 70 dB when 100 cars pass an observer, then it would be 73 dB when 200 cars pass the same observer. Doubling the amount of energy would result in a 3 dB increase to the sound pressure level.

Frequency relates to the number of pressure oscillations per second, or Hertz (Hz). The range of sound frequencies that can be heard by healthy human ears ranges from about 20 Hz at the low frequency end to 20,000 Hz (20kHz) at the high frequency end.

Although the A-weighted noise level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise includes a conglomeration of noise from distant sources, which create a relatively steady background noise in which no particular source is identifiable. To describe the time-varying character of environmental noise, the statistical noise descriptors, L_{01}, L_{10}, L_{50}, and L_{90}, are commonly used. They are the A-weighted noise levels equaled or exceeded during 1%, 10%, 50%, and 90% of a stated time period. A single number descriptor called the L_{eq} is also widely used. The L_{eq} is the average A-weighted noise level during a stated period of time.

Table 3-2 shows typical A-weighted noise levels that occur in human environments.

Table 3-2. Typical Noise Levels in the Environment

Common Outdoor Noise Source	Noise Level (dBA)	Common Indoor Noise Source
	120 dBA	
Jet fly-over at 300 meters		Rock concert
	110 dBA	
Pile driver at 20 meters	100 dBA	
		Night club with live music
	90 dBA	
Large truck pass by at 15 meters		
	80 dBA	Noisy restaurant
		Garbage disposal at 1 meter
Gas lawn mower at 30 meters	70 dBA	Vacuum cleaner at 3 meters
Commercial/Urban area daytime		Normal speech at 1 meter
Suburban expressway at 90 meters	60 dBA	
Suburban daytime		Active office environment
	50 dBA	
Urban area nighttime		Quiet office environment
	40 dBA	
Suburban nighttime		
Quiet rural areas	30 dBA	Library
		Quiet bedroom at night
Wilderness area	20 dBA	
Most quiet remote areas	10 dBA	Quiet recording studio
Threshold of human hearing	0 dBA	Threshold of human hearing

Noise Descriptors

Because sound levels can vary over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-equivalent sound/noise descriptor is called L_{eq}. A common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration. The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA.

Human Response to Noise

Studies have shown that under controlled conditions in an acoustics laboratory, a healthy human ear is able to discern changes in sound levels of 1 dBA. In the normal environment, the healthy human ear can detect changes of about 2 dBA; however, it is widely accepted that changes of 3 dBA in the normal environment are considered barely detectable to most people. A change of 5 dBA is readily perceptible and a change of 10 dBA is perceived as being twice as loud.

Sound Propagation

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

- *Geometric spreading.* Sound from a single source (i.e., a "point" source) radiates uniformly outward as it travels away from the source in a spherical pattern. The sound level attenuates (or drops off) at a rate of 6 dBA for each doubling of distance. Highway noise is not a single, stationary point source of sound. The movement of the vehicles on a highway makes the source of the sound appear to emanate from a line (i.e., a "line" source) rather than from a point. This results in cylindrical spreading rather than the spherical spreading resulting from a point source. The change in sound level from a line source is 3 dBA per doubling of distance.
- *Ground absorption.* Most often, the noise path between the highway and the observer is very close to the ground. Noise attenuation from ground absorption and reflective wave canceling adds to the attenuation. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is done for simplification only; for distances of less than 300 feet, prediction results based on this scheme are sufficiently accurate. For acoustically "hard" sites (i.e., sites with a reflective surface, such as a parking lot or a smooth body of water, between the source and the receiver), no excess ground attenuation is assumed. For acoustically absorptive or "soft" sites (i.e., sites with an absorptive ground surface, such as soft dirt, grass, or scattered bushes and trees), an excess ground attenuation value of 1.5 dBA per doubling of distance is normally assumed. When added to the geometric spreading, the excess ground attenuation results in an overall drop-off rate of 4.5 dBA per doubling of distance for a line source and 7.5 dBA per doubling of distance for a point source.
- *Atmospheric effects.* Research by Caltrans and others has shown that atmospheric conditions can have a significant effect on noise levels, especially locations beyond 200 feet of a highway. Wind has been shown to be the single most important meteorological factor within approximately 500 feet, whereas vertical air temperature gradients are more important over longer distances. Other factors, such as air temperature, humidity, and turbulence, also have significant effects. Receivers 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 because of temperature inversion conditions (i.e., increasing temperature with elevation).
- *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 this shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (such as hills and dense woods) and human-made features (such as buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver to

specifically 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. A higher barrier may provide as much as 20 dB of noise reduction.

For a wall to be effective in reducing traffic noise, it must be made of a material that has a transmission loss that is at least 10 dBA greater than the desired noise reduction. Transmission loss is defined as the amount of energy or noise stopped or absorbed by the material used in the barrier. For example, if the amount of reduction required by a barrier or wall is 5 dB, then the barrier material would need to have a transmission loss of 15 dB or greater. Typically a one-inch thick wood fence has a transmission loss of 21 dBA and would be effective in a situation where a 5 dB noise reduction is desired. Concrete walls which are commonly used for sound walls will typically have a transmission loss that is greater than a one-inch thick wood fence. However, the two materials are equivalent in terms of overall noise reduction because the noise path over the top of wall, and not the noise path through the wall, governs the overall noise level at the receiver.

- *Diffraction.* The amount of noise that is transmitted over the top of a sound barrier is governed by the concept of diffraction which causes sound waves to bend over the top of a sound barrier. The amount of diffraction depends on the wavelength and dimensions of the barrier. Low frequency waves with long wavelengths approaching the size of a barrier are easily diffracted. Higher frequencies with short wavelengths in relation to the size of a barrier are not as easily diffracted. This explains why light, with its very short wavelengths, casts shadows with fairly sharp, well defined edges between light and dark. Sound waves also “cast a shadow” when they strike a barrier. However, because of their much longer wavelengths, the noise shadows are not very well defined and result in a reduction of noise, not a complete elimination of noise (Caltrans 2009). Because low frequency sound waves bend over the top of a barrier more readily than high frequency sound waves, barriers are not as effective in reducing low frequency sound as they are in reducing high frequency sound.

  There have been claims in the past that placement of a sound barrier can actually increase traffic noise behind a barrier at distant locations. This issue is addressed in the Caltrans in Section 8.1.1 of the Technical Noise Supplement to the Caltrans Traffic Noise Analysis Protocol (Caltrans 2009). A brief summary of that discussion is provided here. For receivers behind a single barrier, there is no question that noise barriers are effective in reducing noise within several hundred feet of the barrier. Caltrans has collected an abundance of data through research and routine studies over the years to substantiate this claim. Caltrans has also experienced, in the course of many measurements, that beyond 330 feet or so from a highway, traffic noise levels often approach background levels (the noise levels associated with normal day-to-day activities in the community). Although sound barriers cannot attenuate noise below these levels, Caltrans has never experienced noise increases (above no-barrier noise levels) at any distance behind noise barriers. After years of research and field measurements under controlled conditions, Caltrans has found no objective evidence that noise levels increase perceptibly because of noise barriers. It is widely accepted by acousticians that normal human ears can barely perceive 3-dBA changes in traffic noise levels. Such an increase in noise levels from noise barriers has never been measured (Caltrans 2009).

Regulatory Setting

Federal

There are no federal noise standards that apply to the proposed project.

State

There are no state noise standards that apply to the proposed project.

Local

General Plan Noise Element

The Noise Element of the City of Chico General Plan provides general goals and policies to guide development in the City. Applicable policies identified in the General Plan state that the City should include appropriate noise attenuation techniques in the design of all new arterial streets, and construction operations should use available noise suppression devices and techniques. The noise element of the General Plan contains planning guidelines relating to noise. The noise element identifies goals and policies to support achievement of those goals. The goal and policies contained in the General Plan are applicable through out the City.

- **Policy N-1-1 -** State that noise created by new transportation noise sources should be mitigated so as not to exceed the levels specified in Table 3-3 at outdoor activity areas or interior spaces of existing noise-sensitive land uses.
- **Policy N-1-2 -** It is anticipated that roadway improvement projects will be needed to accommodate build out of the general plan. Therefore, existing noise-sensitive uses may be exposed to increased noise levels due to roadway improvement projects as a result of increased roadway capacity, increases in travel speeds, etc. It may not be practical to reduce increased traffic noise levels consistent with those contained in Table 3-3. Therefore, as an alternative, the following criteria may be used as a test of significance for the environmental review of a roadway improvement project:
    - Where existing traffic noise levels are less than 60 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +5 dB L_{dn} increase in noise levels due to a roadway improvement project will be considered significant; and

- Where existing traffic noise levels range between 60 and 65 dB L_{dn} at the outdoor activity areas of noise sensitive uses, a +3 dB L_{dn} increase in noise levels due to a roadway improvement project will be considered significant; and
- Where existing traffic noise levels are greater than 65 dB L_{dn} at the outdoor activity areas of noise sensitive uses, a +1.5 dB L_{dn} increase in noise levels due to a roadway improvement project will be considered significant.

Table 3-3. Maximum Allowable Noise Exposure Transportation Noise Sources

Land Use	Outdoor Activity Areas[a] L_{dn}/CNEL, dB	Interior Spaces L_{dn}/CNEL, dB	Interior Spaces L_{eq}, dB[b]
Residential	60[c]	45	
Transient Lodging	60[d]	45	
Hospitals, Nursing Homes	60[c]	45	
Theaters, Auditoriums, Music Halls			35
Churches, Meeting Halls	60[c]		40
Office Buildings			45
Schools, Libraries, Museums	60[c]		45
Playgrounds, Neighborhood Parks	70		

Note: Roadway improvement projects can result in increased travel speed and/or an increase in roadway capacity. An analysis of noise impacts associated with a roadway improvement project should evaluate the projected future traffic volumes; speeds, traffic distribution and truck mix with and without the project. Therefore, the changes in traffic speeds and traffic volumes along those roadways, which are attributed solely to the roadway project, will be evaluated with respect to the above-mentioned criteria.

[a] Where the location of outdoor activity areas is unknown, the exterior noise level standard shall be applied to the property line of the receiving land use.

[b] As determined for a typical worst-case hour during periods of use.

[c] Where it is not possible to reduce noise in outdoor activity areas to 60 dB L_{dn} /CNEL or less using a practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB L_{dn}/CNEL may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table.

[d] In the case of hotel/motel facilities or other transient lodging, outdoor activity areas such as pool areas may not be included in the project design. In these cases, only the interior noise level criterion will apply.

The noise element further states that roadway improvement projects can result in increased travel speeds and/or an increase in roadway capacity. An analysis of noise impacts associated with a roadway improvement project should evaluate the projected future traffic volumes, speeds, traffic distribution and truck mix with and without the project. Therefore, the changes in traffic speeds and traffic volumes along those roadways which are attributed solely to the roadway project will be evaluated with respect to the above-mentioned criteria.

The Noise Element defines noise-sensitive land uses as being residences, hotels/motels, schools, libraries, churches, hospitals and nursing homes. Outdoor activity areas are considered to be the portion of the parcel where outdoor activities generally occur (i.e., patios of residences and outdoor instructional areas of schools).

Noise Ordinance

The City of Chico's noise ordinance establishes maximum noise limits allowed within the City based on the land use of the property generating the noise. The ordinance is only enforced once a citizen complaint has been received. These maximum noise limits are described below:

Residential property noise limits: Noise shall not exceed, at any point outside of the property plane, 70 dBA between the hours of 7:00 a.m. and 9:00 p.m. or 60 dBA between the hours of 9:00 p.m. and 7:00 a.m. on any residential property. Where Caltrans requires construction during nighttime hours, construction activity shall be staged so that it does not occur over an extended period of time (i.e., more than 14 days at a time).

Commercial and industrial property noise limits: Noise shall not exceed 70 dBA at any point outside the property plane.

Public property noise limits: Noise shall not exceed 60 dBA at a distance of 7.6 meters (25 feet) or more from the source.

Noise due to construction is exempt from the noise ordinance, provided that construction occurs between the hours of 7:00 a.m. and 9:00 p.m., Monday through Saturday, and between 10:00 a.m. and 6:00 p.m., Sundays and holidays, and does not exceed 83 dBA 7.6 meters (25 feet) from the source or 86 dBA at any point outside of the property plane of the project.

Existing Conditions

This section discusses existing noise conditions in the study area.

Noise Sensitive Land Uses

Noise sensitive land uses within the project area include single family residences and apartment complexes. Figures 3-1a through 3-1f located at the end of this chapter indicate land uses in the project area.

Existing Noise Conditions

Noise measurements were conducted in the project area to characterize existing noise conditions. Noise measurements were conducted at twenty-two noise-sensitive receiver locations on October 26-28, 2005. The noise measurement survey consisted of a combination of long-term measurements (24 hours in duration) and short-term measurements (10 minutes in duration). Five long-term noise measurement locations and seventeen short-term noise measurement locations were selected to represent the varying noise exposures of the identified receivers. Figures 3-1a through 3-1f show the location of each measurement position.

Long-term noise measurements were conducted to show the trend in both 10-minute and hourly noise levels throughout a 24–hour period. Long-term noise measurement locations were selected to generally represent “worst-case” human activity areas. Some locations were only used to evaluate the trend in traffic noise levels. Care was taken to select sites that were primarily affected by noise from SR 32 and to avoid sites in which noise contamination from sources other than the roadway may occur.

Short-term noise measurements were conducted simultaneously with traffic counts at seventeen locations throughout the study area in ten-minute intervals. Measurements were repeated at some locations to confirm traffic noise levels or assess variability due to noise sources other than adjacent highways. Short-term noise measurements were conducted outdoors at areas of frequent human activity or at acoustically equivalent locations. The microphones were located approximately 5 feet above the surrounding ground and at least 15 feet from structures. Worst-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 adjusted peak-hour noise levels were compared to trends measured at nearby long-term noise measurement locations.

Noise measurement locations are used as noise modeling receivers for prediction of future noise levels. Locations of these receivers are shown in Figures 3-1a through 3-1f.

Noise measurements were made using Larson Davis Model 820 Integrating Sound Level Meters. The Model 820 Sound Level Meter was equipped with G.R.A.S. Type 40AQ ½-inch random incidence microphones. The sound level measuring assemblies were calibrated prior to each measurement using a Larson Davis Model CA250 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. All noise levels are reported in decibels A-weighted re 20 micropascals (µPa) with the sound level meter set at “slow” response. Meteorological conditions were observed during long-term and short-term noise measurements and consisted generally of clear skies, calm to light winds, and warm temperatures.

The noise measurement results are summarized in Table 3-4.

Impact Analysis

Approach and Methodology

TNM V2.5 was the primary traffic noise model used in the noise impact analysis for this project. Roadway plans and topography data of the project vicinity were provided by Mark Thomas & Company, Inc. Barrier, receiver, and roadway information were based on these plans and digitally input into a three-dimensional reference coordinate system used by the model.

Table 3-4. Summary of Long-Term and Short-Term Noise Measurement Data

Receptor I.D.	Location	Type of Development	Date	Time	L_{eq}	L_1	L_{10}	L_{50}	L_{90}	Worst Hourly Noise Level (dBA)
LT-1	Turning Point Commons	Residential	10/26/05–10/28/05	2:20 p.m.–10:00 a.m.						64
LT-2	Backyard of #24 Stansbury	Residential	10/27/06–10/28/05	2:40 p.m.–9:40 a.m.						58
LT-3	Backyard of #21 Stansbury	Residential	10/26/05–10/28/05	3:00 p.m.–9:30 a.m.						58
LT-4	Backyard of #11 Hunter Court	Residential	10/26/05–10/28/05	2:20 p.m.–9:20 a.m.						64
LT-5	Front yard of Sierra Lakeside Apartments	Residential	10/26/05–10/28/05	3:50 p.m.–10:20 a.m.						68
ST-1	75 ft From R/W Fence at corner of Sierra lakeside lane and Sierra Sunrise Terrace	Residential	9/20/05	3:50 p.m.	60.6	71.2	63.9	57.4	45.7	63
ST-2	Tennis courts on Sierra Sunrise Terrace	Park	9/20/05	4:10 p.m.	59.2	66.0	63.4	57.4	44.5	61
ST-3	On a lot in the Mission Vista Hills subdivision 50 ft from SR 32 R/W	Residential	9/20/05	4:40 p.m.	63.0	71.3	66.6	61.3	48.4	63
ST-4	Near pool of new apartments west of Yosemite Drive	Residential	10/27/05	9:50 a.m.	61.8	72.9	63.5	56.3	44.5	60
ST-5	#43 Terrace Apartments – Possible reflections from apartment building	Residential	10/27/05	9:50 a.m.	65.0	75.6	66.3	59.4	49.4	58
ST-6	Oak Valley Property 93 ft south of SR 32	Vacant Land	10/27/05	10:30 a.m.	60.8	72.1	64.6	53.0	41.8	61
ST-7	Oak Valley Property 185 ft south of SR 32	Vacant Land	10/27/05	10:30 a.m.	52.7	63.6	55.4	47.5	41.3	56
ST-8	65’ From R/W Fence at corner of Sierra lakeside lane and Sierra Sunrise Terrace	Residential	10/27/05	11:00 a.m.	64.0 61.3	72.4 69.5	68.2 65.3	61.1 57.8	50.1 48.5	63
ST-9	105 ft south and east of Bruce Road	Vacant Land	10/27/05	11:10 a.m.	59.8	70.0	63.0	51.2	46.4	61
ST-10	135 ft north and east of Bruce Road on SR 32	Vacant Land	10/27/05	11:40 a.m.	60.4	68.7	63.0	58.6	52.6	61
ST-11	105 ft south of the center line of SR 32	Vacant Land	10/27/05	11:40 a.m.	58.3	68.2	61.0	55.0	48.5	60
ST-12	In front of Bed and Breakfast	Residential	10/27/05	12:10	63.8	70.7	66.7	63.0	55.2	64
ST-13	Backyard of 1897 Modoc	Residential	10/27/05	12:40	62.4	67.5	65.1	62.2	55.5	64
ST-14	Back side of Turning Point Commons	Residential	10/27/05	1:10	64.0	68.8	66.9	63.7	57.0	64
ST-15	Near patio of #1692 Alpine Street in the Turning Point Commons Apartments	Residential	10/27/05	1:10	65.2	70.0	67.9	64.7	60.4	65
ST-16	Community Care Options	Residential	10/27/05	1:50	58.7	62.9	60.8	58.7	54.5	61
ST-17	Behind Community Care Options equivalent distance from SR 32 to the apartments on the adjacent parcel	Residential	10/27/05	1:50	70.8	76.0	73.7	70.6	61.0	71

[a] See Figure 3-1 for location of receptors.

Worst-hour traffic noise levels were predicted using TNM and traffic projections provided by Fehr & Peers Transportation Consultants. L_{dn} values were developed from worst-hour noise levels and the diurnal traffic noise pattern determined from the long-term measurements. Traffic noise levels in terms of L_{dn} for the following conditions were calculated:

- existing conditions,
- future with project conditions in 2030 and
- future no-project conditions in 2030.

Significance Thresholds

Thresholds of significance for noise impacts have been established for this assessment based on the CEQA Environmental Checklist found in Appendix G of the State CEQA Guidelines. Noise standards found in the City's General Plan noise element and noise ordinance were used as the basis for assessing the significance of noise impacts associated with the proposed project.

Based on these City noise standards, a noise impact is considered significant if:

- construction noise would exceed construction noise limits in the City of Chico noise ordinance,
- traffic noise would exceed the significance thresholds listed in the City's General Plan noise element, or
- the project would be inconsistent with local policies related to noise.

Impacts and Mitigation Measures of Proposed Project and Alternatives

Noise impacts associated with the proposed project and Timber Barrier Alternative would be identical.

Noise impacts associated with Design Options A1 (pre-cast concrete wall), A2 (concrete block wall), and A3 (wooden fence) would also be identical. Sound attenuation provided by a barrier is a function of the barrier material and the height of the barrier relative to the noise source and receiver. Sound travels both through the barrier and over the top of the barrier by diffraction. The noise level received at the receiver is the sum of the sound that goes through the barrier and over the top of the barrier. Once the sound that goes through the barrier is about 10 dB less than the sound that goes over the top, the barrier material becomes irrelevant, and the sound that goes over the top governs the sound level at the receiver. A properly designed solid barrier that has a surface density of at least 4 pounds per square foot would achieve this 10 dB difference. Options A1, A2, and A3 all achieve this minimum density, and thus all are equivalent in terms of their effectiveness in reducing noise.

Impact NZ-1: Exposure of Noise Sensitive Land Uses to Increased Traffic Noise (Less than Significant)

Table 3-5 summarizes the results of the traffic noise modeling analysis. Predicted noise levels for existing conditions and 2030 conditions with and without the project are provided. As indicated in the project description, noise-reducing pavement and a 6-foot sound barrier have been incorporated into the proposed project to reduce traffic noise. The results in Table 3-5 indicate that the project-related and cumulative increase in traffic noise associated with the proposed project would be less than significant. As noted above, the resulting sound levels would be the same for Design Options A1, A2, and A3 as those indicated in Table 3-5. Accordingly, no mitigation is required.

As noted in Chapter 2, the 2007 project IS did not include OGAC or a sound barrier as part of the proposed project. Rather, use of OGAC and construction of a 6-foot sound barrier along the residential property line was recommended as mitigation in the IS. In this document, the use of OGAC and the barrier are included as part of the project description and as such are not identified as mitigation.

The height of the barrier in the IS was also identified relative to the elevation of the travel way. In this document, the height is defined relative to the ground elevation at the residential property line. This approach was taken because it provides a better representation of the location that is being proposed for construction of the sound barrier.

Based on the correct application of the City's noise standards, the revised noise analysis (contained in Appendix E of this report) indicates that a 6-foot-high barrier, measured at the residential property lines, meets City noise standards and results in less-than-significant cumulative impacts. Further reductions in 2030 noise levels would be achieved with an 8-foot-high barrier, as described below.

Table 3-5 presents the predicted noise levels associated with Design Option A4 (8-foot sound barrier) and Location Options B1 and B2. Design Option A4 would reduce 2030 with project noise levels further by as much as 4 dB, as compared to a 6-foot sound barrier.

Constructing a 6-foot sound barrier on the north side of SR 32 between El Monte and Forest Avenues (Location Option B1) would reduce 2030 no-project noise levels by 1 to 2 dB, as compared to having no sound barrier at this location. Constructing an 8-foot wall between El Monte and Forest Avenues would reduce noise levels by 1 to 5 dB, as compared with having no sound barrier at this location.

Constructing a 6-foot sound barrier on the north side of SR 32 east of Fir Street (Location Option B2) would reduce 2030 no-project noise levels by 4 to 7 dB, as compared to having no sound barrier at this location. Constructing an 8-foot wall east of Fir Street would reduce noise levels by 6 to 9 dB, as compared to having no sound barrier at this location.

Table 3-5. Predicted Noise Impact Associated with the Proposed Project

						Proposed Project (6-foot Sound Barrier [Design Options A1, A2, or A3] and OGAC)				Proposed Project with Design Option A4 (8-foot Sound Barrier and OGAC)				Proposed Project with Location Options B1 and B2 (6- or 8-foot Sound Barrier at Optional Locations and OGAC)			
Receptor ID[a]	Number of Residences Represented	Existing (L_{dn})	2030 No-Project (L_{dn})	Increase of Future No-Project over Existing	City of Chico CEQA Criteria (L_{dn})	2030 with Project (6-foot barrier and OGAC)	Change Between 2030 with Project and Future No-Project (Project Impacts)	Project-Level Impact	Cumulative Impact	2030 with Project (8-Foot Sound Barrier and OGAC)	Decrease as Compared to 6-Foot Sound Barrier	Project-Level Impact	Cumulative Impact	2030 with Project and Location Options B1/B2	Change Between 2030 with Project and Future No-Project (Impact of Location Options B1 and B2)	Project-Level Impact	Cumulative Impact
R1	4	66	68	2	1.5	67 (no barrier)	NA	LTS	LTS	67 (no barrier)	NA	LTS	LTS	61 (6-foot barrier) 59 (8-foot barrier)	-7 -9	LTS	LTS
R2	5	61	65	4	3	63 (no barrier)	NA	LTS	LTS	63 (no barrier)	NA	LTS	LTS	59 (6-foot barrier) 58 (8-foot barrier)	-6 -7	LTS	LTS
R3	3	64	67	3	1.5	66 (no barrier)	NA	LTS	LTS	66 (no barrier)	NA	LTS	LTS	62 (6-foot barrier) 60 (8-foot barrier)	-5 -7	LTS	LTS
R4	3	64	66	2	1.5	66 (no barrier)	NA	LTS	LTS	66 (no barrier)	NA	LTS	LTS	62 (6-foot barrier) 60 (8-foot barrier)	-4 -6	LTS	LTS
R5–ST 15	3	65	67	2	1.5	64	-3	LTS	LTS	62	-2	LTS	LTS	NA	NA	NA	NA
R6	2	65	67	2	1.5	64	-3	LTS	LTS	62	-2	LTS	LTS	NA	NA	NA	NA
R7–ST 14	2	65	68	2	1.5	62	-6	LTS	LTS	60	-2	LTS	LTS	NA	NA	NA	NA
R8	2	64	67	2	1.5	64	-3	LTS	LTS	62	-2	LTS	LTS	NA	NA	NA	NA
R17–ST 13	3	65	67	2	1.5	65	-2	LTS	LTS	63	-2	LTS	LTS	NA	NA	NA	NA
R49	1	65	67	2	1.5	~~63~~64	~~-4~~-3	LTS	LTS	62	-1	LTS	LTS	NA	NA	NA	NA
R50	2	65	67	2	1.5	68	-1	LTS	LTS	64	-4	LTS	LTS	NA	NA	NA	NA
R51	2	64	67	2	1.5	65	-2	LTS	LTS	61	-4	LTS	LTS	NA	NA	NA	NA
R52	2	64	67	2	1.5	65	-2	LTS	LTS	62	-3	LTS	LTS	NA	NA	NA	NA
R53	3	65	67	2	1.5	64	-3	LTS	LTS	62	-2	LTS	LTS	NA	NA	NA	NA
R54	2	65	67	2	1.5	64	-3	LTS	LTS	61	-3	LTS	LTS	NA	NA	NA	NA
R55	2	64	66	2	1.5	63	-3	LTS	LTS	60	-3	LTS	LTS	NA	NA	NA	NA
R9–ST 17	4	62	64	2	3	~~58~~60(no barrier)	~~-6~~4	LTS	LTS	60(no barrier)~~?~~	-4~~?~~	LTS	LTS	NA	NA	NA	NA
R11	4	66	68	2	1.5	~~58~~66(no barrier)	~~-10~~2	LTS	LTS	66(no barrier)~~?~~	-2~~?~~	LTS	LTS	NA	NA	NA	NA
R12	6	66	68	2	1.5	~~58~~65(no barrier)	~~-10~~3	LTS	LTS	65(no barrier)~~?~~	-3~~?~~	LTS	LTS	NA	NA	NA	NA
R13	2	64	66	2	1.5	~~57~~62(no barrier)	~~-9~~4	LTS	LTS	62(no barrier)~~?~~	-4~~?~~	LTS	LTS	NA	NA	NA	NA
R14	6	65	68	2	1.5	~~58~~65(no barrier)	~~-10~~3	LTS	LTS	65(no barrier)~~?~~	-3~~?~~	LTS	LTS	NA	NA	NA	NA
R16	4	63	65	2	1.5	~~58~~62(no barrier)	~~-7~~3	LTS	LTS	62(no barrier)~~?~~	-3~~?~~	LTS	LTS	NA	NA	NA	NA
R27	2	57	59	2	5	~~55~~59	~~-4~~0	LTS	LTS	59~~?~~	0~~?~~	LTS	LTS	NA	NA	NA	NA
R28	1	64	66	2	1.5	61	-5	LTS	LTS	60	-1	LTS	LTS	NA	NA	NA	NA
R30	1	67	70	2	1.5	64	-6	LTS	LTS	60	-4	LTS	LTS	NA	NA	NA	NA
R31	2	65	67	2	1.5	60	-4	LTS	LTS	59	-1	LTS	LTS	NA	NA	NA	NA
R18	1	60	63	3	3	61 (no barrier)	NA	LTS	LTS	61 (no barrier)	NA	LTS	LTS	61 (6-foot barrier) 60 (8-foot barrier)	-2 -3	LTS	LTS
R19	1	61	64	3	3	62 (no barrier)	NA	LTS	LTS	62 (no barrier)	NA	LTS	LTS	62 (6-foot barrier) 59 (8-foot barrier)	-2 -5	LTS	LTS
R20	2	62	65	4	1.5	64 (no barrier)	NA	LTS	LTS	64 (no barrier)	NA	LTS	LTS	63 (6-foot barrier) 60 (8-foot barrier)	-2 -5	LTS	LTS
R21	1	61	65	4	3	64 (no barrier)	NA	LTS	LTS	64 (no barrier)	NA	LTS	LTS	63 (6-foot barrier) 60 (8-foot barrier)	-2 -5	LTS	LTS
R22	1	59	63	4	3	62 (no barrier)	NA	LTS	LTS	62 (no barrier)	NA	LTS	LTS	62 (6-foot barrier) 60 (8-foot barrier)	-1 -3	LTS	LTS
R23–ST 12	1	65	68	4	1.5	68 (no barrier)	NA	LTS	LTS	68 (no barrier)	NA	LTS	LTS	67 (6-foot barrier) 64 (8-foot barrier)	-1 -4	LTS	LTS
R24	1	62	65	4	1.5	63 (no barrier)	NA	LTS	LTS	63 (no barrier)	NA	LTS	LTS	64 (6-foot barrier) 63 (8-foot barrier)	-1 -2	LTS	LTS
R25	2	61	64	3	3	63 (no barrier)	+NA	LTS	LTS	63 (no barrier)	NA	LTS	LTS	63 (6-foot barrier) 63 (8-foot barrier)	-1 -1	LTS	LTS
R36–ST 1	4	64	65	2	1.5	63	-2	LTS	LTS	61	-2	LTS	LTS	NA	NA	NA	NA
R37–ST 8	6	64	66	2	1.5	64	-2	LTS	LTS	62	-2	LTS	LTS	NA	NA	NA	NA
R38–ST 2	Rec Area	62	64	2	3	62	-2	LTS	LTS	60	-2	LTS	LTS	NA	NA	NA	NA
R39	4	60	62	2	3	58	-4	LTS	LTS	57	-1	LTS	LTS	NA	NA	NA	NA
R41	6	61	64	3	3	60	-4	LTS	LTS	58	-2	LTS	LTS	NA	NA	NA	NA
R42–ST 4	3	62	65	2	3	58	-7	LTS	LTS	56	-2	LTS	LTS	NA	NA	NA	NA
R43–ST 5	4	60	62	2	3	57	-5	LTS	LTS	56	-1	LTS	LTS	NA	NA	NA	NA
R44	3	58	60	2	3	57	-3	LTS	LTS	56	-1	LTS	LTS	NA	NA	NA	NA
R45	3	60	63	2	3	59	-4	LTS	LTS	57	-2	LTS	LTS	NA	NA	NA	NA

Impact NZ-2: Exposure of Noise Sensitive Land Uses to Construction Noise (Less than Significant with Mitigation Incorporated)

During construction of the project, noise from construction activities (primarily operation of heavy equipment) may intermittently dominate the noise environment in the immediate area of construction. Construction noise is regulated by Caltrans' standard specifications (section 7-1.01I, "Sound Control Requirements"), which state that noise levels generated during construction shall comply with applicable local, state, and federal regulations and that all equipment shall be fitted with adequate mufflers according to the manufacturers' specifications.

Table 3-6 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.

In general, significant noise impacts from construction are not anticipated because construction would be conducted in accordance with Caltrans' standard specifications and would be short-term, intermittent, and dominated by local traffic noise. However, there may be instances where construction activity in close proximity to noise sensitive land uses could result in significant noise impacts (i.e. noise levels that are in excess of the City's construction noise limits specified in the City's noise ordinance). Implementation of this mitigation measure would reduce this impact to a less-than-significant level.

Mitigation Measure NZ-2a: Employ Noise-Reduction Construction Measures

The City shall incorporate the following measures into the construction contract specifications (This first bullet of this measure differs from the language that appeared in the 2007 IS. It has been revised to be consistent with the City's noise ordinance. The remaining bullets are identical to the 2007 IS.):

- Noise shall not exceed, at any point outside of the property plane, 70 dBA between the hours of 7:00 a.m. and 9:00 p.m. or 60 dBA between the hours of 9:00 p.m. and 7:00 a.m. on any residential property. Where construction is required during nighttime hours, construction activity shall be staged so that it does not occur over an extended period of time (i.e., more than 14 days at a time).

  Noise due to construction is exempt from the noise ordinance, provided that construction occurs between the hours of 7:00 a.m. and 9:00 p.m., Monday through Saturday, and between 10:00 a.m. and 6:00 p.m., Sundays and holidays, and does not exceed 83 dBA 7.6 meters (25 feet) from the source or 86 dBA at any point outside of the property plane of the project.

- Equip all internal combustion engine driven equipment with intake and exhaust mufflers, which are in good condition and appropriate for the equipment.
- "Unnecessary" idling of internal combustion engines would be strictly prohibited.
- Avoid staging of construction equipment within 200 feet of residences and locate all stationary noise-generating construction equipment, such as air compressors and portable power generators, as far as practical from existing noise sensitive receptors. Construct temporary barriers to screen stationary noise generating equipment when located in areas adjoining noise-sensitive land uses.
- Utilize "quiet" air compressors and other stationary noise sources where technology exists.
- Route all construction traffic to and from the project site via designated truck routes. Prohibit construction-related heavy truck traffic in residential areas where feasible. Prohibit construction truck traffic in the project vicinity during non-allowed hours.
- Notify residents, businesses, and schools in the project area of the construction schedule in writing.
- Designate a "noise disturbance coordinator" who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator would determine the cause of the noise complaint (e.g., starting too early, bad muffler, etc.) and would require that reasonable measures warranted to correct the problem be implemented. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include it in the notice sent to neighbors regarding the construction schedule. (The City should be responsible for designating a noise disturbance coordinator and the contractor should be responsible for posting the phone number and providing construction schedule notices).

Table 3-6. Construction Equipment Noise Emission Levels

Equipment	Typical Noise Level (dBA) 50 Feet from Source
Air compressor	81
Backhoe	80
Ballast equalizer	82
Ballast tamper	83
Compactor	82
Concrete mixer	85
Concrete pump	82
Concrete vibrator	76
Crane, derrick	88
Crane, mobile	83
Dozer	85
Generator	81
Grader	85
Impact wrench	85
Jack hammer	88
Loader	85
Paver	89
Pile driver (impact)	101
Pile driver (sonic)	96
Pneumatic tool	85
Pump	76
Rail saw	90
Rock drill	98
Roller/sheep's foot	74
Saw	76
Scarifier	83
Scraper	89
Shovel	82
Spike driver	77
Tie cutter	84
Tie handler	80
Tie inserter	85
Truck	88

Source: Federal Transit Administration 2006.

No-Project Alternative

Table 3-5 shows predicted traffic noise levels under 2030 no-project conditions. This condition corresponds to the no-project alternative. The results in Table 3-5 indicate that traffic noise levels in 2030 will be in the range of 2–4 dB higher than existing conditions without implementation of the proposed project. No project-related noise impacts would occur under the No-Project Alternative.

Cumulative Impacts

A significant cumulative noise impact is considered to occur at locations where noise currently or is projected to exceed the City's land use compatibility noise standard. As indicated in Table 3-5, traffic noise levels in 2030 without the proposed project are predicted to exceed 60 L_{dn} at nearly all receivers evaluated (2030 no-project noise levels at Receptor 44 would be 60 $L_{dn.}$). This indicates that a significant cumulative noise impact is predicted to occur along the project corridor in 2030 without implementation of the project. The results in Table 3-5 indicate that implementation of the proposed project would reduce traffic noise levels relative to no-project conditions at all locations evaluated along the project corridor since it incorporates the use of OGAC and construction of a 6-foot sound barrier. Accordingly, implementation of the proposed project would not contribute to the significant cumulative noise impact that is predicted to occur along the corridor in 2030. Implementation of the proposed project is in fact predicted to eliminate the significant cumulative noise impact at some locations by reducing noise below 60 L_{dn}.

Figure 3-1a
Noise Measurement and Modeled Receiver Locations

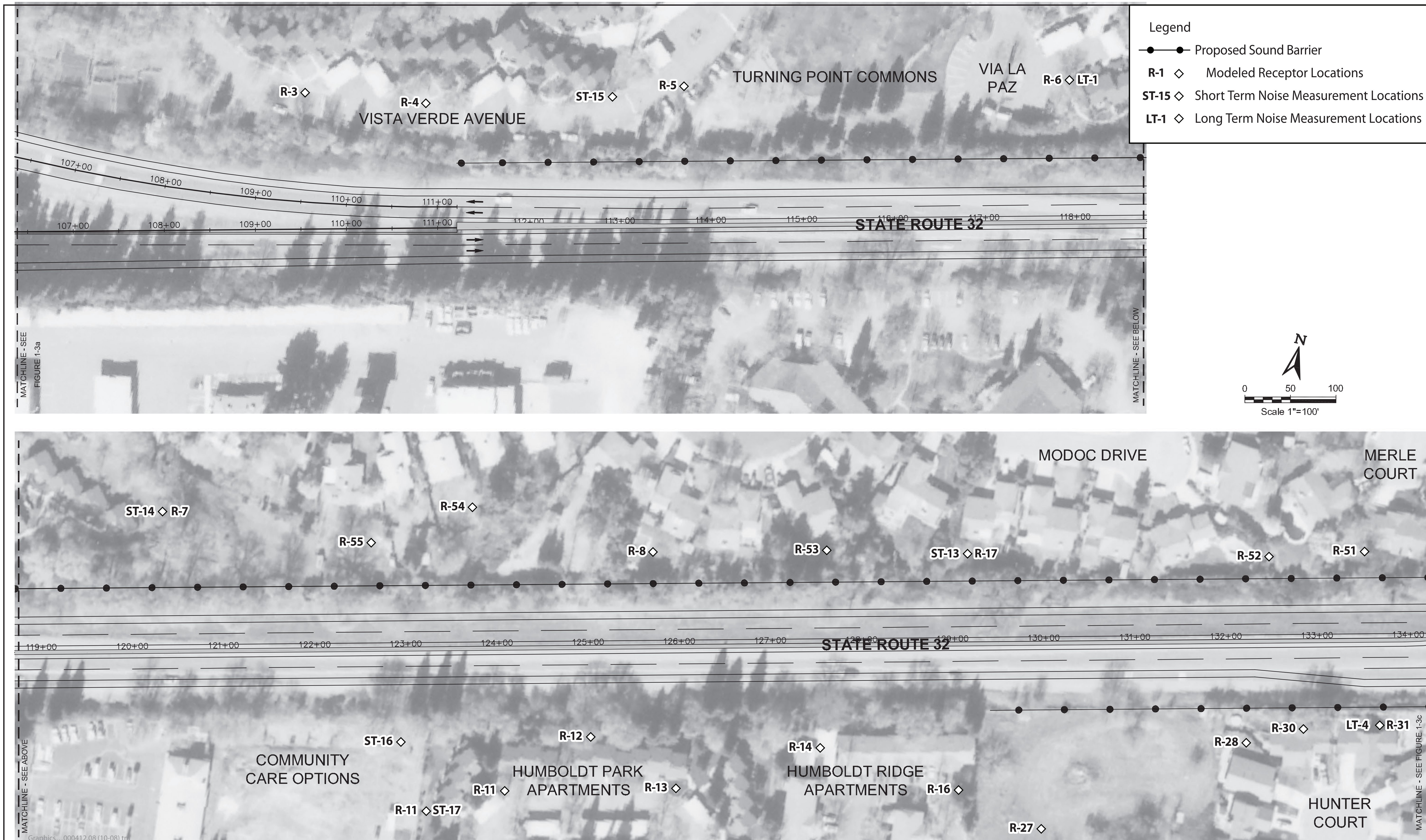

Figure 3-1b
Noise Measurement and Modeled Receiver Locations

Figure 3-1c
Noise Measurement and Modeled Receiver Locations

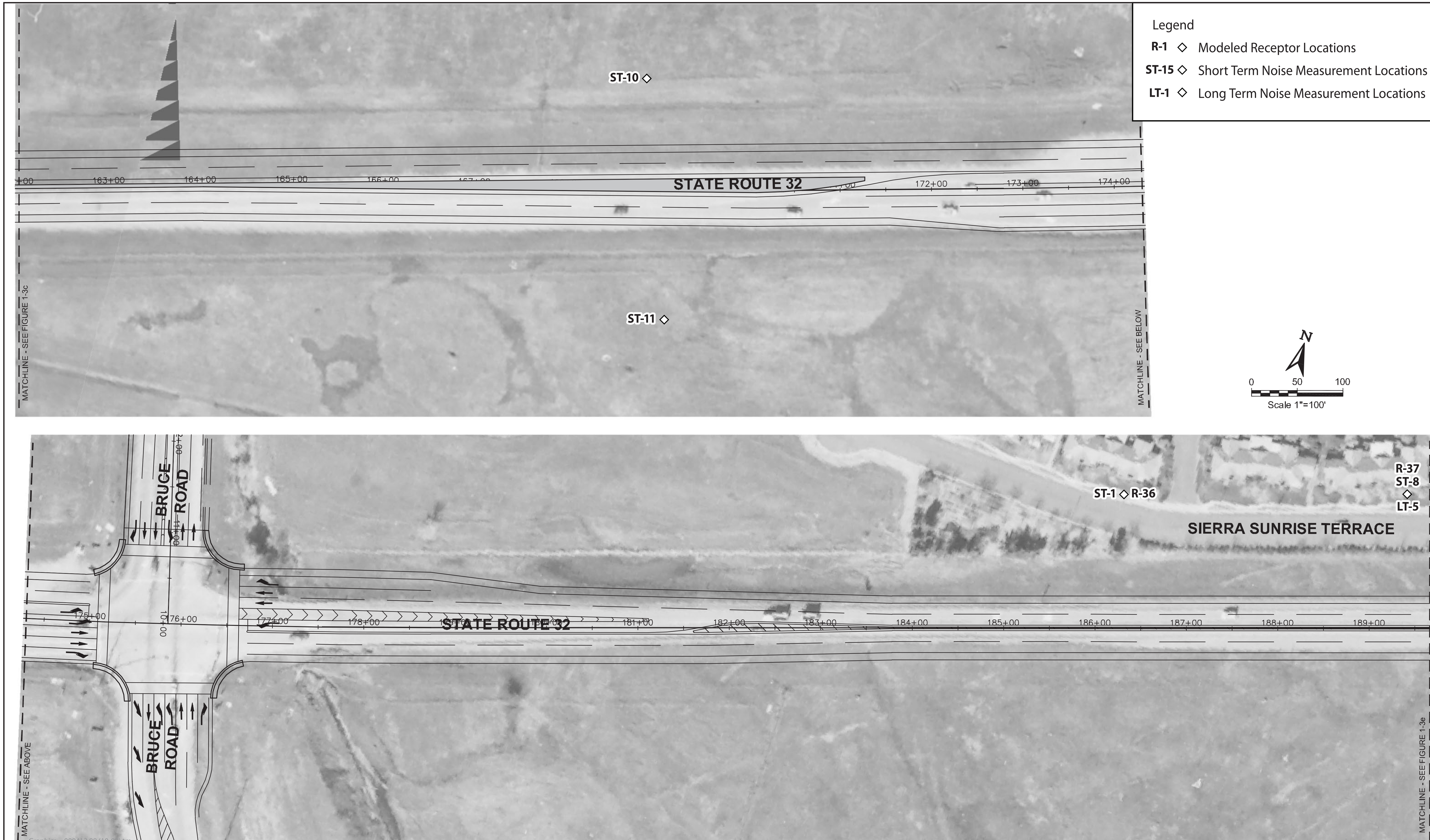

Figure 3-1d
Noise Measurement and Modeled Receiver Locations

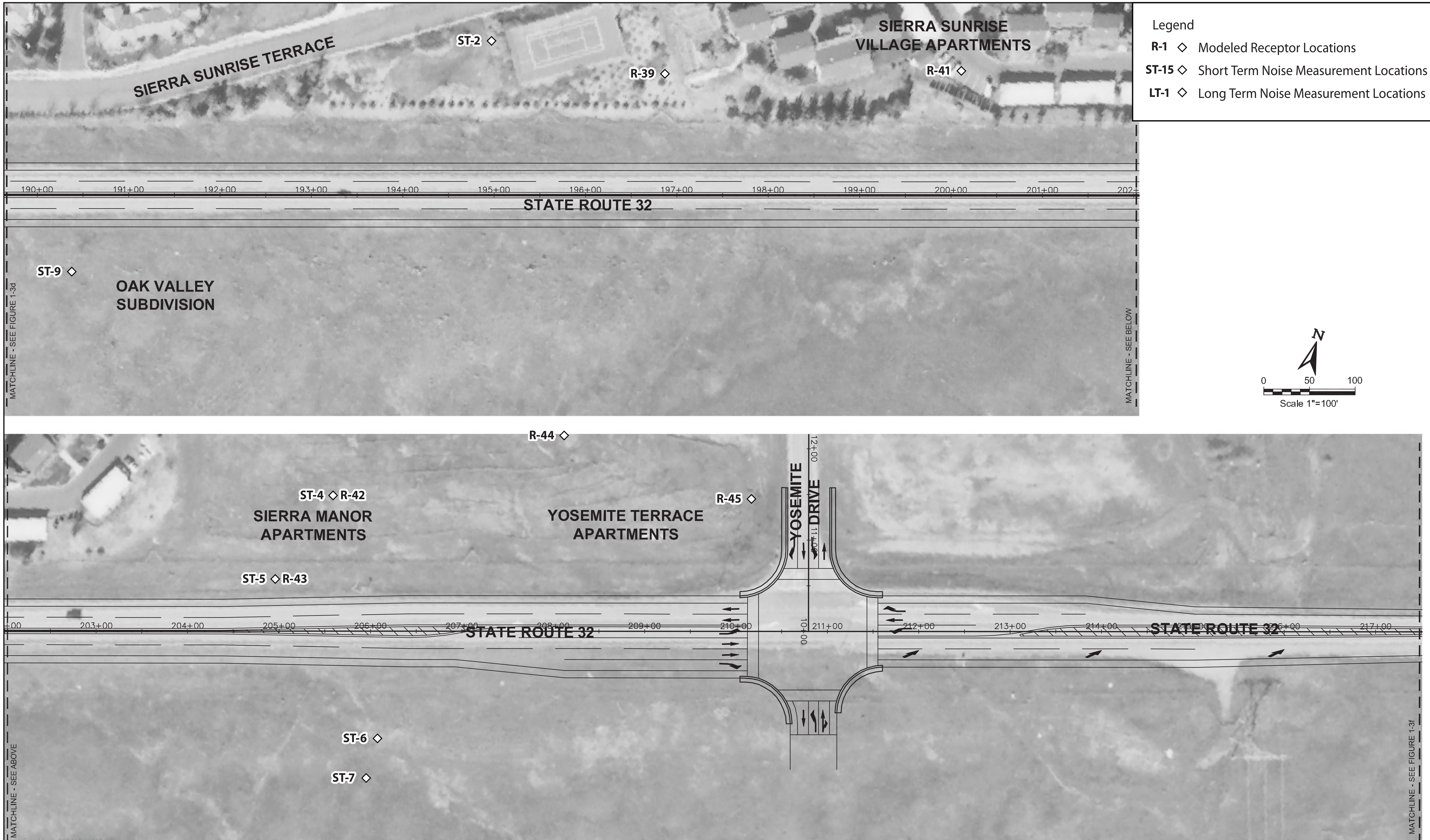

Figure 3-1e
Noise Measurement and Modeled Receiver Locations

Legend

R-1 ◇ Modeled Receptor Locations

ST-15 ◇ Short Term Noise Measurement Locations

LT-1 ◇ Long Term Noise Measurement Locations

No noise measurement locations or modeled receiver locations are present on this sheet.

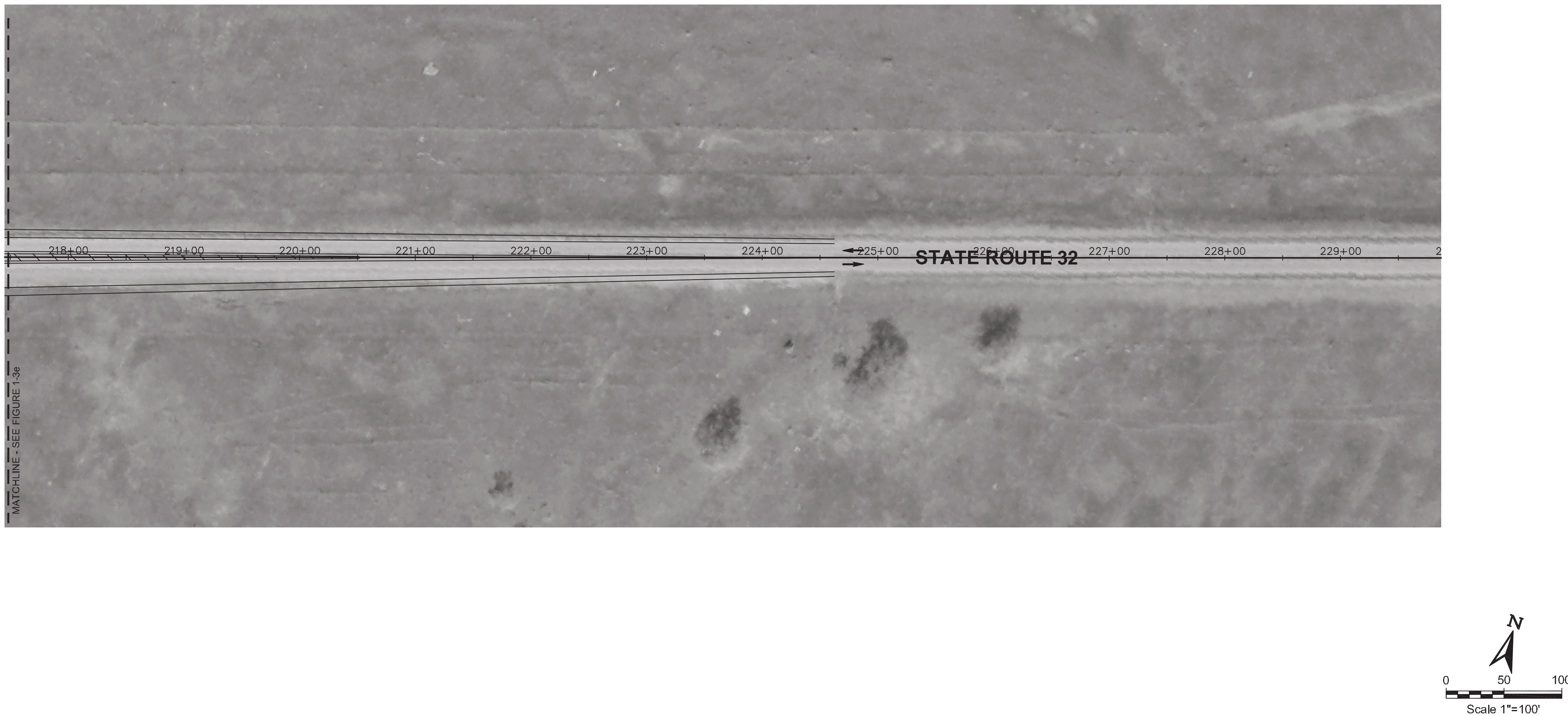

Figure 3-1f

Noise Measurement and Modeled Receiver Locations